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Dividend Policy and Consumption Risk

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Abstract

In this paper, we study the theoretical relationship between dividend policy and risk, in an intertemporal context. We use the fundamental framework of the consumption capital asset pricing model (CCAPM) to demonstrate that the dividend payout ratio of a stock (dividends divided by earnings) is negatively related to its covariance between dividends and consumption, cumulated over many periods. This result is consistent with the long-run definition of consumption risk, recently proposed in the literature. This result also suggests that long-run consumption risk influences dividend policy. In short, our model indicates that the target payout ratio of a firm can be estimated with a simple and easy-to-apply formula.

Keywords: intertemporal model, CCAPM, dividend policy, payout ratio, consumption risk, long-run risk

1. Introduction

It is often asserted that dividends are negatively related with risk. For example, Beaver et al. (1970), Rozeff (1982), and Lapointe (1996) conclude that the dividend payout ratio (dividends divided by earnings) is lower for high-risk stocks, while Pettit (1977), Eades (1982), and Baskin (1989) report a similar relationship with the dividend yield (dividends divided by price). In addition, Bajaj and Vijh (1990) and Michaely et al. (1995) show that the beta level changes after unexpected variations of a regular dividend. Similarly, Jagannathan et al. (2000) find that firms that only pay dividends show lower earnings volatility than firms that only repurchase. Furthermore, Grullon and Michaely (2002) and PÀstor and Pietro (2003) stress that firms that pay dividends have a lower variability of return on assets than firms that do not pay dividends. Evidence also confirms the notion that firms that increase dividends do so when they become more mature and less risky (Grullon et al. 2002; Julio and Ikenberry 2004). Moreover, using survey and field interviews, Brav et al. (2005) find that nearly 40% of managers believe that dividends make stocks less risky. Finally, Carter (2008) provides a mathematical model that illustrates the relationship between dividends and systematic risk.

As noted by Hoberg and Prabhala (2009) and Hussainey et al. (2011), the two following arguments lead us to expect a negative relationship between dividends and risk (Note 1). First, if firms are risk averse and prudent, then those operating in a high level of uncertainty will pay lower dividends to have enough retained earnings for bad earnings years. Second, managers know that stock markets exhibit a negative reaction to dividend cuts (Note 2). As a result, high-risk firms will avoid raising or initiating dividends, since risky firms are more likely to face a scenario in which decisions must be reversed and penalized by the market.

The purpose of this paper is to examine the theoretical relationship between risk and dividend policy, in an intertemporal context. We use the fundamental framework of the consumption capital asset pricing model (CCAPM) of Rubinstein (1976), Lucas (1978), and Breeden (1979) to explore the effect of consumption risk on dividend payout ratio (Note 3).

The development of our model can be summarized as follows. We assume a representative investor maximizes his time-separable utility function and establish that stock price is equivalent to the present value of all future dividends. Then, we isolate the contribution of each dividend payment in the price of the share and divide this value by the corresponding expected earnings. Afterward, using the basic properties of covariance, we aggregate to the entire market and sum over several periods.

In this manner, we show that the dividend payout ratio of a stock is negatively related to its long-run risk, defined as the covariance between dividends and consumption, cumulated over many periods. This relation implies that the dividend payout ratio approaches 100% when risk approaches zero, equals the market payout ratio when risk equals one, and tends to zero when risk tends to infinity (the relation can be illustrated by a curve

that approaches an axis *asymptotically*). This relation also indicates that long-run consumption risk influences dividend policy.

The previous definition of risk is of particular interest. Indeed, for many authors, the relevant measure of consumption risk in stocks is not necessarily the risk of current-period changes in consumption only, but the risk of changes in consumption over many periods. For instance, Bansal and Yaron (2004) argue that consumption and dividend growth rates include a small long-run component that can resolve the equity premium puzzle. Likewise, Bansal et al. (2005) show that long-run covariance between dividends and consumption (cash flow beta) accounts for more than 60% of the cross-sectional variation in risk premia. In addition, when investor horizon tends to infinity, Bansal et al. (2009) demonstrate that the risk of an asset is determined almost exclusively by the long-run cointegration between its dividends and consumption. Furthermore, Bergeron (2011) suggests that risk, estimated by the long-run covariance between dividends and consumption, influences the intrinsic value of a stock (Note 4).

However, none of the above mentioned studies investigated the effect of long-run consumption risk on dividend payout ratio.

For managers, the principal applications of our work naturally concern the choice of a firm's dividends. This payment will depend on the firm's earnings, the dividend payout ratio in the economy, and the firm's level of long-run risk. If this level is superior (inferior) to one, then the corresponding payout ratio will be inferior (superior) to the average for other firms.

Starting from the representative investor's choice problem, section 2 describes the economy. Section 3 derives the relationship between the dividend payout ratio and the consumption long-run risk, in an intertemporal context. Section 4 concludes the paper.

2. The Economy

In the hypothetical economy, the representative investor maximizes the time-separable utility function:

$$E_t \sum_{s=0}^{\infty} \delta^s U(\widetilde{C}_{t+s}), \tag{1}$$

where δ is the time discount factor ($0 < \delta < 1$), $\widetilde{C}_{t+s}$ is the aggregate consumption at time $t+s$ ($s = 0, 1, 2, ..., \infty$), and $U(\bullet)$ is an increasing concave and derivable function (Note 5). The result of this problem leads us to the following equation (see Rubinstein 1976):

$$P_{it} = E_t \sum_{s=1}^{\infty} \delta^s \frac{U'(\widetilde{C}_{t+s})}{U'(C_t)} \widetilde{D}_{i,t+s}, \tag{2}$$

where P_{it} represents the price of stock i ($i = 1, 2, ..., N$) at time t, and $\widetilde{D}_{i,t+s}$ represents the dividends of stock i at time $t+s$ ($s = 1, 2, ..., \infty$) (Note 6). Eq. (2) reveals that the price of a stock equals the present value of all future dividends. Here, the stochastic discount factor corresponds to the intertemporal marginal rate of substitution between t and $t+s$ ($\widetilde{M}_{t+s}$). Given that $\widetilde{M}_{t+s} \equiv \delta^s U'(\widetilde{C}_{t+s}) / U'(C_t)$, Eq. (2) becomes:

$$P_{it} = E_t \sum_{s=1}^{\infty} \widetilde{M}_{t+s} \widetilde{D}_{i,t+s}. \tag{3}$$

If we isolate the element k in the summation, the relation now becomes:

$$P_{it} = E_t[\widetilde{M}_{t+k} \widetilde{D}_{i,t+k}] + E_t \sum_{\substack{s=1 \\ s \neq k}}^{\infty} \widetilde{M}_{t+s} \widetilde{D}_{i,t+s}. \tag{4}$$

This permits us to write that:

$$P_{it} - E_t \sum_{\substack{s=1 \\ s \neq k}}^{\infty} \widetilde{M}_{t+s} \widetilde{D}_{i,t+s} = E_t[\widetilde{M}_{t+k} \widetilde{D}_{i,t+k}]. \tag{5}$$

Eq. (4) and Eq. (5) simply suggest that the contribution of any future dividend payment to stock price can be represented by the actual value of this particular payment. This also suggests that the actual value of each dividend payment can be expressed by the difference between stock price and the present value of the other dividends.

3. Dividends, Earnings, and Long-run Risk

In this section, we show that a firm's dividend policy choice depends on its long-run risk level. First, we divide each expected dividend payment by its corresponding expected earnings. Second, we link the dividend distribution with the covariance between dividends and consumption, for one period. Third, we aggregate over many periods to obtain a negative relationship between dividends and risk, on the long-run.

3.1 Dividends and Earnings

To connect the expected dividends with the expected earnings, we first divide Eq. (5) by $\overline{X}_{i,t+k} \equiv E_t[\widetilde{X}_{i,t+k}]$, where $\widetilde{X}_{i,t+k}$ represents the earnings of stock *i* at time $t+k$. It then follows that:

$$(P_{it} - E_t \sum_{\substack{s=1 \\ s\neq k}}^{\infty} \widetilde{M}_{t+s}\widetilde{D}_{i,t+s}) / \overline{X}_{i,t+k} = E_t[\widetilde{M}_{t+k}\widetilde{D}_{i,t+k}] / \overline{X}_{i,t+k}. \tag{6}$$

Adding $E_t[\widetilde{M}_{t+k}]$ to both sides of Eq. (6) yields:

$$E_t[\widetilde{M}_{t+k}] - E_t[\widetilde{M}_{t+k}\widetilde{D}_{i,t+k} / \overline{X}_{i,t+k}] = E_t[\widetilde{M}_{t+k}] + (E_t \sum_{\substack{s=1 \\ s\neq k}}^{\infty} \widetilde{M}_{t+s}\widetilde{D}_{i,t+s} - P_{it}) / \overline{X}_{i,t+k} \tag{7}$$

or:

$$E_t[\widetilde{M}_{t+k}(1 - \widetilde{D}_{i,t+k} / \overline{X}_{i,t+k})] = E_t[\widetilde{M}_{t+k}] + (E_t \sum_{\substack{s=1 \\ s\neq k}}^{\infty} \widetilde{M}_{t+s}\widetilde{D}_{i,t+s} - P_{it}) / \overline{X}_{i,t+k}. \tag{8}$$

Thus, Eq. (8) gives, after simple manipulations, a particular form of the Euler equation in which the central random variables are driven by the aggregate consumption and dividends. That is:

$$E_t[\widetilde{M}_{t+k}\widetilde{Y}_{i,t+k}] = 1, \tag{9}$$

where $\widetilde{Y}_{i,t+k} \equiv \dfrac{1 - \widetilde{D}_{i,t+k} / \overline{X}_{i,t+k}}{E_t[\widetilde{M}_{t+k}] - E_t[\widetilde{M}_{t+k}\widetilde{D}_{i,t+k} / \overline{X}_{i,t+k}]}$.

3.2 Aggregate Level for One Period

At the aggregate level, for one period, we can also write that:

$$E_t[\widetilde{M}_{t+k}\widetilde{Y}_{m,t+k}] = 1, \tag{10}$$

where the index *m* represents the market portfolio. Therefore, Eq. (9) minus Eq. (10) gives:

$$E_t[\widetilde{M}_{t+k}(\widetilde{Y}_{i,t+k} - \widetilde{Y}_{m,t+k})] = 0, \tag{11}$$

and the definition of covariance permits us to write that:

$$COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{i,t+k} - \widetilde{Y}_{m,t+k}] = -E_t[\widetilde{M}_{t+k}]E_t[\widetilde{Y}_{i,t+k} - \widetilde{Y}_{m,t+k}]. \tag{12}$$

Rearranging Eq. (12) indicates that stock *i* can be related to the entire market in the following manner:

$$E_t[\widetilde{Y}_{i,t+k}] = E_t[\widetilde{Y}_{m,t+k}] + \frac{COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{m,t+k}]}{E_t[\widetilde{M}_{t+k}]} - \frac{COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{i,t+k}]}{E_t[\widetilde{M}_{t+k}]}. \tag{13}$$

In accordance with the previous form of the Euler equation, we can rewrite Eq. (13) in this way:

$$E_t[1-\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]=(E_t[\widetilde{Y}_{m,t+k}]+COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]/E_t[\widetilde{M}_{t+k}])$$

$$\text{x}\,(E_t[\widetilde{M}_{t+k}]-E_t[\widetilde{M}_{t+k}\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}])$$

$$+COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]/E_t[\widetilde{M}_{t+k}]. \tag{14}$$

Integrating the definition of covariance into the second line of Eq. (14) shows that:

$$E_t[1-\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]=(E_t[\widetilde{Y}_{m,t+k}]+COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]/E_t[\widetilde{M}_{t+k}])$$

$$\text{x}\,(E_t[\widetilde{M}_{t+k}]-E_t[\widetilde{M}_{t+k}]E_t[\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}])$$

$$+COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]/E_t[\widetilde{M}_{t+k}]. \tag{15}$$

Hence, after algebraic manipulations, we have:

$$E_t[1-\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]=(E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]+COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])E_t[1-\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]$$

$$+(E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}])$$

$$\text{x}\quad COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}] \tag{16}$$

or:

$$E_t[1-\widetilde{D}_{i,t+k}/\overline{X}_{i,t+k}]=$$

$$\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\;\frac{COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}]}{\overline{X}_{i,t+k}}. \tag{17}$$

By multiplying each side by $\overline{X}_{i,t+k}\equiv E_t[\widetilde{X}_{i,t+k}]$, we get:

$$E_t[\widetilde{X}_{i,t+k}]-E_t[\widetilde{D}_{i,t+k}]=$$

$$\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\;COV_t[\widetilde{M}_{t+k},\widetilde{D}_{i,t+k}] \tag{18}$$

Also, by dividing each side by $\overline{D}_{i,t+k}\equiv E_t[\widetilde{D}_{i,t+k}]$, we obtain:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]}=$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\;COV_t\left[\widetilde{M}_{t+k},\frac{\widetilde{D}_{i,t+k}}{\overline{D}_{i,t+k}}\right] \tag{19}$$

or, after manipulations:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\ COV_t[\widetilde{M}_{t+k},\widetilde{G}_{i,t+k}] \tag{20}$$

with, $\widetilde{G}_{i,t+k} \equiv (1+\widetilde{g}_{i,t+k})/E_t[1+\widetilde{g}_{i,t+k}]$ and $\widetilde{g}_{i,t+k} \equiv \widetilde{D}_{i,t+k}/D_{it}-1$, where variable $\widetilde{g}_{i,t+k}$ represents the dividend growth rate between *t* and *t+k* for stock *i*.

By multiplying each side of Eq. (20) by $COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}]$ we can write:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\ COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}]$$

$$\text{x}\ \ COV_t[\widetilde{M}_{t+k},\widetilde{G}_{i,t+k}]/COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}] \tag{21}$$

with, $\widetilde{G}_{m,t+k} \equiv (1+\widetilde{g}_{m,t+k})/E_t[1+\widetilde{g}_{m,t+k}]$ and $\widetilde{g}_{m,t+k} \equiv \widetilde{D}_{m,t+k}/D_{mt}-1$, where variable $\widetilde{g}_{m,t+k}$ represents the dividend growth rate between *t* and *t+k* for the market portfolio.

To simplify Eq. (21), we suppose that the dividends and the aggregate consumption are bivariate normally distributed. This assumption permits us to use Stein's lemma (Rubinstein 1976, p. 421) and rewrite Eq. (21) as follows (Note 7):

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\ COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}]$$

$$\text{x}\ \ COV_t[\widetilde{G}_{t+k},\widetilde{G}_{i,t+k}]/COV_t[\widetilde{G}_{t+k},\widetilde{G}_{m,t+k}] \tag{22}$$

with, $\widetilde{G}_{t+k} \equiv (1+\widetilde{g}_{t+k})/E_t[1+\widetilde{g}_{t+k}]$ and $\widetilde{g}_{t+k} \equiv \widetilde{C}_{t+k}/C_t-1$, where variable $\widetilde{g}_{t+k}$ represents the growth rate between *t* and *t+k* for aggregate consumption.

For the market portfolio, we have:

$$\frac{E_t[\widetilde{X}_{m,t+k}]}{E_t[\widetilde{D}_{m,t+k}]} =$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\ COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}], \tag{23}$$

since $COV_t[\widetilde{G}_{t+k},\widetilde{G}_{m,t+k}]/COV_t[\widetilde{G}_{t+k},\widetilde{G}_{m,t+k}]=1$.

The equation (23) can thus be arranged and presented as a simple linear relationship. That is:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} = 1 + \lambda_{t+k}\beta^d_{i,t+k}\,, \tag{24}$$

where:

$\lambda_{t+k} \equiv (E_t[\widetilde{X}_{m,t+k}]/E_t[\widetilde{D}_{m,t+k}]) - 1$;

$\beta^d_{i,t+k} \equiv COV_t[\widetilde{G}_{t+k}, \widetilde{G}_{i,t+k}]/COV_t[\widetilde{G}_{t+k}, \widetilde{G}_{m,t+k}]$.

Parameter λ_{t+k} is determined by the expected market earnings on dividends. It is assumed to be positive, if we accept that aggregate earnings are superior to aggregate dividends (Note 8).

Given the available information at time *t*, the parameter $\beta^d_{i,t+k}$ represents the covariance, at time *t*+*k*, between the dividend growth rate of asset *i* and the consumption growth rate, divided by the corresponding covariance for the market. As the *consumption beta* in Mankiw and Shapiro (1986) our parameter $\beta^d_{i,t+k}$ presents an average of one (it equals one for the market). In addition, our parameter is remindful of Abel (1999), who argues that assets with large covariance between dividend and consumption growth rates have larger risk premia. Lastly, as the *dividend beta* in Bansal et al. (2002, p. 5) it measures how sensitive an asset's dividend is to aggregate consumption.

3.3 Many Periods

For many periods, summing from $k = 1$ to $k = K$ yields:

$$\sum_{k=1}^{K} \frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} = \sum_{k=1}^{K} (1 + \lambda_{t+k}\beta^d_{i,t+k})\,. \tag{25}$$

Now, if we accept the usual assumption that firms, given the available information at time *t*, expect to maintain a stable dividend policy, then we can suppose that the dividend payout ratio (or its inverse) is stationary (Note 9). More precisely, if we suppose that: $X_{it}/D_{it} = E_t[\widetilde{X}_{i,t+k}]/E_t[\widetilde{D}_{i,t+k}]$ and that $X_{mt}/D_{mt} = E_t[\widetilde{X}_{m,t+k}]/E_t[\widetilde{D}_{m,t+k}]$, for $k = 1, 2, 3, \ldots, K$, then:

$$K\frac{X_{it}}{D_{it}} = K + \lambda_t \sum_{k=1}^{K} \beta^d_{i,t+k}\,, \tag{26}$$

or:

$$\frac{X_{it}}{D_{it}} = 1 + \lambda_t \beta^d_{it}\,, \tag{27}$$

where X_{it} and D_{it} represent respectively the earnings and the dividends of stock *i* at time *t*, while X_{mt} and D_{mt} represent the corresponding values for the entire market, and where:

$\lambda_t \equiv (X_{mt}/D_{mt}) - 1$, and $\beta^d_{it} \equiv \sum_{k=1}^{K} \beta^d_{i,t+k}/K$.

We term the parameter β^d_{it} the *long-run dividend beta* of asset *i*, given the available information at time *t*. It represents the arithmetic average (over many periods) of $\beta^d_{i,t+k}$ ($k = 1, 2, 3, \ldots, K$). Rearranging Eq. (27), we get:

$$D_{it} = \frac{X_{it}}{1 + \lambda_t \beta^d_{it}}\,. \tag{28}$$

Eq. (28) shows that the normal dividend of a stock is determined by its earnings, adjusted for the level of the payout ratio in the economy and the long-run dividend beta of the stock. Since the last parameter has a negative effect on the dividend, and since dividends are supposed to be lower for stocks with higher risk (Note 10), we can argue that the long-run dividend beta represents a potential measure of risk. Moreover, this parameter supports the long-run definition of consumption risk recently proposed in the literature (see Bergeron (2011),

Bansal et al. (2009), Bansal et al. (2005), Bansal and Yaron (2004), and others). More particularly, it supports the work of Bansal et al. (2005), for whom risk is measured by the covariance between dividend and consumption growth rates over serial periods (this risk measure is called the *cash flow beta*).

Dividing each side of Eq. (28) by X_{it} finally relates the dividend policy of the firm (expressed by the dividend payout ratio) to its long-run consumption risk (expressed by the long-run dividend beta), that is to say:

$$d_{it} = \frac{1}{1+\lambda_t \beta_{it}^d}, \tag{29}$$

where d_{it} is the dividend payout ratio of stock *i* at time *t*: $d_{it} \equiv D_{it} / X_{it}$.

In short, Eq. (29) shows that the dividend payout ratio of a stock is negatively related to its long-run dividend beta (or its long-run risk), defined as the covariance between dividends and consumption, cumulated over many periods (Note 11).

In this manner, a firm with a long-run dividend beta of one should opt for a target dividend payout ratio identical to the market, while a firm considered more (less) risky should opt for a payout ratio less (more) important than the average. In the extreme case of a firm with a long-run dividend beta approaching zero, the payout ratio should approach 100%, and total earnings should be distributed as dividends. On the contrary, if the firm's risk level or long-run dividend beta tends to infinity, the payout ratio should tend to zero. In brief, according to Eq. (29), if the horizontal axis represents risk, and the vertical axis represents the payout ratio, then the inverse dividend-risk relationship should be illustrated by a curve that approaches an axis *asymptotically*.

Furthermore, since the dividend payout ratio depends on the available information on a particular date, it will be revised at each period.

4. Conclusion

We have examined the relationship between dividend policy and risk in an intertemporal economy. Using the CCAPM framework, we have shown that the dividend payout ratio of a stock is negatively related to its long-run dividend beta. Thus, we have concluded that riskier firms are more likely to reinvest their earnings or pay fewer dividends.

We believe that our theoretical model provides an additional element to support the inverse relationship observed between dividends and risk. Also, it clarifies the relationship in a simple equation. Moreover, it shows the importance of a long-run definition of consumption risk for interpreting the difference in dividend distribution across firms. Finally, it leads to practical applications that may be useful for managers and investors, if we accept that the target dividend payout ratio chosen by the firm should correspond to our model.

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References

Abel, A. (1999). Risk premia and term premia in general equilibrium. *Journal of Monetary Economics*, *43*, 3-33. http://dx.doi.org/10.1016/S0304-3932(98)00039-7

Bajaj, M., & Vijh, A. M. (1990). Dividend clienteles and the information content of dividend changes. *Journal of Financial Economics*, *26*, 193-219. http://dx.doi.org/10.1016/0304-405X(90)90003-I

Bansal, R., Dittmar, R. F., & Lundblad, C. (2002). Consumption, dividends, and the cross-section of equity returns. Working paper, Duke University, October.

Bansal, R., Dittmar, R.F., & Lundblad, C. (2005). Consumption, dividends, and the cross-section of equity returns. *The Journal of Finance*, *60*, 1639-1672. http://dx.doi.org/10.1111/j.1540-6261.2005.00776.x

Bansal, R., Dittmar, R. F., & Kiku, D. (2009). Cointegration and consumption risks in asset returns. *Review of Financial Studies*, *22*, 1343-1375. http://dx.doi.org/10.1093/rfs/hhm085

Bansal, R., & Kiku, D. (2011). Cointegration and long-run asset allocation. *Journal of Business and Economic Statistics*, *29*, 161-173. http://dx.doi.org/10.1198/jbes.2010.08062

Bansal, R., & Yaron, A. (2004). Risks for the long run: A potential resolution of asset pricing puzzles. *The Journal of Finance*, *59*, 1481-1509. http://dx.doi.org/10.1111/j.1540-6261.2004.00670.x

Baskin, J. (1989). Dividend policy and the volatility of common stocks. *Journal of Portfolio Management*, *15*, 19-25. http://dx.doi.org/10.3905/jpm.1989.409203

Beaver, W., Kettler, P., & Scholes, M. (1970). The association between market determined and accounting determined risk measures. *Accounting Review*, *45*, 654-682.

Beeler, J., & Campbell, J. (2012). The long-run risks model and aggregate asset prices: an empirical assessment. *Critical Finance Review*, *1*, 141-182. http://dx.doi.org/10.1561/104.00000004

Bergeron, C. (2011). Dividend growth, stock valuation, and long-run risk. *Journal of Economics and Finance* (in press). http://dx.doi.org/10.1007/s12197-011-9196-5

Brav, A., Graham, J. R., Harvey, C. R., & Michaely, R. (2005). Payout policy in the 21st century. *Journal of Financial Economics*, *77*, 483-527. http://dx.doi.org/10.1016/j.jfineco.2004.07.004

Breeden, D. T. (1979). An intertemporal asset pricing model with stochastic consumption and investment opportunities. *Journal of Financial Economics*, *7*, 265-296. http://dx.doi.org/10.1016/0304-405X(79)90016-3

Campbell, J. Y., & Cochrane, J. H., (2000). Explaining the poor performance of consumption-based asset pricing models. *The Journal of Finance*, *55*, 2863-2878. http://dx.doi.org/10.1111/0022-1082.00310

Carter, M. S. (2008). The relationship between dividend payouts and systematic risk: a mathematical approach. *Academy of Accounting and Financial Studies Journal*, 12 Nbr. 2. http://news-business.vlex.com/vid/

Charest, G. (1978). Dividend information, stock returns, and market efficiency-II. *Journal of Financial Economics*, *6*, 297-330. http://dx.doi.org/10.1016/0304-405X(78)90033-8

Cochrane, J. H. (2005). *Asset Pricing*. Princeton University Press. Princeton N.J.

Eades, K. M. (1982). Empirical Evidence on dividends as a signal of firm value. *Journal of Financial and Quantitative Analysis*, *17*, 471-500. http://dx.doi.org/10.2307/2330903

Foerster, S. R., & Sapp, S. G. (2011). Back to fundamentals: The role of expected cash flows in equity valuation. *The North American Journal of Economics and Finance*, *22*, 320-343. http://dx.doi.org/10.1016/j.najef.2011.06.001

Grullon, G., & Michaely R. (2002). Dividends, share repurchases, and the substitution hypothesis. *The Journal of Finance*, *57*, 1649-1684. http://dx.doi.org/10.1111/1540-6261.00474

Grullon, G., Michaely R., & Swaminathan, B. (2002). Are dividend changes a sign of maturity? *Journal of Business*, *75*, 387-424. http://www.jstor.org/stable/10.1086/512530

Hansen, L. P., Heaton, J. C., & Li, N. (2008). Consumption strikes back?: Measuring long-run risk. *Journal of Political Economy*, *116*, 260-302. http://dx.doi.org/10.1086/588200

Hoberg, G., & Prabhala, N. R. (2009). Disapering dividends, catering, and risk. *Review of Financial Studies*, *22*, 79-116. http://dx.doi.org/10.1093/rfs/hhn073

Hussainey, K., Mgbame, C. O., & Chijoke-Mgbame, A. M. (2011). Dividend policy and share price volatility: UK evidenc. *The Journal of Risk Finance*, *12*, 57-68. http://dx.doi.org/10.1108/15265941111100076

Jagannathan, M., Stephens, C. P., & Weisbach M. S. (2000). Financial flexibility and the choice between dividends and stock repurchases. *Journal of Financial Economics*, *57*, 355-384. http://dx.doi.org/10.1016/S0304-405X(00)00061-1

Julio, B., & Ikenberry, D. L. (2004). Reappearing dividends. *Journal of Applied Corporate Finance*, *16*, 89-100. http://dx.doi.org/10.1111/j.1745-6622.2004.00010.x

Lapointe, M. A. (1996). Signalisation via dividende et variabilité du flux monétaire. *Finéco*, *6*, 55-70. http://www.fsa.ulaval.ca/fineco/

Li, B. (2010). Consumption and stock returns in Australia: A revisit. *International Research Journal of Finance and Economics*, *50*, 26-44. http://www.eurojournals.com/finance.htm

Lucas, R. E. (1978). Asset prices in an exchange economy. *Econometrica*, *46*, 1429-1445. http://www.jstor.org/stable/1913837

Malloy, C. J., Moskowitz, T. J., & Vissing-JØrgensen, A. (2009). Long-run stockholder consumption risk and asset returns. *The Journal of Finance*, *64*, 2427-2479. http://dx.doi.org/10.1111/j.1540-6261.2009.01507.x

Mankiw, N. G., & Shapiro, M. D. (1986). Risk and return: Consumption beta versus market beta. *Review of Economics and Statistics*, *68*, 452-459. http://www.mitpressjournals.org/toc/rest/92/3

Michaely, R., Thaler, R. H., & Womack, K. L. (1995). Price reactions to dividend initiations and omissions: overreaction or drift? *The Journal of Finance*, *50*, 573-608. http://dx.doi.org/10.1111/j.1540-6261.1995.tb04796.x

Parker, J. A., & Julliard, C. (2005). Consumption risk and the cross-section of asset returns. *Journal of Political Economy*, *113*, 185-222. http://dx.doi.org/10.1086/426042

PÀstor, L., & Pietro, V. (2003). Stock valuation and learning about profitability. *The Journal of Finance*, *58*, 1749-1790. http://dx.doi.org/10.1111/1540-6261.00587

Pettit, R. R. (1977). Taxes, Transactions Costs and the clientele effect of dividends. *Journal of Financial Economics*, *5*, 419-436. http://dx.doi.org/10.1016/0304-405X(77)90046-0

Rozeff, M. S. (1982). Growth, beta and agency costs as determinants of dividend payout ratios. *Journal of Financial Research*, *5*, 249-259. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=820311

Rubinstein, M. (1976), The valuation of uncertain income streams and the pricing of options. *The Bell Journal of Economics*, *7*, 407-425. http://ideas.repec.org/s/rje/bellje.html

Notes

Note 1. Hussainey et al. (2011) find, in the United Kingdom, a negative relationship between dividend payout ratio and payout volatility.

Note 2. See, for example, Charest (1978).

Note 3. Campbell and Cochrane (2000) consider that the CCAPM represents one the major advances in financial economics. This point of view is also asserted by Cochrane (2005) and Li (2010).

Note 4. See also Parker and Julliard (2005), Hansen et al. (2008), Malloy et al. (2009), Bansal and Kiku (2011), and Beeler and Campbell (2012).

Note 5. In this paper, the operators E_t, VAR_t, and COV_t refer respectively to mathematical expectations, variance, and covariance, where index t implies that we consider the available information at time t. Furthermore, the tilde (~) indicates a random variable.

Note 6. The premium (U') is a derivative of a function.

Note 7. See proof in appendix A.

Note 8. See, table 1 in Foerster and Sapp (2011).

Note 9. In appendix B we relax the assumption of a stable dividend policy.

Note 10. Recall that, for many authors, dividends are lower for stocks with higher risk. See, again, Hussainey et al. (2011), Hoberg and Pradhala (2009), Carter (2008), etc.

Note 11. See appendix C for a numerical example.

Appendix A

In Appendix A, we demonstrate how Eq. (21) can be simplified and reduced to Eq. (22). We suppose that dividends and aggregate consumption are bivariate normally distributed. This assumption permits us to use Stein's lemma (Rubinstein 1976, p. 421), which establishes that: *for random variables* x *and* y*, and for differentiable function* f(x); COV[y, f(x)] = E[f'(x)]COV[y, x], *if* x *and* y are *bivariate normally distributed.*

Indeed, from Eq. (2) and Eq. (21), we have:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1+\frac{E_t^{-1}[\widetilde{M}_{t+k}](1-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}])-E_t[\widetilde{Y}_{m,t+k}]}{1-E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}]-COV_t[\widetilde{M}_{t+k},\widetilde{Y}_{m,t+k}]}\,COV_t[\widetilde{M}_{t+k},\widetilde{G}_{m,t+k}]$$

$$\text{x} \quad \frac{COV_t[U'(\widetilde{C}_{t+k}), \widetilde{G}_{i,t+k}]\delta^k / U(C_t)}{COV_t[U'(\widetilde{C}_{t+k}), \widetilde{G}_{m,t+k}]\delta^k / U(C_t)}. \tag{A1}$$

From Stein's lemma, we get:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1 + \frac{E_t^{-1}[\widetilde{M}_{t+k}](1 - COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{m,t+k}]) - E_t[\widetilde{Y}_{m,t+k}]}{1 - E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}] - COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{m,t+k}]} COV_t[\widetilde{M}_{t+k}, \widetilde{G}_{m,t+k}]$$

$$\text{x} \quad \frac{COV_t[\widetilde{C}_{t+k}, \widetilde{G}_{i,t+k}]E_t[U''(\widetilde{C}_{t+k})]}{COV_t[\widetilde{C}_{t+k}, \widetilde{G}_{m,t+k}]E_t[U''(\widetilde{C}_{t+k})]}. \tag{A2}$$

Multiplying each side of Eq. (A2) by $E_t[\widetilde{C}_{t+k}]$ yields:

$$\frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} =$$

$$1 + \frac{E_t^{-1}[\widetilde{M}_{t+k}](1 - COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{m,t+k}]) - E_t[\widetilde{Y}_{m,t+k}]}{1 - E_t[\widetilde{Y}_{m,t+k}]E_t[\widetilde{M}_{t+k}] - COV_t[\widetilde{M}_{t+k}, \widetilde{Y}_{m,t+k}]} COV_t[\widetilde{M}_{t+k}, \widetilde{G}_{m,t+k}]$$

$$\text{x} \quad \frac{COV_t[\widetilde{C}_{t+k} / E_t[(\widetilde{C}_{t+k})], \widetilde{G}_{i,t+k}]}{COV_t[\widetilde{C}_{t+k} / E_t[(\widetilde{C}_{t+k})], \widetilde{G}_{m,t+k}]}, \tag{A3}$$

which is equivalent to Eq. (22), since $\widetilde{G}_{t+k}$ equals $\widetilde{C}_{t+k} / E_t[(\widetilde{C}_{t+k})]$.

Appendix B

In Appendix B, we relax the assumption of a stable dividend policy. In fact, from Eq. (25), we have:

$$\sum_{k=1}^{K} \frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} = K + \sum_{k=1}^{K} \lambda_{t+k} \beta_{i,t+k}^d. \tag{B1}$$

Multiplying by $\sum_{k=1}^{K} \lambda_{t+k}$ on each side, yields:

$$\sum_{k=1}^{K} \frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} = K + \sum_{k=1}^{K} \lambda_{t+k} \sum_{k=1}^{K} w_{t+k} \beta_{i,t+k}^d \tag{B2}$$

where $w_{t+k} \equiv \lambda_{t+k} \sum_{k=1}^{K} \lambda_{t+k}$, with $\sum_{k=1}^{K} w_{t+k} = 1$.

Dividing by K on each side of Eq. (B2) shows that:

$$\overline{\phi}_{it} = 1 + \overline{\lambda}_t \overline{\beta}_{it}^d, \tag{B3}$$

where:

$$\bar{\phi}_{it} \equiv \sum_{k=1}^{K} \frac{E_t[\widetilde{X}_{i,t+k}]}{E_t[\widetilde{D}_{i,t+k}]} / K \ , \quad \bar{\lambda}_t \equiv \sum_{k=1}^{K} \lambda_{t+k} / K \ , \quad \bar{\beta}_{it}^{d} \equiv \sum_{k=1}^{K} w_{t+k} \beta_{i,t+k}^{d} \ .$$

Thus:

$$\bar{d}_{it} = \frac{1}{1 + \bar{\lambda}_t \bar{\beta}_{it}^{d}} , \tag{B4}$$

with $\bar{d}_{it} \equiv 1/\bar{\phi}_{it}$, where $\bar{d}_{it}$ can be viewed as the inverse of the arithmetic average (over many periods) of the earnings/dividends ratio of stock *i*, given the available information in time *t*, or, to put it differently, the long-run target payout ratio of stock *i*. In the same manner, $\bar{\lambda}_t$ can be viewed as the corresponding average ratio for the market, while $\bar{\beta}_{it}^{d}$ can be viewed as the weighted average of the coefficients $\beta_{i,t+k}^{d}$ (k = 1, 2, 3, …, K).

In brief, as Eq. (29), Eq. (B4) shows that the target dividend payout ratio of a stock is negatively related to its long-run dividend beta (or its long-run risk), defined as the covariance between dividends and consumption, cumulated over many periods. However, in appendix B, the assumption of a stable dividend policy is not required.

Appendix C

In Appendix C, we present a numerical example in which we assume we need to estimate the target dividend payout ratio for a risky firm that has a long-run dividend beta of 1.25. From Table 1 in Foerster and Sapp (2011), we know that the average payout ratio in the United States was 54% between 1982 and 2010. Thus, we can assert that $\lambda_t = 0.54^{-1} - 1$, and conclude that the target payout ratio for this firm should be approximately 48.43%, since Eq. (29) shows that:

$$0.4843 = \frac{1}{1 + (0.54^{-1} - 1)\,1.25} .$$

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Economic Shocks and the Fed's Policy--The Transmission Conduit and Its International Linkage

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Abstract

This paper uses a Bayesian Vector Autoregression (BVAR) model to evaluate the impacts of policy and financial shocks on several economic variables.We use both expected federal funds and unexpected federal funds rates as an indicator of monetary policy respectively.In addition to the traditional financial market measures, i.e., bank loan and equity price changes to signal the financial shocks, we introduce a new credit measure that reflects the differential credit access for small and large firms. We use U.S. monthly data from July 1954 to March 2009.The results of our impulse response functions and variance decomposition provide a positive assessment of the Fed's recent policy actions.We also extend the framework to include four foreign countries and show that foreign stock prices are significantly affected by U.S. equity shock in a later time period, indicating a stronger global integration recently.Nevertheless, the U.S. equity market is not affected much by the foreign equity market.

Keywords: bayesian regression, monetary transmission mechanism, impulse response function, variance decomposition, policy reaction function

1. Introduction

The current recession that began in December 2007 has brought monetary policy back to the center stage of policy making and research.Since the recession was caused by a mortgage-housing-leverage crisis and its ensuing credit freeze, the Fed's main strategy was to ease terms of credit and to prevent economic damage from systemic liquidity risk.The Fed has focused its policy on two fronts.First, the federal funds rate has been changed ten times, lowered from 5.25% in September 2007 to 0-0.25% in December 2008 and held at that rate ever since.Second, the Fed has taken a non-traditional step to lend directly to financial firms and purchase commercial papers from them, conforming mortgages and securities of consumer and small business loans.This direct lending aims to soften the freeze in the credit crunch so the economy can survive the crisis without severe damage.Despite all the aggressive efforts by the Fed, bank lending fell by $587 billion, or 7.5%, in 2009, the largest annual decline since the 1940s.The FDIC considers 702 out of the nation's 8012 banks to be at the risk of failure. (Note 1)The number grew to 888, a historical high, at the end of 2010 and then slipped to 813 in the fourth quarter of 2011. In the equity market, investors pushed the Standard & Poor's 500 from around 1,500 in December 2007 to 676.53 on March 9, 2009, the lowest level since 1996.The stock market has recovered to some extent, and the index stood at around 1,100 in July 2010 and 1,350 in March 2012.The ongoing monetary policy "experiment" and its interactions with the financial markets have prompted a time-honored yet intriguing question: how effective are the Fed's policy actions?

An inquiry into the efficacy of the Fed's actions naturally brings forth the issue of the mechanism through which the policy is transmitted (or channeled).This continues to be a challenging issue for financial economists as well as policy makers perhaps mostly due to the changing dynamics of financial market and the evolving instruments.This paper focuses on two possible channels: credit channel and equity channel.The effectiveness of the credit channel hinges on two links: first, the Fed's actions and bank loans; second, bank loans and the real economy.The new policy tool that the Fed used recently to lend directly to firms (i.e., increase loan availability in the economy directly) ensures the effectiveness of the first linkage.The efficacy of the Fed's policy thus centers on whether the supply of bank loans has a real effect.The literature appears mixed in its findings (Kashyap and Stein, 1994, 2000; Oliner and Rudebusch, 1996; Driscoll, 2004).One explanation for the findings of ineffectiveness in the second linkage (i.e., between bank loans and real output) is that not all firms are

bank-dependent (Driscoll, 2004).For instance, large firms can substitute other forms of finance such as bond or equity financing for bank loans.Thus, bank loans alone may not measure credit conditions appropriately.This view is implied in the financial accelerator model but with a different twist (Hubbard, 1995; Bernanke et al., 1996; Gertler and Gilchrist, 1993; Vijverberg, 2004).The financial accelerator mechanism works through bank-dependent small firms.Since small firms are more dependent on bank loans, they are more sensitive to loan availability and market interest rates.Campello, Graham, and Harvey (2010) extend this line of research by studying credit constraints experienced by nonfinancial firms.In December 2008, they asked 1,050 chief financial officers in 39 countries in Asia, Europe and North America whether they experienced a credit constraint and how they responded during the crisis.The authors discovered that in the United States, 325 of the 569 surveyed firms were somewhat or very affected by a credit constraint.In the overall sample, the constrained firms cut the number of employees 11 percent, more than the 7 percent by the non-constrained firms.These studies evidently show that actions of the Fed may impact bank loan availability and affect firms' expenditures and therefore influence aggregate economic activity.

The argument for monetary transmission through an equity channel can easily find its support from a recent stock market surge caused by Bernanke's surprising remarks at a national conference on maintaining a low interest rate policy. (Note 2)The equity channel is based on Tobin's q-theory (Tobin, 1969).Tobin's q is the ratio of market value of the firm over its replacement cost.When q is greater (less) than one, investment spending is likely to increase (decrease) because it is cheaper (more expensive) to build new factories.When working through the equity channel, a monetary shock or disturbance is expected to change the present value of future earnings.The change in equity (or stock) price implies a change in Tobin's q, which subsequently could affect aggregate spending of the economy.Bernanke and Kuttner (2005) believe that monetary policy has its most direct and immediate effects on the more broadly defined financial market such as the stock market.They point out that the market is unlikely to respond to expected policy changes, suggesting an inevitability to distinguish between expected and unexpected policy actions.Using the CRSP value-weighted index, they find that an unexpected 25-basis-point rate cut leads to a one percent increase in stock prices.

This paper seeks to evaluate policy actions of the Fed empirically and at the same time measure the impact of different economic and financial shocks to key macroeconomic variables. (Note 3)This paper contributes to the literature in three aspects.First, in addition to the traditional credit measure, it applies a new credit measure to reflect the differential access between large firms and small firms.Both credit measures are used to evaluate the two linkages in the credit channel.Given the Fed's policy actions in 2008-2009, it is interesting to see what has happened to the second linkage, i.e., the impact of a credit measure shock on the real economy.This could be used to validate the financial accelerator mechanism.Second, this paper uses both the federal funds rate (ffr) and the unexpected federal funds rate (u.ffr) as indicators of monetary policy.While many event studies such as Ehrmann and Fratzscher (2004) and Bernanke and Kuttner (2005) examine the responses of an unexpected federal funds rate shock on a "daily" basis, this paper uses monthly data.In doing so, we do recognize the possibility that significant responses in higher frequency data may not be captured in lower frequency data.Third, besides measuring the impact of a U.S. equity shock on the U.S. economy, the ever-increasing trend of globalization makes it essential to study the impact of a U.S. equity shocks on foreign equity markets also.In fact, the recent world-wide recession was triggered by the U.S.Even though the Fed cannot manipulate the equity market directly, its policies could change investor confidence and disturb or restore financial stability.For instance, a favorable shock to the equity market may help reduce the unemployment rate in the long run, coincidentally a finding of this paper.The degree of correlation between the American equity market and its foreign counterparts will certainly determine the extent to which the Fed's policy of stabilizing the U.S. equity market helps other economies as well.

To study these policy issues, this paper will apply a Bayesian Vector Autoregression (BVAR) model previously developed by Sims and Zha (1998) and Waggoner and Zha (2003). This BVAR model is briefly discussed in the next section.Section 3 describes the data, and Section 4 presents empirical BVAR estimates of the impulse response functions and variance decompositions.Section 5 extends the research to a set of foreign countries and examines the impact of U.S. monetary policy on foreign share prices.The effect of a shock in the U.S. equity market on the foreign equity markets is also examined.Section 6 closes the paper with concluding remarks.

2. A Bayesian VAR Model

A VAR model with many variables and long lags has lots of parameters.Estimation of these VAR parameters requires a lot of data and the forecasts of the model may be imprecise because of over-parameterization.Bayesian VAR models differ from traditional VAR models by treating the model parameters as random variables.The posterior distributions of these random (parameter) variables derive from the prior and the likelihood of the

data.In contrast to the traditional VAR model, which does not incorporate non-sample information, Bayesian VAR integrates researchers' prior (non-sample) belief. (Note 4) Furthermore, the distribution of the prior that is comprised in a few hyper-parameters reduces the number of parameters directly, which addresses the issue of over-parameterization in traditional VAR models. This enhances the forecast precision of a Bayesian model.In this paper, we will use a BVAR model.

Our model is formulated as the following.Note that, to distinguish between vectors and matrices, a variable with an underscore is a vector and a variable without an underscore is a matrix.

$$\underline{y}_t' \cdot A_0 = \underline{c}_0 + \sum_{i=1}^{p} \underline{y}_{t-i}' \cdot A_i + \varepsilon_t' \quad (1)$$

for $t = 1\ldots.T$ and $i = 1,\ldots p$; where $\underline{y}_{t-i}$ is an $m\times1$ vector of an m-variable observation at t-i,$\underline{c}_0$is a 1×m vector, $\underline{a}_0\underline{\varepsilon}_t$ is an m×1 vector, A_i are mxm parameter matrices, p is the lag length and T is the total number of observations.

The disturbances have a Gaussian distribution with $E(\underline{\varepsilon}_t|\underline{\Lambda}_t) = \underline{0}$ and $Var(\underline{\varepsilon}_t|\underline{\Lambda}_t) = \underline{I}$where$\underline{\Lambda}_t$is information up to t-1.The above equation can be restated as the following:

$$Y \cdot A_0 = X \cdot F + E \quad (2)$$

where both Y and E are $T\times m$ matrices, X is a $T\times m$ (p+1) matrix with each row being $[\underline{c}_0, \underline{y}_{t-1}', \ldots, \underline{y}_{t-p}']$ and $F' = \left[I, A_1', A_2', \ldots, A_p'\right]$ is an $m\times m$ (p+1) matrix. F will be referred to as the lagged parameters. The corresponding reduced form VAR has a reduced form variance matrix of $\Sigma$where$\Sigma = (A_0A_0')^{-1}$.

A Bayesian model consists of two major elements: the likelihood function and the prior.The likelihood function in this model is $L(Y|A_0, F) \propto |A_0|^T \exp[-0.5(YA_0 - XF)'(YA_0 - XF)]$. The prior comes in the form of a probability density function. There are various ways to set up the prior (Sims and Zha, 1998). A brief description of this prior will be given here. Let A= (A_0, F),$\underline{a} = vec(A)$ and $\underline{f} = vec(F)$ where *vec* is the vectorization operator.Based on Sims and Zha (1998), the matrix A has a prior pdf of $\pi(\underline{a}) = \pi_0(\underline{a}_0) \cdot \phi(E\left(\underline{f}|\underline{a}_0\right); \psi)$ where $\pi_0(\underline{a}_0)$ is a marginal distribution of $\underline{a}_0$ and $\phi(..,\psi)$ is a conditional distribution of$\underline{f}$ conditioning on $\underline{a}_0$; $\phi(..,\psi)$ is also a normal pdf with a covariance matrix ψ. In Sims and Zha (1998), specific restrictions are imposed on these two distributions such that the corresponding prior on the reduced form parameters is similar to Litterman's random walk prior. That implies that $E(\underline{f}|\underline{a}_0) = [\underline{a}_0', \underline{0}']$ and $Var(\underline{f}|\underline{a}_0) = \psi$, where ψ is the conditional covariance prior for F. Each diagonal element of ψ corresponds to the variance of the VAR parameter.Each variance has the following form: $\hat{S}_{l,j,i} = (\lambda_0\lambda_1/\sigma_j l^{\lambda_3})^2$, which is for the l^{th} lag of variable j in equation i; and σ_j^2 is the value of error variances from a univariate AR(p) OLS regression of the j^{th} variable on its own lags. These various $\lambda_i s$ are referred to as hyper-parameters. The choice of these $\lambda_i s$ is equivalent to the choice of prior in the model. (Note 5)

Combining the prior with the likelihood function, we may obtain the following posterior distribution: $q(\underline{a}) \propto p(\underline{a}_0|Y) \cdot p(\underline{f}|\underline{a}_0, Y)$. Thus, besides conditioning on the data, the joint posterior distribution contains two parts: the marginal distribution of $\underline{a}_0$ and the conditional distribution of $\underline{f}$ conditioning on $\underline{a}_0$(for a more detailed distributional form, see Waggoner and Zha (2003)).

3. Key Variables and Sample Selection

3.1 The Policy Variables

To choose a proxy for the monetary policy, the selection varies from non-borrowed reserves (Christiano and Eichenbaum, 1992), borrowed reserves (Cosimano and Sheehan, 1994), the percentage of non-borrowed reserves (Strongin, 1995), and the federal funds rate (Bernanke and Blinder, 1992).When tested together with borrowed and non-borrowed reserves (Bernanke and Mihov, 1998), the federal funds rate appears to be an effective policy

proxy.Thus, we will use the federal funds rate (ffr) as an indicator of monetary policy. Nevertheless, Bernanke and Kuttner (2005) pointed out that, to have more discerning equity price responses, it is essential to distinguish between expected and unexpected policy actions because the stock market is unlikely to respond to policy actions that are already anticipated.We will thus also use the unexpected federal funds rate (u.ffr) as an indicator of the policy action.However, this u.ffr can only be constructed for a specific time period.

Even so, it is not straightforward to construct u.ffr.In the literature, there are three ways to identify the unexpected monetary policy action.The difference in these varying methods lies in the derivation of the expected federal funds rate.The u.ffr is defined as the difference between the actual federal funds rate and the expected federal funds rate.The most frequently used method in the literature derives the expected federal funds rate from federal funds futures contracts (Kuttner 2001; Bernanke and Kuttner, 2005).The second method derives its expectation from surveys of market participants (Ehrmann and Fratzscher, 2004).The third method uses the Taylor rule to derive the expected federal funds rate (Konrad, 2009).The first two techniques are suitable for event studies.Since we use BVAR, we will use the Taylor rule to calculate the market expectations of the ffr and the monetary shock.

We follow Konrad (2009) in deriving our expected ffr.Based on *Monetary Trend*, a publication of the St. Louis Federal Reserve, the expected ffr (f_t^e) implied by the Taylor rule is defined as follows:

$$f_t^e = r^* + \pi_{t-1} + 0.5 \times (\pi_{t-1} - \pi^*) + 0.5 \times \left(y_{t-1} - y_{t-1}^p\right) \times 100 \quad (3)$$

where r^* is the equilibrium short-term interest rate at time *t*, π_{t-1} is the previous period's inflation rate on a year-over-year basis, π^* is the target inflation rate, y_{t-1} is the log of previous period's output and y_{t-1}^p is the log of the previous period's potential output.Prior to its April 2000 issue, *Monetary Trend* reported an inflation rate that was measured by CPI.Since then, the CPI inflation rate has been switched to PCE.This paper follows the same convention practiced by the St. Louis Fed, except that we calculate monthly implied ffr instead of quarterly implied rates.In addition, we set π^* at 3% and r^* at 2%. (Note 6) To obtain monthly potential output, we apply the "disaggregate" function with cubic spline interpolation of S+FinMetrics to convert data from quarterly to monthly.The quarterly real actual and real potential GDP data are available from the St. Louis Fed.

The unexpected component of ffr (f_t^u) is calculated in the following manner:

$$f_t^u = f_t^a - f_t^e \quad (4)$$

where f_t^a is the average monthly target ffr. (Note 7)Figure 1 shows the movements of each element of the ffr, i.e., f_t^a, f_t^e, and f_t^u.To check the validity of using the Taylor rule to reflect market expectations of the ffr, we follow the hypothesis of rational expectations, which assumes that the unexpected or the shock component of the ffr should have an expected value of zero, and apply the following regression:

$$f_t^a = \beta_0 + \beta_1 f_t^e + \epsilon \quad (5)$$

where an F test is used to test the null hypothesis H_0: $\beta_0 = 0$ and$\beta_1 = 1$. Using data from 1987:06-2009:03, we obtained a *p*-value of 0.0934.Thus, at 5% significance level, we fail to reject the null and the hypothesis of rational expectations is confirmed.

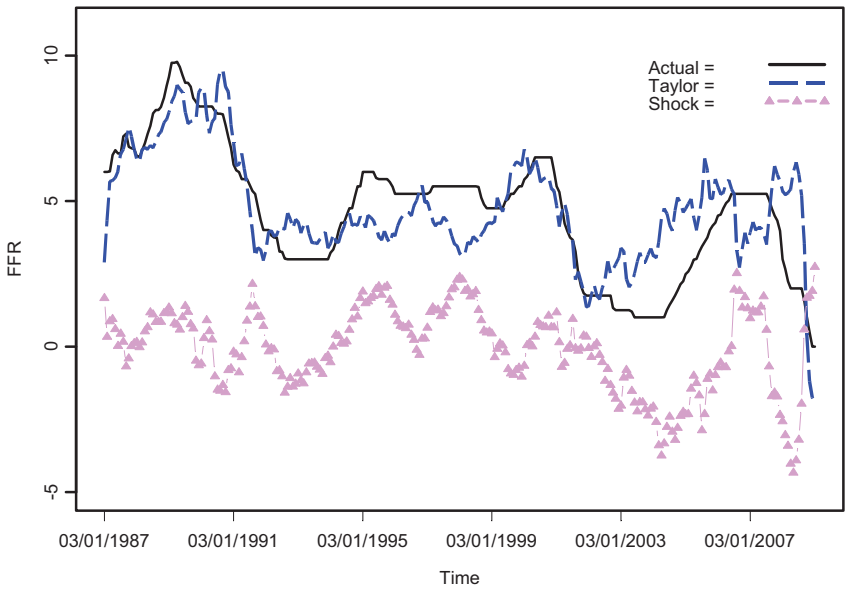

Figure 1. The Actual, Taylor-implied, and Shock Components of FFR

3.2 Indicators of Credit Market Condition

A standard indicator of credit market conditions is the percentage change in commercial and industrial bank loans.This data are obtained from the Federal Reserve of St. Louis.In addition to this standard indicator, we will adopt another indicator of credit markets that derives from the literature of "financial accelerator models" (Vijverberg, 2004). (Note 8)This indicator signals a differential access to credit between large firms and small firms.We use data from U.S. Flow of Funds tables L.102 and F.102 to demonstrate the relevance of this indicator.These are data of non-farm non-financial corporate business.Loans include business loans and other loans while bonds are corporate bonds.Figure 2 shows the growth rates of three measures of credit.The solid line is "p.loan", which is the percentage change of loans.The dashed line is "p.bond" which is the percentage change of corporate bonds.The line with "▲" is "c.index, which is calculated as "p.loan" minus "p.bond".As mentioned, this "c.index" indicates differential credit accessibility for small and large firms.When credit is tightened and banks do not want to lend, small firms' credit is rationed while large firms can still tap into credit markets by issuing corporate bonds.As shown in Figure 2, in each of the last three recessions (1991, 2001 and 2008), bank loans (i.e., "p.loan") dropped significantly while corporate bonds (i.e., "p.bond") still had positive changes.This "c.index" thus measures the credit availability for small firms, given that large firms may issue bonds at any time.A large (small) value of c.index implies easy (tight) loan access for small firms.This variable can be used to validate the financial accelerator mechanism that differential credit accessibility indeed matters in the monetary policy transmission conduit.

All data are seasonally adjusted monthly data.In addition to the c.index mentioned earlier, all data were downloaded from the Federal Reserve Bank of St. Louis except the SP500 index, which comes from Thomas Reuters' Interactive Data Real Time Services.The data we use in this paper, i.e., 1954:07-2009:03, covers a long time period.Since the U.S. economy has gone through many changes in regulations and restructuring, we will look into three different time periods: one whole period(1954:07 -2009:03), (Note 9)and two sub-periods(1954:07-1978:12) and (1987:06 -2009:03). (Note 10) Note that u.ffr is only available for the second sub-period.

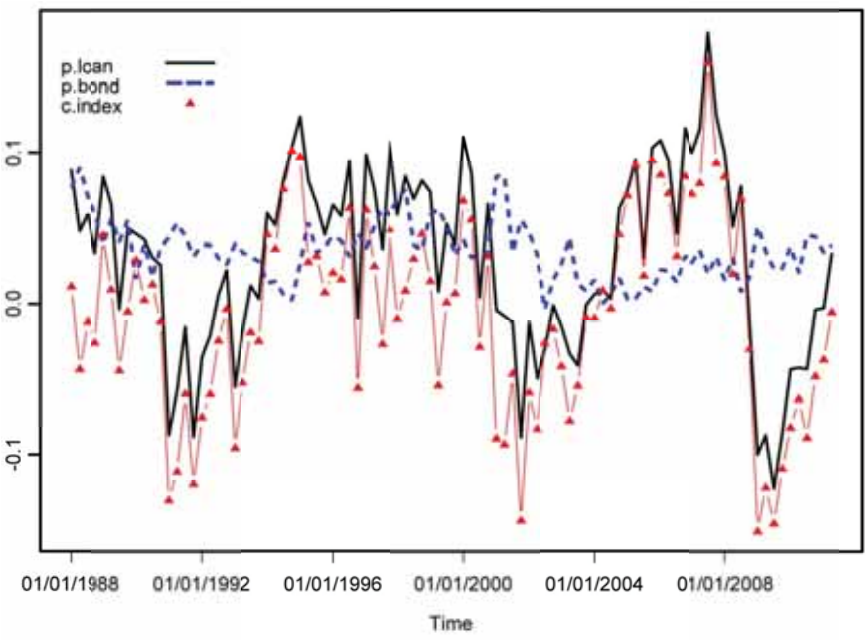

Figure 2. The Percentage Change of Bonds, Loans and the Credit Index

4. Empirical Results: U.S. Responses

As outlined in the previous sections we have two policy variables, namely ffr and u.ffr, and three financial market measures: BL percentage change, the c.index, and SP500 percentage change.The first two financial market measures are indicators of the credit market situation and, thus, represent the credit channel.The third financial market measure indicates pseudo Tobin's q model. In the BVAR model, we order our variables in the following manner: unemployment → inflation → policy variable → financial variables.This ordering implies that the variables on the left side of the arrow (i.e.→) affect the contemporaneous values of those on the right side of the arrow but not vice-versa.Thus, the shock to unemployment at time *t* affects inflation, funds rate, and bank loan/SP500 at the same time period, etc., but the shock of funds rate does not affect the contemporaneous unemployment and inflation values.Note that this kind of ordering is consistent with typical assumptions in the literature (Bernanke and Blinder, 1992; Christiano, Eichenbaum and Evans, 1999, 2005) that the unemployment rate and inflation do not respond contemporaneously to a monetary shock.

In using BVAR, it is necessary to choose the prior.In the Sim-Zha Bayesian model, one set of the priors used was $\lambda_0 = 0.6, \lambda_1 = 0.1, \lambda_2 = \lambda_3 = 1, \lambda_4 = 0.1$ (Waggoner and Zha 1998; Robertson and Tallman 2001) while the other set was $\lambda_0 = 1, \lambda_1 = 0.2, \lambda_3 = \lambda_4 = 1$ (Sims and Zha 1998).We search the priors from the range of $\lambda_0 = (0.6, 0.8, 1), \lambda_1 = (0.1, 0.2), \lambda_3 = (0, 1), \lambda_4 = (0.1, 0.25)$. There are various criteria to choose the prior.Based on the minimized root MSE criterion, the best choice for credit data is$\lambda_0 = 1, \lambda_1 = 0.2, \lambda_3 = 0, \lambda_4 = 0.1$, while, for the SP500 data, the choice is $\lambda_0 = 1, \lambda_1 = 0.1, \lambda_3 = 1, \lambda_4 = 0.25$.For each hypothesis, we also run a flat prior model, i.e., the prior information is a non-dominant factor.Since the results between the specific designated prior and the flat prior models are not significantly different, we will only present the flat prior results in this paper. (Note 11)

In estimation, based on the AIC criterion, we chose lag length p = 9.Using ffr or u.ffr as an indicator of the policy action, we estimate the responses of economic variables to policy or financial shocks in two ways: the reduced-form type impulse response function and variance decomposition.These two methods allow us to study the dynamic effects of the monetary policy on credit market measures and equity price over a long horizon, therefore providing insights about the transmission channel.

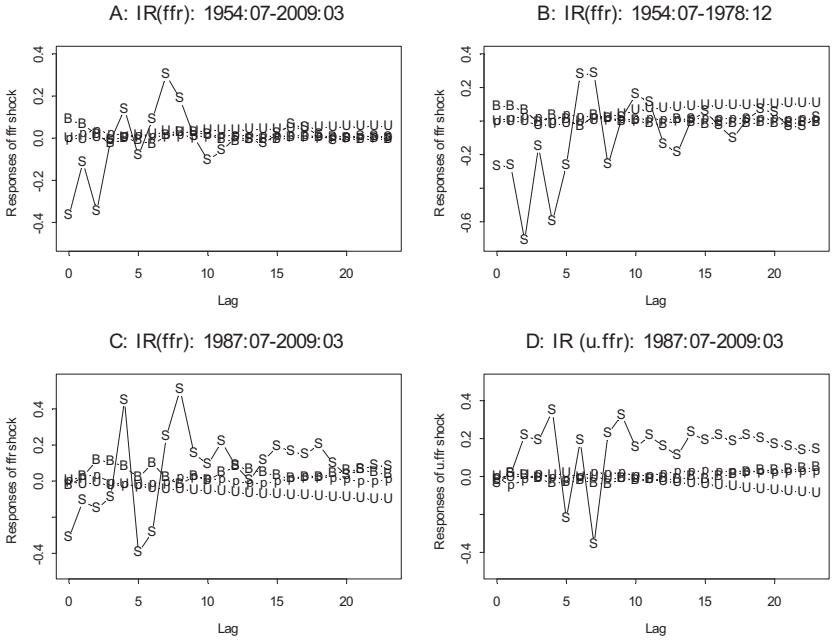

Figure 3. Responses due to a Positive Federal Funds Rate Shock: Different Time Periods

4.1 IRF Results of a Policy Shock in the U.S.

Figures 3A-C illustrates the impulse responses of a positive "ffr" shock on various variables in different time periods.Figure 3D shows the impulse response of a positive "u.ffr" shock on the same variables in the second sub-period.Forthe sake of clarity, we do not plot the standard errors of the impulse responses.As mentioned, the order of the variables is unemployment rate, inflation rate, policy variable and financial market measures. We include one policy variable and both financial market measures, i.e., BL and SP500, in the model.Note that the order of BL and SP500 does not matter because either variable-ordering generates similar answers.Later, as we replace BL with "c.index", the results do not change much.Thus, we only show the results of using BL."U" and "p" in Figures 3A-D indicate the impulse responses of the unemployment and inflation rates respectively, while "B" and "S" represent BL and SP500 responses respectively.The responses of unemployment and inflation are basically "zero" or "flat" in all figures.As for the equity market, Figures 3A-B show that, for 1954-2009 and 1954-1978 periods, the equity price declines for the first 3-6 months following a positive ffr shock.For the second sub-period (i.e., 1987-2009), shown in Figures 3C-D, the percentage change in equity price declines in the first 3-4 months and fluctuates later due to a positive ffr shock; but the percentage change in equity price in the first 2 months is near zero for a positive u.ffr shock. (Note 12)This contradicts the existing literature that an increase in u.ffr will cause a significant decline in equity price.However, as mentioned, we use monthly data while the previous event studies use daily data.The change from high frequency to lower frequency data may be the culprit because lower frequency data may not be able to pick up the variations in the higher frequency data.As for the impact on the credit market, Figures 3AB show that BL has a modest positive change for the first two months, then goes down to zero and stays there.This kind of response may be caused by the fact that loans are contracts between banks and borrowers and it takes time for financial institutions to write or rewrite them.But Figures 3C-D, for the 1987-2009 period, indicate that the credit market actually is not responsive to shocks from either ffr or u.ffr.Thus, compared with the first sub-period (1954-1978), the role of the funds rate has obviously changed in the second period (1987-2009).

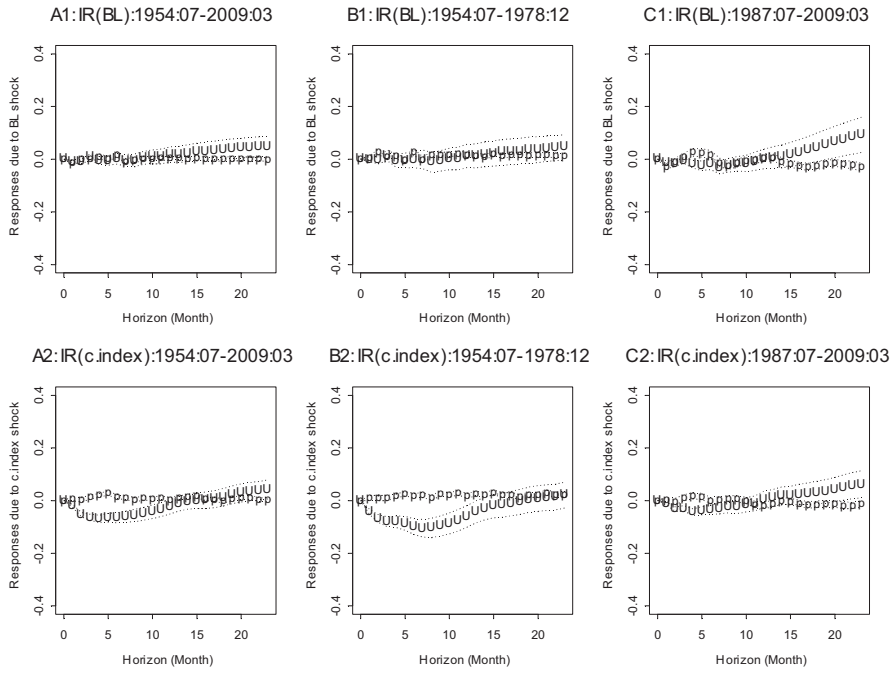

Figure 4. Responses of Unemployment and Inflation due to a Positive Credit Shock

We next investigate the relationship between the channel variables and the economy.We ask a simple question: does a positive shock to credit markets (i.e., BL/c.index) or to the SP500 affect the unemployment rate and inflation?If the answer is yes, then the Fed's recent direct lending strategy is a good remedy in rescuing the unresponsiveness of the ffr reduction policy.Figures 4 and 5 offer a glimpse of the answer.There is a clear difference between these two channels.Figures 4A1-C1 track the responses of unemployment (U) and inflation (p) due to one positive standard deviation shock on BL.Figures 4A2-C2 indicate the responses due to a positive shock to c.index.The dashed lines are the standard errors of the responses.In Figures 4A1-C1, the unemployment rate does not respond downward and the inflation response is basically zero for all three different time periods; however, Figures 4A2-C2 tell a different story.Obviously, the unemployment rate declines when a positive shock to c.index occurs.As mentioned, c.index is the difference between the percentage change of bank loans and the percentage of corporate bonds, and a positive shock to c.index implies a positive injection of credits to small firms (i.e., firms that are unable to issue bonds).The results of Figures 4A2-C2 support the notion of the financial accelerator model that small firms' credit availability matters.This also justifies the Fed's direct lending monetary policy action during the 2008 crisis.However, we should note that the magnitude of unemployment reduction is much smaller in the second sub-period than that of the first sub-period.It implies that the financial accelerator mechanism is stronger in the first sub-period than the second sub-period.As for the equity market, a positive SP500 shock in Figure 5 significantly lowers the unemployment rate after 4-5 months.However, the response of inflation to the stock market shock is basically around zero.

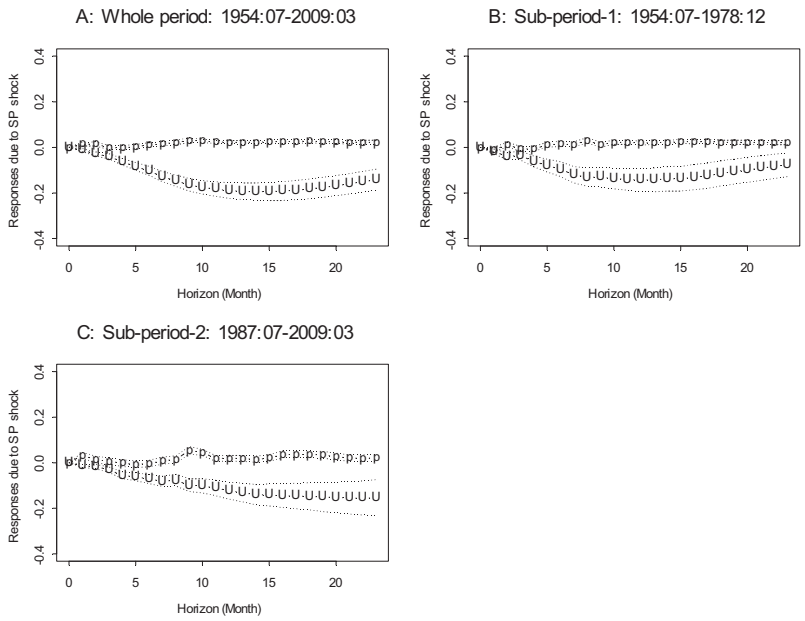

Figure 5. Responses of Unemployment and Inflation due to a Positive SP 500 Shock

4.2 Policy Reaction Function and the Reciprocal Macro Effects

We showed in the previous section how the policy variable initially affects the credit market and the stock market, which, in turn, affect unemployment and inflation.In this section, we will examine this relationship from a different perspective.We first ask how a shock to each of the two macro variables affects the funds rate, the so called policy reaction function.For instance, the Fed may deliberately raise the interest rate to fight inflation or lower the interest rate to curb recession.This type of policy reaction could vary from cycle to cycle in both magnitude and speed.To see whether the equity channel or the credit channel have stronger effects, we include credit market and equity market measures separately in each respective BVAR model.Figures 6 and 7 show the implied response functions of the fed funds rate to shocks of unemployment and inflation, respectively.In both figures, “E” indicates the response from the equity channel and “B” is from the credit channel.Figures 6A-B shows that, given a positive shock to unemployment, the Federal Reserve responds with an easy money policy by lowering the funds rate for almost a year before its gradual return to the long run equilibrium.Figure 6C indicates that it takes longer time periods for ffr to go downward and then upward.This pattern of response is true for both models except that the credit channel shows a stronger reaction to the Fed for the whole time period and the first sub-period.In the case ofa positive inflation shock, Figures 7A-B provide expected results that the Fed would pursue a tightening monetary policy and push up the funds rate.The peak effect comes after 8 to 9 months.Figure 7C shows a peculiar result that, for the period of 1987:07 to 2009:03, the ffr declines slowly after a positive inflation shock.This counter-intuitive result again supports our previous findings that the role of the funds rate has obviously changed in this second sub-period.In addition, the period of 1987:07-2009:03 is a period of low inflation, i.e., the period of great moderation.

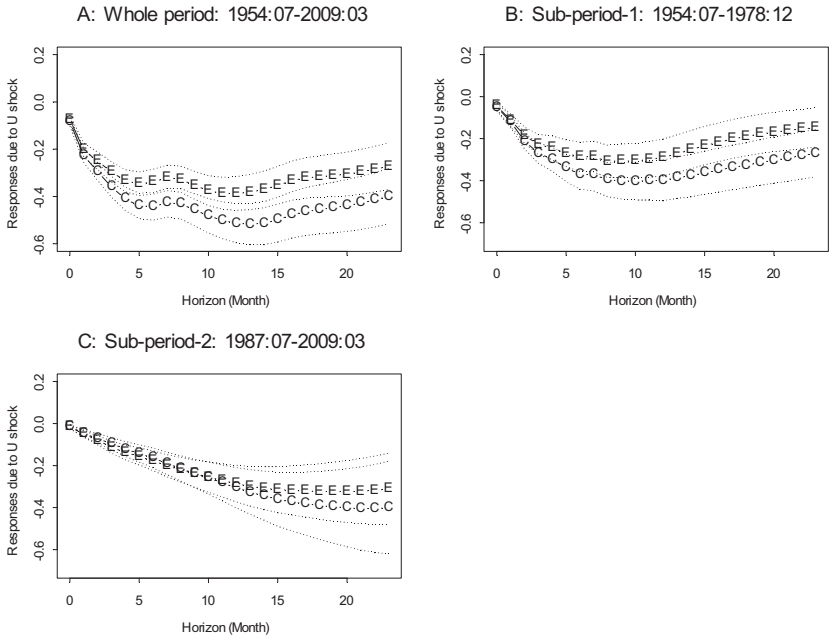

Figure 6. Responses of Funds Rate to Unemployment Shock

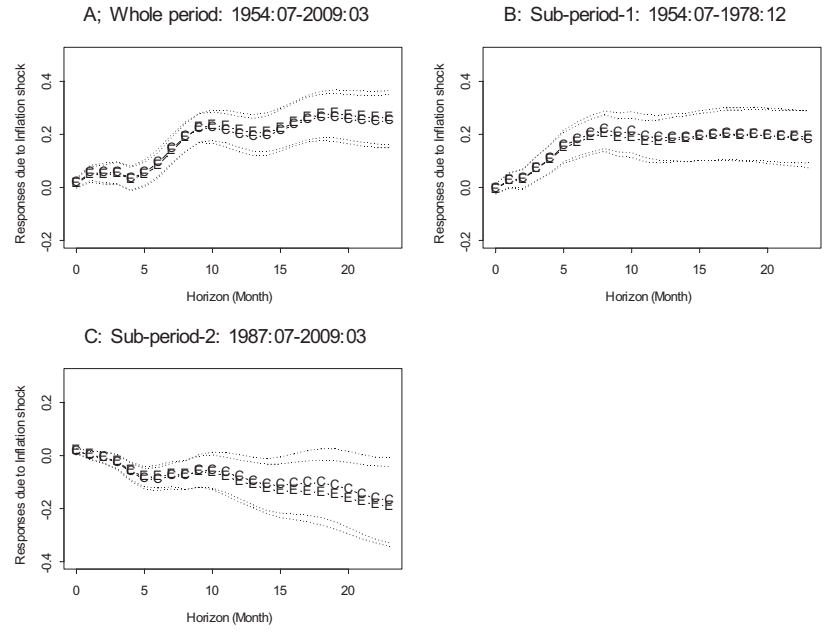

Figure 7. Responses of Funds Rate to Inflation Shock

4.3 Variance Decomposition

So far, we have obtained various results from the impulse response functions.In equation (2), the coefficients A_0 and F measure the direct effect of shocks in one variable on another.To measure the total (direct and indirect) effect of such shocks, we need to use the variance decomposition technique.In this section, we order the variables in a similar sequence, i.e., unemployment, inflation, funds rate, BL, SP500, to diagnose the contribution of the various shocks on a specific forecast error variance. (Note 13)

Table 1. Comparison of Variance Decompositions for Different Sample Periods

Panel A

	Source of Shock, by Period									
	U Rate		Inflation		ffr (u.ffr)		BL		SP500	
Forecasted variable	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09
U Rate	0.73		0.00		0.08		0.00		0.18	
	0.61	0.59	0.07	0.02	0.06	0.02	0.05	0.01	0.21	0.35
	(0.70)		(0.05)		(0.02)		(0.02)		(0.21)	
Inflation	0.09		0.58		0.09		0.12		0.12	
	0.17	0.11	0.56	0.73	0.05	0.04	0.08	0.01	0.13	0.11
	(0.15)		(0.59)		(0.11)		(0.07)		(0.08)	
ffr	0.26		0.10		**0.29**		0.13		0.22	
(u.ffr)	0.27	0.28	0.07	0.12	**0.62**	0.27	0.01	0.02	0.03	0.31
	(0.12)		(0.18)		(0.54)		(0.11)		(0.05)	
BL	0.14		0.05		0.04		**0.68**		0.09	
	0.21	0.12	0.06	0.03	0.09	0.02	**0.49**	0.67	0.16	0.15
	(0.29)		(0.07)		(0.02)		(0.45)		(0.17)	
SP500	0.05		0.06		0.08		0.05		**0.76**	
	0.02	0.02	0.04	0.02	0.06	0.02	0.03	0.00	**0.86**	0.93
	(0.04)		(0.04)		(0.05)		(0.02)		(0.85)	

Panel B

	Source of Shock, by Period									
	U Rate		Inflation		ffr (u.ffr)		c.index		SP500	
Forecasted variable	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09	54-78 87-09	54-09
U Rate	0.71		0.00		0.05		0.07		0.17	
	0.61	0.60	0.08	0.02	0.12	0.02	0.03	0.02	0.15	0.34
	(0.76)		(0.04)		(0.01)		(0.01)		(0.19)	
Inflation	0.05		0.60		0.08		0.13		0.14	
	0.16	0.09	0.62	0.73	0.07	0.04	0.04	0.02	0.11	0.11
	(0.17)		(0.65)		(0.09)		(0.02)		(0.07)	
ffr	0.13		0.12		0.26		0.25		0.25	
(u.ffr)	0.26	0.21	0.07	0.11	0.65	0.29	0.01	0.08	0.02	0.31
	(0.13)		(0.18)		(0.61)		(0.4)		(0.04)	
c.index	0.11		0.03		0.07		0.68		0.12	
	0.20	0.10	0.10	0.02	0.11	0.02	0.48	0.69	0.11	0.17
	(0.33)		(0.06)		(0.02)		(0.44)		(0.14)	
SP500	0.04		0.06		0.08		0.03		0.78	
	0.02	0.02	0.03	0.02	0.06	0.02	0.04	0.01	0.85	0.92
	(0.05)		(0.03)		(0.05)		(0.02)		(0.85)	

The values in Table 1A-B are at the 24th forecasting time horizon; panel A uses BL and panel B uses c.index as the credit measure.Each row of Table 1 represents the percentage of the variance of the forecasted variable accounted for by shocks to the variables listed on the top of each column over a 24-month horizon.Each cell has four numbers: three numbers without parentheses and one number with parenthesis. The three numbers without parentheses represent the results from the time periods of 1954:07-1978:12 (54-78), 1987:07-2009:03 (87-09), and 1954:07 to 2009:03 (54-09), respectively.The one number with parenthesis in each cell is the variance decomposition result of the period 1987:07-2009:03 (87-09) when ffr is replaced by u.ffr.

The percentage of variances explained by shocks to various variables appears to be somewhat sensitive to the selection of the sample period.There are three sets of numbers that are bolded in this table that deserve our attention.The first set is 0.29 and 0.62 where funds rate shock itself contributes 29% to the variance of funds rate forecast error in the 54-78 period and that increases to 62% in the 87-09 period.Thus, the volatility of the funds rate is affected more by itself in the 87-09 period.In addition, inflation and unemployment rate shocks contribute 10% and 26% in the 54-78 period respectively; but the contribution of inflation drops to 7% while the unemployment contribution stays at 27% in the 87-09 period.Thus, unemployment is still an important element in explaining the variation of the funds rate in the 87-09 period, while the inflation rate is less important.The second set is 0.68 and 0.49 where the contribution of the credit market shock (BL) to the variance of BL forecast error decreases from 68% to 49%.Even so, the contribution of the unemployment shock to this variance increases from 14% in the 54-78 period to 21% in the 87-09 period.Thus, unemployment has become more important to the variation of the BL in the 87-09 period.The third set is 0.76 and 0.86 where the contribution of the SP500 shock to the variance of SP500 increases from 76% in the 54-78 period to 86% in the 87-09 period.Thus, the equity market's volatility is affected a bit more by itself than any other policy or macro variables during the 87-09 period.

When ffr is replaced by u.ffr in the model for the 87-09 period, most numbers are quite similar except when the forecast variable is ffr or u.ffr.In the case of u.ffr, the funds rate shock itself contributes 54% while the shocks of other variables, except the shock of equity market, contribute double digit percentages to the variance of the u.ffr forecast error.This differs from the case of ffr where unemployment rate shock is a major contributor to the variance of the ffr forecast error.

The numbers in Panel A are very similar to those in Panel B, except the third row of each panel: when the forecasted variable is ffr.When we use c.index, instead of BL, as the credit measure in the model, there is a re-allocation in the magnitudes of the sources of shocks in the 54-78 period as we decompose the variance of the forecasted error of the ffr.As one may see in the third row of panel B, c.index contributes 25% to the variance of forecasted ffr error, an obvious increase from BL's 13% in panel A.This again indicates that c.index plays a more significant role in the 54-78 period than BL.

5. International Linkage

5.1 IRF Results

In globally connected financial markets, U.S. policy and equity markets may well affect other countries' equity markets.We obtained the share prices of various foreign countries from IMF Financial Statistics data.Both the U.S. credit market and equity market measures are included in the model and the change of foreign share price is placed in the last position.The order between BL (or c.index) and equity price changes does not matter: either way to order these two variables generates similar results.Also, replacing BL with c.index produces approximately the same results.Thus, we will only report one set of these various results in two sub-periods.Countries included in our analysis are Canada, France, Japan, and the U.K. (Note 14)Due to data availability, the starting date of the analyzed time period differs between countries.We examine the impulse responses of the foreign share prices to a positive ffr shock.The results (not shown here) indicate that there is a fairly high degree of co-movement of U.S. and foreign equity markets over both sub-sample periods due to a positive ffr shock.Since the volatility in the U.S. equity market is mostly attributed to itself, we also examine the foreign share price responses due to the U.S. equity market shock.Figures 8A-D indicate the response of foreign share price to a positive SP500 shock during the two sub-sample periods, with "1" indicating the period of 1960:02-1978:12 and "2" indicating the period of 1987:07-2009:03. (Note 15)

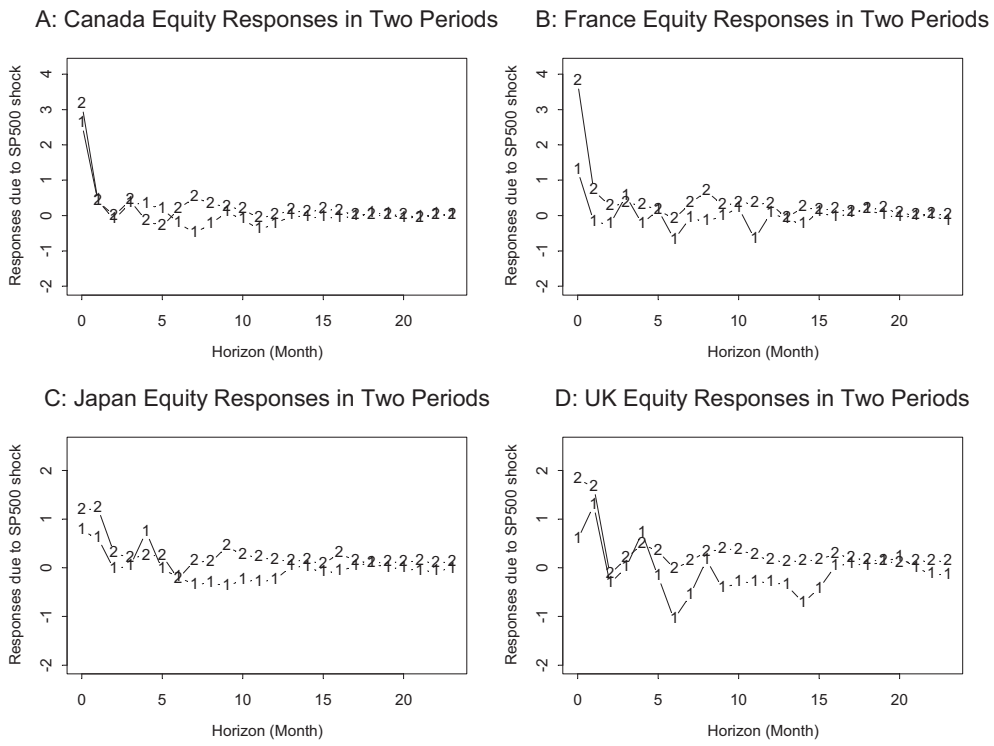

Figure 8. Different Equity Price Responses due to a Positive U.S. Equity Shock

There are two interesting findings from the IRFs of the four nations.First, foreign share prices move in the same direction and magnitude as the U.S. share price due to a funds rate shock.As with the U.S. equity price, the response of foreign stock prices due to a positive funds rate shock is much less in the second period than that of the first period.Second, foreign share prices move upward due to a positive shock in the U.S. share price.The responses occur mostly in the first 2 months.Furthermore, the responses of foreign share prices in the second period is stronger than that of the first period, suggesting a more globalized financial integration in the later period.

5.2 Variance Decomposition

To calculate the variance decomposition in a VAR model, we order the variables in the following manner: unemployment → inflation → federal funds rate → BL →SP 500 → S-other (i.e., foreign country share price). (Note 16) Table 2 shows the variance decomposition of various BVAR models where each model includes a foreign country's equity price (i.e., a specific country's S-other).Since the focus is on the equity market, we decompose the variances of two forecasted variables: SP500 and S-other.The values in Table 2 are at the 24th forecasting time horizon.There are two sub-sample periods for each country so we mayevaluate the possible impact of a greater globalization in recent time period.An additional row is added to each country to report the variance decomposition for the 87-09 period when ffr is replaced by u.ffr.

Regardless of the country involved, there are four general patterns in the results. First, the U.S. equity market is not affected much by the foreign market. In Table 2, when the forecasted variable is SP500, the contribution of S-other to the variance of SP500 is small. For example, in the time periods of 1957-1978 (i.e., 57-78) and 1987-2009 (i.e., 87-09), Canada's (France, Japan, the U.K.) equity market contributed 0.014 and 0.061 (0.027 and 0.022, 0.040 and 0.025, 0.052 and 0.038) respectively. Second, the U.S. equity market has strong impacts on foreign equity markets. When the forecasted variable is S-other, the contribution of SP500 to the variance of S-other is not trivial. In the periods of 57-78 and 87-09, SP500 contributed 0.438 and 0.521 (0.089 and 0.457, 0.082 and 0.120, 0.155 and 0.396) to the share price of Canada (France, Japan, the U.K.). Third, the impacts of U.S. equity market on foreign equity markets are stronger in the 87-09 period than those in the 57-78period. As in Table 2, 0.521 (0.457, 0.120, 0.396) is greater than 0.438 (0.089, 0.082, 0.155) in Canada (France, Japan, the U.K.). The results clearly indicate a greater integration of the U.S and foreign equity markets. Fourth, when u.ffr replaces ffr in the model, the results are very similar, even though the impacts of the U.S. equity market on

foreign equity markets becomes slightly stronger. For France, Japan and the U.K., the contribution of SP500 on the variance of the forecast error of S-other becomes (0.465, 0.148, 0.452) instead of (0.457, 0.120, 0.396).

Table 2. Variance Decomposition Including a Foreign Country

	Time Period	Forecasted Variable	Source of Shock					
			U Rate	Inflation	ffr (u.ffr)	BL	SP500	S-Other
Can	57-78	SP500	0.040	0.069	0.082	0.043	0.752	0.014
		S-other	0.051	0.072	0.067	0.036	0.438	0.335
	87-09	SP500	0.023	0.036	0.084	0.023	0.774	0.061
		S-other	0.035	0.045	0.045	0.025	0.521	0.330
	87-09	SP500	(0.057)	(0.039)	(0.049)	(0.016)	(0.779)	(0.059)
	(u.ffr)	S-other	(0.057)	(0.048)	(0.032)	(0.024)	(0.524)	(0.316)
Fra	60-78	SP500	0.043	0.072	0.101	0.052	0.705	0.027
		S-other	0.045	0.070	0.080	0.054	0.089	0.663
	87-09	SP500	0.018	0.035	0.061	0.036	0.828	0.022
		S-other	0.034	0.035	0.034	0.016	0.457	0.424
	87-09	SP500	(0.046)	(0.034)	(0.058)	(0.023)	(0.812)	(0.027)
	(u.ffr)	S-other	(0.057)	(0.036)	(0.018)	(0.015)	(0.465)	(0.410)
Jap	60-78	SP500	0.048	0.078	0.093	0.056	0.686	0.040
		S-other	0.038	0.066	0.055	0.080	0.082	0.678
	87-09	SP500	0.030	0.035	0.052	0.030	0.828	0.025
		S-other	0.027	0.049	0.053	0.055	0.120	0.696
	87-09	SP500	(0.055)	(0.039)	(0.044)	(0.024)	(0.819)	(0.019)
	(u.ffr)	S-other	(0.056)	(0.041)	(0.037)	(0.057)	(0.148)	(0.661)
UK	63-78	SP500	0.074	0.078	0.146	0.063	0.587	0.052
		S-other	0.086	0.060	0.156	0.049	0.155	0.494
	87-09	SP500	0.021	0.034	0.058	0.031	0.818	0.038
		S-other	0.025	0.053	0.056	0.034	0.396	0.436
	87-09	SP500	(0.046)	(0.039)	(0.047)	(0.020)	(0.821)	(0.028)
	(u.ffr)	S-other	(0.047)	(0.058)	(0.015)	(0.028)	(0.452)	(0.400)

6. Conclusion

This paper uses monthly U.S. data from 1954:07-2009:03 in a BVAR model to evaluate possible impacts of various shocks through different channels. By applying IRF and variance decomposition, we may summarize our results as the following. (1) A funds rate shock has a slightly stronger impact on equity price than on bank loans. However, the shock does not have an impact on inflation. Though it has a minor impact on unemployment in the long run, the shock does not affect unemployment in the short run. In general, most variables are not very responsive to the ffr shock in the second sub-period (87-09), comparing to those of the 54-78 period. Furthermore, a positive (negative) u.ffr shock does not depress (stimulate) the equity market in the short run. (2) We evaluate shocks in the financial market through either the credit market or the equity market. The shock in the credit market is measured in two ways: BL and c. index. A positive shock on BL has no impacts on inflation and the unemployment rate. However, a positive shock to c.index has a negative impact on unemployment but the inflation rate is not affected. The negative short-run impact on the unemployment rate is much stronger in the 54-78 period than in the 87-09 period. As for a positive equity price shock, the unemployment rate decreases in the long run but inflation rate is not affected. (3) A positive unemployment rate shock causes the funds rate to go

down for all three time periods. A positive inflation shock induces the federal funds rate to move up in the 54-78 period, but not in the 87-09 period. (4) As for the global equity markets, a U.S. equity price shock affects foreign equity prices, more strongly so in the 87-09 period than in the 57-78 period. This indicates a stronger financial integration in the 87-09 period. Shocks to foreign equity markets do not have impacts on the U.S. equity prices.

Our results provide the following assessments for the Fed's policy actions. Given that lowering the federal funds rate can only increase equity price in the short run and a positive shock in equity price affects unemployment only in the long run, this rate-reduction policy action does not provide any immediate reliefto high unemployment. Nevertheless, a positive c.index shock does have a mild negative impact onthe unemployment rate in the short run. The Fed's action of lending directly to banks does provide a gentleshort-term lift to the economy. Thus, the dual actions of lowering the federal funds rate and lending directly to banks to ensure loan availability in the economy may lower the unemployment moderately but a significant decline in unemployment rate is not seen, especially in the short run. However, having said so, we do need to give the Fed credit in restoring the investors' confidence and stabilizing the financial system. The dual actions did provide an assurance of the Fed's willingness to resolve the financial crisis and to restore the economy, which has a positive impact on the U.S. equity market. This positive impact spreads through the global connection and provides a concrete effect on other economies.

References

Adrian, T., Paolo, C., & Shin, H. S. (2012). Which Financial Frictions? Parsing the Evidence from the Financial Crisis of 2007-2009. ASSA meetings, Chicago, January 2012.

Bernanke, B. S., & Blinder, A. (1992). The Federal Funds Rate and the Channels of Monetary Transmission. *American Economic Review, 82*(4), 901-921.

Bernanke, B. S., & Mihov, I. (1998). Measuring Monetary Policy. *Quarterly Journal of Economics, 113*(3), 869-902. http://dx.doi.org/10.1162/003355398555775

Bernanke, B. S., & Kuttner, K. N. (2005). What Explains the Stock Market's Reaction to Federal ReservePolicy? *Journal of Finance, 60*(3), 1221-1257. http://dx.doi.org/10.1111/j.1540-6261.2005.00760.x

Bernanke, B. S., Gertler, M., & Gilchrist, S. (1996). The Financial Accelerator and the Flight to Quality. *Review of Economics and Statistics*, February, 1–15. http://dx.doi.org/10.2307/2109844

Campello, M., Graham, J. R., & Harvey, C. R. (2010). The Real Effects of Financial Constraints:Evidence from a Financial Crisis. *Journal of Financial Economics*, *97*(3), 470–87. http://dx.doi.org/10.1016/j.jfineco.2010.02.009

Christiano, L. J., & Eichenbaum, M. (1992). Identification and the Liquidity Effect of a MonetaryPolicy Shock. In A. Cukierman, Z. Hercowitz, & L. Liederman (eds.), *Business Cycles, Political Economy, and Growth*. Cambridge: MIT Press.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (1999). Monetary Policy Shocks: What Have We Learned and to What End. In J. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, *1A*, 64-145.

Christiano, L. J., Eichenbaum, M., & Evans, C. L. (2005). Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy. *Journal of Political Economy*, *113*(1), 1-45. http://dx.doi.org/10.1086/426038

Cosimano, T. F., & Sheehan, R. G. (1994). Federal Reserve Operating Procedure 1984-1991: An Empirical Analysis. *Journal of Macroeconomics, 16*, 573-588. http://dx.doi.org/10.1016/0164-0704(94)90001-9

Driscoll, J. C. (2004). Does Bank Lending Affect Output? Evidence from the U.S. States. *Journal of Monetary Economics*, *51*, 451-471. http://dx.doi.org/10.1016/j.jmoneco.2004.01.001

Ehrmann, M., & Fratzscher, M. (2004). Taking Stock: Monetary Policy Transmission to Equity Markets. *Journal of Money, Credit and Banking*, *36*(4), 719-737. http://dx.doi.org/10.1353/mcb.2004.0063

Gertler, M., & Gilchrist, S. (1993). The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence. *Scandinavian Journal of Economics, 1*, 43–64. http://dx.doi.org/10.2307/3440134

Hubbard, R. G. (1995). Is There a Credit Channel for Monetary Policy? *Federal Reserve Bank of St.Louis Review*, May/June, 63–74.

Kashyap, A. K., & Stein, J. (1994). Monetary Policy and Bank Lending. In Mankiw, N. G. (ed.), *Monetary Policy*. University of Chicago Press, Chicago, IL, 221-256.

Kashyap, A. K., & Stein, J. (2000). What Do a Million Observations on Banks Say About the Transmission of Monetary Policy. *American Economic Review, 90*(3), 407-428. http://dx.doi.org/10.1257/aer.90.3.407

Konrad, E. (2009). The Impact of Monetary Policy Surprises on Asset Return Volatility: the Case of Germany. *Journal Financial Markets and Portfolio Management, 23*, 111-135. http://dx.doi.org/10.1007/s11408-009-0102-5

Kuttner, K. N. (2001). Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. *Journal of Monetary Economics*, *47*(3), 523-44. http://dx.doi.org/10.1016/S0304-3932(01)00055-1

Oliner, S. D., & Rudebusch, G. D. (1996). Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance: Comment. *American Economic Review*, *86*(1), 300 - 309.

Robertson, J. C., & Tallman, E. (2001). Improving Federal-Funds Rate Forecasts in VAR Models Used for Policy Analysis. *Journal of Business and Economic Statistics, 19*(3), 324-30. http://dx.doi.org/10.1198/073500101681019972

Sims, C. A., & Zha, T. (1998). Bayesian Methods for Dynamic Multivariate Models. *International Economic Review, 39*(4), 949-968. http://dx.doi.org/10.2307/2527347

Strongin, S. (1995). The Identification of Monetary Policy Disturbances: Explaining theLiquidity Puzzle. *Journal of Monetary Economics, 35*(3), 463-497. http://dx.doi.org/10.1016/0304-3932(95)01197-V

Tobin, J. (1969). A General Equilibrium Approach to Monetary Theory. *Journal of Money Credit and Banking*, *1*(1), 15-29. http://dx.doi.org/10.2307/1991374

Vijverberg, C. C. (2004). An Empirical Financial Accelerator Model: Small Firms' Investment and Credit Rationing. *Journal of Macroeconomics*, *26*, 101-129. http://dx.doi.org/10.1016/j.jmacro.2002.09.004

Waggoner, D. F., & Zha, T. (2003). Likelihood Preserving Normalization in Multiple Equation Models.*Journal of Econometrics*, *114*(2), 329-347. http://dx.doi.org/10.1016/S0304-4076(03)00087-3

Notes

Note 1. FDIC Press Release (various issues).

Note 2. "Stocks Jump on Bernanke Comments." The Wall Street Journal, March 27, 2012: C4.

Note 3. We will not use q, defined as the market value of firms divided by the replacement cost of capital, in our analysis. Rather, we will use the stock market indicator to link the relationship between the monetary policy and investment. Tobin's q was tested mostly at the manufacturing firm level. Under the assumption of price rigidity for capital input, stock price changes should be a good proxy for changes in q.

Note 4. Note that the prior is also the drawback of the Bayesian model from the Bayesian critics' point of view.

Note 5. According to Sims and Zha (1998), these hyper-parameters specified in the prior have the following implications. The parameter imposes an overall tightness across the elements of the prior on the reduced form variance. A smaller implies a tighter overall prior. is related to the standard deviation around F. The term indicates how the variance shrinks as the lag length increases. The variance of the constant term in the model has a prior variance of. Since our model does not consider other exogenous or dummy variables, we will not consider additional parameters relating to the priors.

Note 6. The St. Louis Fed set at five different rates, i.e., percent, and calculated the implied FFR for each case. was set at 2% before April 2000 and it was changed to 2.5% in later periods.

Note 7. This is calculated as the average daily target federal funds rate over the month.

Note 8. Adrian, Colla and Shin (2012) also mentioned the different patterns of loans and bonds in economic recession times.

Note 9. Since the federal funds rate is available after July 1954, our data will be from July 1954 to March 2009.

Note 10. The reasons for having such a gap between the first and the second sub-periods are the following. First, according to Thornton (2006), even though the FOMC returned to a funds rate operating procedure in September 1982 effectively, the FOMC stated officially that it was targeting borrowed reserves. Thus, for quite a period of time, it was not clear to what extent that the FOMC was targeting the funds rate. Second, as mentioned earlier, u.ffr is a valid construction during the period of 1987:7 – 2009:3.

Note 11. This is not unusual: if the specific prior has a peak in the density function that is close to that of the likelihood function, the flat prior will generate similar results as those of the specific prior.

Note 12. Note that Konrad (2009) used the Taylor rule for the case of Germany.

Note 13. Note that in this model, we put both bank loan and SP500 in the same model. When we change the ordering of the bank loan and SP500, the results are similar. Thus, the variance decomposition results with SP500 preceding bank loan are not presented.

Note 14. Germany is not included because of its reunification in 1989.

Note 15. For France and Japan, the first sub-period is 1960:02 to 1978:12 while for Canada and the U.K. the first sub-period starts from 1957:2 and 1963:2 respectively.

Note 16. The results are very similar if we include BL or do not include BL. If we replace BL with c.index, the results are not much different.

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On Fluctuations in the Cross-Sectional Distribution of Unemployment Rates

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Abstract

The cross-sectional distribution of unemployment rates has been relatively neglected compared to the study of unemployment rate differences across countries over time. This paper helps fill the gap. A drift-diffusion model is proposed to describe the dynamics of the cross-sectional distribution of unemployment rates. The model is fitted to the evolution of unemployment rate distribution across five regions, to estimate the *natural rates* and speeds of convergence to *natural rates* once an economy is hit by an exogenous shock. Given the importance of the *natural rate* for gauging the state of the business cycle, the outlook for future inflation, and the appropriate stance of monetary policy, techniques for its estimation would not be without merit.

Keywords: labor market dynamics, natural rate of unemployment, diffusion processes

1. Introduction

The study is motivated by the observation that the rate of unemployment across different states within a country, and countries within a region varies as a function of time. It would not be unreasonable to assume that a long-run distribution of the equilibrium or *natural rate of unemployment* exists with a certain mean and variance. It is hypothesized that over time a set of similar countries share the same natural rate of unemployment. Given an exogenous shock, the ensemble of states considered tends to converge to this long-run equilibrium. We build a theory of the distribution of the rate of unemployment as a drift-diffusion process, and propose a dynamic stochastic model to address the evolution of the cross-sectional distribution of unemployment rates. An empirical application fits the proposed model to the evolution of unemployment rate distribution across five different sets of countries: a) 52 states of the U.S. b) OECD member countries c) OECD Europe d) a handful of the major economies in South East Asia and e) a handful of major economies in South America. The results are novel. Given that estimates of the natural rate of unemployment and its time variation are typically imprecise and far from robust, the present paper suggests that diffusion may be a preferable technique for the estimation of the natural rate of unemployment and for monitoring labor market dynamics.

2. Literature Review

Dynamic and stochastic elements have played an important role in shaping real-world outcomes. In *The Wealth of Nations,* Adam Smith described what he called the *natural price of a commodity. The Wealth of Nations* was a portrait of a dynamic stochastic model of a perfectly competitive industry, in which Smith's natural price was simply the deterministic steady state equilibrium price. Likewise, Friedman's *natural rate* concept can be viewed as the deterministic steady state equilibrium rate of unemployment. Friedman argued that unemployment has an equilibrium or *natural rate*, determined not by the amount of demand in the economy but by the structure of the labor market. In his (1968) Presidential Address to the *American Economic Association*, Friedman echoed Adam Smith and described an economy in which at any moment in time, actual unemployment may be either above or below its *natural rate*, but is continually gravitating toward it. In other words, as an economy adjusts to any average rate of inflation, unemployment returns to its *natural rate*. In support of Friedman's thesis, one may note that the rate of unemployment across different states within a country, and countries within a region, varies as a function of time. It would therefore not be unreasonable to assume the existence of an *equilibrium* or *natural distribution* of unemployment rates, towards which an out-of-equilibrium labor market tends to gravitate.

Standard economics literature on the determinants of unemployment is built on two main ideas: i) actual unemployment deviates from equilibrium unemployment as shocks hit the economy, and ii) equilibrium

unemployment is determined by structural and institutional factors that differ across countries and even regions within the same country. The natural rate of unemployment is a concept frequently employed in fiscal and monetary policy deliberations. National governments use estimates of the natural rate to compute potential GDP, which in turn is used to make budget projections that affect decisions about federal spending and taxation. Central banks consider estimates of the natural rate to determine the likely course of inflation and what actions they should take to preserve price stability (Dickens 2009). It is therefore not surprising that the economics literature is rich with theories which can be employed to draw inferences about the equilibrium distribution of unemployment rates (Forder 2010, Gali 2010, Karanassou, Sala and Snower 2010, Buianovsky and Presley 2009, Petrongolo and Pissarides 2009, King and Morley 2007, Shimer 2005, Ball and Mankiw 2002, Yashiv 2000).

As it turns out however, estimates of the natural rate and its time variation tend to be rather imprecise and far from robust. The reason is that these estimates are typically obtained from estimates of the Phillips curve which in itself is problematic given the complicated relationship between the inflation rate, the lags in the inflation rate, the unemployment rate, its own lags, inflationary expectations, and supply shocks. In this paper, the characterization of the equilibrium unemployment in the standard literature is re-visited. It is considered that over time a set of countries share the same natural rate of unemployment. This assumption is more realistic across the states of the U.S., but also increasingly realistic across other regions which are going through integration and harmonization efforts. Our aim is to model the evolution of *density* of *cross-sectional distribution* of *unemployment rates*, and to build up a tractable structure for the analysis of the diffusion of shocks across its space.

3. The Model

Consider a region consisting of N states or countries, with differing rates of unemployment. Assume the existence of a long-run equilibrium or *natural distribution of unemployment* with a certain unknown mean and variance, towards which the distribution evolves over time. In general, one can study a Markov process generated by a matrix of transitions from one rate of unemployment to another, where the Markov process can be treated as unemployment rate diffusion. Then one can apply the general Fokker-Planck equation to describe evolution in time of unemployment. Hence, assuming that the rate of unemployment behaves like a stochastic process and that it is continuous and Markovian, consider the most natural candidate; a classical linear stochastic differential equation driven by Gaussian white noise:

$$dS_t + \lambda (u - S_t) dt = \sqrt{(2\varepsilon)} dB \quad (1)$$

where S_t denotes rate of unemployment. λ denotes velocity of adjustment to stationary equilibrium interpreted as unemployment rate adjustment (which for simplicity we assume constant), u denotes the mean of the stationary equilibrium distribution, $\varepsilon > 0$ is a constant diffusion parameter, and B_t is the Brownian motion. Equilibrium in this paper refers to a statistical equilibrium, characterized by a stationary probability distribution of unemployment rates. This equilibrium can be associated with level of unemployment which is in line with the *natural rate of unemployment.*

More precisely, consider the basic conservation law, with q a flux of probability, interpreted as the *spread,* or number of states exiting an unemployment rate interval. In this paper it is assumed that the spread is made of two different parts: a *drift* q_c and some *diffusion* q_d. *Drift* describes supply and demand forces at work, and *diffusion* describes random processes.

Thus,

$$q = q_c + q_d \quad (2)$$

The term q_c measures the portion of the function f transported by the drift velocity. For the drift spread, there exists some long-run equilibrium distribution of unemployment rates towards which the distribution drifts, based on a linear distance from equilibrium. I.e., a flux towards the equilibrium distribution. So,

$$q_c (s,t) = \lambda (u - s) f (s,t) \quad (3)$$

where s measures some relevant aspect of unemployment rate in logarithms. u represents where the mean of the distribution is headed, which we interpret as the natural rate of unemployment, and λ denotes the speed of convergence, or the velocity at which unemployment reaches its equilibrium level.

For the diffusion spread, random effects tend to cause a flux from regions of low concentration to regions of high concentration. The simplest choice is Fick's law:

$$q_d (s,t) = - \varepsilon \partial f / \partial s (s,t) \quad (4)$$

where $\varepsilon > 0$ is a constant diffusion parameter. Thus we have

$$q = \lambda (u - s) f - \varepsilon \partial f / \partial s \quad (5)$$

This is our equation for the density of cross-sectional distribution of unemployment rates. The drift-diffusion mechanism applies to the transition between two long-term equilibriums from (u_0, σ_0) to (u, σ). The process derived from the diffusion model is the size distribution of the population at chosen sequences of times through the observation period. It evolves according to an Ornstein-Uhlenbeck, but with a transition, such that the mean tends to u, instead of 0. From the analytic solution to the model, the dynamics of the distribution can be followed through time, given our initial distribution function f_0. The dynamics of the proposed model rely on two opposing forces: (i) a mean reversion process, call it *drift*, meant to describe supply and demand for labor, concentrating the distribution, and (ii) a counteracting *diffusion* process which flattens the distribution out. Noise is generated by search and learning in the presence of incomplete information and bounded rationality (Levine 2009, Gigerenzer and Selten 2002, Hashemi 2011, Simon 1997, Arrow 1962 and Alchian 1950). Although an equilibrium or *natural* rate of unemployment exists for each region, this equilibrium is assumed uncertain from the point of view of wage and price setters. Agents take time to coordinate, because they collectively need to learn about price and wage rigidities in the economy. Agents follow no precise law to arrive at this optimum, they search and learn by means of trial and error and imitation. After all, labor markets are in a constant state of flux: some firms are expanding employment, others are reducing employment. In the United States alone, 90,000 jobs are destroyed every working day. However, 90,000 other jobs are also created and this intense turnover is a primary engine of fluctuations (Cahuc and Zylberberg (2006)). This search process generates randomness in the system. The drift-diffusion model proposed in this paper studies the fluctuations around the distribution of unemployment rates and measures the dynamics of convergence towards its long run state, or the natural rate of unemployment.

Remark: Fick's law is well known to govern the transport of mass through diffusive means. There are important analogies between Fick's law of diffusion, Fourier's law of heat conduction, Newton's law of viscosity, Darcy's law of permeability, and Ohm's law of electrical conductance. Fick's original experiments dealt with measuring the concentrations and fluxes of salt, diffusing between two reservoirs through tubes of water. Today, Fick's laws form the core of our understanding of diffusion in solids, liquids, and gases. Hashemi (2000) provides an elaboration of this model, albeit in a different context.

4. Empirical Application

4.1 Data and Descriptive Statistics

The empirical analysis applies the model to five different data sets of unemployment rates. The first data set pertains to the rate of unemployment for the 52 states of the United States. The data spans from 1976 up to 2010 and consists of a total of 1820 unemployment rates. The second data set pertains to the rate of unemployment for all countries in Europe that are members of OECD (OECD EU). The data spans from 1970 up to 2009, and consists of a total of 662 unemployment rates from 23 countries. The third data set pertains to all members of OECD. A total of 30 countries are reported and 889 unemployment rates are available from year 1970 up to 2009. The fourth data set pertains to the rate unemployment for Asia. The data spans from 1980 up to 2010 for 10 Asian countries, and consists of a total of 230 unemployment rates. The Asian countries included are: China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand. The fifth data set pertains to the rate unemployment for South America (SA). The data spans from 1984 up to 2010 for 7 South American countries, and consists of a total of 91 unemployment rates. The South American countries included in the sample are: Argentina, Brazil, Chile, Mexico, Peru, Uruguay and Venezuela. In all cases, observations were available annually, and all data have been collected from the Bureau of Labor Statistics and the World Bank.

Figure 1 illustrates the evolution of unemployment rate from 1984 up to 2009 across the five data sets. It is on these years wherein all five data sets have values. Therefore, from this point onwards all analyses will include the data from 1984 to 2009 only. Moreover, it must be noted that data points graphed are based on the average rate per year for each country (or states in the case of the United States).

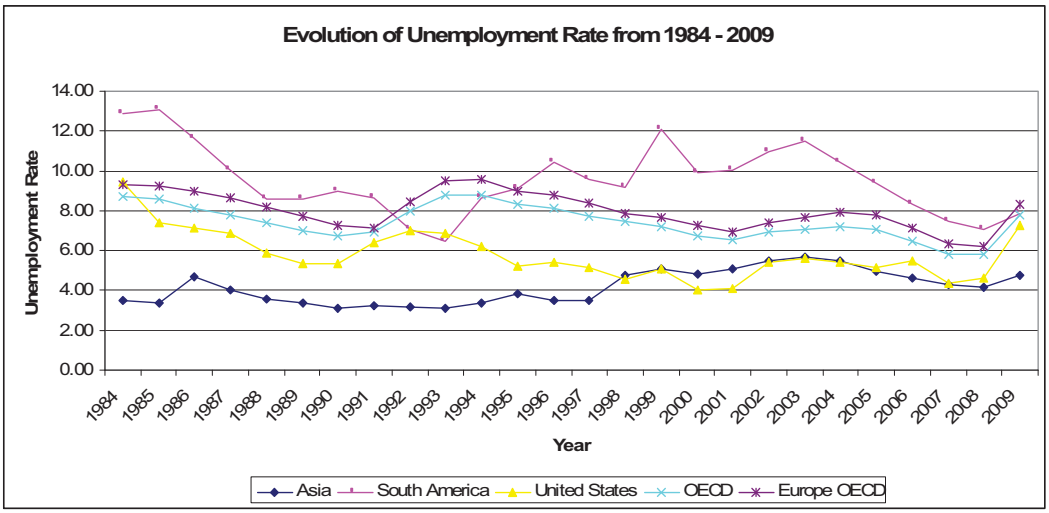
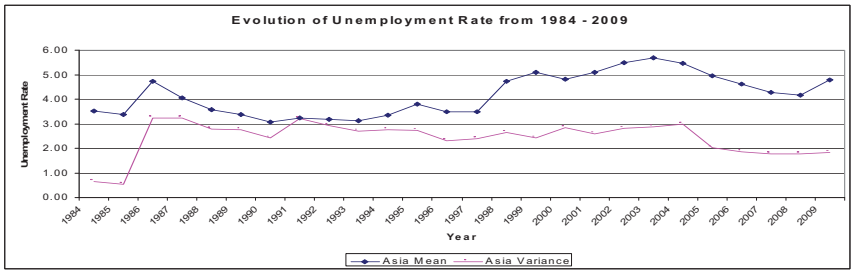
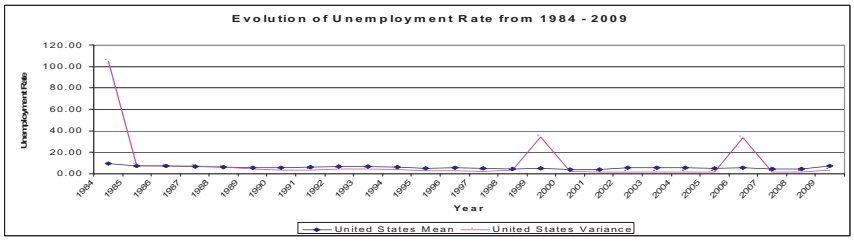


Figure 1. Evolution of Unemployment Rate from 1984 - 2009.

As can be seen, our Asian sample has the lowest but the most stable rate of unemployment and our South American sample on average, has the highest rate with the largest fluctuations. In order to compare countries in terms of the distribution around the mean rate of unemployment, the variance has been investigated. Figure 2 presents the evolution of distribution of unemployment rates for the five regions.





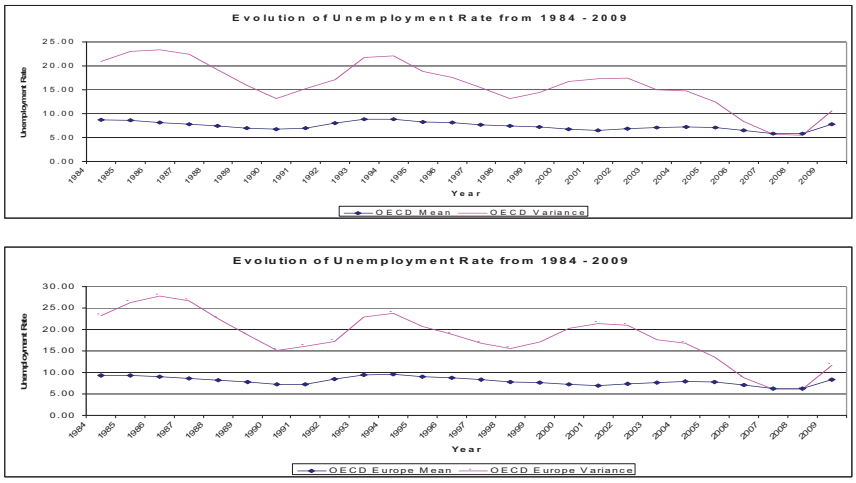


Figure 2. Evolution of Distribution of Unemployment Rates for Asia, South America, the States of the U.S., OECD, and OECD Europe; Mean versus Variance

The first panel in Figure 2 represents Asia. The panel illustrates that fluctuations around the mean unemployment rate significantly decrease from 1986 up to about 1997, however, the variability increases thereafter. This finding may suggest that from 1986 to 1997 the labor markets of our Asian sample were flexible enough to cope with the changing market demands, but may have lost their hold thereafter. This may be partly explained by the Asian financial crisis which began with the devaluation of the Thai Baht in July 1997 and spread like a wave across the region. The second panel illustrates the evolution of distribution of unemployment rates for our South American sample. Like in Asia, there are years where the variability decreases with respect to the mean unemployment rate but only for a while. In fact, during years 1999 to 2002, a sudden upward surge of variability was reported which may suggest that the labor markets of our South American sample may not handle the dynamic nature of their industry as well as those in the United States. One explanation for this variability may be the currency and financial crisis which began in S.E Asia in 1997 and spread like a wave, until it finally arrived in Argentina in 2002. The third panel illustrates the evolution of distribution of unemployment rates for the states of the United States. As can be observed, for most of the years except 1984, 1999, and 2006, the variability of unemployment rate around the mean is relatively small. We observe that only United States has somewhat flattened out the variation of unemployment rates as years pass by. The fourth panel illustrates the evolution of distribution of unemployment rates for OECD member countries. This figure suggests that the labor markets of these countries are having a *relatively* harder time adjusting, conforming to studies which highlight relatively less flexible labor markets in Europe (Nickell (1997), Nickell, Nunziater and Ochel (2005)). The fifth panel illustrates the evolution of distribution of unemployment rates for OECD Europe, and demonstrates the same trend as compared to our OECD sample.

Table 1 reports some descriptive statistics for the five data sets. It can be observed that Asia has the lowest average unemployment rate (M = 4.1746) among the five data sets and that South America has the highest (M = 9.5269). Moreover, the data reported in Table 1 suggests that large fluctuations in the average unemployment rate occurred in South America (SD = 1.7536), followed by the United States (SD = 1.2267), OECD Europe (SD = 0.9338), OECD (SD = 0.8497) and Asia (SD = 0.8380), as depicted by the standard deviations.

Table 1. Descriptive Statistics for the Five Regions

	N	Minimum	Maximum	Mean	Std Deviation
Asia	26	3.08	5.68	4.1746	.83796
South America	26	6.47	13.05	9.5269	1.75366
United States	26	4.02	9.42	5.7992	1.22672
OECD	26	5.78	8.81	7.4227	.84973
OECD Europe	26	6.20	9.55	8.0231	.93378

Furthermore, it is worth investigating if the means or the averages of the five data sets are different from each

other. Table 2 reports the independent samples t-test for all five data sets. The results illustrate that for all pair-wise combinations, there is a significant difference between the means of unemployment rates. Here, a significance value of less than 0.05 ($p < 0.05$) can be interpreted to mean that the average unemployment rate of the two compared countries are significantly different. Let us take for example the case of Asia and South America, a mean of 4.1746 for Asia and 9.5269 for South America, was deemed not to be significantly different with a significance value $p < 0.001$. This finding is the same throughout the pair wise comparison for all countries (Note: Alpha level is set to 0.05).

Table 2. Independent Samples T-test

					95% Confidence Interval of the Difference	
	t	df	Sig.(2-tailed)	Mean Difference	Lower	Upper
Asia	25.403	25	.000	4.17462	3.8362	4.5131
South America	27.701	25	.000	9.52692	8.8186	10 .2352
Asia	25.403	25	.000	4.17462	3.8362	4.5131
United States	24.105	25	.000	5.79923	5.3037	6.2947
Asia	25.403	25	.000	4.17462	3.8362	4.5131
OECD	44.542	25	.000	7.42269	7.0795	7.7 659
Asia	25.403	25	.000	4.17462	3.8362	4.5131
OECD Europe	43.811	25	.000	8.02308	7.6459	8.4002
South America	27.701	25	.000	9.52692	8.8186	10 .2352
United States	24.105	25	.000	5.79923	5.3037	6.2947
South America	27.701	25	.000	9.52692	8.8186	10 .2352
OECD	44.542	25	.000	7.42269	7.0795	7.7659
South America	27.701	25	.000	9.52692	8.8186	10.2352
OECD Europe	43.801	25	.000	8.02308	7.6459	8.4002
United States	24.105	25	.000	5.79923	5.3037	6.2947
OECD	44.542	25	.000	7.42269	7.0795	7.7659
United States	24.105	25	.000	5.79923	5.3037	6.2947
OECD Europe	43.811	25	.000	8.02308	7.6459	8.4002
OECD	44.542	25	.000	7.42269	7.0795	7.7659
OECD Europe	43.811	25	.000	8.02308	7.6459	8.4002

Table 2. Sample t-tests for the Five Regions

4.2 Method of Estimation

A second order partial differential equation has been proposed to express the dynamics of the distribution of unemployment rates across different regions. The model has five parameters: u_0, u, ε, σ_0^2 and λ. u_0 denotes the initial mean of the unemployment distribution (1980), and u denotes where the initial mean is heading, which we associate with the natural rate of unemployment. σ_0 is the standard deviation at time zero (1980), ε represents the diffusion parameter, and λ represents the rate of convergence to the long-run steady state equilibrium.

The model has been fitted to the log unemployment rate as a function of time, using non-linear least squares, and using a two-step procedure. First, the values for u_0, u and λ were estimated using the expectation of the distribution, expressed by the first moment:

$$u_t = u(1 - e^{-\lambda t}) + u_0 e^{-\lambda t} \quad (6)$$

In the second step, the values for ε and σ_0 were computed using the expression for the second moment of the distribution:

$$\sigma_t^2 = \sigma_0^2 e^{-2\lambda t} + \varepsilon/\lambda \ (1 - e^{-2\lambda t}) \quad (7)$$

The diffusive limit, as $t \to \infty$ of the variance is: ε/λ.

Remark: The Ornstein-Uhlenbeck process is the most general normal stationary Markovian process with zero expectations. For $t > T$, the transition density from (T, s) to (t, y) is normal with expectation $e^{-\lambda(r-t)}s$ and variance $\sigma^2(1 - e^{-2\lambda(r-t)})$. As $t \to \infty$, the expectation tends to 0 and the variance to σ^2. The analytic solution derived for our

diffusion equation is a normal distribution for all t. There is the $se^{\lambda t}$ factor; with a change of variables, it can be shown that the solution is normal with a constant multiplied by it.

4.3 Estimation Results and Model Checks

Tables 3-7 report estimates for the five model parameters λ , u, u_0, σ_0 and ε, along with the standard errors and t-values for our five samples: `

Table 3. United States Parameter estimates

Parameter	Value	Std Error.	t-value
	1.56	1.16	0.55
u	1.21	0.03	67. 68
u_0	1.26	0.04	21.04
`	0.95	0.04	13.47
	0.65	0.04	14.62

Table 4. Asia Parameter estimates

Parameter	Value	Std Error.	t-value
	1.25	0.93	0.54
u	0.97	0.03	57.53
u_0	1.01	0.04	17.88
`	0.76	0.04	11 .45
	0.52	0.04	12 .43

Table 5. South America Parameter estimates

Parameter	Value	Std Error.	t-value
	2.87	2.14	0.89
u	2.23	0.03	110.2
u_0	2.31	0.04	34.26
`	1.74	0.04	21.93
	1.19	0.05	23. 81

Table 6. OECD Parameter estimates

Parameter	Value	Std Error.	t-value
	1.95	1.46	0.64
u	1.52	0.03	79.62
u_0	1.57	0.04	24.75
`	1.18	0.04	15.84
	0.81	0.04	17.20

Table 7. OECD Europe Parameter estimates

Parameter	Value	Std Error.	t-value
	2.44	1.82	0.76
u	1.90	0.03	93.67
u_0	1.96	0.04	29.12
`	1.48	0.04	18.64
	1.01	0.04	20.24

Tables 3-7: Parameter Estimates for the Five Data Sets

It can be observed from these tables that the parameter estimates conform to the real data presented in the descriptive analysis section above. The following observations can be made concerning the results:

1. The mean and variance of all distributions are clearly evolving, suggesting a clear trend for the natural rate of unemployment. This finding corresponds to our theoretical predictions.

2. The speed of convergence to long-run equilibrium or *natural rate* λ, varies from region to region, and is positive as expected. This velocity is fastest for our South American sample, followed by OECD Europe, OECD, the U.S., and our Asian sample. This finding is important as it illustrates that the velocity at which unemployment reaches it equilibrium level is not constant, but rather depends on the particular region considered.

3. The value for the diffusion parameter for all regions examined is small and positive, conforming to our theoretical predictions. The diffusive limit, i.e., the limit as $t \to \infty$ of the variance is ε/λ. The results predict that if we start with a normal distribution and let the model drive the distribution, the distribution variance will tend toward a constant ε/λ, and concentrated around a mean u, representing the natural rate of unemployment. This rate is largest for our South American sample, followed by OECD Europe, the OECD, the U.S., and our Asian sample.

Figures 3a - e illustrate the actual vs. predicted time plots that can be generated from the real and the estimated data, for the five regions:

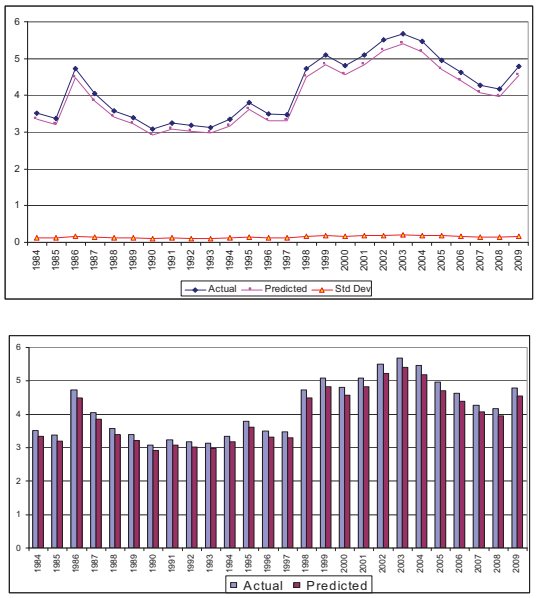


Figure 3a. Asia

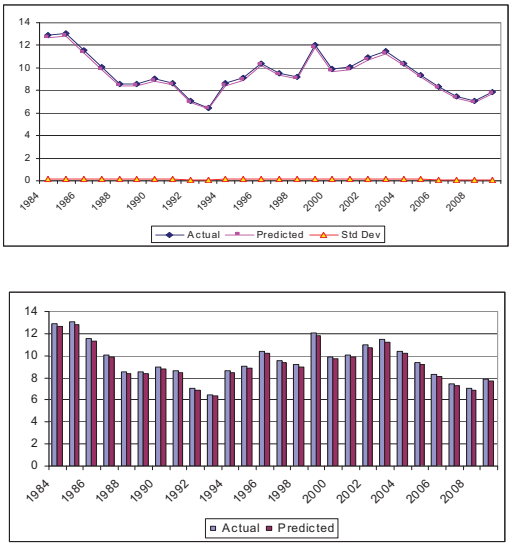


Figure 3b. South America

Figure 3c. United States

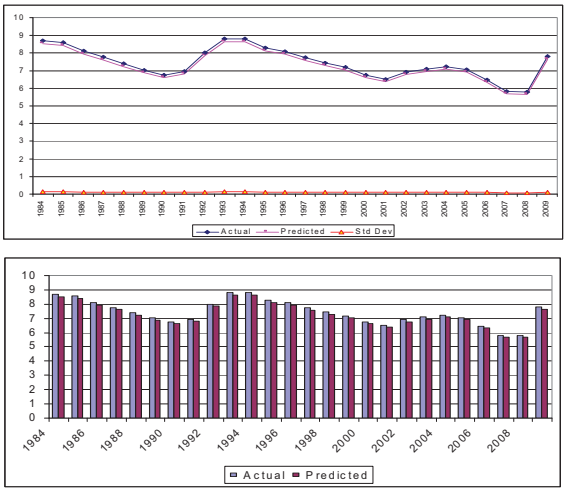


Figure 3d. OECD

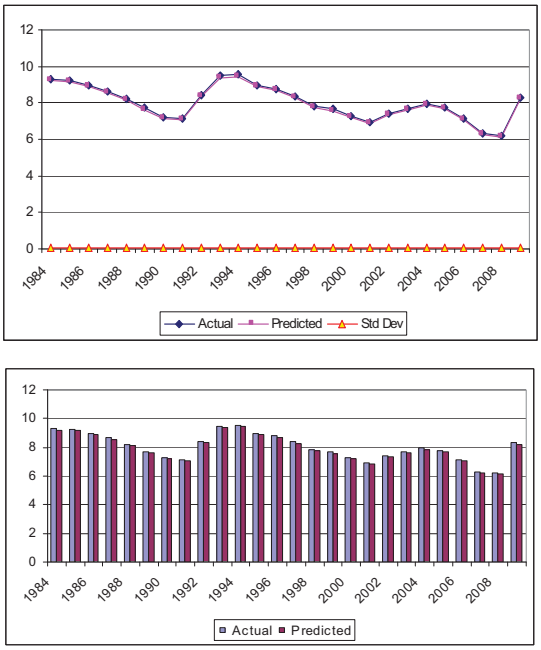


Figure 3e. OECD Europe

Figure 4 illustrates the evolution of the distribution of unemployment rates (log-normals) over time, superimposed on histograms which describe the time evolution of the distribution of the unemployment rates in the data (for selected years). The solid curves in these figures illustrate the distribution of the unemployment rates as predicted by the model, and the dotted curves illustrate the distribution of the unemployment rates in the data. The x-axes on these figures denote rate of unemployment and the y-axes denote number of observations. The five panels represent Asia, South America, United States, OECD and OECD Europe respectively:

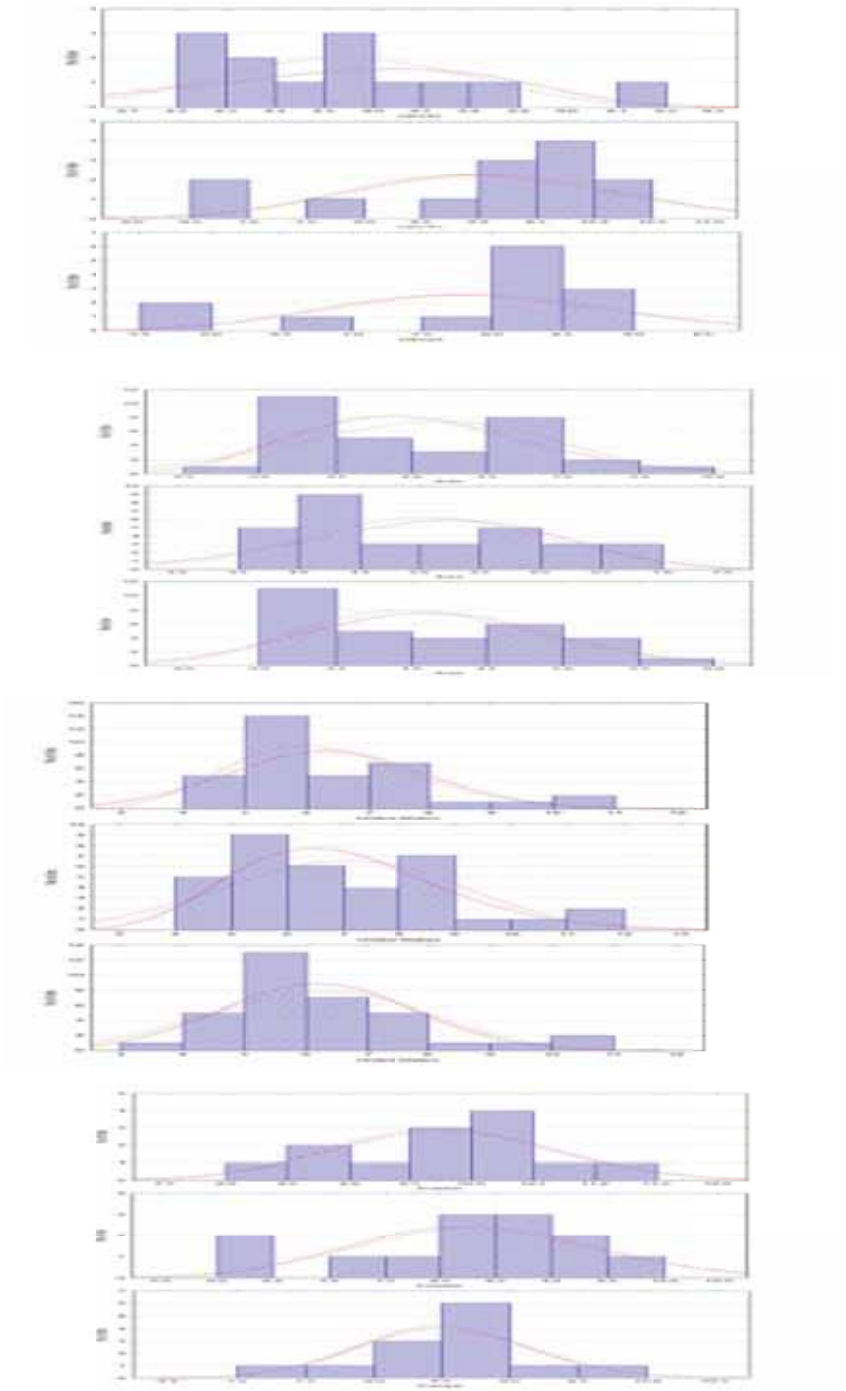


Figure 4. Actual vs. Predicted Distributions for the Five Regions (for years 2000, 2005, 2009)

As can be seen from Figure 4, the neat pattern which we see in the fitted log normals are being pulled out of a set of histograms whose shape are irregular. The actual and predicted values for all five data sets are almost in the same shape and within the tolerance limit for estimation. It can be concluded from the illustrations that the values generated by the predictive model are reliable in characterizing the five actual data sets.

5. Concluding Remarks

The present study provides a useful framework for thinking about macroeconomic policy questions, in particular with reference to the ability to explain changes in the inflation rate. When unemployment is below the *natural*

rate, inflation can be expected to rise, and when it is above, inflation can be expected to fall. In general, a model that can successfully account for movements in unemployment will presumably be useful in analyzing how alternative policies would affect unemployment and what the welfare consequences of these policies would be. For example, the *natural rate of unemployment* is sometimes referred to as a proxy for broader macroeconomic equilibrium. A measure of the *natural rate* is therefore potentially useful for assessing the contribution of equilibrium fluctuations to overall macroeconomic volatility, the structural sources of equilibrium fluctuations, and the short run relationship between inflation and movements away from equilibrium (Stock and Watson (2002)).

By considerations of analytical tractability, the model developed in this paper constitutes a considerable simplification, for example with respect to homogeneity of parameters across countries. One may control for heterogeneity and introduce some determinant of the natural rate of unemployment and of the labor market dynamics. The present paper cites frictions in the labor market as a relevant determinant of the dynamics of unemployment when the stochastic equilibrium is reached. The first implication of such frictions may be to increase the *natural rate of unemployment*, and difference in frictions may generate difference in the *natural rate of unemployment*. The assumption that over time a set of countries share the same *natural rate of unemployment*, is more realistic across the states of the U.S., but also increasingly realistic in the European case moving forward. The dynamic process in the evolution of unemployment rates in Germany, France and Spain have been dramatically different over the last two decades. Once again, given the European integration efforts, the assumption that they would revert the same way and at the same pace becomes increasingly appropriate, were it not for the ongoing sovereign debt crisis which, at the time of writing, jeopardizes the whole European project. Finally, the assumption that the difference in unemployment volatility between these three countries is a matter of chance and due to different realizations of the shock process is also a strong assumption but becomes increasingly reasonable moving forward. The diffusion model developed in this paper is capable of extrapolation to a variety of realistic assumptions pertaining to the functional form of the parameters. These extensions would no doubt enrich the model and should prove insightful but only at the expense of considerable complexity. Given the importance of the *natural rate of unemployment* as a benchmark for gauging the state of the business cycle, appropriate techniques for its estimation are not without merit. The present paper illustrates that diffusion is a potential method to estimate the *natural rate of unemployment* and to monitor labor market dynamics.

References

Abraham, & Lawrence. (1986). Cyclical Unemployment: Sectoral Shifts or Aggregate Disturbances. *Journal of Political Economy, 94.*

Alchian. (1950). Uncertainty, Evolution and Economic Theory. *Journal of Political Economy, 58*, 211-221.

Arrow. (1962). *The Economic Implications of Learning-by-Doing, 29*(3), 155-173.

Ball, & Mankiw. (2002). The NAIRU in Theory and Practice. *Journal of Economic Perspectives, 16*(4).

Blanchard, & Katz. (1992). The Evolution of Economic Regions. *Brookings Papers on Economic Activity*, no.1

Boianovsky, & Presley. (2009). The Robertson Connection between the Natural Rates of Interest and Unemployment. *Structural Change and Economic Dynamics, 2*0(2), 136-50.

Dickens. (2009). *A New Method of Estimating Time Variation of the NAIRU.*

Fair. (2000). Testing the NAIRU model for the United State. *Review of Economics and Statistics, 82*(1), 6471.

Feller. (1966). *An Introduction to Probability and its Applications*. New York, Wiley.

Forder. (2010). The Historical Place of the 'Friedman-Phelps' Expectations Critique. *European Journal of the History of Economic Thought, 17*(3), 493-511.

Gali. (2010). The Return of the Wage Phillips Curve'National Bureau of Economic Research. *NBER Working Papers*, 15758.

Gigerenzer, & Selten. (2002). *Bounded Rationality.* Cambridge: MIT Press.

Gilks, Richardson, & Spiegelhalter. (1996). *Markov Chain Monte Carlo in Practice*, London: Chapman and Hall.

Hashemi. (2000). An Evolutionary Model of the Size Distribution of Firms. *Journal of Evolutionary Economics, 10*(2), 507-521.

Hashemi. (2002). A Dynamic Model for the Cross-sectional Distribution of Unemployment Rates. *Labour, 16*(1), 89.

Kahneman. (2003). Maps of Bounded Rationality: Psychology for Behavioral Economics. *The American Economic Review, 93*(5), 1449-1475.

Karanassou, Sala, & Snower. (2010). Philipps Curves and Unemployment Dynamics: A Critique and a Holistic Perspective. *Journal of Economic Surveys, 24*(1), 1-51. http://dx.doi.org/10.1111/j.1467-6419.2009.00598.x

King, & Morley. (2007). In Search of the Natural Rate of Unemployment. *Journal of Monetary Economics, 54*, 550-564. http://dx.doi.org/10.1016/j.jmoneco.2005.11.002

Leon-Ledesma, & McAdam. (2004). Unemployment, hysterisis and transition. *Scottish Journal of Political Economy, 51*(3), 377-401. http://dx.doi.org/10.1111/j.0036-9292.2004.00311.x

Levine. (2009). *Is Behavioral Economics Doomed' Max Weber Lecture*s? Cahuc and Zylberberg (2006): The Natural Survival of Work, MIT Press.

Nickell, Nunziata, & Ochel. (2005). Unemployment in the OECD since the 1960s. What do we know? *Economic Journal, 115*, 1-27. http://dx.doi.org/10.1111/j.1468-0297.2004.00958.x

Nickell. (1997). Unemployment and labour market rigidities: Europe versus North America. *Journal of Economic Perspectives, 11*(3), 55-74.

Orphanides, & Williams. (2010). Monetary policy mistakes and the evolution of inflation expectations' Federal Reserve Bank of San Francisco. *Working Paper Series*, 2010-12.

Petrongolo, & Pissarides. (2008). The Ins and Outs of European Unemployment. *American Economic Review, 98*(2), 256-262. http://dx.doi.org/10.1257/aer.98.2.256

Phelps. (1994). *Structural Slumps*. Cambridge, MA: Harvard University Press.

Shimer, Robert. (2005). The Cyclical Behavior of Equilibrium Unemployment and Vacancies. *American Economic Review, 95*(1), 25-49. http://dx.doi.org/10.1257/0002828053828572

Simon. (1997). *Models of Bounded Rationality*, *3*. MIT Press.

Simon. (1997). *Models of bounded rationality: Empirically grounded economic reason*. Cambridge, MA: The MIT Press.

Smith, & Zoega. (2009). Keynes, Investment, Unemployment and Expectations. *International Review of Applied Economics, 23*(4), 427-44.

Stock , & Watson. (2002). Forecasting inflation. *Journal of Monetary Economics, 44*, 293-33.

Tanner. (1993). *Tools for Statistical Inference*. 2nd edition. New York: Springer-Verlag.

Yashiv, Eran. (2000). The Determinants of Equilibrium Unemployment. *American Economic Review, 90*(5), 1297-1322. http://dx.doi.org/10.1257/aer.90.5.1297

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Rationalizing the Investment Decision in Computerized Accounting Information Systems - An Applied Study on Saudi Arabian Companies

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Abstract

This paper aims to help companies to rationalize their investments in Computerized Accounting Information Systems (CAIS hereafter) through focusing on the experience of companies that have changed their systems. The paper opted for a survey research approach using a questionnaire which has been tested for its content validity. The questionnaire has been designed to capture the experience of companies that have changed their CAIS. The questionnaires were distributed among both accountants and managers of Saudi Arabian companies of different sizes and fields that have experienced problems in their CAIS. The paper provides an insight of the reasons behind the decision to change CAIS based on the practical experience of companies in Saudi Arabia. It shows that there has been a significant change in the priorities of choosing a CAIS due to experience. It is noted also that there are some features which are available in CAIS which are not widely required by system users, and hence, it would be unwise to pay for their costs. Finally, it is noted that there is no significant difference between the managers and the accountants' requirement regarding CAIS.

Keywords: computerized accounting information system, management information system, Saudi Arabia, investment decisions

1. Introduction

The advancements in Information Technology resulted in the reliance of companies on performing their business in an electronic form. A lot of companies in the Middle East started to use Computerized Accounting Information Systems ("CAIS" hereafter). A number of research studies showed that business generally were disappointed with their new purchases of CAIS. They did not get the benefits they expected, and the projects took substantially longer and cost more than anticipated (Tate, 1999). Ivancevich (S. Ivancevich, H. Ivancevich, & Elikai, 2010) stated that selecting the right accounting software is critical to any business. A wrong choice could mean incompatibility problems, functional limitations, and frustration, as well as unhappy workers and customers. The right choice means that a business can focus on the products or services that are relevant to its core business model rather than losing effort, time and money trying to overcome CAIS problems.

Building or rebuilding of CAIS is an expensive task, as it requires a lot of time, effort and money in each of the stages of building such a system whether in the stage of planning, analyzing, designing or implementing the system. Accordingly, it is assumed that such cost would have a positive effect on the organization performance in the form of increasing its profits on the long term. To achieve this, such resources have to be managed and employed in a good manner. This depends on a full understanding of how to utilize such systems to support the needs of the decision maker (Alkary, 2005).

It is noticed also in some Middle Eastern countries that companies (specially small and mid-size) face changing of CAIS several times due to the inappropriateness of it to their requirements.

The success of CAIS usage depends not only on the amount of the investments, but the right choice of hardware, software, database and personal qualifications. All these components are closely connected among themselves and reflect common, useful results, which have to be evaluated from economic, technical and social aspects (Asta Raupeliene& Linas Stabingis, 2003).

The importance of the output of accounting information systems is emphasized in several researches. Xu (Xu, 2009) stated that the quality of information is one of the competitive advantages for an organization. In an accounting information system, the quality of information provided is imperative to the success of the systems.

Meall (Meall, 2009) supported such opinion by stating that the information produced by CAIS is regarded as one of the basic resources of the organizations. It is the base of financial decision making whether it is related to operating, investing or financing decisions. Such decisions contribute to increase the level of organizational performance and create a strategic advantage to it, which reflects on its market value and hence increase investors' wealth. Also, Redman supported this (Redman, 1992) by stating that inaccurate or incomplete data may adversely affect the competitive success of an organization. Nord also supported this (Nord, Jeretta Horn Nord, & Xu, 2005) by stating that poor quality information can have a significant social and business impact.

However, the reliance on such CAIS has its accompanying risks. The system can fail due to several reasons such as the inability of users to cope with it, or it is technically inadequate to fulfill the company's requirements, or the riskiness of using it on the company's resources….etc. There are also operational risks as using such systems could lead to losing the company's assets whether by losing data or failure of the system to record all accounting information in a correct manner, or it could not be secured correctly which enables hackers or unauthorized users to access the system and change data whether intentionally or unintentionally.

Choosing an accounting system for large enterprise has never been easy, but then again it has never been more difficult than it is right now (Meall, 2009). Correctly choosing CAIS can have a positive influence on not only data processing, but also on the efficiency of an enterprise's activity (Asta Raupeliene& Linas Stabingis, 2003). All these factors show the importance of concentrating on the process of selecting the most suitable CAIS before implementing it.

This research shares the definition of the effectiveness of CAIS with another research (Nicolaou I., 2000) where it is defined in terms of the perceptions of decision makers that the output information available to them through transaction processing, management reporting, and budgeting systems meets their requirements for organizational coordination and control. Accordingly, to determine the effectiveness of CAIS, a comparison between the needs of users and company management are matched with the CAIS capabilities and features to find out the extent to which such CAIS meets those requirements.

2. Literature Review

The researches, which have been implemented in such a field, could be classified as follows:

2.1 Research Related to the Risk of Implementing CAIS

Yau and Auyeun (Yau & Auyeung, June 29 - July 2, 1995) studied the risks of implementing a CAIS, and they found that they were related to some problems such as; users are opposing the adoption of new techniques; the availability of "off-the-shelf" software (as a cheaper alternative to the tailored made software) implied that users have to try to fit their requirement to the software's capabilities; very few CAIS actually perform sophisticated management and cost accounting systems;

S.Ivancevich, (Ivancevich et al., 2010) studied the factors that influence the CAIS selection and those that lead to satisfaction. They surveyed a large number of professionals, and questioned several suggested factors that could affect the software's selection and satisfaction. The distributed questionnaire also addressed other issues such as what are the most important areas for improving the software and the reasons behind not changing the software. The results revealed that the functionality of the software was rated as most important to users when selecting the software. Also, security of data and real-time processing topped the list in importance. While report-writing and flexibility topped the areas of improvement. The "cost" appeared to be the most important obstacle for changing the software, and then the hassle associated with such a change comes next. It is also noted that there has been some similarities and differences between large and small company users. The study concluded that there is a need to develop a standard set of measures for management to ascertain the impact of information technology investment on the accounting system.

The conclusion of the previous study goes in coherent with the goals of this research, where it identifies the companies' requirements of CAIS and determining their priorities when choosing such systems in order to rationalize their investments in such a field. This goal implies that the CAIS should be fitting the requirements of the accountant's and the decision makers' needs. It is to be noted that the requirements of the decision makers could differ according to the culture and the environment in which the CAIS is implemented. This research will explore the CAIS selecting criteria in Saudi Arabia. Additionally, it will attempt to find the reasons of

abandoning CAIS to another new one and it will test the fitness of the current implemented CAIS to the users' needs.

2.2 Research Related to Developing Models of Evaluating CAIS

There are different researches that strived to develop a model of evaluating CAIS. Raupeliene and Stabingis, (Asta Raupeliene & Linas Stabingis, 2003) studied the models of evaluating CAIS and analysed the theoretical aspects of the enterprise's AIS effectiveness and formulated the following conclusions:

- The effectiveness of CAIS can be considered successful if it ensures user's needs.
- Most of the models which are provided in academic publications allow the evaluation of CAIS effectiveness only from technical-economic or in social-economic aspect.
- There isn't an integrated and for practical usage adjusted CAIS effectiveness evaluation model which allow CAIS effectiveness evaluation from economic, technical and social aspects contemporaneously.

The study suggested a theoretical mathematical model to measure the effectiveness of the CAIS; however, it didn't apply such a model in practice and it didn't show how companies could use such a model to be a useful tool in the process of choosing a new CAIS to be implemented. This adds to the importance of this research as it focuses on the features that is most important for users and explores the alignment of the users' needs with the CAIS capabilities, hence rationalizing the investment in such a field. Additionally, it could be regarded as a step towards designing a model to aid in choosing the CAIS for small and medium sized companies.

Ismail and king (Ismail & King, 2005) studied the relation between firm performance and CAIS alignment. Where they explored the fit between AIS requirements and AIS capacity and whether this fit is linked to performance in Small and Medium size Enterprises (SMEs). It measured AIS requirements in terms of importance to the business attached to 19 accounting information characteristics. AIS capacity was measured in terms of the Information System support available for each of the 19 accounting information characteristics. The results suggest that the firms' AIS processing capacities were in many cases insufficient to match their AIS requirements, which implies that the managers of SMEs were not being as effective as they could be in utilizing IT. Further, the results of the moderation perspective of measuring of fit indicated varying degrees of alignment of the nineteen information characteristics. However, using cluster analysis, three significantly different AIS alignment groups were later identified which could be clearly labeled as "aligned", "moderate", and "non-aligned". Finally, the three AIS alignment groups were tested against performance. The results show a positive association between AIS alignment and firm performance. Such results are of importance to the current research due to the fact that there is a positive association between CAIS alignment and firm's performance would lead to the conclusion that aligning CAIS would rationalize the investment in CAIS which is the goal of this research. Accordingly, this research will be exploring such alignment in the Saudi market and focusing on the important features which are required by the users of the CAIS.

3. Data Collection

This research aims to provide the experience of companies that implemented CAIS more than one time to be used to rationalize the investment in such field. It should answer questions of whether the priorities have changed from the first to the second time of implementation; what are the mostly required specifications of CAIS by companies and if the new implemented system fulfills such needs; whether the new CAIS comprises solutions to the previous problems that were the main reason of abandoning the previous CAIS; and finally whether the features of the CAIS differ from an accountant to a manager perspective. Based on such discussion, this research tests six hypothesis to answer those questions. The data are gathered through a questionnaire.

3.1 Designing of the Questionnaire

The questionnaire is designed to collect the information required to test the research hypothesis and to achieve the research objectives. (Appendix I).

3.1.1 Assessing Questionnaire Validity

The researcher has used the content validity method to assess the validity of the research questionnaire. The researcher has selected 15 experts in the area of accounting including academician (mainly University faculty members) and practitioners (accountants and managers working in professional firms) and distributed the questionnaire to them with a cover letter explaining the objectives and hypothesis of the study and asking them to indicate whether the questions in the attached questionnaire collect the data required to test the hypothesis and achieve the study objectives.

Most of them agreed that the questionnaire collects the required data and some of them had some concerns related to some questions as well as adding additional questions to cover the research objectives and hypothesis. The questionnaire is updated accordingly.

3.1.2 Assessing Questionnaire Reliability

The researcher has used the Test-retest method to assure that the questions are clear and specific and homogenous. With regard to test – retest method the researcher selected a small group of the research population (accountants & managers) and distributed the questionnaire to them and after 5 days he distributed the questionnaire a second time and the data was analyzed, and a correlation coefficient of the results of the first and second test is conducted, and it has been found that it is significant.

3.2 Sample of the Study

A number of 300 questionnaires have been distributed among accountants and senior decision making managers working in firms operating in Saudi Arabia that have changed their CAIS at least once. The questionnaire has been distributed randomly. The returned questionnaires amounted to 136 questionnaires (45.3%). Questionnaires were analyzed, and it was found that 15 questionnaires were invalid as either they were not complete or not answered in a valid way (such as repeating numbers in prioritizing the factors that affect the selection of CAIS). etc. Hence, there are 121 valid questionnaires collected representing 40.3% of the valid questionnaires. The distribution of the sample according to companies' field of business were as follows: Industrial 30%; Services 57% and Trading 13%.

To determine the size of the companies which comprises the sample of the study, two measures are considered; number of employee and capital size. Around 78% of the sample's companies employ more than 100 employees, while the mid-size companies (employing from 50-100 employees) represented 9%, and around 13% employed less than 50 employees.

From a capital perspective, the big companies (more than SR 50 million of capital) represent more than two thirds of the sample, while mid-size companies (SR 10- 50 million of capital) represented 9%, while companies with less than SR 10 million represented 21%. This measure of company size also supports the previous number of employees' measure, where both showed that large companies have greater weight in the sample size which is appropriate with the objective of the research.

4. Testing the Research Hypothesis and Findings

The researcher used the statistical program SPSS to perform the statistical analysis.

4.1 Testing the First Hypothesis: H1- The Priorities of CAIS Choosing Criteria Did Not Differ Significantly from the First to the Second Time of Implementation

Table 1. Determining the priorities of selecting CAIS

Order	1	2	3	4	5	6	7	8	9	10
Fist time	FO-1	FO-5	FO-6	FO-4	FO-3	FO-9	FO-2	FO-7	FO-8	FO-10
Frequency	40	30	29	15	6	1	0	0	0	0
Second time	FC-5	FC-6	FC-9	FC-3	FC-1	FC-4	FC-10	FC-2	FC-8	FC-7
Frequency	44	33	11	10	9	7	4	2	1	0

F1 Cost of acquiring the CAIS software

F2 User friendliness

F3 Easiness of system implementation

F4 The level of support provided by the CAIS developer

F5 CAIS capabilities and features

F6 Ability of CAIS to grow and be developed to meet future company growth

F7 Availability of full detailed manuals for the CAIS

F8 The developer of the software has a long list of clients

F9 Experience and reputation of the CAIS developer

F10 Cost of the needed Hardware (or compatibility of the present hardware) to run the CAIS

FO = Factors of Old CAIS FC = Factors of Current CAIS

It is clear that the priorities of the selection criteria of the respondents have changed when implemented the CAIS from the first to the second time of implementation. To stand on the significance of such difference a ranked T-Test is performed for the relative frequencies of question 4 (variables FC) and 5 (variables FO) of the questionnaire and the following results could be summarized.

Table 2.

Factor	Mean	Std. Deviation	Rank	T Test	Sig.
FC-1	4.74	2.38	4	3.732	0.000(*)
FO-1	3.53	2.75	1		
FC-2	5.40	2.59	6	0.324	0.746
FO-2	5.33	2.55	5		
FC-3	5.36	2.49	5	-0.631	0.529
FO-3	5.50	2.11	6		
FC-4	4.45	2.17	3	-0.036	0.971
FO-4	4.45	2.61	4		
FC-5	3.24	2.59	2	-2.156	0.033(*)
FO-5	3.82	2.77	2		
FC-6	3.16	2.37	1	-3.721	0.000(*)
FO-6	4.45	3.17	3		
FC-7	6.99	2.24	8	-3.891	0.000(*)
FO-7	7.85	1.97	10		
FC-8	7.34	2.46	9	-1.867	0.064
FO-8	7.85	2.11	9		
FC-9	6.69	2.46	7	3.260	0.001(*)
FO-9	6.04	1.83	7		
FC-10	7.50	2.72	10	5.037	0.000(*)
FO-10	6.14	2.71	8		

Based on the previous table it could be concluded that there is a significant difference in priorities between the 1st and 2nd time of implementing the CAIS for the following factors; cost of acquiring the CAIS software (FC-1 & FO-1); CAIS capabilities and features (FC-5 & FO-5); Ability of CAIS to grow and be developed to meet future company growth (FC-6 & FO-6);Availability of full-detailed manuals for the CAIS (FC-7 & FO-7); Experience and reputation of the CAIS developer (FC-9 & FO-9); Cost of the needed hardware (or compatibility of the present hardware) to run the CAIS (FC-10 & FO-10);

While there is no significant difference in priorities between the 1st and 2nd time of implementing the CAIS for the following factors; user friendliness (FC-2 & FO-2); Easiness of system implementation (FC-3 & FO-3), the level of support provided by the CAIS developer (FC-4 & FO-4); and the developer of the software has a long list of clients (FC-8 & FO-8).

Based on the previous discussion it is clear that there were only four of the factors which didn't change significantly from the first to the second time of implementation, while the other six factors have changed significantly. Accordingly, the null hypothesis of H1 could be rejected, and the alternative hypothesis is accepted which states:

"The priorities of CAIS choosing criteria changed significantly when implementing such system from the first to the second time."

4.2 Testing the Second & Third Hypothesis

The two hypotheses are formulated as follows:

H2: The CAIS implemented in the company fulfill the company's mostly needed requirements.

H3: CAIS features which are regarded as important by companies are present in the CAIS system implemented.

4.2.1 Determining the Required Features by Companies and Their Availability in CAIS

Based on analysing the questionnaire, a comparison is done between 20 features required by the company's accountants and managers and those features already available in the system. The following results are found:

Table 3.

Order	1	2	3	4	5	6	7	8	9	10
Required Features	R-1	R-18	R-4	R-2	R-7	R-10	R-14	R-20	R-5	R-12
Frequency	115	111	102	98	92	92	88	86	82	79
Present Features	P-1	P-13	P-3	P-9	P-20	P-4	P-5	P-7	P-10	P16
Frequency	113	111	109	109	104	94	94	94	92	88

Order	11	12	13	14	15	16	17	18	19	20
Required Features	R-3	R-13	R-15	R-9	R-6	R-16	R-19	R-17	R-11	R-8
Frequency	78	76	72	61	55	50	47	46	42	39
Present Features	P-14	P-2	P-11	P-18	P-12	P-15	P-6	P-19	P-8	P-17
Frequency	86	83	82	82	78	75	54	52	39	39

R/P-1 Ability to prepare full set of financial statements.
R/P-2 Capabilities to handle a multi-business
R/P-3 Frequency of reporting.
R/P-4 Ability to customize reports.
R/P-5 Real-time reporting.
R/P-6 "What if" analysis.
R/P-7 Strong internal controls.
R/P-8 Online help.
R/P-9 Existence of automatic entries for recurring transactions.
R/P-10 Integration with other modules of ERP system.
R = Required Features

R/P-11 Existence of statistical (nonfinancial) reports.
R/P-12 Ability to prepare reports on the level of a responsibility center.
R/P-13 Real-time processing for transactions.
R/P-14 Developing budgets and analyzing actual and budgeted figures
R/P-15 Bank reconciliation and bank transaction management.
R/P-16 Multi-Currency support
R/P-17 Bilingual – Arabic /English support
R/P-18 Disaster Recovery feature – Automatic Backup system
R/P-19 Internet integration and e-commerce capability.
R/P-20 Excel-Based financial reporting and custom reports.
P= Present Features

Based on the previous table it could be concluded that the features required by the companies are not necessarily available by the same importance. The only features which is common in importance between what is required and what is available, is the preparation of a full set of financial statements (R-1) and (P-1) respectively. However, all the other features differed in importance (based on the frequency of the responses) between what is required and what is available.

4.2.2 Determining the Alignment of The CAIS Features to The Companies Requirements

In order to observe the available CAIS features alignment with those features required by the companies, a cross tabulation is prepared for each of the features in Question 6 (asking about the companies' preferred features) with the adjacent features in Question 7 (asking about the available features in the present CAIS).

The availability of the features is classified into three groups as follows:

- Highly available: Are those features which are reported by more than 75% of the respondents as "Available".
- Moderate Availability: Are those features which are reported by more than 50% and less than 75% of the respondents as "Available".
- Low Availability: Are those features which are reported by less than 50% of the respondents as "Available".

Respondents are asked to determine whether each feature is either "insignificant", "Neutral" or "important". The following table summarizes such results.

Table 4.

Importance	Availability		
	Low	Moderate	High
High		• Capabilities to handle multi-business; • Disaster Recovery feature (Automatic Backup system).	• Ability to prepare full set of financial statements. • Ability to customize reports. • Integration with other modules of ERP system.
Moderate		• Ability to prepare reports on the level of a responsibility center. • Developing budgets and analyzing actual and budgeted figures. • Bank reconciliation and bank transaction management.	• Frequency of reporting • Real-time reporting. • Strong internal controls. • Real-time processing for transactions. • Excel-Based financial reporting and custom reports.
Low	• "What if" analysis • Online help. • Bilingual – Arabic /English support. • Internet integration and e-commerce capability.	• Existence of statistical (nonfinancial) reports. • Multi-Currency support.	• Existence of automatic entries for recurring transactions

Based on the previous table the following could be deduced:

- There are 9 features representing 45% of the features are "Highly available", while, 3 features of them are of high importance, and 5 are of moderate importance, and 1 is of low importance.
- There are 7 features representing 35% are "Moderately available", while 2 features of them are of high importance, and 3 are of moderate importance, and 2 are of low importance.
- There are 4 features representing 20% are of "Low availability", and all of them are of low importance.
- On the other hand, there are 5 features which are regarded as important by the accountants, 3 features (representing 60%) are highly available, while 2 features (representing 40%) are moderately available. Hence, we can accept H2 and H3 of the research indicating that the CAIS implemented in the company fulfil the companies mostly required specification, and the CAIS features which are regarded as important by accountants, are present in the CAIS system implemented by their companies.

4.3 Testing The Fourth Hypothesis: H4 -The Features, Which Were One of The Reasons of Abandoning the Previous CAIS, Are Present in The Currently Adopted CAIS

4.3.1 Determining the Real Factors of Abandoning CAIS

In order to determine the factors which lead to abandoning a CAIS system, question 7 of the questionnaire is analysed and the following could be concluded.

Table 5.

Order	1	2	3	4	5	6	7	8	9	10
Feature that lead to the departure	A-10	A-14	A-2	A-18	A-20	A-7	A-1	A-12	A-3	A-4
Frequency	69	64	63	60	58	53	52	52	46	46

Order	11	12	13	14	15	16	17	18	19	20
Feature that lead to the departure	A-9	A-13	A-5	A-17	A-6	A16	A-15	A-11	A-19	A-8
Frequency	42	35	31	28	23	23	22	19	18	13

A = Features that lead to abandoning a CAIS system.

By applying Chi square Test to the answers of the respondents to question 7 of the questionnaire and by comparing the availability of the features which were a cause of abandoning the previous CAIS, the following results are found: (review table "3" for codes)

Table 6.

Feature #	Available in the current system	Not Cause of change		Cause of change		Total		Chi Square	Sig.
		#	%	#	%	#	%		
1	Not Available	8	11.6	0	0.0	8	6.6	6.46	0.011
	Available	61	88.4	52	100	113	93.4		
	Total	69	100	52	100	121	100		
2	Not Available	38	65.5	0	0.0	38	31.4	60.17	0.000
	Available	20	34.5	63	100	83	68.6		
	Total	58	100	63	100	121	100		
3	Not Available	10	13.3	2	4.3	12	9.9	2.58	0.108
	Available	65	86.7	44	95.7	109	90.1		
	Total	75	100	46	100	121	100		
4	Not Available	25	33.3	2	4.3	27	22.3	13.82	0.001
	Available	50	66.7	44	97.8	94	78.3		
	Total	75	100	46	100	121	100		
5	Not Available	26	28.9	1	3.2	27	22.3	8.76	0.003
	Available	64	71.1	30	96.8	94	77.7		
	Total	90	100	31	100	121	100		
6	Not Available	66	67.3	1	4.3	67	55.4	29.92	0.000
	Available	32	32.7	22	95.7	54	44.6		
	Total	98	100	23	100	121	100		
7	Not Available	27	39.7	0	0.0	27	22.3	27.09	0.000
	Available	41	60.3	53	100	94	77.7		
	Total	68	100	53	100	121	100		
8	Not Available	81	75.0	1	7.7	82	67.8	24.07	0.000
	Available	27	25.0	12	92.3	39	32.2		
	Total	108	100	13	100	121	100		
9	Not Available	11	13.9	1	2.4	12	9.9	4.09	0.043
	Available	68	86.1	41	97.6	109	90.1		
	Total	79	100	42	100	121	100		
10	Not Available	28	53.8	1	1.4	29	24.0	44.68	0.000
	Available	24	46.2	68	98.6	92	76.0		
	Total	52	100	69	100	121	100		

	Not Available	39	38.2	0	0.0	39	32.2		
11	Available	63	61.8	19	100	82	67.8	10.72	0.000
	Total	102	100	19	100	121	100		
	Not Available	43	62.3	0	0.0	43	35.5		
12	Available	26	37.7	52	100	78	64.5	50.27	0.000
	Total	69	100	52	100	121	100		
	Not Available	10	11.6	0	0.0	10	8.3		
13	Available	76	88.4	35	100	111	91.7	4.44	0.035
	Total	86	100	35	100	121	100		
	Not Available	34	59.6	1	1.6	35	28.9		
14	Available	23	40.4	63	98.4	86	71.1	40.48	0.000
	Total	57	100	64	100	121	100		
	Not Available	45	45.4	1	4.5	46	35.9		
15	Available	54	54.6	21	95.5	75	64.1	12.78	0.001
	Total	99	100	22	100	121	100		
	Not Available	33	33.7	0	0.0	33	27.3		
16	Available	65	66.3	23	100	88	72.7	16.65	0.001
	Total	98	100	23	100	121	100		
	Not Available	82	88.2	0	0.0	82	67.8		
17	Available	11	11.8	28	100	39	32.2	76.60	0.000
	Total	93	100	28	100	121	100		
	Not Available	39	63.9	0	0.0	39	32.2		
18	Available	22	36.1	60	100	82	67.8	56.61	0.000
	Total	61	100	60	100	121	100		
	Not Available	69	67.0	0	0.0	69	57.0		
19	Available	34	33.0	18	100	52	43.0	28.06	0.000
	Total	103	100	18	100	121	100		
	Not Available	17	27.0	0	0.0	17	14.0		
20	Available	46	73.0	58	100	104	86.0	18.21	0.000
	Total	63	100	58	100	121	100		

Based on the previous table, it could be concluded that Chi square test is significant for all of the features except for the frequency of reporting which appeared to be insignificant. Accordingly, it could be concluded that there is a relationship between the cause of change and the availability of the feature in the newly adopted CAIS, which is logical as those who are selecting the new CAIS would be looking for the features which were one of the reasons of abandoning the old CAIS. Accordingly, the fourth hypothesis H4 of this research could be accepted, indicating that the features which were one of the reasons of abandoning the previous CAIS, are present in the currently adopted CAIS**.**

4.4 Testing the Fifth Hypothesis: H5 -The Features Which Were One of the Reasons of Abandoning the Previous CAIS Are Those Features Which Are Regarded by the Respondents as "Important"

To test such hypothesis an analysis to the reasons of abandoning the old CAIS (in question 7) are compared by the importance of the feature (in question 6). By applying Chi square Test, the following results are obtained: (review table "3" for codes)

Table 7.

	Cause	Not Cause		Cause		Total			
Item #	Importance	#	%	#	%	#	%	Chi Square	Sig.
	Natural	6	8.7	0	0.0	6	5.0		
1	Important	63	91.3	52	100	115	95.0	4.76	0.029
	Total	69	100	52	100	121	100		
2	Insignificant	12	20.7	0	0.0	12	9.9	30.85	0.000

	Natural	11	19.0	0	0.0	11	9.1		
	Important	35	60.3	63	100	98	81.0		
	Total	58	100	63	100	121	100		
3	Insignificant	5	6.7	0	0.0	5	4.1	31.57	0.000
	Natural	36	48.0	2	4.3	38	31.4		
	Important	34	45.3	44	95.7	78	64.5		
	Total	75	100	46	100	121	100		
4	Insignificant	1	1.3	0	0.0	1	0.8	13.82	0.000
	Natural	18	24.0	0	0.0	18	14.9		
	Important	56	74.7	46	100	102	84.3		
	Total	75	100	46	100	121	100		
5	Insignificant	7	7.8	0	0.0	7	5.8	19.82	0.000
	Natural	32	35.6	0	0.0	32	26.4		
	Important	51	56.7	31	100	82	67.8		
	Total	90	100	31	100	121	100		
6	Insignificant	17	17.3	1	4.3	18	14.9	29.12	0.000
	Natural	48	49.0	0	0.0	48	39.7		
	Important	33	33.7	22	95.7	55	45.5		
	Total	98	100	23	100	121	100		
7	Insignificant	5	7.4	0	0.0	5	4.1	29.73	0.000
	Natural	24	35.3	0	0.0	24	19.8		
	Important	39	57.4	53	100	92	76.0		
	Total	68	100	53	100	121	100		
8	Insignificant	36	33.3	1	7.7	37	30.6	24.22	0.000
	Natural	45	41.7	0	0.0	45	37.2		
	Important	27	25.0	12	92.3	39	32.2		
	Total	108	100	13	100	121	100		
9	Insignificant	19	24.1	1	2.4	20	16.5	57.49	0.000
	Natural	40	50.6	0	0.0	40	33.1		
	Important	20	25.3	41	97.6	61	50.4		
	Total	79	100	42	100	121	100		
10	Insignificant	7	13.5	1	1.4	8	6.6	45.04	0.000
	Natural	21	40.4	0	0.0	21	17.4		
	Important	24	46.2	68	98.6	92	76.0		
	Total	52	100	69	100	121	100		
11	Insignificant	7	6.9	0	0.0	7	5.8	35.85	0.000
	Natural	71	69.6	1	5.3	72	59.5		
	Important	24	23.5	18	94.7	42	34.7		
	Total	102	100	19	100	121	100		
12	Insignificant	14	20.3	0	0.0	14	11.6	48.48	0.000
	Natural	28	40.6	0	0.0	28	23.1		
	Important	27	39.1	52	100	79	65.3		
	Total	69	100	52	100	121	100		
13	Natural	45	52.3	0	0.0	45	37.2	4.44	0.035
	Important	41	47.7	35	100	76	62.8		
	Total	86	100	35	100	121	100		
14	Insignificant	6	10.5	0	0.0	6	5.0	50.95	0.000
	Natural	27	47.4	0	0.0	27	22.3		
	Important	24	42.1	64	100	88	72.7		
	Total	57	100	64	100	121	100		
15	Insignificant	6	6.1	0	0.0	6	5.0	18.30	0.000
	Natural	43	43.4	0	0.0	43	35.5		
	Important	50	50.5	22	100	72	59.5		
	Total	99	100	22	100	121	100		

16	Insignificant	24	24.5	0	0.0	24	19.8	40.33	0.000
	Natural	47	48.0	0	0.0	47	38.8		
	Important	27	27.6	23	100	50	41.3		
	Total	98	100	23	100	121	100		
17	Insignificant	47	50.5	0	0.0	47	38.8	59.40	0.000
	Natural	28	30.1	0	0.0	28	23.1		
	Important	18	19.4	28	100	46	38.0		
	Total	93	100	28	100	121	100		
18	Natural	10	16.4	0	0.0	10	8.3	56.61	0.000
	Important	51	83.6	60	100	111	91.7		
	Total	61	100	60	100	121	100		
19	Insignificant	27	26.2	0	0.0	27	22.3	33.29	0.000
	Natural	47	45.6	0	0.0	47	38.8		
	Important	29	28.2	18	100	47	38.8		
	Total	103	100	18	100	121	100		
20	Insignificant	10	16.9	0	0.0	10	8.5	31.62	0.000
	Natural	19	32.2	2	3.4	21	17.9		
	Important	30	50.8	56	96.6	86	73.5		
	Total	59	100	58	100	117	100		

The features which were one of the reasons of abandoning the previous CAIS, are those features which are regarded by the respondents as “important" by 100% and chi square test is significant: (review table “3” for codes).

Table 8.

Feature #	Feature
1	Ability to prepare full set of financial statements
2	Capabilities to handle a multi-business
4	Ability to customize reports
5	Real-time reporting
7	Strong internal controls
12	Ability to prepare reports on the level of a responsibility center
13	Real-time processing for transactions
14	Developing budgets and analyzing actual and budgeted figures
15	Bank reconciliation and bank transaction management
16	Multi-Currency support
17	Bilingual - Arabic /English support
18	Disaster Recovery feature - Automatic Backup system
19	Internet integration and e-commerce capability

The other features which were one of the reasons of abandoning the previous CAIS, are those features which are regarded by the respondents as “important" by approximately 100% (ranges from 92.3% - 98.6%) and the chi square test is significant are as follow:

Table 9.

Feature #	Feature	%
3	Frequency of reporting	95.7%
6	What if” analysis	95.7%.
8	Online help	92.3%
9	Existence of automatic entries for recurring transactions	97.6%.
10	Integration with other modules of ERP system	98.6%.
11	Existence of statistical (non-financial) reports	94.7%
20	Excel-Based financial reporting and custom reports	96.6%.

From the previous analysis and since most of the respondents (90% and more) have indicated that the features which they have regarded as “important”, are the cause of change, then H5 could be accepted indicating that the features which were one of the reasons of abandoning the previous CAIS, are those features which are regarded by the respondents as “important".

4.5 Testing The Sixth Hypothesis: H6- The Features That the Accountants Require in a CAIS Differ Significantly than Those Features Required by the Decision Maker

By comparing the responses of the managers and the accountants to “question 6” of the questionnaire, and by applying Chi square Test, the following results could be concluded. (review table “3” for codes).

Table 10.

Item #	Cause	Decision Maker		Accountant		Total		Chi Square	Sig.
	Importance	#	%	#	%	#	%		
1	Natural	2	3.4	4	6.5	6	5.0	0.60	0.438
	Important	57	96.6	58	94	115	95.0		
	Total	59	100	62	100	121	100		
2	Insignificant	9	15.3	3	4.8	12	9.9	3.67	0.159
	Natural	5	8.5	6	9.7	11	9.1		
	Important	45	76.3	53	85	98	81.0		
	Total	59	100	62	100	121	100		
3	Insignificant	4	6.8	1	1.6	5	4.1	5.93	0.052
	Natural	23	39.0	15	24.2	38	31.4		
	Important	32	54.2	46	74.2	78	64.5		
	Total	59	100	62	100	121	100		
4	Insignificant	1	1.7	0	0.0	1	0.8	2.96	0.227
	Natural	6	10.2	12	19.4	18	14.9		
	Important	52	88.1	50	81	102	84.3		
	Total	59	100	62	100	121	100		
5	Insignificant	5	8.5	2	3.2	7	5.8	5.61	0.061
	Natural	20	33.9	12	19.4	32	26.4		
	Important	34	57.6	48	77	82	67.8		
	Total	59	100	62	100	121	100		
6	Insignificant	13	22.0	5	8.1	18	14.9	5.04	0.080
	Natural	23	39.0	25	40.3	48	39.7		
	Important	23	39.0	32	51.6	55	45.5		
	Total	59	100	62	100	121	100		
7	Insignificant	2	3.4	3	4.8	5	4.1	0.29	0.864
	Natural	11	18.6	13	21.0	24	19.8		
	Important	46	78.0	46	74	92	76.0		
	Total	59	100	62	100	121	100		
8	Insignificant	19	32.2	18	29.0	37	30.6	0.18	0.915
	Natural	21	35.6	24	38.7	45	37.2		
	Important	19	32.2	20	32.3	39	32.2		
	Total	59	100	62	100	121	100		
9	Insignificant	9	15.3	11	17.7	20	16.5	0.14	0.931
	Natural	20	33.9	20	32.3	40	33.1		
	Important	30	50.8	31	50.0	61	50.4		
	Total	59	100	62	100	121	100		
10	Insignificant	5	8.5	3	4.8	8	6.6	0.87	0.649
	Natural	11	18.6	10	16.1	21	17.4		
	Important	43	72.9	49	79.0	92	76.0		
	Total	59	100	62	100	121	100		

Item #	Cause	Decision Maker		Accountant		Total		Chi Square	Sig.
	Importance	#	%	#	%	#	%		
11	Insignificant	4	6.8	3	4.8	7	5.8	2.32	0.314
	Natural	31	52.5	41	66.1	72	59.5		
	Important	24	40.7	18	29.0	42	34.7		
	Total	59	100	62	100	121	100		
12	Insignificant	8	13.6	6	9.7	14	11.6	1.81	0.405
	Natural	16	27.1	12	19.4	28	23.1		
	Important	35	59.3	44	71	79	65.3		
	Total	59	100	62	100	121	100		
13	Natural	26	44.1	19	30.6	45	37.2	2.33	0.127
	Important	33	55.9	43	69	76	62.8		
	Total	59	100	62	100	121	100		
14	Insignificant	5	8.5	1	1.6	6	5.0	8.51	0.014
	Natural	18	30.5	9	14.5	27	22.3		
	Important	36	61.0	52	84	88	72.7		
	Total	59	100	62	100	121	100		
15	Insignificant	5	8.5	1	1.6	6	5.0	5.18	0.075
	Natural	24	40.7	19	30.6	43	35.5		
	Important	30	50.8	42	68	72	59.5		
	Total	59	100	62	100	121	100		
16	Insignificant	12	20.3	12	19.4	24	19.8	0.84	0.658
	Natural	25	42.4	22	35.5	47	38.8		
	Important	22	37.3	28	45	50	41.3		
	Total	59	100	62	100	121	100		
17	Insignificant	27	45.8	20	32.3	47	38.8	6.20	0.045
	Natural	8	13.6	20	32.3	28	23.1		
	Important	24	40.7	22	35	46	38.0		
	Total	59	100	62	100	121	100		
18	Natural	6	10.2	4	6.5	10	8.3	0.55	0.458
	Important	53	89.8	58	94	111	91.7		
	Total	59	100	62	100	121	100		
19	Insignificant	13	22.0	14	22.6	27	22.3	0.69	0.709
	Natural	25	42.4	22	35.5	47	38.8		
	Important	21	35.6	26	42	47	38.8		
	Total	59	100	62	100	121	100		
20	Insignificant	5	8.8	5	8.3	10	8.5	0.72	0.991
	Natural	10	17.5	11	18.3	21	17.9		
	Important	42	73.7	44	73.3	86	73.5		
	Total	57	100	60	100	117	100		

Based on the previous chi square test, it could be concluded that there are only two features which differ significantly between accountants and managers.

- Feature no. 14 which is "Developing budgets and analyzing actual and budgeted figures". It is clear that the accountants required this features more than the decision makers, This could be explained that the accountants greatly need such a feature during budget preparation, while the decision makers uses the budget and they don't prepare its details and that is why they don't regard the preparation feature as important as the accountants.

- Feature no. 17 which is "Bilingual Arabic/English support". It is clear that the decision makers require this feature more than accountants. However, this feature is of low importance since there are only 38% of responses in the whole sample.

On the other hand, the other features mentioned in the questionnaire do not differ significantly from a decision maker to an accountant perspective.

Accordingly there are only one feature in CAIS that differ significantly between accountants and decision makers and the other nineteen features did not differ significantly. Hence, we can **reject** the 6th hypothesis of the research and accept the alternative hypothesis indicating that the features that the accountants require in a CAIS does not differ significantly than those features required by the managers.

5. Conclusions and Recommendations

5.1 Conclusions

This paper investigates the experience of companies that have changed their CAIS more than once. The aim of such investigation is to rationalize the investment decision in such a field. The results revealed that there is a significant change in the relative importance of the criteria used to choose CAIS from the first to the second time of implementation. It is concluded that the mostly required features by the accountants are present in the currently implemented CAIS and that the features that were the reason of abandoning the previous CAIS are present in the currently adopted one. As expected that the features which were one of the reasons of abandoning the previous accounting system, are those features which are regarded by the accountant as "important". Finally, the opinion of the managers and the accountants differed significantly only in one feature while there is no significant change regarding the other features.

5.2 Recommendations

Based on the above conclusions and findings the researcher recommends the following recommendations to the companies which are planning to introduce or update their CAIS system in order to rationalize their investments in such a field:

- Companies should consider the change in priorities mentioned in this research while choosing their new CAIS to learn from the experience of others.
- Companies should concentrate on the main features required by both managers and accountants when choosing a CAIS. Other features which would appear valuable, and would increase the cost of the CAIS, but are neither required by the accountants nor by the managers. Hence, it should be eliminated as it would be regarded as extra cost without having a real added value.
- There are some companies which provide various types of CAIS which fulfills the needs of various types of businesses and companies. However, such CAIS varies in prices and in performance and the support provided by its developers, in addition to some differences in functions and specifications. Such variances and differences in the wide range spectrum which the companies provide make it fairly difficult for small and midsize companies to choose the appropriate CAIS.(Maheshwari & McLain, 2006). Based on that, the researcher recommends designing a model to allow companies to align their needs with the features present in the different CAIS available. Such a model should include the different variables such as the needs, the resources available to the companies and the different features of the CAIS, then uses such variables to suggest certain CAIS solutions to companies. This would be a topic of another research.

References

Alkary, A. (2005). Cost of investment in information systems and its relation with organizational perofrmance - an applied studied on the commercial banks in jordan. [– تكلفة الاستثمار فى أنظمة المعلومات وعلاقتها بأداء المنظمات [دراسة تطبيقية على البنوك التجارية فى الأردن *مجلة علوم/انسانية*, (24)

Asta Raupeliene, & Linas Stabingis. (2003). Development of a model for evaluating the effectiveness of accounting information systems. *EFITA 2003 Conference,* Debrecen, Hungary. (July) 339-445.

Ismail, N. A., & King, M. (2005). Firm performance and AIS alignment in malaysian SMEs. *International Journal of Accounting Information Systems, 6*(4), 241-259. http://dx.doi.org/10.1016/j.accinf.2005.09.001

Ivancevich, S. H., Ivancevich, D. M., & Elikai, F. (2010). Accounting software selection and satisfaction. *The CPA Journal, 80*(1), 66-72.

Maheshwari, S. K., & McLain, M. P. (2006). Selection of accounting software tools for small business: Analytical hierarchy process approach. *Proceedings of the Academy of Accounting and Financial Studies,* Reno. *, 11*(2), 39-45.

Meall, L. (2009). How to choose large enterprise software. *The Accountancy Age Guide Series,* (21st May), 19.

Nicolaou I., A. (2000). A contingency model of perceived effectiveness in accounting information systems: Organizational coordination and control effects. *International Journal of Accounting Information Systems, 1*, 91-105. http://dx.doi.org/10.1016/S1467-0895(00)00006-3

Nord, G. D., Jeretta Horn Nord, & Xu, H. (2005). An investigation of the impact of organization size on data quality issues. *Journal of Database Management, 16*(3), 58-71. http://dx.doi.org/10.4018/jdm.2005070104

Redman, T. C. (1992). *Data quality: Management and technology*. New York: Bantam Books.

Tate, J. (1999). How to select new business software. *Financial Management, 77*(4), 52-54.

Xu, H. (2009). Data quality issues for accounting information systems' implementation: Systems, stakeholders, and organizational factors. *Journal of Technology Research, 1*, 1-11.

Yau, C., & Auyeung, P. K. (June 29 - July 2, 1995). Issues of accounting information system for the year 2000. *The Second Pacific Asia Conference on Information Systems, PACIS,* Singapore. 440-447.

Appendix I. General Information

Please check in front the appropriate answer that fits your company.

1. Company field of business

Industrial	Trading	Services	Distribution	Banking	Others : (Please Specify)
☐	☐	☐	☐	☐	☐

2- Number of Employees

1-49	50-100	Over 100
☐	☐	☐

3. Company's Capital

Less than one Million	1 Million to 10 Million	10 Million to 50 Million	Over 50 Million
☐	☐	☐	☐

4. What are the priorities which you considered when selecting the Computerized Accounting Information System (CAIS hereafter) which you implemented lately? Please put a number from 1 to 10 in front of each factor. Please do not repeat the number twice. Where "1" is the most important, and "10" is the least important.

Factors that affect the selection of CAIS	Degree of importance
1. Cost of acquiring the CAIS software	
2. User friendliness	
3. Easiness of system implementation	
4. The level of support provided by the CAIS developer.	
5. CAIS capabilities and features	
6. Ability of CAIS to grow and be developed to meet future company growth.	
7. Presence of full detailed manuals for the CAIS	
8. The developer of the software has a long list of clients.	
9. Experience and reputation of the CAIS developer.	
10. Cost of the needed Hardware (or compatibility of the present hardware) to run the CAIS.	

5. If you have implemented a previous CAIS before, what were your priorities when you selected such a system?

Factors that affect the selection of CAIS	Degree of importance
1- Cost of acquiring the CAIS software .	
2- User friendliness	
3- Easiness of system implementation	
4- The level of support provided by the CAIS developer.	
5- CAIS capabilities and features	
6- Ability of CAIS to grow and be developed to meet future company growth.	
7- Presence of full detailed manuals for the CAIS	
8- The developer of the software has a long list of clients.	
9- Experience and reputation of the CAIS developer.	
10- Cost of the needed Hardware (or compatibility of the present hardware) to run the CAIS.	

6. Please indicate the importance of each of the following features which you would be considering when selecting a CAIS. Please check only one box in front of each feature:

Mostly required features in CAIS from an accountant/decision maker perspective: (What you hope to have in the system.)

Feature	Important	Neutral	Insignificant
1- Ability to prepare full set of financial statements.			
2. Capabilities to handle multi-business			
3. Frequency of reporting.			
4. Ability to customize reports.			
5. Real-time reporting.			
6. “What if” analysis.			
7. Strong internal controls.			
8. Online help.			
9. Existence of automatic entries for recurring transactions.			
10. Integration with other modules of ERP system.			
11. Existence of statistical (non-financial) reports.			
12. Ability to prepare reports on the level of a responsibility centre.			
13. Real-time processing for transactions.			
14. Developing budgets and analyzing actual and budgeted figures			
15. Bank reconciliation and bank transaction management.			
16. Multi-Currency support			
17. Bilingual – Arabic /English support			
18. Disaster Recovery feature – Automatic Backup system			
19. Internet integration and e-commerce capability.			
20. Excel-Based financial reporting and custom reports.			

7. The present features of CAIS already present in your implemented system.

Please indicate which of the following features are already available in your system. Only put one check in front of each feature. If you have implemented a new CAIS system instead of an older one, please check in the last column to the right which of these features was one of the reasons of such a change. In case that this is your first CAIS, then leave the last column to the right empty.

Feature	Available in the current system	Not available in the current system	This is one of the reasons that lead to the change from the older CAIS to the current one.
1. Ability to prepare full set of financial statements.			
2. Capabilities to handle multi-business			
3. Frequency of reporting.			
4. Ability to customize reports.			
5. Real-time reporting.			
6. "What if" analysis.			
7. Strong internal controls.			
8. Online help.			
9. Existence of automatic entries for recurring transactions.			
10. Integration with other modules of ERP system.			
11. Existence of statistical (non-financial) reports.			
12. Ability to prepare reports on the level of a responsibility center.			
13. Real-time processing for transactions.			
14. Developing budgets and analyzing actual and budgeted figures			
15. Bank reconciliation and bank transaction management.			
16. Multi-Currency support			
17. Bilingual – Arabic /English support			
18. Disaster Recovery feature – Automatic Backup system			
19. Internet integration and e-commerce capability.			
20. Excel-Based financial reporting and custom reports.			

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The Demand for Money in Asia: Some Further Evidence

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Abstract

This paper investigates empirically the impact of exchange rate changes on the money demand of seven Asian countries over the quarterly period, 1973 – 2009. Estimates of the cointegrating relations are obtained using different estimators and the error-correction technique was used to obtain the estimates of the short-run dynamics. The major results show that increases in the exchange rate, exert a significant positive effect upon money demand in both the long-run and the short-run in each of the seven countries. Further, domestic interest rates are found to have significant negative effect on the demand for money. These effects may result in significant reallocation of resources by monetary authorities and market participants. Our results provide justifications for the monetary authorization to pay attention to broad money.

Keywords: money, demand, model, exchange rate, cointegration

JEL: E41

1. Introduction

During the last two decades, exchange-rate changes have played an important role in the behavior of market participants in Asia – witness the discussions about the financial turmoil of 1997 and 1998 which led to currency devaluations and even, issuance of bailout packages by the International Monetary Fund (IMF) for some countries. Also, as the housing bubble in the United States that started in August 2007 resulted into a worst world-wide financial and economic upheaval between 2007 and 2009 (Das, 2012), it forced Asian economies into significant depreciations. Further, after the G-20 Summit in June 2010, these economies started a buildup of foreign exchange reserves. They held more than enough precautionary foreign exchange reserves in order to have greater flexibility and to minimize currency appreciations. A central question has been the effects of such movements in the exchange rate on the demand for money behavior. This paper tries to understand empirically the possible contribution of exchange-rate changes in explaining the short-and long-run money demand behavior of the Asian economies.

In conventional money demand studies for less-developed countries (LDCs), real money balances are usually modeled as a function of real domestic income and expected inflation rate; that is, the interest rate variable is generally excluded. It is often claimed that the inflation rate should be preferred because for LDCs the choice of asset holdings is limited to either real goods or money in the absence of interest bearing financial assets -- see, for instance, Bahmani-OsKooee and Rehman (2005). Others have argued that the interest rates data when available have shown very little dispersion over time due to government control. In this paper, we suggest that failure to include interest rates will lead to omitted variable bias because over the past two decades, Asian economies have instituted continuing policies of financial market liberalization and economic reforms which have led to greater interest rate liberalization as well as varying interest rate data (Arize & Shwiff, 1993). Furthermore, it can be argued that even if the deposit rates in LDCs are set by the monetary authorities, it is still a relevant alternative asset to money that the public can hold (Arize, Malindretos & Grivoyannis, 2005). Thus, the empirical importance of the interest rate variable should be treated as an empirical matter.

Concerning the impact of exchange rate on money demand, we note that with the advent of the floating exchange-rate era in 1973, a number of analysts have identified the exchange rate as a possible omitted variable in the money demand function of developed and developing countries; see, for example, Arango and Nadiri (1979, 1981), Arize (1989), Arize and Ndubizu (1990), Arize and Shwiff (1993) and Bahmani-OsKooee and

Rhee (1994). Econometric theory suggests that omission of such a variable may bias a model towards overstating the influence of the included variables. Also, McNown and Wallace (1992:107), who examined the demand for money in the U.S. have concluded that "nonstationarity in the demand for money can be resolved by inclusion of the exchange rate." Few empirical studies have investigated the impact of exchange rate on the demand for money in LDCs, and the results have been mixed.

Lee and Chung (1995) find that exchange rate exerts a negative and statistically significant effect on Korea's demand for money. Tan (1997) considers the demand for money in Malaysia and reports that exchange rate has a statistically significant effect on real M1 balances and no effect on real M2 balances. Ibrahim (2001) reexamines Malaysia and finds that exchange rate has a negative effect on demand for money. Weliwata and Ekanayake (1998) study Sri Lanka's demand for money and find that exchange rate has a significantly negative effect on real M1 balances. They failed to obtain a meaningful real M2 relation. Asian economies are largely quite open to the rest of the world and exchange-rate movements have had a bearing upon domestic money demand; see Rajan (2010) for more on this. An empirical study of the money demand function can provide monetary authorities with useful information for designing appropriate stabilization policies.

The primary purpose of this paper is to examine the long-run relations and short-run dynamics of the demand for broad money in Asian economies (India, Korea, Malaysia, Pakistan, the Philippines, Sri Lanka and Thailand) over the quarterly period 1973:1 through 2009:4. (Note 1) Our objectives are fourfold.

The first objective is to check the data for unit roots. The second objective is to determine whether there exists a stationary long-run relationship between real money balances, domestic interest rate and exchange rate. The cointegration method used is the Johansen (1995) method, which is a Full Information Maximum Likelihood (FIML) estimator. The choice of this technique follows from the Monte Carlo study by Haug (1996), which shows that the Johansen estimator has the least size distortion. The third objective is to determine, provided the long-run equilibrium exists, the sign, magnitude and statistical significance of the long-run effects of real income, interest rate and exchange rates on money demand. Recent specification suggestions (Note 2) have shown that it is better to employ single equation estimator once r =1 (cointegration) has been confirmed. We report the estimated long-run elasticities obtained after normalizing them on real money balances and our analysis is based on Fully Modified Least Squares (FIML) estimator of Phillips and Hansen (1990). The fourth objective is to examine the short-run dynamics of the money demand model for each country using the general–to-specific paradigm (see Hendry, 1987).

The features of this paper which distinguish it from the other research in this area are: (1) the inclusion of interest rate data rather than the inflation rate; (2) the focus on the movements of exchange rate as an important determinant of demand for money; (3) the use of recent quarterly data instead of data before the financial crises noted above; (4) evidence from more than one country; and (5) testing for nonlinearity in the short-run dynamics of the model.

The rest of the paper is organized as follows. Section 2 describes the money demand model. The empirical results are presented in Section 3, and concluding remarks close the paper in Section 4.

2. Model Specification and Theoretical Considerations

A standard simple money demand specification is as follows:

$$m_t = a_0\, y_t^{\alpha_1} i_t^{\alpha_2}; \qquad a_1 > 0 \text{ and } a_2 < 0 \tag{1}$$

where m_t refers to real money balances at time t, y_t is real income and at time t, and i_t is domestic interest rate at time t.

Drawing on the empirical literature in this area (Arize, 1989; Arize & Shwiff, 1993) and the implications for dynamic specification of the possible existence of error-correcting mechanisms in the data-generating process, we estimate a simple, conventional model, augmented with exchange rate as the long-run equilibrium (equation 2) and the short-run relationship (equation 3) for the (desired) real money balances:

$$m_t^* = \alpha_0 + \alpha_1 y_t + \alpha_2 i_t + \alpha_3 e_t + \varepsilon_t \tag{2}$$

$$\Delta m_t - \alpha - \beta L(\Delta X_t) - \gamma \varepsilon_{t-1} = \psi_t \tag{3}$$

where m_t* is the logarithm of desired holdings of real money balances (real M2); (Note 3) real M2 consists of currency outside the banks and demand deposits plus quasi-money divided by the consumer price index; (Note 4) y_t is the logarithm of real GDP; i_t is the level of domestic interest rate which is proxied by money market rate or lending rate; e_t is the exchange rate variable; and the stochastic disturbance is ε_t.

According to equation (2), real money balances are assumed to be an increasing function of real income (i.e., real GDP) as the usual budget conditions dictate; that is, α_1 is expected to be positive. On the other hand, the opportunity cost of holding money relative to financial assets (i) is expected to yield a negative influence on money demand, so α_2 is expected to be negative.

To provide a background on how variations in exchange rates could affect the demand for money in an open economy, we start by noting that foreign sector considerations, such as variations in exchange rates (Arango & Nadiri, 1981:70) play important roles in determining domestic money demand. The currency substitution literature (Agenor & Khan, 1996) suggests that portfolio shifts between domestic and foreign money provide a role for a foreign exchange variable. (Note 5) At least two effects on the demand for domestic currency will result from variations in the foreign exchange rate. On the one hand, there is a wealth effect as currency depreciation leads to increases in the domestic price of foreign securities which then causes portfolio-adjustment effects; see the discussions, for instance, by Arango & Nadiri (1979, 1981), Arize and Shwiff (1993) and Bahmani-Oskooee and Techaratanachai (2001). Assume that if wealth holders evaluate their asset portfolios in terms of their domestic currency, (Note 6) a depreciation of the domestic exchange rate that increases the value of foreign assets held by domestic residents would boost wealth (i.e., a wealth-enhancing effect). This in turn leads to a rebalancing effect because, in order to maintain a fixed share of their wealth invested in domestic assets, they will repatriate part of their foreign assets to domestic assets, including domestic currency (i.e., rebalancing). (Note 7) As Arango and Nadiri (1981:79) have argued, it is because of the "rebalancing effect" brought about by changes in the exchange rate, that an exchange rate depreciation has a positive effect on the demand for money. Hence, exchange rate depreciation would increase the demand for domestic currency.

On the other hand, variations in the exchange rate can generate a currency substitution effect in which a key role is played by investors' expectations. According to the currency substitution literature, as a weak domestic currency develops expectations for further weakening, asset holders will respond by shifting some of their portfolios away from domestic currency into foreign assets. So, if an increase in exchange rate (i.e., depreciation) induces a decline in money holding by domestic residents, the estimate of α_3 should be negative. To summarize, based on the above discussions, an increase in the exchange (i.e., depreciation) could have a positive or negative effect on the demand for money; therefore, which effect dominates is an empirical issue.

As is customary, equation (2) has assumed that in the long run, any deviation of actual (observable) real money balances from desired (unobservable) should disappear so that it may be viewed as cointegrating model (Ericisson, 1998). The basic idea of cointegration is that two or more nonstationary time series may be regarded as defining a long-run equilibrium relationship if a linear combination of the variables in the model is stationary (converges to an equilibrium over time). (Note 8) Because the money demand function in equation (2) describes a stationary long-run relationship among the variables, this can be interpreted to mean that the stochastic trend in real money balances is related to the stochastic trends in the explanatory variables. In other words, even if deviations from the equilibrium should occur, they are mean- reverting (Arize, 1997).

3. Estimation Results

The empirical analysis uses quarterly frequency data for seven Asian counties, namely India, Korea, Malaysia, Pakistan, the Philippines, Sri Lanka and Thailand. The data are taken from the International Monetary Fund's *International Financial Statistics* (IFS) latest CD-ROM (2009). The data used are the logarithmic value of real broad money, real GDP and exchange rate. In general, the data for the period, 1973:1 through 2009:4 were used for our analyses.

The first step in testing for cointegration in a set of variables is to test for stochastic trends in the autoregressive representation of each individual time series using augmented Dickey-Fuller and Johansen tests. For space consideration, the empirical results are not presented here, but they suggest that all the variables in equation (2) are nonstationary.

For any set of I (1) variables, Johansen (1995) has developed a system-based cointegration procedure to test the absence or presence of long-run equilibria among the variables in equation (2). The test utilizes two likelihood ratio (LR) test statistics, the maximal eigenvalue (λ-max), and trace (Tr) to test the presence or absence of long-run equilibria between the variables in equation (2). For the λ-max, the null hypothesis of r is tested against r+1 cointegrating vector, whereas for the trace, the null hypothesis is that there are at most r cointegrating vectors and the alternative hypothesis is of a general form. The presence of a significant cointegrating vector or vectors indicates a stable relationship among the relevant variables. The number of lags used in the Vector Autoregression (VAR) is based on evidences provided by Schwarz's criterion; however, in the case of serial correlation sufficient numbers of lags are introduced to eliminate the serial correlation of the residual. For the

four-variable system, we employ the lag order of two for India, Korea and Malaysia, three for the Philippines, and Sri Lanka, one for Pakistan, and five for Thailand, respectively.

Table 1. Results from cointegration tests

		Maximum Eigenvalue				Trace statistics			
	H0:	**r=0**	**r≤1**	**r≤2**	**r≤3**	**r=0**	**r≤1**	**r≤2**	**r≤3**
	H1:	**r=1**	**r=2**	**r=3**	**r=4**	**r≥1**	**r≥2**	**r≥3**	**r≥4**
India	2	40.30	15.59	1.42	0.238	57.54	17.25	1.66	0.23
Korea	2	38.30	13.26	11.73	2.81	66.10	27.80	14.54	2.81
Malaysia	2	42.40	16.47	7.35	0.84	67.06	24.66	8.18	0.84
Pakistan	1	40.39	10.61	5.34	0.0001	56.34	15.95	5.34	0.0001
Philippine	3	62.27	19.15	7.12	1.29	89.83	27.55	8.40	1.29
Sri Lanka	3	43.68	12.97	6.51	1.64	64.80	21.12	8.15	1.64
Thailand	5	28.38	10.64	7.40	2.42	48.83	20.46	9.82	2.42
CV (5%)		27.07	20.97	14.07	3.76	47.21	29.68	15.41	3.76

Description: The critical values are from Table 1 of Osterwald-Lenum (1992). The 5%* shown above represents the critical values from table 2* of Osterwald-Lenum (1992). It is used because South Africa's model allows for a trend and constant in the cointegration space; see Johansen (1995).

Table 1 presents the cointegration test results. The results answer to two questions: whether a long-run equilibrium relationship exists and whether it is unique. Starting with the λ-max test result, the null hypothesis tested is that there is no cointegrating vector ($r = 0$) against the alternative of cointegration of order one ($r = 1$). Since all test values in column 1 of Table 1 are significantly larger than the critical value of 27.07 at the five per cent level, we easily reject the null hypothesis ($r = 0$) of no cointegration. For space reasons, we do not report the data for comparing the null hypothesis of cointegration with $r \leq 1$ to the alternative of cointegration with $r = 2$ because none of the test statistics exceeds the critical value for this test (20.97 at the five per cent level) so we accept the null of cointegration with a single cointegrating vector.

A similar procedure applies to the trace test statistic. We first test the null hypothesis of $r = 0$ against the alternative hypothesis of $r \geq 1$ in each country. Since all empirical test statistics exceed the critical value of 47.21 for the trace statistic, we reject the null of $r = 0$ for all countries. Next, we test $r \leq 1$ against the $r \geq 2$ alternative hypothesis. This time, none of test statistic exceeds the critical value of 29.68 and we thus accept the null of cointegration with a single cointegrating vector. Note that, had we excluded the exchange rate variable from our system, we would not have found evidence of cointegration at the 5 percent level. This finding implies that the effect of exchange rate is crucial to the long-run stability of the system.

3.1 Long-run Equilibrium Estimates

Next, we are interested in the long-run impact of the three explanatory variables (real income, domestic interest rate and exchange rate) on money demand. In particular, we want to know whether the signs of the estimated coefficients are in line with their predicted values, whether these estimates are statistically significant, and how the explanatory variables perform in relative terms. Except the interest rate, our semi-log specification of the estimation model (see equation (2)), yield long-run elasticities in the case of real income and exchange rate. In Table 2, we show the empirical results of Equation (2) using the fully modified least squares (FMLS) estimator of Phillips and Hansen (Note 9). To increase confidence in the estimates obtained, we provide empirical results from the dynamic least squares (DLS) estimator of Stock and Watson. From these estimates, we gather that our conclusions are not particularly influenced by the method of estimation.

Table 2. Long-run Elasticities and Hypothesis tests

Country	Phillips-Hansen Estimator (FMOLS)			Stock-Watson Estimator (DOLS)		
	y	*i*	*e*	*y*	*i*	*e*
India	1.17	-0.06	0.24	1.66	-0.02	0.17
	(12.39)	(5.56)	(3.88)	(11.62)	(2.55)	(1.81)
Korea	1.36	-0.02	0.74	1.36	-0.02	0.74
	(26.11)	(2.1)	(7.2)	(25.6)	(2.54)	(7.11)
Malaysia	1.58	-0.02	0.18	1.01	-0.01	0.02
	(22.45)	(1.72)	(1.37)	-20.46	-3.35	-1.62
Pakistan	1.68	-0.02	0.61	1.38	-0.06	0.27
	(11.66)	(2.62)	(4.46)	-9.08	-1.99	-2.31
Philippine	0.94	-0.03	0.50	0.64	-0.03	0.55
	(5.41)	(4.74)	(7.18)	(1.86)	(1.78)	(4.15)
Sri Lanka	1.57	0.01	0.26	1.86	-0.01	-0.44
	(7.64)	(3.45)	(1.97)	(9.07)	(2.73)	(3.38)
Thailand	1.361	-0.003	0.899	1.549	-0.010	0.269
	(59.66)	(1.43)	(18.96)	(29.35)	(1.42)	(1.79)

Description: The absolute t-values are in the parentheses beneath each estimated coefficient. The critical value at 10 percent is 1.3 and 1.67 at 5 percent level.

Focusing on the results obtained from the FMLS estimator, we gather that the demand relation is estimated to be positive for real income (y) and exchange rate (e), but negative for the interest rate (i). These hold for all Asian countries in the sample. Furthermore, all coefficient estimates are statistically significant at the conventional levels. For the domestic interest rate variable, ignored in several LDCs studies, the equilibrium elasticities (calculated by multiplying the impact elasticities by the mean of the variable) are -0.624, -0.217, -0.095, -.172, -0.448, -0.184, and -0.024 for India, Korea, Malaysia, Pakistan, the Philippines, Sri Lanka and Thailand, respectively. These results provide strong support for the theoretical predictions regarding the impact of real income, interest rate and exchange rate on real money balances. As far as relative strength of the various determinants is concerned, we find that the magnitude of the exchange-rate effect is substantially smaller than the real income effect but it is generally (in absolute terms) larger than of interest-rate elasticity. This implies that the economic importance of both income levels and exchange rate effects far outweighs the importance of interest rate variations for money demand.

Table 3A. Long-run parameters using inflation rate (inf).

Country	Phillips-Hansen Estimator (FMOLS)		
	y	*inf*	*e*
India	1.63	-0.02	0.18
	(15.69)	(2.31)	(2.62)
Korea	1.34	0.02	-0.01
	(28.96)	(3.03)	(-6.00)
Malaysia	1.59	-0.02	-0.03
	(68.16)	(1.65)	(0.37)
Pakistan	1.99	-0.03	0.81
	(7.37)	(1.76)	(3.25)
Philippine	1.36	-0.02	0.36
	(8.21)	(1.49)	(4.72)
Sri Lanka	0.19	0.01	0.67
	(0.98)	(0.72)	(6.16)
Thailand	1.49	-0.03	0.39
	(36.23)	(2.92)	(4.09)

Table 3B. Bahmani-Oskooee and Rehman (2005) Long-run Coefficient Estimates

Country	**Parameters Estimates**		
	Y	***inf***	***e***
India	-3.83	-488.60	3.49
	(0.18)	(0.26)	(0.23)
Malaysia	1.25	-5.49	-0.75
	(27.04)	(1.83)	(3.38)
Pakistan	0.58	-4.98	0.34
	(6.86)	(2.31)	(4.64)
Philippine	1.13	-22.65	-1.09
	(5.11)	(2.24)	(2.60)
Thailand	0.90	-19.82	-0.76
	(10.92)	(1.63)	(1.23)

Description: See Table 2 for details, however, note that the data reported in Table 3b are taken from Bahamani-Oskooee and Rehman(2005) whose sample period is from 1972:1 through 2000:4.

For comparison, we report estimates of the cointegrating equation using the inflation rate in place of the domestic interest rate in Panel A of Table 3. Also, in Panel B of the same table, we report those taken from Bahmani-Oskooee and Rehman (2005). Without discussing each panel in detail, it is noteworthy that in Panel A, the inflation rate variable has a positive sign and significant in Korea. The same is true for Sri Lanka. For the Philippines and Malaysia, the coefficient on inflation has the correct sign but the t-values are generally small and statistically insignificant at the 5 percent level. Also, note that for Sri Lanka, our real income is only 0.19, and for Malaysia, the exchange rate is statistically non-significant at the conventional levels.

How do these results compare to those of Bahmani-Oskooee and Rehman (2005)? As can be seen in Panel B, coefficient on real income in India is wrongly signed and inflation and exchange rate are statistically insignificant. In a similar vein, the exchange rate variable is insignificant in Thailand. Further, the estimated coefficients on inflation variable, although correctly signed, are of an unusual magnitude. Nevertheless, our real income coefficients are generally consistent with theirs. All in all, the results suggest that the inflation variable is no longer adequate for these countries because their use can lead to misleading inference.

Further, we note that we experimented with the inclusion of foreign interest rate (the rate of U.S. certificate of deposit or U.S. Treasury bill rate) in the cointegration model, that is, testing for the existence of cointegration among real money balances, real income, domestic interest rate, foreign interest rate without much success. Before turning to issue of error-correction modeling, it seems prudent to check whether the variables in Equation (2) are weakly exogenous (Arize, Osang and Slottge, 2000). The results are reported in Table 4.

Table 4. Results of weak exogeneity test

Countries	Real Balance	Real Income	Interest rate	Exchange rate
India	-0.024(1.81)*	0.050(1.56)	-1.174(4.78)*	0.022(1.12)
Korea	-0.057(3.15)*	0.100(2.98)*	-2.036(4.06)*	0.024(1.33)
Malaysia	-0.096(5.04)*	0.030(0.88)	-1.590(3.10)*	0.040(1.31)
Pakistan	-0.095(2.61)*	0.003(0.28)	-1.490(1.35)	0.027(1.53)
The Philippines	-0.064(2.62)*	0.054(2.31)*	-0.940(1.32)	0.021(1.28)
Sri lanka	-0.163(3.39)*	0.090(4.41)*	-6.460(3.88)*	0.002(0.06)
Thailand	-0.042(1.70)*	0.001(0.03)	-5.170(4.79)*	0.004(0.15)

Description: The absolute t-values are in parentheses and the critical value is 1.645.

The data in Table 4 suggest that it may be appropriate to utilize an instrumental variable (IV) estimator when estimating our error-correction models. This is so because the null of weak exogeneity can be rejected in four out of seven cases for the real income variable and interest rate for five out of seven cases. The results also confirm that the real money demand variable should be considered endogenous.

3.2 Error-correction Model

The Granger representation theorem (GRT) proves that, if a congregating relationship exists among a set of nonstationary series, then a dynamic error-correction representation of the data also exists. The method used to find this representation follows the "general-to-specific" paradigm. For this purpose; the following error-correction model (ECM) exists for the variable in equation (2):

$$\Delta m_t = k_0 + \mu + \lambda EC^*_{t-1} + \omega D_t + \sum_{j=1}^{5}\left(\delta_j \Delta y_{t-j} + \delta_{5+j}\Delta i_{t-j} + \delta_{10+j}\Delta e_{t-j}\right) + \sum_{j=0}^{5}\beta_j \Delta m_{t-j-1}, \quad (4)$$

where EC_{t-1} is the error-correction (one-lagged error) term generated from the FMLS cointegrating estimates, μ is the error term, and D_t are country-specific time dummies that account for observable money demand shocks otherwise not included in the model. The existence of the error-correction term (EC_{t-1}) in equation (4) reflects the belief that actual real money balances do not adjust promptly to their long-run determinants; see Arize and Malindretos, (2012) for a detailed discussion.

The error-correction model results are summarized in Table 5. The list of instrumental variables consists of the constant term, the lagged EC term, five lags in the difference of the variables included in the long-run solution. In the case of Pakistan, we did not use any IV procedure. Note that the results from Sargan's test for legitimacy of the instrument set (not reported here) support the validity of the instrument set.

Table 5. Error- Correction Model Regression Results (1980:1-2010:1)

India

$$\Delta m_t = 0.015 - 0.024EC_{t-1} + 0.345\Delta m_{t-4} + 0.108\Delta y_{t-2} - 0.001\Delta i_{t-3} + 0.065\Delta e^*_{t-2}$$

(5.92) (1.81) (4.79) (3.23) (1.90) (1.70)

$$R^2 = 0.38, \overline{R}^2 = 0.36, F(5,135) = 16.7, DW = 1.93, BG - F = 1.2\ (0.32)$$

Korea

$$\Delta m_t = 0.014 - 0.057EC_{t-1} + 0.311\Delta m_{t-4} - 0.055\Delta y_{t-2} + 0.125\Delta y_{t-4} - 0.005\Delta i_t + 0.70\Delta e^*_t$$

(5.02) (3.15) (4.09) (3.25) (5.63) (3.22) (2.20)

$$R^2 = 0.51, \overline{R}^2 = 0.49, F(6,124) = 21.4, DW = 2.04, BG - F = 1.5\ (0.22)$$

Malaysia

$$\Delta m_t = 0.022 - 0.096EC_{t-1} + 0.162\Delta m_{t-1} + 0.146\Delta y^*_t - 0.009\Delta i_t + 0.006\Delta i_{t-1} - 0.134\Delta e_t + 0.143\Delta e_{t-1}$$

(8.30) (5.04) (2.14) (2.94) (4.14) (2.78) (2.25) (2.28)

$$R^2 = 0.33, \overline{R}^2 = 0.30, F(7,130) = 9.3, DW = 1.89, BG - F = 1.3\ (0.27)$$

Pakistan

$$\Delta m_t = 0.009 - 0.095EC_{t-1} + 0.085\Delta m^*_t + 0.543\Delta y_{t-2} - 0.013\Delta i_{t-1} + 0.604\Delta e^*_t - 0.742D_1$$

(0.938) (2.61) (1.82) (2.39) (1.63) (3.22) (9.81)

$$R^2 = 0.54, \overline{R}^2 = 0.52, F(6,138) = 26.5, DW = 1.84, BG - F = 19.2\ (0.00)$$

The Philippines

$$\Delta m_t = -0.005 - 0.064EC_{t-1} + 0.777\Delta m_{t-4} + 0.2\Delta y^*_t - 0.149\Delta y^*_{t-1} - 0.006\Delta i_t + 0.375\Delta e_t - 0.234D_2 - 1.343D_3$$

(1.11) (2.62) (18.70) (2.45) (2.27) (2.14) (4.83) (7.36) (28.58)

$$R^2 = 0.89, \overline{R}^2 = 0.89, F(7,126) = 149.99, DW = 1.957, BG - F = 0.567\ (0.678)$$

Sri Lanka

$$\Delta m_t = 0.006 - 0.163EC_{t-1} + 0.134\Delta m_{t-1} + 0.343\Delta m_{t-4} + 0.242\Delta y^*_t - 0.006\Delta i_t - 0.091\Delta e^*_{t-1} + 0.104D_4$$

(1.91) (3.39) (1.57) (4.59) (1.21) (2.33) (2.46) (4.54)

$$R^2 = 0.34, \overline{R}^2 = 0.3, F(7,114) = 8.52, DW = 1.9, BG - F = 0.9\ (0.45)$$

Thailand

$$\Delta m = 0.007 - 0.042EC_{t-1} + 0.084\Delta m_{t-1} + 0.567\Delta m_{t-4} + 0.093\Delta y^*_t - 0.098\Delta e^*_{t-1} - 1.15D_5$$

(2.68) (1.70) (3.05) (7.79) (2.50) (1.81) (43.20)

$$R^2 = 0.95, \overline{R}^2 = 0.94, F(7,114) = 368.67, DW = 1.86, BG - F = 0.96\ (0.43)$$

Description: The number in parentheses report absolute t-statistics. The critical value at 10 per cent is 1.67 and 1.96 at 5 per cent level. Tests: DW=Durbin-Watson test statistic, BG =Breusch-Godfrey test. D_1 =1 2008:1,-1 in 2008:3 and zero otherwise. $D_{2=1}$ in 1984:1, 1 in 1984:3 and zero otherwise. D_3 =1 in 2008:1, -1 in 2009:1 and zero otherwise. D_4 =1 in 1982:1, -1 in 1989:1 and zero otherwise and D_5 =1 in 2009:3 and zero otherwise. Δm^*_t is $\Delta m_{t-2} + \Delta m_{t-3}$. Δy^*_t for Malaysia is $\Delta y - \Delta y_{t-4}$. Δy^*_t for The Philippines is $\Delta y + \Delta y_{t-1}$. Δy^*_t for Sri Langa is $\Delta y + \Delta y_{t-1}$. Δy^*_t for Thailand is $(y_{t-1} - \Delta y_{t-4}) - (\Delta y - \Delta y_{t-3})$. Δe^*_{t-2} for India is $(\Delta e_{t-1} - \Delta e_{t-4}) - \Delta e_{t-2}$. Δe^*_t for Korea is $\Delta e_t - \Delta e_{t-4}$. Δe^*_t for Pakistan is $\Delta e + \Delta e_{t-1}$. Δe^*_{t-1} for Sri Lanka is $\Delta e_{t-2} + \Delta e_{t-4}$. Δe^*_{t-1} for Thailand is $\Delta e_{t-1} + \Delta e_{t-4}$.

The regress and in Table 5 is the change in real M2 balances as the dependent variable. Focusing on these results, we conclude that the short-run impact of any explanatory variable on money demand is positive (negative) if the sum of the statistically significant point estimates of the covariate in question in equation (4) is positive

(negative). For each country, a parsimonious and statistically acceptable model is obtained through the simplification of a fifth-order ECM. The simplification process involves deleting successively the first-differenced variable with the lowest t-ratios.

Considering that each regress and in the table is cast in the first difference, the empirical results suggest that the statistical fit of the each model to the data is satisfactory, as indicated by the value of adjusted coefficient of determination, which ranges from 0.30 (Sri Lanka and Malaysia) to 0.94 (Thailand). The statistical appropriateness of the models is further supported by a number of diagnostic tests. In particular, we report the Durbin-Watson and the Breusch-Godfrey test to test for non-independence of the error distribution. Based on these two statistics, we can reject the null of non-independence for all countries. Parameter stability tests reveal no serious violation of stable parameters. For example, we experimented with a t-test of the null hypothesis that the mean of the recursive residuals for each of our estimated models is not statistically significant. A similar finding was obtained by using the Dufour test. Furthermore, to ensure that no serious violation of the linearity assumption in the structure of the model, we implemented two nonlinear cointegration tests-- Kapetanios, Shin and Snell (2003) test as well as the Sollis (2009) – along the lines suggested by Ghoshray (2010). The results are reported in the Appendix.

Table 6. Speed of adjustments and mean time lags for adjustments of desired real imports.

Countries	Speed of Adjustments	Response of Desired Real Imports to Each Regressor			
	Desired Real Imports	Half-Life Adjustment	Mean Time Lag		
	m	*ψ*	*y*	*i*	*e*
India	-0.024 (0.013)	7.13	5.70	6.83	6.15
Korea	-0.057 (0.018)	2.95	2.71	3.04	-0.05
Malaysia	-0.096 (0.019)	1.72	1.80	2.19	2.16
Pakistan	-0.095 (0.036	1.73	0.98	2.44	0.82
The Phillipines	-0.064 (0.024)	2.62	0.67	0.89	-0.59
Sri Lanka	-0.163 (0.048)	0.97	0.43	0.81	0.94
Thailand	-0.042 (0.025)	4.04	1.52	2.08	2.66
Average		3.02	1.97	2.61	1.73

Description: The values in parentheses beside the speed of adjustments are the stand errors. Both the half-life and the mean time lag are in absolute terms and in quarters

Having provided evidence supporting the adequacy of the estimated equations, several features of the results in Table 5 deserve mention. First and foremost, the coefficient of the error-correction term is statistically significant in each of the seven cases and is always negative. Therefore, the validity of an equilibrium relationship among the variables in the cointegrating equation is supported. This implies that overlooking the cointegratedness of the variables would have introduced misspecification in the underlying dynamic structure and note that there is no evidence of possible nonlinear cointegration. In the case of the Philippines, the possibility of asymmetric adjustment exists given the significance of Sollis test.

Second, the change in real money balancer per quarter that is attributed to the disequilibrium between the actual and equilibrium levels is measured by the absolute values of the EC term of each equation. There is considerable intercountry variation in the adjustment speed to the last period's disequibrium, with Sri Lanka having the largest and India, the smallest. The average coefficient is -0.077 per quarter. This implies that the adjustment of real balance to changes in the regressors may take about six quarters in Sri Lanka to slightly more than thirty-eight quarters in India. In economic terms, this means that when real balances exceed their long-run relationship with their regressors, they adjust downwards at a rate of 6 to 38 percent in each quarter. Our results concerning the coefficient of the EC term for India, conflict with those of Bahmani-Oskooee and Rehman (2005), because they obtain -0.006 which is statistically insignificant with a t-value of 0.26. However, their results of -0.12, -0.15, -0.21 and -0.30 for Malaysia, Pakistan the Philippines and Thailand, respectively, are similar to those reported in Table 5 and are (in absolute terms) within the unit interval. Taken together, these results point to the existence of market forces in the money market that operates to restore long-run equilibrium after a short-run disturbance.

Finally, the dynamics of the equation show that changes in real income, interest rate and exchange rate have short-run effects on real balances in addition to their long-run effects established earlier. Therefore, they are consistent with the theory.

In sum, our findings imply (a) that not noticing the cointegration of the variables would have introduced a misspecification in the underlying dynamic structure; (b) that use of interest rate as the opportunity cost of holding money performs better than the expected inflation in the estimated Asian money demand relations; (c) that there exist market forces in the money market sector that operate to restore long-run equilibrium after a short-run deviation; (d) that, on average, it takes more than three years for 50 per cent of the deviations from long-run equilibrium (the cointegration equation) to be corrected, although much longer for India (see Table 6); (e) that the mean time lags suggest that real balances react faster to changes in domestic income than to changes in exchange rates; (f) that real balances react faster to exchange rate changes than to interest rate changes, therefore, had we focused only on the traditional variables (income and interest rate), we would have obtained more inference bias and missed the key role that exchange rates play in the demand for money function of Asian economies; (g) that linear error correction model is quite likely a good approximation of the short-run dynamics because both the KSS and Solis methods revealed insignificant t-values and (f) that the full adjustment of real balances to changes in the regressors may take between six to thirty-eight quarters, depending on the country.

4. Concluding Remarks

As set out in the introduction, the primary aim of this paper has been to investigate empirically the fundamental issue of whether exchange rate changes influence the demand for money in Asian countries by using recent breakthrough time series econometrics. Unlike previous research, this paper uses interest rate as the opportunity cost of holding money. Therefore, the basis of our analysis is a money demand function in which real money balances depend on real income, short-term interest rate and exchange rate.

Our results suggest that there is a unique, statistically significant long-run equilibrium relationship among the real M2 balance, real income, interest rates and exchange rate in each of the seven countries. The addition of exchange rate to the money demand model was found to be quantitatively important in improving money demand formulation. Exchange rate was positively signed in all cases and implies that an increase in exchange rate (i.e., depreciation of, for example Thai baht), would increase the demand for real money balances – that is, the value of foreign securities owned by domestic residents rises; also, the value of domestic securities in the hands of foreigners is lowered. This, in turn, increases the demand for real balances. Our results are directly relevant to concerns about which monetary aggregates best determines the long run effects of monetary policy action in Asia.

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References

Agenor, P. R., & Khan, M. S. (1996). Foreign Currency Deposits and Demand for Money in Developing Countries. *Journal of Development Economics*, *50*, 101-118. http://dx.doi.org/10.1016/0304-3878(96)00005-3

Ambler, S., & McKinnon, R. (1985). U.S. Monetary Policy and the Exchange Rate: Comment. *American Economic Review*, *75*, 557-559.

Arango, S., & Nadiri I. M. (1979, June). *Price Expectations, Foreign Exchange and Interest Rates, and Demand for Money in an Open Economy (Working Paper no.359)*. Retrieved from Nationl Bureau of Economic Research website: http://www.nber.org/papers/w0359

Arango, S., & Nadiri I. M. (1981, January). Demand for Money in Open Economies. *Journal of Monetary Economics*, *7*, 69-83. http://dx.doi.org/10.1016/0304-3932(81)90052-0

Arize, A. C. (1989). An Econometric Investigation of Money Demand Behavior in Four Asian Developing Economies. *International Economic Journal*, *3*, Winter, 79-93. http://dx.doi.org/10.1080/10168738900080030

Arize, A. C. (1997). Conditional Exchange-Rate Volatility and the Volume of Foreign Trade: Evidence from Seven Industralized Countries. *Southern Economic Journal*, *64*, 235-254. http://dx.doi.org/10.2307/1061049

Arize, A. C., & Malindretos, J. (2012). Foreign Exchange Reserve in Asia and its Impact on Import Demand. *Journal of Economics and Finance, 4*(3), 21-32.

Arize, A. C., Malindretos, J., & Grivoyannis, E. C. (2005). Inflation-rate Volatility and Money Demand:

Evidence from Less Developed Countries. *International Review of Economics & Finance, 14*(1), 57-80. http://dx.doi.org/10.1016/j.iref.2003.04.001, PMid: 16735669

Arize, A. C., & Ndubuzi, G. (1990). Modeling Money Demand Functions with Exchange Rates: Regression Estimates and Diagnostic Tests. *The International Journal of Finance*, *2*(2), 88-104.

Arize, A. C., Osang, T., & Stottje, D. (2000, January). Exchange-Rate Volatility and Foreign Trade: Evidence from Thirteen LDC's. *Journal of Business and Economic Statistics*, *18*(1), 10-17. http://dx.doi.org/10.2307/1392132

Arize, A. C., & Shwiff, S. S. (1993, June). Cointegration, Real Exchange Rate and Modeling in the Demand for Broad Money in Japan. *Applied Economics*, *25*(6), 717-726. http://dx.doi.org/10.1080/00036849300000124

Bahmani-Oskooee, M., & Techaratanchai A. (2001). Currency Substitution in Thailand. *Journal of Policy Modeling*, *23*, 141-145. http://dx.doi.org/10.1016/S0161-8938(00)00030-2

Bahmani-Oskooee, M., & Rhee H. J. (1994). Long Run Elasticities of the Demand for Money in Korea: Evidence from Cointegration Analysis. *International Economic Journal*, *8*, 1-11. http://dx.doi.org/10.1080/10168739400000015

Bahmani-Oskooee, M., & Rehman, H. (2005). Stability of the Money Demand Function in Asian Developing Countries. *Applied Economics*, *37*, 773-792. http://dx.doi.org/10.1080/0003684042000337424

Das, D. D. (2012). How did the Asian economy cope with the global financial crisis and recession? A Revaluation and Review. *Asia Pacific Business Review*, *18(*1), 7-25. http://dx.doi.org/10.1080/13602381.2011.601584

Domowitz, I., & Craig S. H. (1990). January-March. Interpreting an Error Correction Model: Partial Adjustment, Forward Looking Behavior, and Dynamic, International Money Demand. *Journal of Applied Econometrics*, *5*, 29-46. http://dx.doi.org/10.1002/jae.3950050103

Ericsson, N. R. (1998). Empirical Modeling of Money Demand. *Empirical Economics*, *23*, 295-315. http://dx.doi.org/10.1007/BF01294409

Engle, R. F., & Granger, C. W. J. (1987, March). Cointegration and Error-Correction: Representation, Estimation and Testing. *Econometrica*, *55*, 251-276. http://dx.doi.org/10.2307/1913236

Funke, M. (2001). Money Demand in Euroland. *Journal of International Money and Finance*, *20*, 701–713. http://dx.doi.org/10.1016/S0261-5606(01)00017-1

Ghoshray, A. (2010). Smooth Transition Effects in Price Transmission: the Case of International Wheat Export Prices. *Economics Letters*, *106*, 169-171. http://dx.doi.org/10.1016/j.econlet.2009.11.011

Goldfeld, S. M. (1976). The Demand for Money Revisited. *Brookings Papers on Economic Activity*, *3*, 557-646.

Haug, A. A. (1996). Tests of Cointegration: A Monte Carlo Comparision. *Journal of Econometrics*, *71*, 89-115. http://dx.doi.org/10.1016/0304-4076(94)01696-8

Haug, A. A., & Robert F. L. (1996). Long-Run Money Demand in Canada: In Search of Stability. *Review of Economics and Statistics, 78*, 345-348. http://dx.doi.org/10.2307/2109938

Ibrahim, M. H. (2001). Financial Factors and The Empirical Behavior of Money Demand: A Case Study of Malaysia. *International Economic Journal*, *15*, Autumn, 55-72. http://dx.doi.org/10.1080/10168730100000043

Johansen, S. (1995). *Likelihood-Based Inference in Cointegrating Vector Autoregressive Models*. New York: Oxford University Press. http://dx.doi.org/10.1093/0198774508.001.0001

Kapetanios, G., Shin, Y., & Snell, A. (2003). Testing for a Unit Root in the Nonlinear STAR Framework. *Journal of Econometrics*, *112*, 359-379. http://dx.doi.org/10.1016/S0304-4076(02)00202-6

Lee, T. H., & Chung K. J. (1995). Further Results on the Long-Run Demand for Money in Korea. *International Economic Journal*, *9*, Autumn, 103-113. http://dx.doi.org/10.1080/10168739500000024

McKinnon, R. I. (1983). Currency Substitution and Instability in the World dollar Standard. *American Economic Review*, *72*, 320-333.

McNown, R., & Wallace, M. S. (1992, February). Cointegration Tests of a Long-Run Relationship between Money Demand and the Effective Exchange Rate. *Journal of International Money and Finance*, *11*, 107-114. http://dx.doi.org/10.1016/0261-5606(92)90024-R

Mundell, A. R. (1963). Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates. *Canadian Journal of Economics and Political Science*, *29*, 475-485. http://dx.doi.org/10.2307/139336

Osterwald-Lenum, M. (1992, August). A Note with Quantiles of the Asymptotic Distributions of the Maximum Likelihood Cointegration Ranks Test Statistics: Four Cases. *Oxford Bulletin of Economics and Statistics*, 461-472. http://dx.doi.org/10.1111/j.1468-0084.1992.tb00013.x

Philips, P. C. B., & Hansen B. E. (1990). Statistical Inference in Instrumental Variables Regression with I (1) Processes. *The Review of Economic Studies*, *57*, 99-125. http://dx.doi.org/10.2307/2297545

Rajan, R. S. (2010, July). *The Evolution and Impact of Asian Exchange-Rate Regimes. (Economics Working Series No 208).* Retrieved from Asia Development Bank website: http://www.adb.org/publications/evolution-and-impact-asian-exchange-rate-regimes

Sollis, F. (2009). A Simple Unit root Test Against Asymmetric STAR Nonlinearity with An Application to Real Exchange Rates in Nordic Countries. *Economic Modelling*, *26*, 118–125. http://dx.doi.org/10.1016/j.econmod.2008.06.002

Tan, E. C. (1997). Money Demand Amid Financial Sector Developments in Malaysia. *Applied Economics, 29*, 1201-1215. http://dx.doi.org/10.1080/00036849700000011

Weliwita, A., & Ekanayake, E. M. (1998). Demand for Money in Sri Lanka During the Post-1977 Period: Cointegration and Error-Correction Analysis. *Applied Economics*, *30*, 1219-1229. http://dx.doi.org/10.1080/000368498325101

Notes

Note 1. Specifically, our sample period for each country ends in 2009:4, however, for India, Malaysia and Pakistan the starting quarter is 1973:1. In the case of the Philippines and Thailand, it is 1977:1; for Sri Lanka, it is 1978:1, and for Korea, it is 1976:1. Availability of interest rate data was a major factor in determining our starting quarterly period.

Note 2. See the discussions in the *Review of Economics and Statistic*s (RESTAT), 79, May (1997: 311-328); see RESTAT, 80, August (1998: 400-403; *Journal of Business and Economic Statistics*, 16, October 1998; Arize, Osange and Slottje (2000); Funke (2001) and Arize (2012).

Note 3. It is imperative that we estimate the demand for money in real terms, because we want to understand how the real demands for money balances behave over time, so that changes in the nominal stock of money are adapted to the growing real demand at constant prices. See also Goldfeld (1976: 624).

Note 4. See Domowitz and Hakkio (1990:30) for a detailed explanation of the importance of deflating by consumer price index and using real GDP as scale measure.

Note 5. Mundell (1963) has argued that the demand for money is likely to depend upon the exchange rate, in addition to the interest rate and the level of income. A portfolio model of the financial market explored by Arango and Nadiri (1981) provide a role for the exchange rate variable in the money demand function; however they point out that the effect of the exchange is more difficult to sign. See, also McKinnon (1963).

Note 6. The exposition draws from Arango and Nadiri (1979, 1981), Arize (1989), Bahmani-OsKooee and Rhee (1994) and Bahmani-OsKooee and Techaratanachai (2001).

Note 7. Rebalancing is the process of adjusting the allocation of various assets in a portfolio to reflect the new scenario or to achieve or maintain a desired mix.

Note 8. The consequence of nonstationarity is the inapplicability of the standard sampling theory. The cointegration approach is attractive in that it can properly account for the nonstationary series.

Note 9. Following the specification suggestion in Funke (2001) we base our coefficient analysis on FMLS estimator.As Funke (2001) points out “one of the key advantages of this approved over alternative estimators, such as Johansen (1988) and Stock and Watson (1988), is that it facilitates a complete analysis of the inclusion of deterministic trends in the cointegration set. An additional benefit of the above framework is that it facilitates a test of cointegration, where cointegration is taken to be the null hypothesis. In the statistics literature this would be the natural way to test for cointegration…”

Appendix. Nonlinear Tests of the Residents of the Long-run Equation.

Country	Sample Period	KSS	Sollis	
			$H_0: \emptyset_1 = \emptyset_2 = 0$	$H_0: \emptyset_2 = 0$
India	1980:1-2011:10	-0.97	1.14	1.51 (0.13)
Korea	1980:1-2011:10	-1.59	1.68	-0.22 (0.82)
Malaysia	1980:1-2011:10	-1.16	2.33	0.58 (0.56)
Pakistan	1980:1-2011:10	-1.15	26.64	0.22 (0.83)
Philippines	1980:1-2011:10	-1.24	4.39	-2.21 (0.03)*
Sri Lanka	1980:1-2011:10	-0.55	5.12	-1.49 (0.14)
Thailand	1980:1-2011:10	-1.57	2.67	1.46 (0.15)
Critical Value (10%)		2.66	3.73	

Description: The values in parentheses are the p-values.

a. Kapetanios, G., Shin,Y., and Snell, A. (2003) was obtained from

$$\Delta m_t = \lambda EC_{t-1}^3 + \sum_{i=0}^{5} \theta_i \Delta y_{t-i} + \sum_{i=0}^{5} \vartheta_i \Delta i_{t-i} + \sum_{i=0}^{5} \beta_i e_{t-i} + \sum_{i=0}^{5} \gamma_i \Delta m_{t-i} + v_t$$

H_0: $\lambda = 0$ and H_a: $\lambda < 0$

b. Sollis (2009) was obtained from

$$\Delta m_t = \phi_1 EC_{t-1}^3 + \phi_2 EC_{t-1}^4 + \sum_{i=0}^{5} \theta_i \Delta y_{t-i} + \sum_{i=0}^{5} \vartheta_i \Delta i_{t-i} + \sum_{i=0}^{5} \beta_i e_{t-i} + \sum_{i=0}^{5} \gamma_i \Delta m_{t-i} + w_t$$

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Demand for Money: Implications for the Conduct of Monetary Policy in Kenya

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Abstract

The paper analyses demand for different monetary aggregates (M0, M1, M2 and M3) in Kenya for the period 1997:4-2011:2. Dynamic frameworks are used to estimate and uncover parsimonious and empirically stable demand for money functions. Price, real GDP, nominal 91-Day Treasury bill rate, nominal interbank rate, nominal deposit rate and foreign interest rate affected the long-run demand for money functions to different degrees. The demand for money functions is found to be unstable over the period for the parameter values, implying that the current monetary targeting policy framework is inappropriate. However, there are challenges in adopting an alternative monetary policy framework.

Keywords: money demand, cointegrated VAR

JEL Classification: C51, E31, E52

1. Introduction

A stable money demand function is generally considered essential for the formulation and conduct of efficient monetary policy as it enables a policy-driven change in monetary aggregates to have a predictable influence on output, interest rates and ultimately price (Sriram, 2001). Consequently, considerable effort has been made in the empirical literature for both industrial and developing countries to determine the factors that affect the long-run demand for money and the stability of the relationship between these factors and various monetary aggregates.

Most of the research on the demand for money up until 1980s was carried out by the so-called partial adjustment models in which demand for real money is formulated as a function of a scale variable and a vector of opportunity cost variables. Demand for money models built under this framework for the United States and industrial countries using post World War II data indicated that the demand for money was unstable in the 1970s, which is commonly referred to as the "missing money episode". The "missing money episode" was due to the assumption of a stable velocity and misspecification of the model. On the policy front, it made most of the industrial countries to abandon the monetary aggregate targeting policy framework in favour of inflation targeting. However, in the recent past, this view has changed, since a number of empirical studies using different data definitions and econometric methodology have been successful in finding stable demand relations. These include among others, Carlson *et al.* (2000) for the US, Hendry and Ericsson (1991) for the UK and Hoffman *et al.* (1995) for the US, Japan, Canada, the UK, and Germany.

Majority of empirical studies on money demand are on developed countries. Research work is limited for developing countries partly because of complacency offered by the International Monetary Fund (IMF) financial programming framework, where demand for money is approximated via a basic quantity theory of money equation. Nonetheless, demand for money in Kenya has received some attention from macroeconomists. Studies on the demand for money include, among others, Pathak (1981), Darrat (1985), Kanga (1985), Killick and Mwega (1990), Adams (1992), Ndung'u (1994) and Kisinguh, Korir and Maana (2004). However, prior to Adams (1992) the work on demand for money turned out disparate findings regarding the determinants and stability of the demand for money. Adams (1992) attributed the differences in reported results to differences in sample size, composition of explanatory variables and the appropriate specification of the dynamic adjustment in the demand for money.

The need to revisit the money demand function in Kenya reflects several considerations. First, Kenya's financial system has undergone reforms under the liberalization process guided by the Bretton Woods institutions (i.e. the World Bank and the IMF) in late 1980s and early 1990s. Second, the shift to a floating exchange rate regime in 1991 and the liberalization of the capital account of the balance of payment in 1995 not only expanded the menu of assets available to economic agents in Kenya but also made exchange rate an indirect instrument of monetary policy, thus exogenizing the money supply process. This regime shift may have introduced some instability in the money demand function. Similarly, a floating exchange rate regime meant that the economy lost a nominal anchor to tie prices down (as the experience after 1992 elections shows). Third, the recent years has seen the Kenyan financial sector being transformed by financial innovations and developments that may have impacted on the monetary aggregates and the stability of money demand. Thus this study attempts to estimate the demand for money functions using recent data and to ascertain the stability of the estimated relationship.

The rest of the paper is organised as follows. Section 2 provides a brief account of the theoretical framework. Section 3 presents the empirical methodology. Section 4, reviews the data while section 5 presents the integration and cointegration analysis. Section 6 presents formal tests of stability of the demand for money. In section 7 we present the concluding remarks and policy recommendations.

2. Theoretical Framework

The theoretical underpinnings of the demand for money emphasize transactions, speculative, precautionary or utility considerations, and are well articulated in the economic literature. These include the classical quantity theory, Keynes (1936) liquidity preference, Baumol (1952) and Tobin (1956) inventory theoretical approach, Friedman's (1956) restatement of the quantity theory, and the Cambridge version. These theories share common elements (variables) such as scale variable. Boorman (1976) argues that what separates them is the specific role assigned to each variable. Sriram (2001) argues that the general consensus in the literature is that the empirical work on the demand for money is motivated by a blend of theories. As pointed out by Nachega (2001), empirical studies on demand for money should converge to a specification in equation 1 where real money balances is a function of a scale variable, opportunity cost of holding money and own rate of return on money.

$$M_t = f\underset{(+)\quad(-)\ (+)}{\left(P_t, scale_t, i_t, i_t^d\right)} \tag{1}$$

Where M_t is the demand for nominal money balances, P_t is the domestic price level (consumer price index or GDP deflator), $scale_t$ is a scale variable (the real income, expenditure, or wealth), i_t is the nominal rate of return on alternative asset, i_t^d is the nominal own rate of return.

An increase in the general level of prices leads to a rise in the transactions demand for money since economic agents need to hold more money to undertake the same amount of real expenditures. With absence of money illusion, an increase in the general level of prices will induce a proportionate increase in the nominal demand for money, leaving the level of real money balances unchanged. This is the price homogeneity assumption that underlies demand for real money balances.

The scale variable is used to capture the transactions motive since the higher the level of scale variable the greater the demand for real money balances. The quantity theory of money demand posits a one-for-one relationship between money demand and income.

The opportunity cost of holding money has three considerations: the own-rate of return, rate of return on assets alternative to money and expected rate of inflation. Tobin (1958) argues in favour of including both rates. Ericsson (1998) points out that omission of own-rate of money leads to break down of the estimated money demand especially when financial innovations occur in the economy. Friedman (1956) argues that the expected rate of inflation should be included in the demand for money.

In an open economy like Kenya, the choice of assets for portfolio diversification is wider as foreign currency denominated assets are available in addition to the domestic financial and real assets. Thus as suggested by Bahmani-Oskooeee (2001), the domestic money demand could be sensitive to the external monetary and financial factors. An increase in rates of returns in foreign securities may potentially induce domestic residents to increase their foreign asset holdings financed by drawing down the domestic money holdings. Similarly, if the domestic currency is expected to depreciate, the domestic investors would be encouraged to readjust their portfolios in favour of foreign assets. This implies the possibility of the uncovered interest parity (UIP) relationship. UIP states that if domestic interest rates are higher than similar foreign interest rates, then investors

will shift their investment portfolios to the domestic assets leading to nominal exchange rate appreciation. UIP can be expressed algebraically as

$$i_t^m = i_t^{m*} + \Delta e_{t+1}^e + u_t \quad (2)$$

Where e_t is the expectation on the basis of all information available at time t, i_t^m is the yield on domestic assets with maturity m at time t, i_t^{m*} is an equivalent foreign interest rate and u_t is the risk premium associated with domestic assets.

3. Empirical Methodology

The definition of money varies across countries due to either institutional characteristics or arbitrary decisions. Ericsson and Sharma (1996) argue that although it is easy to control narrowly defined aggregates, they are less useful in policy analysis because their relationship with price and output is subject to considerable variability. Broader monetary aggregates appear more stable relative to nominal income but less amenable to control. For the purpose of this study, the assets considered are Kenya shilling money as measured by money stock (M0, M1, M2 and M3). It is however important to note that money (M3) is the intermediate target under the current monetary policy framework in Kenya.

Money demand functions have moved from traditional specification to include more variables to the specification and from use of simple regression time series econometrics to use more sophisticated methodologies such as Vector error Correction methodologies. Sanvi et al (2011), study's the money demand functions for the Euro area and add equity price to the traditional money demand specification. Using the VECM methodology they find money demand to be stable with equity price and less stable without equity prices. AL-Abdulrazag and Abdullah (2011), add exchange rate depreciation variable to the traditional specification of money demand function for the Jordian economy. Using Johansen Juselius Cointegration test they find the cointegration exists between the variables of income, interest rates and exchange rate with a positive relationship between money aggregates and the level of income and a negative relationship between monetary aggregates and interest rate and exchange rate depreciation. The money demand function was however found to be unstable.

In line with other studies on demand for money, the real GDP is used as a scale variable. The choice of the real GDP is also informed by the availability of data for the sample period in quarterly frequency.

There are different measures of the return on assets alternative to money: yields on short-term government securities, commercial paper, return on equities, yields on long-term government securities. The study uses the interest rate on 91-day Treasury bills as the return on assets alternative to money since it is the benchmark interest rate used in the financial market during the period of study.

The study uses average deposit rate as own return to money. This is motivated by the fact that demand deposits for corporate customers, all savings and time deposits are paid interest in Kenya.

The external influence is captured by the US three months Treasury bill rate adjusted for the expected depreciation/appreciation of the nominal Kenya Shilling US exchange rate.

The study uses cointegrated vector autoregression (VAR) analysis as presented in Johansen (1996) and Juselius (2006). The basic p-dimensional reduced-form VAR model with Gausian errors is specified as follows;

$$x_t = A_1 x_{t-1} + ... + A_k x_{t-k} + \Phi D_t + \varepsilon_t, t = 1,..,T \quad (3)$$

Where the vector of variables (Note 1), x_t is:

$$x_t = \left(m_t^i, p_t, y_t, i_t^{tb}, i_t^{ib}, i_t^d, i_t^{*k}, atm\right), i = 0,1,2,3 \quad (4)$$

$x_0,...x_{-k+1}$ are fixed, $\varepsilon_1,...\varepsilon_T$ are $iid \sim N_P(0,\Omega)$, D_t is a vector of deterministic variables such as constant, linear trend, centred seasonal and intervention dummies.

In an I(1) framework equation 3 can be reparameterised as a vector error correction model (VECM) as follows;

$$\Delta x_t = \Pi x_{t-1} + \Gamma_1 \Delta x_{t-1} ... + \Gamma_{k-1} \Delta x_{t-k+} + \Phi D_t + \varepsilon_t, t = 1,..,T \quad (5)$$

Where $\Pi = \sum_{i=1}^{k} A_i - I_P$ and $\Gamma_i = -\sum_{i=i+1}^{k} A_i$

Presence of unit roots in the unrestricted VAR model corresponds to nonstationary stochastic behaviour which can be accounted for by reduced rank ($r < p$) restrictions of the long-run levels matrix, $\Pi = \alpha\beta'$. The matrix α is the loading/speed of adjustment coefficients while β is the cointegrating vector so that $\beta' x_{t-1}$ is $r \times 1$ vector of stationary cointegrating relations.

4. A Look at the Data

In this section we use graphs to show the character of the data and give some intuition why cointegration holds. Figure 1 shows the components of the broad money (M3), which is the dependent variable in the analysis. Consequently, the analysis attempts to incorporate the factors that are likely to impact on these components. All variables in the demand for money functions are graphically analysed and several characteristics emerge.

First, some of the variables show a strong presence of a deterministic trend. This is apparent in figure 1 of the nominal money stock (M1, M2 and M3) and from graphical analysis of overall CPI, real GDP, 91-Day Treasury bill rate and nominal deposit rate. The presence of the deterministic trend in the data calls for the need to incorporate deterministic trend in the cointegrated VAR.

Second, there are structural breaks during the period of analysis. The structural breaks reflect the changes in monetary and fiscal regime in 2003 following the end of the Kenya African National Union (KANU) leadership in 2002 and the coming to power of the National Rainbow Coalition (NARC) government at the beginning of 2003; impact of the reduction in cash ratio requirement which caused substantial liquidity surplus in the market in 2003/2004; drought conditions in the year 2006 and effects of the post-election violence in 2008 which adversely affected the food supply chains causing a rise in inflation.

Finally, there is a strong component of seasonality for the variables. The analysis thus takes seasonality into consideration.

5. Integration and Cointegration Analysis

In testing for the level of integration and cointegration, we first carry out unit roots for the variables of interest. We then proceed to perform cointegration analysis with a view to finding out if the data support the models.

Traditionally, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to assess the order of integration of variables. In view of the fact that ADF and PP unit root tests take structural breaks in the series as evidence in favour of non-stationarity, the study uses the Perron-Vogelsang (1992) and Clemente-Montanes-Reyes (1998) tests are preferable. Both these tests offer two models: an additive outlier model (OA) and an innovative outlier model (IO). The OA model captures sudden change in the mean of a series while (IO) allows for a gradual shift in the mean of the series of the model. Since these tests can identify the date of the structural break, they can facilitate the analysis of whether a structural break on a certain variable is associated with a particular event in the economic calendar.

The ADF and Clemente-Montanes-Reyes (1998) test results are not presented due to space limitations (Note 2). The starting point is to use the ADF test for the variables in levels and then apply the Clemente-Montanes-Reyes test to take into account existence of structural breaks. Generally, all variables have unit roots since the null hypothesis of non-stationarity is not rejected. However, the Clemente-Montanes-Reyes (1998) tests for the broad money (M3) suggest that it is an I(2) process. We, however, took a conservative view and used the ADF result which suggest that it is I(1) process. We then proceed under the assumption that no variable contains more than one unit root and that the first difference of each series is stationary.

Several issues emerge from the unit root tests. First, since overall CPI is I(1), inflation, which is I(0), cannot be included in the long-run demand for money. Second, since no variable is I(2), there is no possibility of existence of polynomially cointegrated relationships. The analysis therefore does not use I(2) analysis framework. Finally, existence of double structural breaks in most variables implies a need to incorporate structural breaks in the VAR analysis.

For each monetary aggregate the first step in the estimation process entailed specification and estimation of a reduced-form VAR model. The second step is the conduct of diagnostic tests on the reduced form VAR in terms of appropriate lag length (Schwarz criterion, Hannan-Quinn criterion and LM-test for autocorrelation at that particular lag), multivariate normality, autocorrelation, autoregressive conditional heteroscedasticity (ARCH) effects and modulus of largest root of the companion matrix. The VAR diagnostic test results are not reported due to space limitations (Note 3). Generally, the models for the different demand for money pass the diagnostic tests, with the exception of the ARCH effects for the money (M2).

Having performed diagnostic statistics for each of the reduced form VAR, the final specification of the VAR is settled upon. For money M0, time trend plus dummy variables for year 2003 change of government and 2008 post-election violence are added to the variables in equation 4. For money M1, time trend plus dummy variables for year 2000 drought, 2003 change of government, 2008 post-election violence and 2010 economic recovery are added to the variables in equation 4. For money M2, the specification is the same as M1 except that the ATM and nominal interbank rate are excluded from equation. For money M3, the additional variables are as in M0, with the exception that ATM is excluded. In effect the ATM is excluded in M2 and M3 while nominal interbank rate is included in M3 only.

The next step is to determine the cointegration rank using Johansen's maximum likelihood procedure. As pointed out by Juselius (2006), the determination of the cointegration rank is a crucial step in the empirical analysis and yet quite difficult since the distinction between stationary and non-stationary directions of the vector process is not straight forward.

Table 1 presents the results for the trace test of the cointegrating rank. The test is a sequential in nature beginning from the null hypothesis that there is no cointegration (i.e. $r = 0$). If the null of no cointegration is rejected, we continue until first failure to reject the null.

Table 1. Cointegration test results for the demand for money

Null	Small sample(Bartlett-corrected) trace test(λ^*_{trace})			
	M0	**M1**	**M2**	**M3**
$r = 0$	143.665 (0.005)***	136.448 (0.019)**	110.382(0.045)**	168.102(0.024)**
$r = 1$	88.936 (0.192)	84.831 (0.304)	64.050(0.469)	123.338(0.112)
$r = 2$	57.678 (0.393)	54.586 (0.532)	27.960(0.949)	85.278(0.283)
$r = 3$	27.491 (0.847)	25.610 (0.903)	7.299(0.999)	55.012(0.509)
$r = 4$	10.293 (0.961)	11.492 (0.926)	4.498(0.910)	32.053(0.651)
$r = 5$	2.682 (0.945)	NA	NA	13.911(0.832)
$r = 6$	NA	NA	NA	5.036(0.751)

Notes: p-values in brackets. * and ** show rejection of null at 10% and 5% level of significance,

Respectively. NA means the order of the VAR could not allow the trace test to be computed.

On the basis of this criterion, we conclude that there is one cointegrating vector for M0, M1 and M2. However, for M3, the null hypothesis of two cointegrating vectors is barely accepted at 10%. We therefore conclude that there are two cointegrating vectors.

The estimated unrestricted cointegrating vectors may or may not make economic sense. They are uniquely defined based on the ordering of the λ_i and the choice of the eigenvector normalisation. For each of the four VAR models systems, we need at least r^2 long-run restrictions to ensure exact identification. This was easy for M0, M1, and M2 since the trace test returned a verdict of one cointegrating vector (i.e. $r = 1$), which implied that exact identification could be achieved by one restriction i.e. the eigenvector normalisation. For M3 with two cointegrating vectors, four ($2^2 = 4$) restrictions must be imposed for exact identification. We chose to identify demand for money (M3) and uncovered interest parity (UIP) equations.

Table 2 presents the final long-run parameters. Prior to the imposition of the unit price elasticity (long-run price homogeneity), the coefficient for price differed substantially for the different monetary aggregates. Specifically, the coefficients were 0.568, 0.722, 0.843, 1 360 for M0, M1, M2 and M3 respectively. The difference from unit price elasticity may be attributed to two factors. First, as the economy grows, the basket of goods and services in the CPI may become less relevant for firms and households that are increasing their broad money holding. Indeed, the new CPI basket, based on the Kenya Integrated Household Survey done in 2005/2006, has 234 compared to 216 items in the old CPI basket based on 1997 Household Survey. Second, technological progress may have changed the relationship between nominal broad money supply and price. Long-run price homogeneity is imposed in line with earlier demand for money studies in Kenya such as Killick and Mwega (1990), Adams (1992), Ndungú (1994), and Kisinguh *et.al.* (2004).

Table 2. Long-run coefficients ($\hat{\beta}$)

	m_t^0	m_t^1	m_t^2	m_t^3	**UIP**
p_t	1.000	1.000	1.000	1.000	0.000
y_t	1.381	1.822	1.977	1.459	0.000
	(7.648)	(18.582)	(11.609)	(13.794)	
i_t^{tb}	-5.896	-3.291	-5.420	-2.737	-0.676
	(-8.902)	(-9.189)	(-7.809)	(-4.309)	(-3.207)
i_t^d	8.710	4.474	8.693	7.085	0.000
	(8.564)	(8.165)	(8.110)	(11.224)	
i_t^{ib}	0.000	0.000	0.000	-2.024	0.000
				(-3.962)	
i_t^{*k}	0.000	0.000	-0.847	0.000	1.000
			(-2.663)		
atm	0.000	0.000	0.000	0.000	0.000
t	0.000	0.000	0.000	0.000	0.000

The income elasticity of demand is greater than unity and varies substantially. The finding of greater than unity income elasticity suggests that over the sample period changes in real income have induced, on average, more than proportionate increase in the demand for real money balances. A test imposing unitary income elasticity is rejected for most monetary aggregates with the exception of M0. This finding is in line with earlier works of Ndele (1991), who found income elasticity for M3 of 1.92 and Ndung'u (1994) who found an elasticity of 1.7. The greater than unitary income elasticity may be attributed to economic development and monetization in the Kenyan economy. It also means that money is considered a luxury or it indicates neglected wealth effects. The results are, however, contrary to the works of Killick and Mwega (1990) who found income elasticity of 0.56 for money M3 and Kisinguh *et al.*(2004) who found income elasticity for money supply with foreign currency deposits (M3) of 0.977.

The coefficient for the nominal 91-Day Treasury bill rate is negative as expected for all the monetary aggregates. This is in line with theory since the higher the return on the alternative asset (The 91-Day Treasury bills), the lower the incentive to hold money (Ceteris Paribus). Most studies on demand for broad money in Kenya have found significant negative effects for Treasury bill rates for M3. Ndung'u (1994) found an interest elasticity of -1.97, Killick and Mwega (1990) found -0.250 and Kisinguh et al. (2004) found an elasticity of -0.01.

The nominal deposit rate (own-return on money) has a positive effect on the demand for all the real money balances. This is in line with economic theory since the higher the own-return on money, the less the incentive to hold assets alternative to money.

The nominal interbank rate has a negative effect on the demand for real broad money (M3) balances. This is in line with economic theory since the higher the interbank rate, the less the incentive to hold money.

Foreign interest rate adjusted with nominal exchange rate depreciation (i_t^{*k}) has a negative effect for the demand for real money (M2) and M3). This can be explained by the fact that an increase in foreign interest rate as it potentially induces domestic residents to increase their holdings of foreign assets which are financed by drawing down domestic money holding. Similarly, the expected depreciation implies that the expected returns from holding foreign money increases and hence agents would substitute the domestic currency for foreign currency. The results are fairly close to those found in Killick and Mwega (1990) and Kisinguh et al. (2004). Finally, financial innovations as proxied by the number of ATMs do not seem to have affected the demand for real money balances with the exception of M1. Table 3 presents the corresponding loading matrices.

Table 3. Loading matrices ($\hat{\alpha}$)

Variables	m_t^0	m_t^1	m_t^2	m_t^3	UIP
Δm_t^i	-0.173***	-0.294***	-0.096***	-0.103***	-0.052
	(-5.316)	(-3.508)	(-3.832)	(-3.502)	(-1.835)
Δp_t	0.087***	0.262***	0.047	0.135***	0.054
	(2.755)	(5.081)	(1.230)	(2.557)	(1.057)
Δy_t	-0.058	-0.023	0.014	-0.007	0.050
	(-1.947)	(-0.385)	(0.394)	(-0.130)	(1.010)
Δi_t^{tb}	-0.068***	-0.037	-0.136***	-0.102***	0.113***
	(-2.151)	(-0.637)	(-4.932)	(-2.189)	(2.509)
Δi_t^{ib}	0.000	0.000	0.000	-0.144***	0.074
				(-3.101)	(1.648)
Δi_t^d	0.015	0.035***	-0.012	0.015	0.017
	(1.691)	(2.119)	(-1.260)	(1.229)	(1.493)
Δi_t^{*k}	0.000	0.000	0.000	-0.099	-0.899***
				(-0.694)	(-6.521)
Δatm_t	-0.019	-0.041	0.000	0.000	0.000
	(-0.236)	(-0.272)			
Restrictions: $\chi^2(v)$	3.979	5.44	0.869	9.240	9.240
	(0.264)	(0.142)	(0.648)	(0.236)	(0.236)

The long-run restrictions are not rejected in the Kenyan data as shown by the Chi-square test in table 3. Several issues can be noted from Table 3, which are useful for monetary policy making. First, the speed of adjustments in the second row shows a slow adjustment process, which reflects structural rigidities in the Kenyan financial market. Second, the fact that the speed of adjustment relating to inflation (Δp_t in the third row) is positive implies that when supply for real money balances deviate from the long-run demand for real money, it leads to inflationary pressures in the case of M0, M1 and M3. Finally, the loading matrices provide information regarding variables which are weakly exogenous in a particular money demand equation. Those variables whose adjustment coefficients are statistically significant (indicated by ***) are endogenous. For instance, for the money demand (M0), there is a two-way Granger causality between M0 and price and nominal Treasury bill rate. Contrariwise, those variables whose adjustment coefficients are statistically insignificant are weakly exogenous (one-way Granger causality).

6. Stability of Demand for Money Tests

As pointed out by Judd and Scadding (1982) stability of the demand for money refers to a set of necessary conditions for money to exert a predictable influence on the economy so that the central bank can control reserve (base) money as an instrument of monetary policy. Judd and Scadding add that there are three key elements of the stability of the demand for money. First, the demand for money function should be predictable in a statistical sense. In other words the demand for money function must forecast accurately out of sample. Second, the demand for money should have relatively few determinants. They argue that a demand for money relationship that requires knowledge about a large number of variables in order to pin it down is not predictable. Finally, the variables in the demand function should represent significant links to spending and economic activity in the real sector. Juselius (2006) argues that stability of a function relates to a constant parameter regime.

In this section, a battery of tests suggested by Hansen and Johansen (2002) for testing stability for a cointegrated VAR model is utilized. There are two versions of the tests: forward recursive tests and backward recursive tests. The idea behind the forward recursive tests is to choose a baseline sample from the first part of the sample, estimate a first model, and then recursively test whether the more recent observations have followed the same model. The backward recursive tests provide information about the possibility of non-constant parameters in the beginning of the sample. The recursion is performed by adding more and more distant observations.

The results are presented for two versions of the model: the full model version (X-form) and the concentrated model version (R-form). The X-form is a function of the short-run dynamics and deterministic components and hence the degrees of freedom are fewer leading to increased volatility in the graphs. The R-from is corrected for these effects and generally looks stable than the X-form over time. The study reports mainly the R-form due to space limitations.

The results are summarised in table 4 and cover recursive estimates of $\hat{\beta}$ coefficients for the demand for money and UIP equation, recursive tests of the full model, recursive tests based on eigenvalues, recursive tests based on the constancy of the cointegrating space and recursive tests of predictive failure both for the full system and for individual series. First, the recursive graphs of $\hat{\beta}$ coefficients are generally unstable even after correcting for short-run dynamics. Second, the recursive tests of the full model, which check whether the model is approximately acceptable or not, rejects constancy of the demand for M0, M1, M2 and M3. Third, the recursive tests based on the eigenvalues, λ_i ,as well as transformation of them, rejects stability of the demand for M2 and M3. However, the demand for money (M0 and M1) is found to be stable. Fourth, the max test of constant β , suggested by Nyblom (1989) and referred to as the Nyblom Q test, focuses on testing whether β has changed with time or not. This test shows that the demand for money M0, M1,M2 and M3 are stable. Fifth, the test of β being equal to "known" β fails shows that the demand for money M0 and M1 are stable while the demand for M2 and M3 are unstable. Finally, the recursively calculated prediction tests show predictive failure in all the four monetary aggregates.

Table 4. Summary of Stability of demand for money for the R-form (concentrated version)

Test	**M0**	**M1**	**M2**	**M3**
A. Visual inspection of recursive $\hat{\beta}$				
Recursive $\hat{\beta}$	Unstable	Unstable	Unstable	Unstable
B. Recursive tests of the full model				
Test of constancy of log-likelihood	Unstable	Unstable	Unstable	Unstable
C. Recursive tests based on the eigenvalues, λ_i *as well as transformation of them*				
Eigenvalue fluctuation test	Stable	Stable	Unstable	Unstable
D. Recursive tests of the constancy of the cointegrating space, $\beta' x$				
1.Nyblom Q Test of β constancy	Stable	Stable	Stable	Stable
2. Test of β equal to "known" β	Stable	Stable	Unstable	Unstable
E. Recursively calculated prediction tests				
1-Step prediction test	Unstable	Unstable	Unstable	Unstable

Notes: A verdict of instability is returned once stability is rejected by at least one criterion

In summary the stability tests show that the demand for different monetary aggregates is unstable over the period 1997:4 to 2011:2. This is consistent with the work of Killick and Mwega (1990) and Kisinguh *et.al.* (2004). The instability of the demand for money may be attributed to a number of factors. First, there is substantial financial innovations within the financial markets that have introduced a number of quasi-money products. Second, the removal of the capital and financial regulations in the 1990s removed a key factor that contributed to the stability of the money multiplier and the money demand in the 1980s.

Finding unstable demand for money means that the current monetary policy framework, guided by the assumption of a stable demand for broad money (M3), is inconsistent with monetary theory. It means that the

central bank does not have control of the money supply process. This makes it difficult to steer the reserve money (operating target) with a view to creating monetary conditions that are consistent with the ultimate objectives of price stability.

Several alternatives of monetary policy frameworks exist: Net domestic Assets (NDA) targeting, interest rate targeting and inflation targeting. The NDA targeting suffers the same problems as the monetary aggregate targeting since it assumes a stable demand for money and velocity. The interest rate targeting and inflation targeting assume that the money markets are efficient and fully developed so that monetary policy impulses are transmitted through the interest rate. Additionally, they assume that clear patterns between changes in the short-term interest rates and inflation have been observed.

7. Concluding Remarks and Policy Recommendations

The study set out to analyse the demand for different monetary aggregates (M0, M1, M2 and M3) in Kenya using quarterly data for the period 1997:4-2011:2. The resulting models are parsimonious but empirically unstable.

Our key finding is that demand for the different monetary aggregates are affected to varying degrees by changes in real GDP, nominal Treasury bill rate, nominal exchange rates and nominal foreign interest rate.

We find that the demand for the different monetary aggregates is unstable implying that the the current monetary policy framework based on stable and predictable demand for money is inappropriate. However, there are challenges in moving to alternative monetary policy frameworks. The NDA targeting is dependent on stable demand for money while the interest rate and inflation targeting frameworks assume fully developed and efficient money and capital markets. Additionally, the interest rate and inflation targeting require that a clear relationship between changes in short-term interest rates and inflation should have been observed.

References

Adams, C. (1992). On the Dynamic Specification of the Money Demand in Kenya. *Journal of African Economies*, *1*, 233-270.

AL-Abdulrazag Bashier, & Abdullah Dahlan. (2011). The Money Demand Function for Jordan: An Empirical Investigation. *International Journal of Business and Social Science, 2*, 77.

Bahmani-Oskooee, M. (2001). How stable is M2 money demand function in Japan? *Japan and the World Economy, 13*(4), 455-461. Elsevier. http://dx.doi.org/10.1016/S0922-1425(01)00064-0

Baumol, W. J. (1952). The Transactions Demand for Cash: An Inventory Theoretic Approach. *Quarterly Journal of Economics*, *66*, 545-556. http://dx.doi.org/10.2307/1882104

Boorman, J. T. (1976). The Evidence on the Demand for Money: Theoretical and Empirical Results. *Current Issues in Monetary Theory and Policy*. (ed), By Thomas M. Havrilesky and Johan T.Boorman. Arlington Heights, Illinois: AHM Public Corporation, 315-360.

Carlson, J. B., Hoffman, D. L., Keen, B. D., & Rasche, R. H. (2000), Results of a study of the stability of cointegrating relations comprised of broad monetary aggregates. *Journal of Monetary Economics*, *46*, 345-383. http://dx.doi.org/10.1016/S0304-3932(00)00029-5

Clemente, J., Montañés, A., & Reyes, M. (1998), Testing for a Unit Root in Variables With a Double Change in Mean. *Economic Letters*, *59*(2), 175-182. http://dx.doi.org/10.1016/S0165-1765(98)00052-4

Darrat, A. F. (1985). Demand for Money in a Developing Country: The Case of Kenya. *World Development*, *13*, 1163-1170. http://dx.doi.org/10.1016/0305-750X(85)90034-8

Ericsson, N. R. (1998). Empirical Modelling of Money Demand. *Empirical Economics*, *23*(3), 295-315.

Ericsson, N. R., & Sharma, S. (1996). Broad Money Demand and Financial Liberalisation in Greece, IMF Working Paper No.WP/96/62. Washington: International Monetary Fund. http://dx.doi.org/10.1007/BF01294409

For The Euro Area: Some Empirical Evidence. *Bulletin of Economic Research*. http://dx.doi.org/10.1111/j.1467-8586.2010.00388.x

Friedman, B. M. (1956). The Quantity Theory of Money-A Restatement, *Studies in the Quantity Theory of Money*. (ed.) by Milton Friedman. Chicago: University of Chicago Press.

Friedman, M. (1956). The Quantity Theory of Money: A Restatement. *Studies in the Quantity Theory of Money.* (ed.) by Milton Friedman, Chicago: University of Chicago Press, 3-21.

Hansen, H., & Johansen, S. (2002). Some tests of Parameter Constancy in Cointegrated VAR Model, *The Econometrics Journal*, *2*(2), 306-333. http://dx.doi.org/ 10.1111/1368-423X.00035

Hendry, D. F., & N. E. Ericsson. (1991). Modeling the demand for narrow money I the United Kingdom and United States. *European Economic Review, 35,* 833-81. http://dx.doi.org/10.1016/0014-2921(91)90039-L

Hoffman, D. L., H. Raasche, & M. A. Tieslau. (1995). The stability of long run money demand in five industrial countries. *Journal of Monetary Economics, 35*, 319-39. http://dx.doi.org/10.1016/0304-3932(95)01189-U

James Tobin. (1958). Liquidity Preference as Behaviour Towards Risk. *The Review of Economics Studies*, *25*(67), 65-86.

Johansen, S. (1996). *Likelihood-Based Inference in Cointegrated Vector Autoregression Models*, Oxford University Press.

Judd, J. P., & Scadding, J. L. (1982). The Search for a Stable Money Demand Function: A Survey of the Post-1973 Literature. *Journal of Economic Literature*, *20*(3), 993-1023.

Juselius, K. (2006). *The Cointegrated VAR* Model. Oxford University Press: Oxford.

Kanga, M. J. P. (1985). Reserve Ratios as Monetary Policy Instruments in Kenya, University of Nairobi, unpublished M.A Research Paper.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*, 7. JMK. London: Macmillan.

Killick, T., & Mwega, F. M. (1990). Monetary Policy in Kenya, 1967-1988. Working Paper no.39, Overseas Development Institute, London.

Kisingu, K., N. B. A. Korir, & Maana, I. (2004). A Demand for Money Function for Kenya, Working Paper Series No.1 of 2004, Central Bank of Kenya.

Nachega, J. (2001). A Cointegration Analysis of Broad Money Demand in Cameroon, IMF Working Paper Series, WP/01/26.

Ndele, S. M. (1991). The Effects of Non-Bank Financial Intermediaries on the Demand for Money in Kenya, African Economic Research Consortium Research Paper No.5.

Ndungú, N. S. (1994). Monetary Model of Inflation: Kenyan Case. *African Development Review*, *6*(2), 109-136. http://dx.doi.org/10.1111/j.1467-8268.1994.tb00062.x

Nyblom, J. (1989). Testing for Constancy of Parameters Over Time, *Journal of the American Statistical Association*, *55*, 324-330.

Pathak, D. S. (1981). Demand for Money in Developing Kenya: An Econometric Study 1968-78, *Indian Economic Journal*, *29*, 10-16.

Perron, P., & Vogelsang, T. J. (1992). Nonstationarity and level shifts with an application to purchasing power parity. *Journal of Business and Economic Statistics*, *10*(3), 301-320. http://dx.doi.org/10.2307/1391544

Sanvi Avouyi-Dovi, Françoise Drumetz, & Jean-Guillaume Sahuc. (2011). The Money Demand Function

Sriram, S. S. (2001). Survey of recent empirical money demand studies. IMF Staff Papers Vol. 47, No. 3

Tobin, J. (1956). The Interest Elasticity of the Transactions Demand for Cash. *Review of Economics and Statistics*, *38*, 241-247. http://dx.doi.org/10.2307/1925776

Notes

Note 1. m_t^i is the log of nominal money (M0,M1,M2 and M3), p_t is the log of overall CPI, y_t is the log of real GDP, i_t^{tb} is the nominal 91-Day Treasury bill rate, i_t^d is the nominal deposit rate, i_t^{ib} is the nominal interbank rate, i_t^{*k} is the nominal three months US Treasury bill rate adjusted for expected nominal exchange rate appreciation/depreciation and atm is the log of the number of ATMs.

Note 2. The unit root test results are available from the authors upon request.

Note 3. The VAR diagnostic test results are available from the authors upon request.

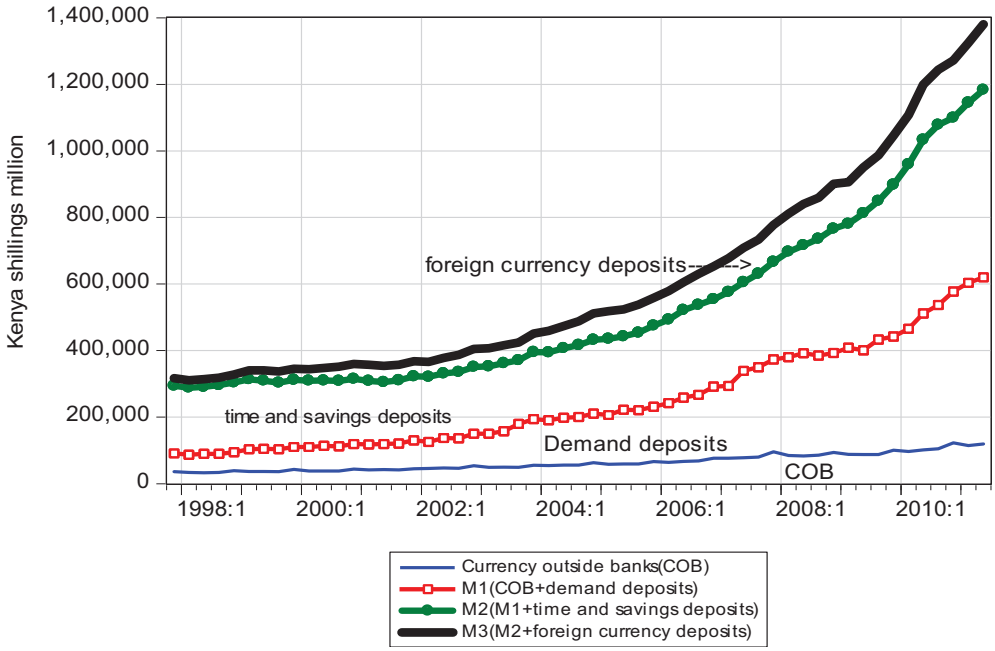

Figure 1. Components of the Broad Money – 1997:4 to 2011:2

Appendix: Data Description

Nominal money M0, M1, M2 and M3 (M_t): This is collected from CBK.

Quarterly real GDP data (Y_t): In view of the fact that real quarterly GDP data reported from the Kenyan National Bureau of Statistics (KNBS) start from 2000 (with October 2001 as base year), temporal disaggregation of data is done using the seasonalities in the post 2000 period.

Price level data (P_t): Use KNBS CPI based on new methodology and basket. This is then rebased to 2001 to agree with the real GDP base.

Nominal Treasury bill rate (i_t^{tb}): Nominal 91-Day Treasury bill rate from the CBK. This is divided by 100.

Nominal interbank rate (i_t^{ib}): Nominal interbank rate from the CBK. This is divided by 100.

Nominal deposit rate(i_t^d): Nominal Average deposit rate from CBK. This is divided 100.

Three months US Treasury bill rate: Collected from the US Federal system. This is adjusted using expected depreciation. $i_t^{*k} = i_t^* + \Delta e_t^e$.

ATMs: This refers to the number of ATMS in Kenya. This is collected from the CBK.

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Corporate Governance and Capital Structure of Small Business Service Firms in India

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Abstract

This study examines the relationship between corporate governance and capital structure of small business service firms in India. This study also seeks to extend the findings of Gill *et al.* (2012). The owners of small business service firms in the Punjab area of India were surveyed to collect data. Subjects were asked about their perceptions, beliefs, and feelings regarding the corporate governance and capital structure of their small business service firms. Results show that CEO Duality, Board Size, Small Business Growth, and Family positively impact on the capital structure of small business service firms in India. This study contributes to the literature on the relationship between corporate governance and capital structure of small business firms. The findings may be useful for small business management consultants.

Keywords: CEO tenure, CEO duality, board size, capital structure, small business growth, corporate governance, finance

1. Introduction

Small business firms play an important role in the Indian economy. Small business sector comprises 95% of the total industrial units in India, accounting for 40% of the total industrial production, 34% of the national exports, and about 25 million persons of industrial employment (Malepati, 2011, p. 1). Small business firms tend to rely on debt financing. The decision of debt financing instead of equity financing is usually driven by the needs of small business firms and the lack of owners' financial resources. In India, the majority of small business services firms are operated by family members. In the service industry, investment in machinery and equipment is almost non-existent (Gill, Biger, & Bhutani, 2008) and firms have essentially no tangible assets. Therefore, with no real assets collaterals small business service firms face financing challenges and tend to rely on family financing, trade credits, and bank financing.

Modigliani and Miller (1958) were the first authors to develop a theory of capital structure. Although many scholars have extended their capital structure theory, very few tested the relationship between corporate governance and capital structure of the family businesses. The issues of corporate governance have usually been associated with large and listed firms. Less attention has been paid to the relationship between corporate governance and capital structure of small business firms. To fill the gap, the present study focuses on the link between corporate governance and capital structure of small business service firms in India. Corporate governance, in the context of this study, is defined as the structures, processes, and systems that lead to successful operation of the small business service firm. The majority of the small business firms in India are not listed and boards of the directors consist of family members. In many cases, the CEO is also from the same family. Thus, family has full control on small business firms in India (Gollakota & Gupta, 2006).

The goals of family business firms are similar to those of larger firms in terms of maximizing shareholders' wealth and having optimal capital structure. An optimal capital structure is defined as capital structure that minimizes chances of bankruptcy and maximizes shareholders' wealth. The issue of optimality of capital structure has been debated for many years and it is still one of the unsolved issues in the corporate finance

literature. Many theoretical studies and much empirical research have addressed this issue, but there is not yet a fully supported and unanimously accepted theory (Morri & Beretta, 2008).

At variance with publically traded firms, small business firms face different issues related to such complexities as shorter expected life, presence of estate tax, intergenerational transfer problems, and prevalence of implicit contracts. Problems such as agency and asymmetric information are more complex (Ang, 1992) in the small business industry. The literature proposes a variety of variables that might potentially affect the capital structure of firms. In this study, we chose explanatory variables with reference to alternative capital structure theories and previous empirical work. This study includes five proxy variables for governance: CEO Tenure, CEO Duality, Board Size, Small Business Growth, and Family to examine their relationship with capital structure of firms.

1.1 Institutional Environment of Small Business and Corporate Governance Structure in India

Although the Indian legal system provides strong creditor protection, the environment is perceived to be contaminated by corruption, red tape, and regulatory impediments to growth (Gill, Biger, & Tibrewala, 2010). Since 1991, India has introduced a wide range of changes in laws and regulations in an effort to improve corporate governance and investor protection. The changes in laws and regulations also aimed at minimizing corporate scandals. For example, Indian government implemented Clause 49 regulations. The key mandatory features of Clause 49 regulations deal with the followings: i) composition of the board of directors, ii) the composition and functioning of the audit committee, iii) governance and disclosures regarding subsidiary companies, iv) disclosures by the company, v) CEO/CFO certification of financial results, vi) reporting on corporate governance as part of the annual report, and vii) certification of compliance of a company with the provisions of Clause 49 (Chakrabarti, Megginson, & Yadav, 2007, p. 14). These changes have forced all firms (small and large) to improve their corporate governance.

1.2 Relevant Literature Review

Firms use a mix of debt and equity in order to minimize the cost of capital (Modigliani and Miller, 1958) and maximize owners' wealth. Banks however are reluctant to finance family businesses particularly small business service firms because they lack tangible assets as collaterals. Therefore, small and young firms tend draw capital from internal sources such as family, friends (Gill *et al.,* 2012), and retained earnings. Myers (1984) refers this to a "pecking order" where firms use internally generated funds before they look for external financing. Thus, capital structure of the family business firms differs from the larger publically traded firms.

An examination of the effect of corporate governance in small business firms is fairly new. In the past, corporate governance was examined in the context of large publically traded firms. In such firms, agency problems exist because of the separation between ownership and control. In small business firms the separation is not an important issue because most of these firms are operated by family members. Hart (1995) found that in many cases small and even medium enterprises are made up of only the owner who is the sole proprietor and manager. Most of the small business firms are controlled by families and family members are the members of board of directors. The board and the CEO make financing decisions. Thus, the board of directors is charged with the responsibility of managing small business firms and their operations. Lipton and Lorsch (1992) reported that there is a significant relationship between the board size and capital structure. The CEO duality (the CEO being also the chairman of the board) influences the financing decision of the firm. Fama and Jensen (1983) claim that if board is controlled by the CEO, this implies or signals absence of separation of decision management and decision control.

A limited list of international empirical studies on the relationship between corporate governance and capital structure is described below:

Alba *et al.* (1998) used data from Thailand and found that ownership concentration is positively linked with leverage.

Wen *et al.* (2002) collected data from Chinese listed firms and found that the board composition and the CEO tenure are negatively linked with leverage of the firm.

Du and Dai (2005) used data of East Asian firms from 1994-96 and found that controlling owners with little shareholding choose higher debt.

Abor (2007) examined the relationship between corporate governance and capital structure decisions by taking a sample of 22 firms listed on the Ghana Stock Exchange (GSE) during the six-year period (1998-2003). Abor found that capital structure is positively associated with board size, board composition, and CEO duality, and negatively associated with CEO tenure.

Antoniou *et al.* (2008) conducted a study to investigate how firms operating in capital market-oriented economies (the U.K. and the U.S.) and bank-oriented economies (France, Germany, and Japan) determine their capital structure. They found that capital structure of a firm is heavily influenced by the corporate governance practices and exposure to capital markets.

Bodaghi and Ahmadpour (2010) collected data from 50 Iranian firms listed at Tehran Stock Exchange to test the relationship between corporate governance and capital structure. They found a negative relationship between board size and debt to equity ratio. Authors also found that CEO duality does not significantly influence corporate financing behavior.

Saad (2010) took a sample of 126 Malaysian publically listed companies from four industries i) consumer products, ii) industrial products, iii) trading/services, and iv) plantations for the period from 1998 to 2006. Through multiple regression analysis, Saad found i) a negative relationship between CEO duality and capital structure, and ii) positive relationships between board size and capital structure.

Rehman *et al.* (2010) investigated the relationship between corporate governance and capital structure of randomly selected 19 banks of Pakistan from 2005-2006. They found a positive relationship between board size and capital structure.

Vakilifard *et al.* (2011) used data from Tehran Stock Exchange (TSE), Iran over the over the period 2005–2010. They found a positive relationship between CEO duality and leverage, and a negative relationship between board size and leverage.

Gill *et al.* (2012) sampled small business owners from India and found that small business growth and family positively influence capital structure of small business firms.

In summary, literature review shows that CEO tenure, CEO duality, board size, small business growth, and family influence the capital structure of firms. Hence the following hypotheses are formulated:

H1) Capital structure of small business service firms in India is positively affected by the CEO tenure.

H2) Capital structure of small business service firms in India is positively affected by the CEO duality.

H3) Capital structure of small business service firms in India is positively affected by the board size.

H4) Capital structure of small business service firms in India is positively affected by the small business growth.

H5) Capital structure of small business service firms in India is positively affected by family.

Conjecture: There might be CEO gender differences regarding the nature of the relationship between the factors and the financial leverage of small business service firms in India.

2. Method

2.1 Measurement

Consistent with previous research, the measures were taken from three referent studies, which are based on previous studies in financial economics. All measures pertaining to:

i) CEO Tenure, CEO Duality, and Board Size were adopted from Kyereboah-Coleman (2007),

ii) Small Business Growth were adopted from Zehir *et al.* (2006), and

iii) Measures pertaining to Capital Structure were adopted from Beattie *et al.* (2006).

All the scale items were reworded to apply to Indian small business owners and the reliability of these re-worded items was re-tested. Respondents were asked to indicate their agreement with each item, using a five-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree.”

CEO Tenure (independent variable) was measured by single item that asked a respondent to describe the number of years he or she has been involved as a CEO in small business. Categorized alternative responses were: i) 0-4 Years, ii) 5-9 Years, iii) 10-30 Years, and iv) 31 Years and Over.

CEO Duality (independent variable) was measured by a single item that asked a respondent to describe if he or she is the Chairman of the board in his/her company. Categorized alternative responses were: 1) Yes and 0) No.

Board Size (independent variable) was measured by a single item that asked a respondent to describe number of directors (decision makers) he or she has in his/her company. Categorized alternative responses were: i) 1-3 directors and ii) 4 and more.

Family (dummy variable) was measured by a single item that asked a respondent to describe the characteristics of their families. Categorized alternative responses were: 0) Single Family and i) Joint Family.

Small Business Growth (SBG), as the control variable, was operationalized as the extent to which small business owners perceive that sales and market share of their companies have improved over the last three years. These two items were taken from Zehir *et al.'s* (2006) growth and performance indicators. Attesting to SBG's reliability, a Cronbach alpha calculated on the responses of 29 small business owners who participated in the pre-test of the above scale items was 0.95.

Capital Structure (CS), as dependent variable, was operationalized as the extent to which small business owners perceive that they maintain a level of financial leverage that i) improves company performance, ii) maximizes cash inflows, iii) minimizes chances of bankruptcy, and iv) indicates long-term survival. Beattie *et al.* (2006) used thirteen-items which measures appropriate amount of debt. Four items were selected to measure the "CS" variable. Scale items were reworded and the reliability of these re-worded items was re-tested. Attesting to CS's reliability, a Cronbach alpha calculated on the responses of 29 small business owners who participated in the pre-test of the above scale items was 0.89.

2.2 Sampling Frame, Questionnaire Distribution, and Collection

The current study consisted of the population of Indian owners of small business service firms. Indian small business owners living in Punjab area of India were chosen as a sampling frame.

2.3 Sampling Method, Sampling Issues, and Possible Planned Solutions

The Punjab area of India was chosen as the research site to collect data. The focal population was comprised of owners of small business service firms in the Punjab area of India. There was no need to translate the survey questions into Punjabi or Hindi since almost all the small business owners can read and write English. In cases of difficulties, researchers were available for translation. The instruction sheet indicated that participants could contact the researchers by telephone and/or email regarding any questions or concerns they might have about the research.

To avoid sampling bias, data collection team members were asked to only choose participants that represent the target population. Non-Indian small business owners were excluded.

To achieve a reasonable convenience sample, an exhaustive list of Indian small business owners' names and telephone numbers was created. Survey questionnaire bundles coupled with an instruction sheet were provided to the surveyors for distribution.

The sample included approximately 600 Indian small business owners. A total of 142 surveys were completed over the telephone (approximately 8% of the surveys were completed over the telephone), through personal visits, and received by mail. Two surveys were non-usable. The response rate was roughly 23.67%. The remaining cases were assumed to be similar to the selected research participants.

2.4 Issues Related to Confidentiality of the Research Participants

All individuals who were approached were ensured that their names will not be disclosed and confidentiality will be strictly maintained. In addition all subjects were asked not to disclose their names on the questionnaire. Since the research was based on the survey questionnaire owners of small business service firms were not forced to respond to each specific question.

The Consent Letter specifically indicated that by completing the survey, subjects have consented to participate in the study. Any information that was obtained in connection with this study and that can be identified with subjects will remain confidential and will be disclosed only with subjects' permission or as required by law.

3. Analysis and Results

Table 1, 2, and Table 3 show descriptive statistics. The explanation descriptive statistics is as follows:

Skewness: Within the range of: -0.721 to -1.361 (see Table 1)

Kurtosis: Within the range of: 0.455 to 1.466 (see Table 2)

Table 1.

Descriptive Statistics							
	Min	Max	Mean	SD	Variance	Skewness	Kurtosis
SBG1) Sales of my company has gone up over last three years.	1	5	3.81	1.031	1.063	-1.361	1.466
SBG2) Market share of my company has gone up over three years.	1	5	3.64	0.998	0.996	-0.844	0.455
I maintain a level of leverage that…:							
CS1) … Improves company performance.	1	5	3.82	0.900	0.810	-0.721	0.463
CS2) … Maximizes cash inflows.	1	5	3.73	0.928	0.861	-0.801	0.754
CS3) … Minimizes chances of bankruptcy.	1	5	3.86	0.956	0.915	-1.110	1.372
CS4) … Indicates long-term survival.	1	5	3.87	0.966	0.933	-0.953	0.857

Min = Minimum

Max = Maximum

SD = Standard Deviation

SBG = Small Business Growth

CS = Capital Structure

Varimax rotation: 84.63% (see Table 2)

Factor analysis: All the items loaded on the expected factors (see table 3)

Table 2.

Total Variance Explained – Rotation Sums of Square Loadings			
Total Variance Explained			
	Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	3.250	54.162	54.162
2	1.828	30.470	84.632

Extraction Method: Principal Component Analysis.

Table 3.

Rotated Component Matrix [a]		
	Component	
	1	2
SBG1) Sales of my company has gone up over last three years.	0.212	**0.910**
SBG2) Market share of my company has gone up over three years.	.0198	**0.914**
I maintain a level of leverage that…:		
CS1) … Improves company performance.	**0.891**	0.186
CS2) … Maximizes cash inflows.	**0.880**	0.211
CS3) … Minimizes chances of bankruptcy.	**0.884**	0.232
CS4) … Indicates long-term survival.	**0.903**	0.175

Notes: [a] Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization

Rotation converged in 3 iterations

Cronbach Alpha of SBG: 0.856

Cronbach Alpha of CS: 0.93

The question subsets were analyzed in order to enable the calculation of the weighted factor scores. In terms of these weighted factor score items: two SBG and four CS, loaded approximately equally.

3.1 Pearson Bivariate Correlation Analysis

Table 4 shows that Capital Structure (CS) is positively correlated with CEO Duality (CD), Board Size (BS), Small Business Growth (SBG), and Family. CEO Tenure (Tenure) was not found to be significant.

Table 4.

Pearson Bivariate Correlation Analysis

	CS	Tenure	CD	BS	SBG	Family
CS	1	0.144	0.221**	0.254**	0.428**	0.265**
Tenure		1	-0.020	0.148	0.149	0.074
CD			1	-0.126	0.251**	-0.146
BS				1	0.067	0.320**
SBG					1	0.209*
Family						1

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

3.2 Regression Analysis to Test Hypotheses

Regression analysis section presents the empirical findings regarding the relationships between Tenure, CD, BS, SBG, Family, and CS of small business service firms in India.

It was hypothesized that:

i) Capital structure of small business service firms in India is positively affected by the CEO tenure.

ii) Capital structure of small business service firms in India is positively affected by the CEO duality.

iii) Capital structure of small business service firms in India is positively affected by the board size.

iv) Capital structure of small business service firms in India is positively affected by the small business growth.

v) Capital structure of small business service firms in India is positively affected by family.

Positive relationships between i) CD and CS, ii) BS and CS, iii) SBG and CS, and iv) Family and CS were found (see Table 5). These factors predict the capital structure of small business service firms in India. A non-significant relationship between Tenure and CS was found. The CEO tenure does not impact on capital structure of small business service firms in India.

Table 5.

Regression Coefficients [a, b, c]

R^2 = 0.281; Adjusted R^2 = 0.255; SEE = 0.863; F = 10.49; ANOVA's Test Sig. = 0.000

Regression Equation: CS = -1.168 + 0.007*Tenure + 0.456*CD + 0.254*BS + 0.327*SBG + 0.315*Family

	Unstandardized Coefficients		Standardized Coefficients [c]			Collinearity Statistics	
	B	Std. Error	Beta	t	Sig.	Tolerance	VIF
(Constant)	-1.168	0.310		-3.765	0.000		
Tenure	0.007	0.009	0.058	0.779	0.438	0.957	1.045
CD	0.456	0.189	0.188	2.417	0.017	0.887	1.127
BS	0.254	0.101	0.197	2.519	0.013	0.876	1.142
SBG	0.327	0.079	0.327	4.131	0.000	0.857	1.167
Family	0.315	0.161	0.156	1.952	0.053	0.836	1.196

[a] Dependent Variable: CS

[b] Independent Variables: Tenure, CD, BS, SBG, and Family

[c] Linear Regression through the Origin

SEE = Standard Error of the Estimate

Tenure = CEO tenure

SBG = Small business growth

CS = Capital structure

Note that all the variance inflation factor (VIF) coefficients are less than 2 and tolerance coefficients are greater than 0.50. Also note that Family, Tenure, CD, BS, and SBG explain 28.1% of the variance in CS (see Table 5).

4. Discussion, Limitations, and Future Research

4.1 Discussion

The purpose of this study was to examine the perceived relationships between corporate governance and capital structure (CS) of small business service firms in India. Findings of this study show that CS of small business service firms is positively associated with CD, BS, SBG, and Family (see Table 5). These results lend some support to the findings of Alba *et al.* (1998), Du and Dai (2005), Abor (2007), Antoniou *et al.* (2008), Saad (2010), Rehman *et al.* (2010), Vakilifard *et al.* (2011), and Gill *et al.* (2012). The results of this study contradict with the findings of Wen *et al.* (2002), Abor (2007), Bodaghi and Ahmadpour (2010), Saad (2010), Vakilifard *et al.* (2011).

The different results may be attributed to the fact that the above studies are related to larger firms from different countries. In addition, large board size and large family means more financial and operational support to small business service firms, which in turn, help increasing the capacity of small business firms to make liability payments. The CEO duality increases CEO experience in small business management. Small business growth increases revenues and profitability, which in turn, help paying debt down.

Table 6 shows the summary of previous authors' findings.

Table 6.

Previous Findings Related to Corporate Governance and Capital Structure

Author	Findings	Country
Alba *et al.* (1998)	Found that ownership concentration is positively linked with leverage.	Thailand
Wen *et al.* (2002)	Found that the board composition and the CEO tenure are negatively linked with leverage of the firm.	China
Du and Dai (2005)	Found that controlling owners with little shareholding choose higher debt.	East Asia
Abor (2007)	Found that capital structure is positively associated with board size, board composition, and CEO duality, and negatively associated with CEO tenure.	Ghana
Antoniou *et al.* (2008)	Found that capital structure of a firm is heavily influenced by the corporate governance practices and exposure to capital markets.	North America and Europe
Bodaghi and Ahmadpour (2010)	Found a negative relationship between board size and debt to equity ratio. Authors also found that CEO duality does not significantly influence corporate financing behavior.	Iran
Saad (2010)	Found a negative relationship between CEO duality and capital structure, and a positive relationship between board size and capital structure.	Malaysia
Rehman *et al.* (2010)	Found a positive relationship between board size and capital structure.	Pakistan
Vakilifard *et al.* (2011)	Found a positive relationship between CEO duality and leverage, and a negative relationship between board size and leverage.	Iran
Gill *et al.* (2012)	Found that small business growth and family positively influence capital structure of small business firms.	India

In conclusion, the CEO duality, board size, small business growth, and family positively impact on the capital structure of small business service firms in India. Findings also show that joint family system in India lead to larger board size and high small business growth. Although, large board size may not in the favor of small business service firms because it has negative impact on decision making, joint family system is in the favor of small business service firms for their growth (see Table 4). The CEO duality and large board size lead to high debt which is not in the favor of small business service firms because it increases chances of bankruptcy. Therefore, CEO duality should be used with caution and small business firms should have optimal board size based on the firm size.

4.2 Limitations

The sample size is small. Because we used survey questionnaire to collect data, respondents could not provide additional information which could have been useful. Also surveys were dropped off which led to low response rate.

4.3 Future Research

Because this study is limited to perceptions and intentions, the relationship between independent and dependent variable that we found may suffer from common factor bias, as the questions were parts of the same data collection instrument. Future research should test the relationships between corporate governance and capital structure small business firms through different samples from different industries (e.g., manufacturing and transportation) and different countries (e.g., Canada and United Kingdom). The impact of cultures on capital structure should be explored. Data collection methods such as interview method should also be used to improve the validity of data.

References

Abor, J. (2007). Corporate governance and financing decisions of Ghanaian listed firms. *Corporate Governance*, *7*(1), 83 - 92.

Alba, P., Claessens, S., & Djankov, S. (1998). Thailand's corporate financing and governance structures: Impact on firm's competitiveness', *Conference on Thailand's Dynamic Economic Recovery and Competitiveness 20-21 May 1998, UNCC, Bangkok*, 1-26. [Online] Available: http://econ.tu.ac.th/class/archan/RANGSUN/MB%20663/MB%20663%20Readings/%E0%B9%93.%20%E0%B8%9A%E0%B8%A3%E0%B8%A3%E0%B8%A9%E0%B8%B1%E0%B8%97%E0%B8%A0%E0%B8%B4%E0%B8%9A%E0%B8%B2%E0%B8%A5/Corporate%20Governance/Thailand/Thailand's%20Corporate%20Financing%20and%20Governance%20Structures.pdf (April 22, 2012)

Ang, J. S. (1991). Small business uniqueness and the theory of financial management. *Journal of Small Business Finance*, *1*(1), 1-13.

Ang, J. S. (1992). On the theory of finance for privately held firms. *Journal of Small Business Finance*, *1*(3), 185-203.

Antoniou, A., Guney, Y., & Paudyal, K. (2008). The Determinants of Capital Structure: Capital Market Oriented versus Bank Oriented Institutions. *Journal of Financial and Quantitative Analysis*, *43*(1), 59-99.

Beattie, V., Goodacre, A., & Thomson, S. J. (2006). Corporate financing decisions: UK survey evidence. *Journal of Business Finance and Accounting*, *33*(9/10), 1402-1434. http://dx.doi.org/10.1111/j.1468-5957.2006.00640.x

Bodaghi, A., & Ahmadpour, A. (2010). The effect of corporate governance and ownership structure on capital

Chakrabarti, R., Megginson, W. L., & Yadav, P. K. (2007). Corporate Governance in India. CFR-Working Paper NO. 08-02, 1-25. http://www.cfr-cologne.de/download/workingpaper/cfr-08-02.pdf (Accessed May 29, 2012)

Du, J., & Dai, Y. (2005). Ultimate corporate ownership structures and capital structures: Evidence from East Asian Economies. *Corporate Governance: An International Journal*, *13*(1), 60-71.

Fama, E., & Jensen, M. (1983). Separation of ownership and control. *Journal of Law and Economics*, *26*(2), 301-325.

Gill, A., Biger, N., & Bhutani, S. (2008). Corporate performance and the chief executive officer's compensation in the service industry. *The Open Business Journal, 1*, 62-66. http://dx.doi.org/10.2174/1874915100801010062

Gill, A., Biger, N., & Tibrewala, R. (2010). Understanding and mitigating direct investment-risk in the Indian real estate market. *Business and Economics Journal*, 1-10.

Gill, A., Mand, H. S., Sharma, S. P., & Mathur, N. (2012). Factors that influence financial leverage of small Business firms in India. *International Journal of Economics and Finance*, *4*(3). 33-45. http://dx.doi.org/10.5539/ijef.v4n3p33

Gollakota, K., & Gupta, V. (2006). History, ownership forms and corporate governance in India. *Journal of Management History*, *12*(2), 185-198. http://dx.doi.org/10.1108/13552520610654078

Hart, O. (1995). Corporate governance: Some theory and implications. *The Economic Journal*, *105*(430), 678-689. http://dx.doi.org/10.2307/2235027

Kyereboah-Coleman, A. (2007). Corporate governance and firm performance in Africa: A dynamic panel data analysis. A paper prepared for the "International Conference on Corporate Governance in Emerging Markets. [Online] Available: http://www.ifc.org/ifcext/cgf.nsf/AttachmentsByTitle/PS2.3/$FILE/Kyereboah-Coleman%2B-%2BCorporate%2BGovernance.pdf (April 22, 2012)

Lipton, M., & Lorsch, J. W. (1992). A modest proposal for improved corporate governance. *Business Lawyer*, *48*(1), 59-77.

Malepati, V. R. (2011). The performance of small scale industries (SSIs) in India: An overview. *Working Paper Series*, pp. 1-13. Obtained through the Internet: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1737836 [accessed 14/5/2012]

Modigliani, F., & Miller, M. (1958). The cost of capital, corporation finance and the theory of investment. *The American Economic Review*, *48*(3), 261-97.

Morri, G., & Beretta, C. (2008). The capital structure determinants of REITs. Is it a peculiar industry? *Journal of European Real Estate Research*, *1*(1), 6-57. http://dx.doi.org/10.1108/17539260810891488

Myers, S. C. (1984). The capital structure puzzle. *Journal of Finance*, *39*, 575-92. http://dx.doi.org/10.2307/2327916

Rehman, M. A., Rehman, R. U., & Raoof, A. (2010). Does corporate governance lead to a change in the capital structure? *American Journal of Social and Management Sciences*, *1*(2), 191-195. http://dx.doi.org/10.5251/ajsms.2010.1.2.191.195

Saad, N. M. (2010). Corporate Governance Compliance and the Effects to Capital Structure in Malaysia. *International Journal of Economics and Finance, 2*(1), 105-114.

structure of Iranian listed companies. 7th International Conference on Enterprise Systems, Accounting and Logistics (7th ICESAL 2010) 28-29 June 2010, Rhodes Island, Greece, 89-96. [Online] Available: http://www.icesal.org/2010%20PROCEEDINGS/docs/P8.pdf (April 22, 2012).

Vakilifard, H. R., Gerayli, M. S., Yanesari, A. M., & Ma'atoofi, A. R. (2011). Effect of Corporate Governance on Capital Structure: Case of the Iranian Listed Firms. *European Journal of Economics, Finance and Administrative Sciences*, *35*, 165-172.

Wen, Y., Rwegasira, K., & Bilderbeek, J. (2002). Corporate governance and capital structure decisions of the Chinese Listed Firms. *Corporate Governance: An International Review*, *10*, 75-83. http://dx.doi.org/10.1111/1467-8683.00271.

Zehir, C., Acar, A. Z., & Tanriverdi, H. (2006). Identifying organizational capabilities as predictors of growth and business performance. *The Business Review*, *5*(2), 109-116.

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A New Explanation of Heterogeneous Human Capital and Trade

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Abstract

This paper constructs a simple two-sector, competitive trade model with heterogeneous labor and considers two countries' differences in both diversities and means of human capital distributions. We prove that the distributions differences affect the comparative advantage through two channels including "the diversity effect" and "the mean effect". When the diversity effect dominates the mean effect, the country will have comparative advantages in the *S*-sector, and hence will lead to an expansion in the *S*-sector, *vice versa*.

Keywords: heterogeneous human capital, trade, the diversity effect, the mean effect

JEL classification: F11

1. Introduction

In recent years, the effects of heterogeneous human capital on the industrial structure and the pattern of trade (POT) of an economy have received considerable attention. Some earlier theoretical studies, for example, Roy (1951), Heckman and Sedlacek (1985) and Heckman and Honoré (1990), explore the relationship between heterogeneous workers and industrial structure. In addition, in order to account for the observation that a large volume of international trade takes place between rich countries with similar technologies and endowments, in their pioneering work, Grossman and Maggi (2000) argue that the distribution of human capital can matter for the pattern of comparative advantage and industrial structure. (Note 1)

The recent literature exploring the impact of heterogeneous human capital on trade includes Ishikawa (1996), Grossman and Maggi (2000), Grossman (2004), Bougheas and Riezman (2007), and Ohnsorge and Trefler (2007). First, Ishikawa (1996) stresses the role of aggregate human capital endowments in affecting comparative advantage and industrial structure. Although Ishikawa investigates the relationship between the distribution of human capital and trade, he ignores the effects of diversity of human capital on trade.

Next, Grossman and Maggi (2000) and Grossman (2004) prove that a country with less diverse human capital will have comparative advantage in passenger cars, industrial equipment and chemicals, produced by a supermodular technology (or by teams). In contrast, a country with a more diverse human capital will have comparative advantage in software and financial services produced by a submodular technology (or by individual efforts). Bougheas and Riezman (2007) demonstrate that the POT between two countries with identical aggregate human capital endowments depends on the properties of the distribution of human capital. Ohnsorge and Trefler (2007) consider each worker bringing two skills to the workplace (e.g., quantitative and communication skills) and point out that the second moments of the distributions of skills can affect comparative advantage. In sum, they argue that diversity of human capital plays an important role in determining the POT and industrial structure.

Whether the immigration policy will affect the pattern of comparative advantage and industrial structure of an economy or not is an interesting and important issue. Intuitively, government immigration policies will lead to a change in the distribution of human capital, which in turn will determine the POT and industrial structure.

Table 1. Industrial Composition in Singapore, 1991 & 2001

Industrial Composition (%)	1991	2001	Change (%)
Manufacturing	28.2	18.8	- 33.3
Commerce	22.7	21.1	- 7.0
Transport and Communication	10.0	11.1	+ 10.0
Financial and Business Services	10.7	17.2	+ 37.8
Community and Personal Services	21.1	24.7	+ 14.6
Others	7.3	7.1	- 2.7

Source: MOM (2002) and Frost and Chiu (2003).

There is prominent evidence illustrating the impact of the immigration policy on the pattern of comparative advantage and industrial structure. Singapore successful immigration policies alter not only industrial structure but also the pattern of comparative advantage, and then improve Singapore's economic development. Table 1 reveals Singapore's industrial composition in 1991 and 2001. It is not difficult to find that Singapore's industrial structure has been translated from being based on the manufacturing sector to the financial and personal services sectors. Namely, two sectors referring to financial and business services along with community and personal services have grown significantly in the 1990s. In addition, many empirical studies show that, in Singapore, the volume of services trade has also increased rapidly in the 1990s, for example, Blomqvist (2004), Kee (2009) and Wong et al. (2009). At the same time, we observe that Singapore's main economic strategy is based on attracting foreign skilled labor. To reach this goal, Singapore government liberalizes the immigration policies, as addressed by Yeoh (2007). Table 2 shows Singapore's foreign workers and indicates that those increase rapidly from 248,000 foreign workers constituting 16.1% of the total labor force in 1990 to 612,200 foreign workers constituting 29.2% of the total labor force in 2000. Furthermore, Piper (2004) and Yeoh (2007) offer further that about 112,200 of these foreign workers fall under the category of skilled labor in 2000, that is, skilled workers account for 18.3% (which is equal to 112,200/612,200) of Singapore's total foreign workers. More specification, we observe that Singapore's immigration policies alter the distribution of human capital (Table 2), and then lead to a change in the POT and industrial structure. As mentioned earlier, the industrial structure has translated from manufacturing sector using a supermodular technology (or by teams) to financial and personal services produced by a submodular technology (or by individual efforts). Therefore, this paper will provide an alternative explanation for the Singapore case addressed above.

Table 2. Foreign Workers in Singapore

Year	Total Labor Force	Foreign Workers	Percent of Total Labor Force
1990	1,537,000	248,000	16.1%
2000	2,094,800	612,200	29.2%

Source: see Yeoh (2007).

The existing literature ignores the impact of both aggregate human capital endowments and diversity on the pattern of comparative advantage and industrial structure. As a complement to the literature, we will construct a simple two-sector, competitive trade model with heterogeneous labor and consider two countries' differences in both diversities and means of human capital distributions. We prove that the distributions differences affect the comparative advantage and industrial structure through two channels. The first is "the diversity effect" whereby an increase in the diversity of human capital leads to an expansion in the submodular sector, and hence gives the economy more comparative advantages in the submodular goods. The second is "the mean effect" whereby a rise in the mean of human capital leads to an expansion in the supermodular sector, and hence gives the economy more comparative advantages in the supermodular goods. Building on these results, we are able to generate new predictions on the pattern of comparative advantage and industrial structure.

The remainder of this paper is organized as follow. Section 2 establishes the theoretical model. Section 3 analyzes the impact of the distribution differences in human capital on the comparative advantage. Section 4 concludes the paper.

2. The Model

The setup of this paper closely follows the trade model of Grossman and Maggi (2000), with heterogeneous

human capital.

2.1 The Setup of Model

Consider the economy comprising two small open countries, *A* and *B*, each with a fixed amount of workers (denoted by L^j, $j \in \{A, B\}$). Each worker is endowed with a fixed level of talent *t* which is assumed to be heterogeneous and perfectly observable to all the workers. Assume that the distribution of talent *t* is a uniform distribution with probability density function $\phi^j(t)$ in country *j* as shown below: (Note 2)

$$\phi^j(t) = \begin{cases} \frac{1}{b^j}, & if \ \ t \in [t^j_{\min}, t^j_{\max}], \\ 0, & otherwise, \end{cases}$$

where $t^j_{\min} = \bar{t}^j - b^j/2$ and $t^j_{\max} = \bar{t}^j + b^j/2$. Obviously, the variables $t^j_{\min}$ and $t^j_{\max}$ are the minimum and maximum talent levels respectively and $\bar{t}^j$ is the average talent level. The variable b^j represents the diversity of talent. The larger the variable b^j is, the more diverse the distribution will be.

Suppose that both countries are similar in their production technologies and that there are two sectors in each country, sector *C* with supermodular technology and sector *S* with submodular technology. The production process for each sector involves two tasks, *x* and *v*. The tasks are indivisible and each task is performed by exactly one worker. For simplicity, we let the production function of sector *C* be $F_C(t_x, t_v) = \min\{t_x, t_v\}$, where the task *x* (task *v*) is performed by a worker with talent t_x (talent t_v), which implies that a pair of workers performs complementary tasks. Similarly, for simplicity, we assume that the production function of sector *S* is $F_S(t_x, t_v) = \max\{t_x, t_v\}$, which indicates that the talent of the superior worker fully dominates the effective output and the workers toil on substitutive tasks. (Note 3)

In equilibrium, the *C* sector employs workers with similar abilities, i.e., "skill-clustering", and the *S* sector attracts the most-talented and least-talented workers, i.e., "cross-matching", as proved by Grossman and Maggi (2000). We define that, in the *C* sector, the variables $\hat{t}^j$ and $m^j(\hat{t}^j) = 2\bar{t}^j - \hat{t}^j$ represent the talent levels of the least-talented and most-talented workers respectively. Consequently, total outputs of good *C* and good *S* (denoted by Y^j_C and Y^j_S respectively) can be obtained as follows:

$$Y^j_C = L^j \int_{\hat{t}^j}^{m^j(\hat{t}^j)} F_C(t,t)\phi^j(t)dt = \frac{L^j \bar{t}^j}{b^j}(\bar{t}^j - \hat{t}^j), \tag{1}$$

$$Y^j_S = L^j \int_{t^j_{\min}}^{\hat{t}^j} F_S[t, m^j(t)]\phi^j(t)dt = \frac{L^j}{2b^j}\left(\frac{b^j}{2} - \bar{t}^j + \hat{t}^j\right)\left(\frac{b^j}{2} + 3\bar{t}^j - \hat{t}^j\right). \tag{2}$$

By combining equations (1) with (2) and eliminating the variable $\hat{t}^j$, we can derive the production possibility frontier of country *j* as shown below:

$$Y^j_S = \frac{L^j}{2}\left(\frac{1}{2} - \frac{1}{L^j \bar{t}^j} Y^j_C\right)\left(\frac{b^j}{2} + 2\bar{t}^j + \frac{b^j}{L^j \bar{t}^j} Y^j_C\right). \tag{3}$$

Hence, the marginal rate of transformation (MRT^j) can be calculated as follows:

$$MRT^j = -\frac{\partial Y^j_S}{\partial Y^j_C} = 1 + \frac{b^j}{L^j \bar{t}^{j2}} Y^j_C. \tag{4}$$

Assume that preferences in the countries *A* and *B* are identical and homothetic. Therefore, the competitive, free-trade equilibrium maximizes the national aggregate output at a given terms of trade, *p*, which represents the relative price of good *C*.

2.2 Free Trade Equilibrium

In free-trade equilibrium, the equilibrium condition ($p = MRT^j$) holds and then substituting equation (4) into the equilibrium condition can get:

$$Y^j_C = \frac{L^j \bar{t}^{j2}}{b^j}(p-1). \tag{5}$$

By substituting equation (5) into equation (3), we obtain:

$$Y_S^j = \frac{L^j \bar{t}^{j2}}{2b^j}[(1+\frac{b^j}{2\bar{t}^j})^2 - p^2]. \tag{6}$$

From equations (5) and (6), we can find the relative equilibrium output of country *j* as shown below:

$$\frac{Y_S^j}{Y_C^j} = \frac{(1+\frac{b^j}{2\bar{t}^j})^2 - p^2}{2(p-1)}. \tag{7}$$

From equation (7), we find that, in addition to *p*, the factors affecting the relative equilibrium output include b^j and $\bar{t}^j$. That is to say, the talent distribution differences including b^j and $\bar{t}^j$ can affect the relative equilibrium output and then matter for the comparative advantage. Therefore, before proceeding any further, it would be helpful to discuss the economic intuition of the talent diversity (b^j) and mean ($\bar{t}^j$) from the aspect of comparative advantage. Obviously, a larger value of b^j represents more diversity of the talent distribution, and hence gives the economy more comparative advantages in the *S*-sector, called the diversity effect by Grossman and Maggi (2000). On the contrary, since the mean ($\bar{t}^j$) represents the average talent level, the greater the mean is, the more the total talent employed in the *C*-sector is, implying more comparative advantage in the *C*-sector, called the mean effect hereafter. (Note 4)

3. Comparative Advantage

In this section, we will explore how the diversity effect and the mean effect affect the pattern of comparative advantage and industrial structure. For this purpose, suppose that the relationship of the diversities of talent between countries *A* and *B* is $b^A = \alpha b^B$ and $\alpha > 0$. In addition, we also assume that the relationship of the average talent levels of countries *A* and *B* is $\bar{t}^A = \beta \bar{t}^B$ and $\beta > 0$. Obviously, the variable α can capture the diversity effect and the variable β can capture the mean effect. Therefore, from equation (7), we can obtain the relative equilibrium outputs of countries *A* and *B* as follows:

$$\frac{Y_S^A}{Y_C^A} = \frac{(1+\frac{\alpha b^B}{2\beta \bar{t}^B})^2 - p^2}{2(p-1)}, \quad \frac{Y_S^B}{Y_C^B} = \frac{(1+\frac{b^B}{2\bar{t}^B})^2 - p^2}{2(p-1)}. \tag{8}$$

Equation (8) shows that whether country *A*'s equilibrium output ratio of *S* with respect to *C* is larger than that of country *B* or not depends on both the diversity effect (α) and the mean effect (β). The results will be derived under three cases: (1) $\alpha > \beta$, (2) $\alpha < \beta$ and (3) $\alpha = \beta$.

Case 1: $\alpha > \beta$

Obviously, Case 1 implies that the diversity effect is larger than the mean effect. From equation (8), we have:

$$\frac{Y_S^A}{Y_C^A} > \frac{Y_S^B}{Y_C^B}. \tag{9}$$

Equation (9) indicates that country *A*'s equilibrium output ratio of *S* with respect to *C* is larger than that of country *B*, and thus induces higher comparative advantage in *S*-sector for country *A*. While the diversity effect is shown in the literature to be better for the *S*-sector than for the *C*-sector, we prove that if the diversity effect dominates the mean effect, the economy will have comparative advantages in the *S*-sector, and hence will lead to an expansion in the *S*-sector.

Case 2: $\alpha < \beta$

Case 2 reveals that the diversity effect is smaller than the mean effect. Again, from equation (8), we get:

$$\frac{Y_S^A}{Y_C^A} < \frac{Y_S^B}{Y_C^B}. \tag{10}$$

Equation (10) proves that the relative equilibrium output of country *A* is smaller than that of country *B*, and hence leads to higher comparative advantage in *C*-sector for country *A*. Namely, if the mean effect dominates the diversity effect, the economy will have comparative advantages in the *C*-sector, and then the *C*-sector will expand.

Case 3: $\alpha = \beta$

Finally, Case 3 implies that the diversity effect is equal to the mean effect. From equation (8), we obtain:

$$\frac{Y_S^A}{Y_C^A} = \frac{Y_S^B}{Y_C^B} . \tag{11}$$

Equation (11) shows that country *A*'s equilibrium output ratio of *S* with respect to *C* is equal to that of country *B*. That is to say, if the diversity effect is equal to the mean effect, then the differences of talent distribution will not affect the pattern of comparative advantage and industrial structure.

As analyzed earlier, we claim that the impact of the talent distribution differences in human capital on the comparative advantage and industrial structure depends on not only the diversity effect but also the mean effect. In sum, the results including Case 1, Case 2 and Case 3 can be summarized as below:

Proposition 1. *When the diversity effect dominates the mean effect*, *the country will have comparative advantages in the S-sector*. *On the contrary*, *when the mean effect dominates the diversity effect*, *the country will have comparative advantages in the C-sector*. *Finally*, *if the diversity effect is equal to the mean effect*, *then the pattern of comparative advantage will be unaltered.*

4. Conclusion

This paper sets up a simple two-sector, competitive trade model with heterogeneous labor to explore the impact of the differences of human capital distributions on the POT and industrial structure. We prove that the effects of the distributions differences on the pattern of comparative advantage and industrial structure depend on not only the diversity effect but also the mean effect. If the diversity effect dominates the mean effect, the economy will have comparative advantages in the *S*-sector, and hence will lead to an expansion in the *S*-sector, *vice versa*.

Immigration policy implications can be drawn from our results. Government immigration policy will alter the distribution of human capital. The distributions differences will affect the comparative advantage and industrial structure through two channels including the diversity effect and the mean effect. Therefore, Singapore's immigration policies attracting foreign skilled labor generate the result that the diversity effect dominates the mean effect, which in turn lead to an expansion in the financial and business services sector (i.e., the *S*-sector).

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References

Blomqvist, H. C. (2004). Explaining trade flows of Singapore. *Asian Economic Journal*, *18*, 25-43. http://dx.doi.org/10.1111/j.1467-8381.2004.00180.x

Bougheas, S., & Riezman, R. (2007). Trade and the distribution of human capital. *Journal of International Economics*, *73*, 421-433. http://dx.doi.org/10.1016/j.jinteco.2007.03.002

Brander, J. A. (1981). Intra-industry trade in identical commodities. *Journal of International Economics*, *11*, 1-14. http://dx.doi.org/10.1016/0022-1996(81)90041-6

Costinot, A. (2009). On the origins of comparative advantage. *Journal of International Economics*, *77*, 255-264. http://dx.doi.org/10.1016/j.jinteco.2009.01.007

Das, S. P. (2005). Vertical diversity, communication gap and equilibrium growth. *Topics in Macroeconomics, 5*, Article 22. http://dx.doi.org/10.2202/1534-5998.1334

Davis, D. (1995). Intra-industry trade: A Heckscher-Ohlin-Ricardo approach. *Journal of International Economics*, *39*, 201-226. http://dx.doi.org/10.1016/0022-1996(95)01383-3

Frost, S., & Chiu, C. C. H. (2003). Labour relations and regbulation in Singapore: Theory and practice. *Working Papers Series*, *55*, Southeast Asia Research Centre, City University of Hong Kong.

Grossman, G. M. (2004). The distribution of talent and the pattern and consequences of international trade. *Journal of Political Economy*, *112*, 209-239. http://dx.doi.org/10.1086/379935

Grossman, G. M., & Maggi, G. (2000). Diversity and trade. *American Economic Review*, *90*, 1255-1275. http://dx.doi.org/10.1257/aer.90.5.1255

Heckman, J. J., & Honoré, B. E. (1990). The empirical content of the Roy model. *Econometrica*, *58*, 1121-1149. http://dx.doi.org/10.2307/2938303

Heckman, J. J., & Sedlacek, G. (1985). Heterogeneity, aggregation, and market wage functions: An empirical model of self-selection in the labor market. *Journal of Political Economy*, *93*, 1077-1125. http://dx.doi.org/10.1086/261352

Ishikawa, J. (1996). Scale economies in factor supplies, international trade, and migration. *Canadian Journal of Economics*, *29*, 573-594. http://dx.doi.org/10.2307/136251

Kee, H. L. (2009). Findlay-Grubert versus Rybczynski: Testing growth hypotheses in classic trade theories using Singapore's industries. *The Journal of International Trade and Economic Development*, *18*, 443-486. http://dx.doi.org/10.1080/09638190903217727

Kremer, M. (1993). The O-Ring theory of economic development. *Quarterly Journal of Economics*, *108*, 551-575. http://dx.doi.org/10.2307/2118400

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade. *Journal of International Economics*, *9*, 469-479. http://dx.doi.org/10.1016/0022-1996(79)90017-5

Lee, C. T. (2009). The enlargement of an integrated economy and growth. *Economics Bulletin*, *29*, 1499-1509.

Milgrom, P., & Roberts, J. (1990). The economics of modern manufacturing: Technology, strategy, and organization. *American Economic Review*, *80*, 511-528.

MOM. (2002). *Report on Labour Force in Singapore, 2001*. Singapore: Ministry of Manpower.

Ohnsorge, F., & Trefler, D. (2007). Sorting it out: International trade and protection with heterogeneous workers. *Journal of Political Economy*, *115*, 868-892. http://dx.doi.org/10.1086/523657

Piper, N. (2004). Gender and migration policies in Southeast and East Asia: Legal protection and socio-cultural empowerment of unskilled migrant women. *Singapore Journal of Tropical Geography*, *25*, 216-231. http://dx.doi.org/10.1111/j.0129-7619.2004.00183.x

Roy, A. D. (1951). Some thoughts on the distribution of earnings. *Oxford Economic Papers*, *3*, 135-146.

Wong, K. N., Tang, T. C., & Fausten, D. K. (2009). Foreign direct investment and services trade: Evidence from Malaysia and Singapore. *Global Economic Review*, *38*, 265-276. http://dx.doi.org/10.1080/12265080903157318

Yeoh, B. S. A. (2007). Singapore: Hungry for foreign workers at all skill levels. *Migration Information Source* (Migration Policy Institute). http://www.migrationinformation.org/profiles/display.cfm?id=570.

Notes

Note 1. The other theoretical papers, for example, Krugman (1979), Brander (1981), Davis (1995), and Costinot (2009), have also explained the observation.

Note 2. The similar specification of the probability density function can also be seen in Lee (2009).

Note 3. For the implications of the supermodular and submodular technologies, please also see Milgrom and Roberts (1990), Kremer (1993), Grossman and Maggi (2000) and Das (2005).

Note 4. Bougheas and Riezman (2007) point out that the mean of human capital distribution can be viewed as the aggregate endowment of human capital.

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An Empirical Analysis of Labor Productivity Growth for the Taiwanese Rice Sector

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Abstract

This paper investigates the factors responsible for a high growth rate of labor productivity of the agricultural sector for the period 1976-93 for Taiwan. This investigation is carried out by a newly devised procedure which decomposes the growth rate of labor productivity into (1) the total substitution effect which consists of the effects due to factor price changes and biased technological change and (2) the TFP effect composed of the effects due to scale economies and technological progress. Based on empirical estimation of the translog cost function, it was found that the total substitution effect contributed to the growth of labor productivity much more than the TFP effect did for the period under question.

Keywords: labor productivity, translog cost function, total substitution effect, TFP effect, Taiwanese rice sector

1. Introduction

In Taiwan the agriculture sector was the backbone of the economy, the main foreign exchange earner and contributed greatly to economic development. Since 1960s, it has rapidly lost ground, slowly declined and increasingly depends for its survival on government protection. Like Japan and South Korea, Taiwan is a rich market that has attracted the attention of world agribusiness. Agriculture's contribution to the net domestic product (NDP) decreased from 30percent in 1960-64 to 6percent in 1985-89 and over this period, agricultural production, consumption, trade, farm operations and income have also changed dramatically (Huang, 1993). Rice is the staple food and still the dominant crop in Taiwan. During 1950s and 1960s, rice production increased rapidly, not only meeting the needs of domestic food consumption but also providing a surplus for export (Kuroda, 1997a). But its relative importance has diminished substantially. The share of rice in total crop decreased from 40.2percent in 1960-64 to about 17.3percent in 1985-89.While the increased production costs led to the uncompetitiveness of Taiwan's rice in the world market, fast economic growth ended the role of rice as a 'wage good' in the domestic market (Huang, 1993).

The high quality of human capital was an important factor for the high rates of economic growth in Taiwan. Human capital includes formal education as well as the ideas, knowledge, experiences, and even attitudes and work ethics acquired through employment and other social and economic interactions, which improved the quality of labor and made them most valuable resources for the country. Emphasis on rural education improved farm management and receptivity to technology and also the capacity for learning by doing in agriculture. Education also increased labor mobility, the labor force participation rate of women and the propensity to develop positive mental constructs toward market and agriculture institution.

The labor productivity growth rate has played an important role in Taiwanese agricultural sector. It grew by 3.0percent, 4.9percent, and 3.3percent annually in 1952-60, 1960-70, and 1970-82 respectively (Mao, 1986). For the economy as a whole, labor productivity grew at annual rates of 8.43percent from 1951 to 1965 and 6.2percent from 1966 to 1980 (Liu, 1985). But the expansion of manufacturing and service sectors caused out-migration of young farmers and thus changed employment structure in the agriculture sector. Agricultural labor force in total employment steadily decreased from 50.9percent in 1960-64 to only 15.3percent in 1985-89 (Huang, 1993).

Taiwan's farming is characterized by small-scale family operations with an average farm size of about 1 hectare. In addition, the distribution of the land is increasingly concentrated in small-size farms. Farm household under1 hectare increased from 66.5percent in 1960 to 75.2 percent in 1990, while farms above 3 hectares decreased from 3.3percent to 2.5percent (Huang, 1993). The total planted area for rice production has shown a strong downward trend from 790,248 hectares in 1975 to 391,457 hectares in 1993 (Kuroda, 1997a).

Since 1965, rice acreage has decreased consistently but productivity per hectare has increased. In 1989, paddy field accounted for 40% of total crop acreage (Huang, 1992). This increased productivity was primarily caused by technological innovation such as improvement in rice varieties, chemical inputs and improved irrigation practices. The establishment of strong agricultural research, extension, and other support institutions along with a steady commitment to rural infrastructure construction provided the essential foundation for high productivity growth in agriculture and the commercialization of the rural economy. Continuous contact with research and extension organizations overtime and successful precedents increased farmers trust and willingness to adopt new technologies. Extension efforts were complemented by special economic incentives to encourage adoption of new techniques and crop varieties. Positive attitudes toward technology adoption were also fostered by the commercialization of agriculture.

Due to out-migration of farmers, mechanization became the only way to overcome the labor constraint. The 1970s were widely agreed on as a turning point that marked the beginning of a new phase in Taiwan's agricultural development – one without an abundance of labor (Huang, 1993). Since, the out-migrants were relatively young, farm labor was aging. Farmers older than 60 years were 3percent of the agriculturally employed in 1965-69, but 12percent in 1985-89 (Huang, 1993).

There are several studies on the Taiwanese rice sector. For example: Effects of government programs on rice acreage decisions under rational expectation (Huang, 1992); Structural change in agricultural economy (Huang, 1993); Rural development and dynamic externalities in structural transformation (Park and Johnston, 1995); An empirical investigation of the rice production structure (Kuroda, 1997a), Effects of R & E activities on rice production (Kuroda, 1997b) and so on. But none has done decomposition analysis of labor productivity growth rate of the rice sector. To fill this gap, this study investigates empirically the factors responsible for the high growth rate of labor productivity of the rice sector for the 1976-93 period. The objective of this study is to investigate which factors are responsible for this increased growth rate, which is directly related to the decomposition analysis of labor productivity growth rate. However, this study is limited to the labor productivity growth rate of the rice sector.

For decomposition analysis of labor productivity growth rate, the conventional growth accounting method has been applied by different researchers (Solow, 1957; Berndt and Watkins, 1981; Denny and Fuss, 1983; Doi, 1985; Morrison, 1993). According to this method, the growth rate of labor productivity is decomposed into the growth rate of factor intensities and TFP. To derive this decomposition, one has to introduce three strict assumptions on the production technology as: (1) constant returns to scale; (2) Hicks-neutral technological change (Hicks, 1963); and (3) the producer equilibrium. If any of these assumptions is not satisfied in reality, the conventional growth accounting procedure may cause bias in the results. In particular, for the first two assumptions, one cannot analyze the economic factors behind changes in the growth rates of factor intensities and TFP by the conventional method. Because, a) shifts in relative prices and bias of technological change are major possibilities for changes in the growth rate of factor intensities, and b) economies of scale and the rate of technological change are major components for changes in the growth rate of TFP.

To pursue the objective, this study uses the device developed by Kuroda (1995) which enables one to link the growth rate of labor productivity with that of total factor productivity (TFP). Kuroda (1995) applied this procedure in his study of labor productivity measurement in Japanese agriculture, 1956-90. The present study is going to decompose the growth rate of labor productivity into factor price effect, fixed input effect, scale effect and technological change effect. For the empirical measurement of these effects, a non-homothetitic and Hicks non-neutral translog variable cost function is specified and estimated for the 1976-93 period. The present study makes a detailed comparison of labor productivity decomposition among six districts and five farm size classes of Taiwan.

2. Method

In this study it is assumed that the rice sector has a variable cost function as a dual of the production function which satisfies the neoclassical regularity conditions,

$$C = G(Q, P, Z_B, T) \tag{1}$$

Where Q is the quantity of output; P is a factor price vector corresponds to a factor input vector X which is composed of labor X_L, intermediate input X_I, and capital X_K; Z_B is land considered as a fixed input; T is time as an index of technological change; $C = \sum_{i=1}^{3} P_i X_i (i = L, I, K)$ is the minimized variable cost; and C is homogeneous of degree one in factor prices.

The treatment of land as a fixed input is due to the fact that the farmland market does not seem to be competitive so that it is very unlikely that the farm-firm utilizes the optimum level of land for the rice production in Taiwan. In addition, various regulations have restricted land movement in Taiwanese agriculture (Kuroda, 1997).

Through Shepard lemma (Shepard, 1970), the cost minimizing factor demand equation for the variable cost function can be derived as follows:

$$X_i(Q, P, Z_B, T) = \frac{\partial C(Q, P, Z_B, T)}{\partial P_i}, \quad i = L, I, K \tag{2}$$

Multiplying both sides of (2) by P_i / C, the cost share equation of the ith factor input S_i can be obtained as:

$$S_i = \frac{P_i X_i}{C} = \frac{\partial C}{\partial P_i}\frac{P_i}{C} = \frac{\partial \ln C}{\partial \ln P_i}, \qquad i = L, I, K \tag{3}$$

The decomposition procedure for the growth rate of labor productivity into various effects, which is going to be used in this study, can be applied to the decomposition of the growth rate of any single-factor productivity.

The growth rate of labor productivity can be expressed as the growth rate of output minus the growth rate of labor input:

$$\frac{d \ln(Q / X_L)}{dT} = \frac{d \ln Q}{dT} - \frac{d \ln X_L}{dT} = G(Q) - G(X_L) \tag{4}$$

Where $G(.)$ designates the growth rate of a specific variable, and subscript L denotes labor input.

The growth rate of labor input $G(X_L)$ can further be decomposed into several effects. Differentiating totally the labor demand function given in equation (2) with respect to time, dividing both sides by X_L and rearranging yields the following equation:

$$\begin{aligned} G(X_L) &= \frac{d \ln X_L}{dT} \\ &= \sum_{i=1}^{3} \frac{\partial \ln X_L}{\partial \ln P_i} G(P_i) + \frac{\partial \ln X_L}{\partial \ln Q} G(Q) + \frac{\partial \ln X_L}{\partial \ln Z_B} G(Z_B) + \frac{\partial \ln X_L}{\partial T} \\ &= \sum_{i=1}^{3} e_{Li} G(P_i) + \frac{\partial \ln X_L}{\partial \ln Q} G(Q) + \frac{\partial \ln X_L}{\partial \ln Z_B} G(Z_B) + \frac{\partial \ln X_L}{\partial T} \\ & i = L, I, K. \end{aligned} \tag{5}$$

Where $e_{Li} (= \partial \ln X_L / \partial \ln P_i)$ is the price elasticity of labor demand with respect to the price of the ith input ($i = L, I, K$). Equation (5) shows that the growth rate of labor input can be decomposed into the price effect (the first term), the output effect (the second term), the fixed input effect (the third term) and the technological change effect (the fourth term).

The output effect, the fixed input effect, and the technological change effect may further be decomposed as follows. Taking the natural logarithms of both sides of the labor cost share equation given in equation (3) linked by the first equality sign and rearranging yields:

$$\ln X_L = \ln C + \ln S_L - \ln P_L \tag{6}$$

Using (6), the following relations are obtained.

$$\frac{\partial \ln X_L}{\partial \ln Q} = \frac{\partial \ln C}{\partial \ln Q} + \frac{\partial \ln S_L}{\partial \ln Q} = \varepsilon_{CQ} + \frac{1}{S_L}\frac{\partial S_L}{\partial \ln Q} \tag{7}$$

$$\frac{\partial \ln X_L}{\partial \ln Z_B} = \frac{\partial \ln C}{\partial \ln Z_B} + \frac{\partial \ln S_L}{\partial \ln Z_B} = \varepsilon_{CB} + \frac{1}{S_L}\frac{\partial S_L}{\partial \ln Z_B} = \varepsilon_{CB} + \frac{\theta_{LB}}{S_L} \tag{8}$$

$$\frac{\partial \ln X_L}{\partial T} = \frac{\partial \ln C}{\partial T} + \frac{\partial \ln S_L}{\partial T} = \lambda + \frac{1}{S_L}\frac{\partial S_L}{\partial T} \tag{9}$$

Where ε_{CQ} and ε_{CB} are the cost-output elasticity and the cost-fixed input elasticity, respectively, and λ indicates the rate of shift of the cost function due to technological change. The second term of (7) indicates the bias effect on the demand for labor due to changes in output; the second term of (8) indicates the labor bias due to changes in the fixed input; and the second term of (9) indicates the labor bias of technological change. Substituting (5), (7), (8), and (9) into (4) and rearranging yields

$$G(\frac{Q}{X_L}) = [-\sum_{i=1}^{3} e_{Li} G(P_i)] + [\varepsilon_{CB} G(Z_B)] + [\{-\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Z_B} G(Z_B)\} + \{-\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Q} G(Q)\} + \{\frac{1}{S_L}\frac{\partial S_L}{\partial T}\}] + [(1-\varepsilon_{CQ})G(Q) + (-\lambda)] \tag{10}$$

According to Caves *et.al*., 1981, the productivity growth rate with inputs held constant in the case of a single-output variable cost function is given by,

$$PGQ = -(\frac{\partial C}{\partial T})/(\frac{\partial C}{\partial Q}) = -\lambda / \varepsilon_{CQ} \tag{11}$$

Then, the cost elasticity (ε_{CQ}) can be rewritten as,

$$\varepsilon_{CQ} = -\lambda / PGQ \tag{12}$$

Thus, equation (10) can be rewritten as,

$$G(\frac{Q}{X_L}) = \left[-\sum_{i=1}^{3} e_{Li} G(P_i)\right] + [\varepsilon_{CB} G(Z_B)] + \left[\left\{-\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Z_B} G(Z_B)\right\} + \left\{-\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Q} G(Q)\right\} + \left\{\frac{1}{S_L}\frac{\partial S_L}{\partial T}\right\}\right] + [(1+\lambda/PGQ)G(Q) + (-\lambda)] \tag{13}$$

The first term on the right hand side of (13) indicates the sum of the substitution effects on labor demand due to changes in the variable input prices and the quantity of the fixed input, land. The second term is the sum of the bias effects due to the fixed input, output scale, and technological change. Following Antle and Capalbo (1988), the sum of these three effects may be defined as the (extended) Hicksian biased technological change effect (Blackorby, et al. 1977). All the components of the first and second terms are factors which lead to factor substitutions. Therefore, the sum of these effects is called the total substitution effect in this study.

Next, [(1+λ/PGQ)G(Q)] in the third term may be defined as the scale-induced technological progress. The second component of the third term ($-\lambda$) indicates the dual rate of technological progress, i.e., the rate of cost diminution. Thus, the sum of these two effects may be defined as the total technological progress effect.

According to the conventional growth accounting procedure with the assumptions of producer equilibrium, constant returns to scale, and Hicks neutral technological change, the growth rate of labor productivity can be decomposed into the growth rates of factor intensities and the growth rate of TFP (Solow, 1957; Morrison, 1993).

Kuroda (1995) showed, in the case of the total cost function, that unlike the conventional growth accounting method, if both constant returns to scale and Hicks neutrality are not assumed a priori, changes in the growth rates of factor intensities can be decomposed into price effects, bias effects due to output scale and technological change, while changes in the growth rate of TFP can be decomposed into the effects due to scale economies and technological progress.

This study has extended Kuroda's procedure to the case of the variable cost function. That is, if the cost function is non-homothetic and Hicks non-neutral in the space of the variable inputs, the rate of growth of labor productivity can be decomposed into the total substitution effects which are composed of price effects, and bias

effects due to the fixed inputs, output scale, and technological change, and the total technological progress effects consisting of the rate of the scale-induced technological progress and the rate of cost diminution.

If parameters such as price elasticities of labor demand, cost elasticity, cost-fixed inputs elasticities, and the rate and biases of technological change are estimated, all of these effects can be quantitatively measured. The empirical estimation of these effects expressed in equation (13) will not only be very interesting from the academic viewpoint, but also very important from the viewpoint of offering information for policy-makers.

In order to obtain the necessary parameters for the decomposition analysis based on Eq. (13), a translog form is specified for the variable cost function (1):

$$\begin{aligned}\ln C = {} & \alpha_0 + \alpha_Q \ln Q + \sum_{i=1}^{3} \alpha_i \ln P_i + \beta_B \ln Z_B + \beta_T T \\ & + \frac{1}{2}\gamma_{QQ}(\ln Q)^2 + \frac{1}{2}\sum_{i=1}^{3}\sum_{j=1}^{3}\gamma_{ij} \ln P_i \ln P_j \\ & + \sum_{i=1}^{3}\theta_{iB} \ln P_i \ln Z_B + \frac{1}{2}\theta_{BB}(\ln Z_B)^2 \\ & + \sum_{i=1}^{3}\delta_{Qi} \ln Q \ln P_i + \delta_{QB} \ln Q \ln Z_B \\ & + \mu_{QT}(\ln Q)T + \sum_{i=1}^{3}\mu_{iT}(\ln P_i)T \\ & + \beta_{BT}(\ln Z_B)T + \frac{1}{2}\beta_{TT}T^2 \\ & + \sum_{k=2}^{6} d_{Rk} D_{Rk} + \sum_{l=2}^{5} d_{Sl} D_{Sl} \end{aligned} \tag{14}$$

Where $\gamma_{ij} = \gamma_{ji}$ and $i = j = L, I, K.$

Here, in order to take into account heterogeneous intercepts with respect to six different districts and five size classes, regional dummies D_{RK} (k = 2,3,4,5,6) and size dummies D_{Sl} (l = 2,3,4,5) were introduced (Note 1).

Now the cost share (S_i) are derived as

$$\begin{aligned} S_i &= \frac{\partial C}{\partial P_i}\frac{P_i}{C} = \frac{\partial \ln C}{\partial \ln P_i} \\ &= \alpha_i + \sum_{j=1}^{3}\gamma_{ij} \ln P_j + \delta_{Qi} \ln Q + \theta_{iB} \ln Z_B + \mu_{iT} T \end{aligned} \tag{15}$$

The translog cost function can be used along with the profit-maximizing condition to generate an additional equation representing the optimal choice of the endogenous output (Q) (Fuss and Waverman, 1981).

Taking the derivative of the cost function (1) with respect to the endogenous output Q, we have

$$\frac{\partial \ln C}{\partial \ln Q} = \frac{\partial C}{\partial Q}\frac{Q}{C} = \frac{PQ}{C}$$

where, P is the price of output (Note 2). Denoting PQ/C as S_Q, the revenue share equation can be written as

$$\begin{aligned} S_Q &= \frac{\partial C}{\partial Q}\frac{Q}{C} = \frac{\partial \ln C}{\partial \ln Q} \\ &= \alpha_Q + \sum_{i=1}^{3}\delta_{Qi} \ln P_i + \gamma_{QQ} \ln Q + \delta_{QB} \ln Z_B + \mu_{QT} T \end{aligned} \tag{16}$$

$$i = j = L, I, K.$$

Including the revenue share equation in the estimation of the system of equations will, in general, lead to more efficient estimation of the coefficients, in particular, of the output–associated variables due to additional information provided by the revenue share (Note 3).

Any sensible cost function must be homogeneous of degree one in input prices. In the translog cost function (1) this requires that $\sum_{i=1}^{3}\alpha_i = 1, \sum_{i=1}^{3}\gamma_{ij} = 0, \sum_{i=1}^{3}\delta_{Qi} = 0, \sum_{i=1}^{3}\theta_{iB} = 0,$

and $\sum_{i=1}^{3}\mu_{iT} = 0 \quad (i = j = L, I, K).$ The translog cost function (13) has a general form in the sense that the restrictions of homotheticity and Hicks neutrality in the space of the variable inputs are not imposed a priori. Instead, these restrictions can be statistically tested in the process of estimation of this function. The following three hypotheses concerning with the production technology will be tested in this study.

First, constant returns to scale (CRTS) can be tested in the variable cost function framework. If the primal production function exhibits constant returns to scale, then the cost function can be written as $C(Q, P, Z_B, T) = G(Q, Z_B).H(P, T)$ where $G(Q, Z_B)$ on the right hand side is a linearly homogeneous function with respect to Q and Z_B. This implies the following set of parameter restrictions on the translog cost function (1); $\alpha_Q + \beta_B = 1, \delta_{Qi} + \theta_{iB} = \delta_{QB} + \theta_{BB} = \gamma_{QQ} + \delta_{QB} = \mu_{QT} + \beta_{BT} = 0 (i = L, I, K).$

Third, neutrality of the variable factor shares with respect to output scale is tested by imposing the restrictions, $\delta_{Qi} = 0 \quad (i = L, I, K).$

As shown immediately later when we discuss the measure of the biases of technological change, the test results of the last two hypotheses are intimately related to the pure bias effect and the scale bias effect as defined by Antle and Capalbo (1988). The various economic indicators to investigate the technology structure of the Taiwanese rice sector can be obtained by the equations as detailed below: (Note 4)

Now, the necessary parameters for the decomposition equation (13) can be computed based on the translog cost function (14) as follows. First, the price elasticities of demand for labor can be computed through (Berndt and Christensen, 1973),

$$e_{LL} = S_L \sigma_{LL} \tag{17}$$

$$e_{Li} = S_i \sigma_{Li} \tag{18}$$

$$i = I, K$$

Where σ_{LL} and σ_{Li} are the Allen partial elasticities of substitution and can be obtained by

$$\sigma_{LL} = (\gamma_{LL} + S_L^2 - S_L) / S_L^2 \tag{19}$$

$$\sigma_{Li} = (\gamma_{Li} + S_L S_i) / S_L S_i \tag{20}$$

$$i = I, K.$$

Next, for the estimation of the fixed factor effect of the total substitution effects, ε_{CB} is given by

$$\varepsilon_{CB} = \frac{\partial \ln C}{\partial \ln Z_B} = \beta_B + \sum_{i=1}^{3}\theta_{iB} \ln P_i + \delta_{QB} \ln Q + \theta_{BB} \ln Z_B + \beta_{BT} T \tag{21}$$

$$i = L, I, K.$$

Third, the labor bias effects with respect to output scale, fixed input, and technological change are given respectively by

$$\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Q} = \frac{\delta_{QL}}{S_L} \tag{22}$$

$$\frac{1}{S_L}\frac{\partial S_L}{\partial \ln Z_B} = \frac{\theta_{BL}}{S_L} \tag{23}$$

$$\frac{1}{S_L}\frac{\partial S_L}{\partial T} = \frac{\mu_{LT}}{S_L} \tag{24}$$

$$\varepsilon_{CQ} = \frac{\partial \ln C}{\partial \ln Q} = \alpha_Q + \sum_{i=1}^{3} \delta_{Qi} \ln P_i + \gamma_{QQ} \ln Q + \delta_{QB} \ln Z_B + \mu_{QT} T \tag{25}$$

$$\lambda = \frac{\partial \ln C}{\partial T} = \beta_T + \sum_{i=1}^{3} \ln P_i + \mu_{QT} \ln Q + \beta_{BT} \ln Z_B + \beta_{TT} T \tag{26}$$

$$i = L, I, K.$$

2.1 The Data

The variables required to estimate the variable cost function model are the variable cost, the total revenue and the quantity and price of total output, and the prices and cost shares of the three variable factors of production (labor, intermediate inputs, and capital), and the quantity of land as a fixed input. A pooled cross-section of time-series data were collected and processed for the Taiwanese rice sector for the period 1976-93 based mainly on the Survey Report of Rice Production Costs (SRRPC), published annually by the Food Bureau, Taiwan Provincial Government, ROC. The necessary data were collected for average farm-firm in each of the five size classes from six districts classified in the SRRPC. The five size classes are (1) less than 0.5 hectare, (2) 0.5-0.75 hectare, (3) 0.75-1.0 hectare, (4) 1.0-1.5 hectare, and (5) 1.5 hectares and over. The six districts are Taipei, Hsinchu, Taichung, Tainan, Kaohsiung, and Taitung. Thus, the sample size is 18(years) x 5(classes) x 6(districts) =540.

Several points are worth mentioning here about the agricultural districts and the sampling procedure of the SRRPC. First, agricultural "district" is used for an area with climatically similar characteristics and in general covers wider areas than prefectures. Taipei district is composed of Taipei and Yilan prefectures; Hsinchu district is composed of Taoyuan, Hsinchu, and Miaoli prefectures; Taichung district is composed of Taichung, Changhwa, and Nantou prefectures; Tainan district is composed of Yunlin, Chiayi, and Tainan prefectures; Kaohsiung district is composed of Kaohsiung and Pingtung prefectures; and Taitung is composed of Taitung and Hwalien prefectures. These six districts cover more than 95 percent of the total rice production in the province of Taiwan. The most important districts are Hsinchu, Taichung, and Tainan which shared 80.4 percent of the total rice production in 1993.

Second, the survey is conducted by sampling about 530 rice farms for the six districts in each year. In 1993, for example, 528 rice farms were sampled; 52,112, 115, 118, 75, and 56 farms were assigned to Taipei, Hsinchu, Taichung, Tainan, Kaohsiung and Taitung. It seems that these sample numbers reflect the shares of production of these six districts in the total rice production. Furthermore, the distribution of the samples, 528, among the six size classes were 125 for class 1, 158 for class 2, 71 for class 3, 109 for class 4, and 65 for class 5, indicating a fairly even sampling. These tendencies in the sampling procedure were consistent over time, although the latter sort of distribution is not given for each district.

One can compile each pooled data set separately for the first and second crops. The first crop is produced during March through June and the second crop during July through October. The second crop needs a shorter time because it includes summer time with high temperature. The total quantities of production of both the first and second crops have been declining; they were 1.38 and 1.27 million metric tons in 1976 and declined to 1.05 and 0.77 million metric tons in 1993 in terms of brown rice. The quantity of production of the second crop used to be slightly greater than that of the first crop until around the late-1960s. Since then, however, the share of the first crop in the total rice production became greater than that of the second crop; it increased from 54 percent in 1971 to58 percent in 1993. The harvested areas have been fairly equal between the first and second crops. Thus, the major difference in the total quantities of production between the first and second crops comes from the difference in the yields per hectare of the two crops. Although the yields of the two crops increased consistently over time, the absolute levels of them have been in favor of the first crop; the yields of the first and second crops increased from 3,863 and 3,017 kilograms in 1976 to 4,947 and 4,310 kilograms in 1993, respectively. This study utilized the data set for the first crop (Note 5).

Since the data are expressed in per hectare terms, it is necessary to multiply the needed variables by the planted area of the average farm-firm in each size class in each district in order to express them in per-farm-firm terms.

The quantity of total output (Q) was obtained by multiplying the amount of production (kilograms) per hectare by the planted area. The price of output (P) was obtained as a weighted average of the government purchasing prices for the Japonica and Indica rice. The total revenue (TR = PQ) was estimated as a product of the total

output and the price. The price data were taken from the Taiwan Food Statistics Book (TFSB), published annually by the Food Bureau, Taiwan Provincial Government, and ROC.

The cost of labor input ($C_L = P_L X_L$) was defined as the sum of the wage bills for family and hired labor and the wage bill for contract work. This was multiplied by the planted area to yield the farm-firm labor cost. As for the price of labor (P_L), the Tornqvist-Theil index was obtained by the Caves-Christensen-and-Diewert (CCD) method (Caves, et al. 1982). The CCD method is most relevant when it comes to estimating the Tornqvist-

Theil index for a pooled cross-section of time-series data set. In the following paragraphs, all indices were obtained based on this method. The SRRPC reports the wage bills for family labor, hired labor, and contract labor and the hours worked and the average wage rate for each category separately for male and female. In each category, a weighted average wage rate of male and female labor is estimated in the SRRPC by dividing the sum of the wage bills for male and female labor by the sum of the male and female labor hours worked. For these wage bills and weighted average wage rates, the CCD method was applied. Needless to say, in measuring the quantity and price of labor as above, we are assuming perfect substitutability both between male and female labor and between family, hired, and contract labor. Unfortunately, however, the wage bills and weighted average wage rates are reported only for the average farm-firm in each district. Therefore, the same price of labor has to be used for the five different size classes in each district.

The cost of capital ($C_K = P_K X_K$) was defined as the sum of the wage bills for animal service and machinery service and expenditures on farm buildings, equipment, and tools. The sum of these expenditures was multiplied by the planted area in order to obtain the cost of capital input for the farm-firm. The price index (P_K) of capital input was obtained by the CCD method in a very similar fashion as in the case of labor input. In the estimation, the price index for farm machinery was used for the complex of farm building, equipment, and tools taken from the TFSB. In this case also, the wage bills and the wage rates for animal and machinery services are reported only for the average farm-firm in each district. Fortunately, however, the expenditures on farm building, equipment, and tools are reported for the average farm-firm of the five size classes in all districts. However, it was found from the computation that these expenditures, shares in the total capital costs are very small. Thus, it is safe to say that there would not be many differences in P_K among different size classes in each district.

The cost of intermediate inputs ($C_I = P_I X_I$) was defined as the sum of expenditures on seeds, materials, agri-chemicals, and fertilizers. This sum was multiplied by the planted area, yielding the cost of intermediate inputs of the farm-firm. The price index (P_I) was obtained by the CCD method. In this estimation, the price indices for these items were obtained from the TFSB. As for land (Z_B), because it is treated as a fixed input, the planted area was used. It is reported for each size class in each district in the SRRPC.

The variable cost (C) can now be estimated as $C = P_L X_L + P_I X_I + P_K X_K$. The cost share of each variable factor input and the revenue share can be obtained as $S_i = C_i / C$, $i = L, I, K$, and $S_Q = TR/C$.

Note 5.Indeed, the same estimations were made using the data set for the second crop. The results were very similar in all parameters and economic indicators for the two crops. Thus it may be safe to stick to the analysis based on the data set only for the first crop.

2.2 Statistical Method

For statistical estimations, since the quantity of output (Q) in the right-hand-side of the cost function (14) is in general endogenously determined, a simultaneous estimation procedure should be employed in the estimation of the set of equations consisting of the cost function (14), two of the three cost share equations (15) (Note 6), and one revenue share equation (16). Note here that the estimating model as a whole is complete in the sense that it has as many (four) equations as endogenous variables (four). The method chosen was thus the full information maximum likelihood (FIML) method. In this process, the restrictions due to symmetry and linear homogeneity in prices were imposed. The coefficients of the omitted (i.e. the capital) cost share equation were obtained using the linear homogeneity restrictions after the system was estimated.

3. Results & Discussion

For the tests of the three hypotheses, i.e. constant returns to scale (CRTS), Hicks neutrality of technological change, and scale neutrality of the variable factor shares, a Wald Chi-square test was applied. The computed Chi-square statistics for these three hypotheses were 9.5, 495.0, and 883.3 with the degrees of freedom, 7, 3, and 3, respectively. The critical values at the 0.05 and 0.01 significance levels for the degrees of freedom 7 and 3 are 14.6 and 7.8, and 18.4 and 11.3, respectively. Thus, the hypotheses of Hicks neutrality and scale neutrality were

strongly rejected both at the 0.05 and at the 0.01 significance levels. However, the hypothesis of CRTS could not be rejected both at the 0.05 and at the 0.01 significance levels, which implies the existence of constant returns to scale in the Taiwanese rice sector. This indicates that when the farm-firm increases the scale of rice production in terms of output, the average production cost per unit of output will remain at the same minimum level.

In addition, the joint null hypothesis of no regional differences in the intercept ($H_0 : d_{Rk} = 0$ for all $k = 2,3,4,5,6$) was tested and strongly rejected. Furthermore, the coefficients of all the regional dummy variables had fairly large asymptotically computed t-values, indicating statistical significance of them. A casual examination of the coefficients of these dummies tells us that Hsinchu, Taichung, Tainan, and Kaohsiung districts had lower total cost than Taipei district (Note 7), while Taitung district showed higher total cost than Taipei district. On the other hand, the joint null hypothesis of no size differences in the intercept ($H_0 : d_{Sl} = 0$ for all $l = 2,3,4,5$) was not rejected. Indeed, the asymptotically computed t-values of all the size dummy coefficients were less than unity, indicating that they are not statistically significant.

Thus, the system of equations (14), (15) and (16) were re-estimated with an additional imposition of the parameter restrictions of CRTS and no size effects on the intercept. The coefficients of the omitted (capital) cost share equation were obtained using the parameter relations of linear homogeneity restrictions. The results are presented in Table 1. The computed R^2's were 0.932, 0.718, 0.614, and 0.645 for the variable cost function, labor share equation, intermediate-inputs share equation, and revenue share equation. Furthermore, except for only a few coefficients, the (asymptotically) computed t-statistics are fairly large, indicating that the estimated coefficients are statistically significant except for a few coefficients. Thus, it can be said that the goodness of fit is considerably high. This set of estimates is referred to as the final specification of the model and will be used for further analyses (Note 8).

Factor demand elasticities with respect to factor prices as well as the Allen partial elasticities of substitution and fixed input elasticity, scale and technological change effect were computed by using estimated parameter of Table 1, for the entire 1976-93 period. Several findings are noteworthy here from the computed result:

First, the own-price elasticities of demand for labor are less than unity in absolute value (0.287) indicating that the demand for labor in agriculture is inelastic. This inelastic demand for labour in agriculture may be linked to the out-migration of workers from the agriculture to the manufacturing and services sectors.

Second, the substitution elasticities between labor and intermediate input and between labor and capital are all positive indicate that the variable factor inputs are mutually substitutes and own substitution effect was dominant.

Table 1. FIML estimates of the translog variable cost function for the Taiwanese rice sector with the imposition of the CRTS restrictions, for 1976-1993 (First Crop)

Parameter	Coefficient	t-statistics	Parameter	Coefficient	t-statistics
α_0	11.182	357.2	θ_{BB}	0.639	20.4
α_Q	1.598	71.9	δ_{QL}	0.209	18.4
α_L	0.559	65.1	δ_{QI}	0.138	20.8
α_I	0.170	24.4	δ_{QK}	0.071	7.5
α_K	0.271	5.1	δ_{QB}	0.639	20.4
β_B	0.598	280.3	μ_{QT}	0.002	3.1
β_T	0.038	5.7	μ_{LT}	0.016	18.5
γ_{QQ}	0.639	13.5	μ_{IT}	0.006	8.0
γ_{LL}	0.086	7.6	μ_{KT}	0.010	1.2
γ_{II}	0.082	9.3	β_{BT}	-0.002	-1.0
γ_{KK}	0.050	3.7	β_{TT}	-0.000	-0.0
γ_{LI}	0.059	9.0	d_{R2}	-0.202	-9.6
γ_{LK}	0.026	3.6	d_{R3}	-0.225	-11.1
γ_{IK}	0.023	2.3	d_{R4}	-0.212	-7.2
θ_{LB}	0.209	10.9	d_{R5}	-0.164	-7.3
θ_{IB}	0.138	11.0	d_{R6}	0.032	1.7
θ_{KB}	0.071	7.5			

Estimating Equations	$\overline{R}^2$
Cost Function	0.932
Labor Share Equation	0.718
Intermediate Input Share Equation	0.614
Revenue Share Equation	0.645

Third, the Allen Elasticity of Substitution (AES) between labor and intermediate inputs and labor and capital are 0.37, and 0.83 respectively which indicates that labor and intermediate inputs are not good substitutes, but labor and capital are fairly good substitutes. That is, technical possibilities of substitution exist between labor and capital, which support the findings of Kuroda (1997a).

Table 2 and Table 3 represent the labor productivity growth rate for the Taiwanese rice sector by districts and by farm sizes respectively. It is found that among farm sizes, labor productivity growth rates are more or less similar but it varies district to district. Based on equation 13 the decomposition was executed for the entire 1976-93 period by districts and farm sizes. The results are presented in Tables 4-7. Based on the results, a general evaluation will first be made and then followed by the differences between six districts and five farm size classes. Table 4 shows the fixed input effect, scale effect and technological change effect at the means and it is found that the technological change effect is the highest among these three effects and bias effect is higher than the cost reduction effect.

Table 2. Labor Productivity Growth Rate for Taiwanese rice sector by districts, 1976-93

Districts	Output Growth Rate	Labor Growth Rate	Labor Productivity Growth Rate
Taipei	0.017	-0.078	0.094
Hsinchu	0.014	-0.078	0.092
Taichung	0.010	-0.077	0.087
Tainan	0.007	-0.096	0.103
Kaohsiung	0.006	-0.090	0.096
Taitung	0.015	-0.087	0.102
Taiwan	**0.012**	**-0.084**	**0.096**

Note: All the figures are simple averages of all samples.

Table 3. Labor Productivity Growth Rate for Taiwanese rice sector by farm size, 1976-93

Farm Size (hectares)	Output Growth Rate	Labor Growth Rate	Labor Productivity Growth Rate
> 0.50	0.019	-0.078	0.097
0.50 - 0.75	0.010	-0.086	0.096
0.75 - 1.00	0.010	-0.087	0.097
1.00 - 1.50	0.005	-0.089	0.094
1.50 & above	0.014	-0.081	0.095
Taiwan	**0.012**	**-0.084**	**0.096**

Note: All the figures are simple averages of all samples.

From Table 5, it can be observed that for the entire 1976-93 period, total substitution effect is higher than that of total technological progress effect and contributed about 66.5percent to the growth rates of labor productivity. Hicksian biased technological change effect due to fixed input, output scale and technological change contributes 43.7per cent. Substitution effect due to price effect and changes in quantity of fixed input contributes 22.8 percent and total technological progress effect contributes 32.6 percent to the growth rates of labor productivity. Therefore, Hicksian biased technological change effect contributed the highest among the three effects. Among all effects, the sum of cost reduction effect and biased technological change effect contributes about 81 per cent to the growth rate.

Table 4. Fixed input effect, Scale effect and Technological change effect at the means.

Fixed Input Effect			Scale Effect			Technological Change Effect		
Quantity of of Fixed Input	Bias Effect of Fixed Input	Total	Scale Induced Technological Progress	Bias Effect due to Output Scale	Total	Rate of Cost Diminution	Bias Effect	Total
-0.001	-0.001	-0.002	-0.007	0.004	-0.003	0.024	0.028	0.052

Table 5. Decomposition of Labor Productivity Growth Rate, 1976-93 (unit:%)

Growth Rate of Labor Productivity	Total Substitution Effect								Total Technological Progress Effect			Residual
	Substitution Effect			Hicksian Biased Technological Change Effect				Total Effect	Scale Induced Technological Progress	Rate of Cost Diminution	Total	
	Price Effect	Changes in Quantity of Fixed Input	Total	Fixed Input	Output Scale	Technological Change	Total					
9.58	2.05	0.13	2.18	-0.38	0.59	3.98	4.19	6.37	-0.67	3.79	3.12	0.09
(100)	21.4	1.4	22.8	-4.0	6.5	41.5	43.7	66.5	-7.0	39.6	32.6	0.9

Note: The figures are simple average of all samples.

Contribution of different effects to the labor productivity growth rate by districts and farm sizes are presented in Table 6 and Table 7 respectively. These contributions differ among districts but are found to be fairly close for different farm sizes which might be due to the fact that different farms and all the rice producing farmers are using the same production technology. It is found that for every district and farm size, biased technological change effect has the highest contribution whereas total technological progress effect has moderate and substitution effect and the other effects have very low contribution to the growth rate of labor productivity. The growth rate of labor productivity for the whole period found by computation is 9.58. The constant return to scale (CRTS) characteristics in the rice sector may be linked to the small farm size especially since labour productivity does not vary with farm size. The largest contribution of the substitution effect (namely the Hicksian biased technological change effect) to labour productivity growth is linked to the fact that input growth is no longer independent of technical when technical change is Hicks biased.

Table 6. Decomposition of Labor Productivity Growth Rate by Districts (unit: %)

Districts	Growth Rate of Labor Productivity	Total Substitution Effect								Total Technological Progress Effect			Residual
		Substitution Effect			Hicksian Biased Technological Change Effect				Total Effect	Scale Induced Technological Progress	Rate of Cost Diminution		Total
		Price Effect	Changes in Quantity of Fixed Input	Total	Fixed Input	Output Scale	Technological Change	Total					
Taipei	9.44	1.08	0.27	1.35	-0.83	0.74	3.37	3.28	4.63	-0.7	4.49	3.79	1.02
	100	11.4	2.9	14.3	-8.8	7.8	35.7	36.4	49.0	-7.4	47.6	40.1	10.8
Hsinchu	9.2	1.32	-0.18	1.14	0.52	0.68	3.62	4.82	5.96	-0.73	3.91	3.18	0.04
	100	14.3	-2.0	12.4	5.7	7.4	39.3	53.6	64.8	-7.9	42.5	34.6	0.4
Taichung	8.74	2.57	0.29	2.86	-0.82	0.55	4.13	3.86	6.72	-0.68	3.74	3.06	-1.03
	100	29.4	3.3	32.7	-9.4	6.3	47.3	42.9	76.9	-7.8	42.8	35.0	-11.8
Tainan	10.25	3.26	-0.06	3.2	0.17	0.4	4.32	4.89	8.09	-0.51	3.60	3.09	-0.93
	100	31.8	-0.6	31.2	1.7	3.9	42.1	54.3	78.9	-5.0	35.1	30.1	-9.1
Kaohsiung	9.62	2.63	0.23	2.86	-0.63	0.4	4.52	4.29	7.15	-0.5	3.35	2.85	-0.36
	100	27.3	2.4	29.7	-6.5	4.2	47.0	47.7	74.3	-5.2	34.8	29.6	-3.7
Taitung	10.19	1.44	0.24	1.68	-0.68	0.78	3.88	3.98	5.66	-0.89	3.66	2.77	1.76
	100	14.1	2.4	16.5	-6.7	7.7	38.1	44.2	55.5	-8.7	35.9	27.2	17.3

Note: The figures are simple average of all samples.

Table 7. Decomposition of Labor Productivity Growth Rate by Farm Sizes (unit: %)

Farm Sizes	Growth Rate of Labor Productivity	Total Substitution Effect								Total Technological Progress Effect			Residual
		Substitution Effect			Hicksian Biased Technological Change Effect				Total Effect	Scale Induced Technological Progress	Rate of Cost Diminution	Total	
		Price Effect	Changes in Quantity of Fixed Input	Total	Fixed Input	Output Scale	Technological Change	Total					
> 0.50	9.69	2.04	0.54	2.58	-1.52	0.97	3.97	3.42	6.00	-1.12	3.79	2.67	1.02
	100	21.1	5.6	26.6	-15.7	10.0	41.0	35.3	61.9	-11.6	39.1	27.6	10.5
0.50 - 0.75	9.61	2.07	-0.001	2.069	-0.005	0.50	3.98	4.48	6.54	-0.55	3.79	3.24	-0.17
	100	21.5	0.0	21.5	-0.1	5.2	41.4	46.6	68.1	-5.7	39.4	33.7	-1.8
0.75 - 1.00	9.67	2.05	-0.01	2.04	0.03	0.52	3.98	4.53	6.57	-0.59	3.79	3.2	-0.09
	100	21.2	-0.1	21.1	0.3	5.4	41.2	46.8	67.9	-6.1	39.2	33.1	-0.9
1.00 - 1.50	9.44	2.04	-0.20	1.84	0.57	0.24	3.96	4.77	6.61	-0.26	3.79	3.53	-0.7
	100	21.6	-2.1	19.5	6.0	2.5	41.9	50.5	70.0	-2.8	40.1	37.4	-7.4
1.50 & above	9.47	2.05	0.33	2.38	-0.96	0.72	3.98	3.74	6.12	-0.83	3.79	2.96	0.38
	100	21.6	3.5	25.1	-10.1	7.6	42.0	39.5	64.6	-8.8	40.0	31.3	4.0

Note: The figures are simple average of all samples.

The above findings reflect that technological change effect is the dominant factor influencing labor productivity growth rate, which implies that technological innovation and diffusions have been considerably effective. Price effect shows that farmers are sensitive to changes in the factor prices. Negative scale effect is caused by negative growth rates of labor input, and biased technological change towards saving labor and capital and the use of intermediate input. Negative fixed input effect may be caused by a decrease in planted area of rice for the diversified crop program, changes in food consumption pattern and for some other use of land (Huang, 1992).

This study has shown that using a variable cost function framework, the growth rate of labor productivity can be decomposed into (1) the total substitution effect, which consists of the effects due to factor price changes and biased technological change and (2) TFP effect, composed of the effects due to scale economies and technological progress. Based on the empirical estimations, the findings of the study may be summarized as follows:

First, it was found that the total substitution effect contributed to the growth of labor productivity much more than the TFP effect did.

Second, negative growth rate of labor input and biased technological change towards labor saving caused negative scale effect.

Third, decreased rice planted area and changed in consumption pattern caused negative fixed input effect.

Fourth, total technological change effect i.e. sum of biased effect and cost reduction effect has contributed about 81per cent, the highest value for all districts and farm sizes.

This study may conclude that the Taiwanese rice sector's major source of labor productivity growth for the 1976-93 period was attributed to the total substitution effect and all these factors which are intimately associated have also been responsible for the increase in the growth rate of labor productivity.

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References

Antle, J. M., & Capalbo, S. M. (1988). An introduction to recent development in production theory and productivity measurement. In S. M. Capalbo and J. M. Antle (Eds.), *Agricultural productivity: Measurement and explanation.* Resources for the Future, Inc., (Washington DC).

Berndt, E. R., & Watkins, G. C. (1981). Energy prices and productivity trends in the Canadian manufacturing sector, 1957-76: Some explanatory results. (Canadian Government Publishing Center, Supply and Services

Canada, Ottawa, Ontario).

Berndt, E. R., & Christensen, L. R. (1973). The translog function and the substitution of equipment, structures, and labor in U.S. manufacturing, 1929-68. *Journal of Econometrics, 1*(1), 81-113. http://dx.doi.org/10.1016/0304-4076(73)90007-9

Blackorby, C., Lovell, C. A. K., & Thursby, M. C. (1976). Extended Hicks neutral technological change. *The Economic Journal, 86*(344), 845-852. http://dx.doi.org/10.2307/2231457

Capalbo, S. M. (1988). A Comparison of econometric models of U.S. agricultural productivity and aggregate technology. In S. M. Capalbo and J. M. Antle (Eds.), *Agricultural productivity: Measurement and explanation.* Resources for the Future, Inc., (Washington DC).

Caves, D. W., Christensen, L. R., & Diewert, W. E. (1982). Multilateral comparison of output, input, and productivity using superlative index numbers. *The Economic Journal, 92*(365), 73-86. http://dx.doi.org/10.2307/2232257

Caves, D. W., Christensen, L. R., & Swanson, J. A. (1981). Productivity Growth, Scale Economies, and Capacity Utilization in U. S. Railroads, 1955-74. *American Economic Review, 71*(5), 994-1002.

Denny, M.S., & Fuss, M. (1983). Intertemporal changes in the level of regional labor productivity in Canadian manufacturing. In A. Dogramaci (Ed.), *Developments in Econometric Analysis of productivity,* (Kluwer-Nijhoff, Boston, MA). http://dx.doi.org/10.1007/978-94-009-7406-7_2

Doi, T. (1985). Insaku rodoseisansei no josho to sono yoin bunseki [A decompositional analysis of increases in labor productivity in rice production]. In S. Sakiura, (Ed.), *Keizai Hatten to Nogyo Kaihatsu [Economic Development and Agricultural Growth in Japan]*. (Norin Tokei Kyokai, Tokyo).

Food Bureau, Taiwan Provincial Government, ROC. Survey Report on Rice Production Costs. Various issues.

Food Bureau, Taiwan Provincial Government, ROC. Taiwan Food Statistics Book. Various issues.

Fuss, M., & Waverman, L. (1981). Regulation and the multiproduct firm: The case of telecommunications in Canada. In G. Fromm (Ed.), *Studies in public regulations,* (The MIT Press, Cambridge).

Hicks, J. R. (1963). *The theory of wages* (2nd ed.). Macmillan, London.

Huang, C-H. (1992). Effects of government programs on rice acreage decisions under rational expectations: The case of Taiwan. *American Journal of Agricultural Economics, 74*(2), 310-317. http://dx.doi.org/10.2307/1242485

Huang, S. W. (1993). Structural change in Taiwan's agricultural economy. *Economic Development and Cultural Change, (The University of Chicago), 42*(1), 43-65.

Kuroda, Y. (1995). Labor productivity measurement in Japanese agriculture, 1956-90. *Agricultural Economics, 12*(1), 55-68. http://dx.doi.org/10.1016/0169-5150(94)00032-W

Kuroda, Y. (1997a). An empirical investigation of the rice production structure in Taiwan, 1976-93, Discussion Paper Series No. 730, (Institute of Policy and Planning Sciences, University of Tsukuba, Japan).

Kuroda, Y. (1997b). Effects of R&E activities on rice production in Taiwan, 1976-93, Discussion Paper Series No. 734, (Institute of Policy and Planning Sciences, University of Tsukuba, Japan).

Liu, P. K. C. (1985). Human resource development and modern economic growth in Taiwan, *Academic Economic Papers, 13*, 336-406.

Mao, Y-K. (1986). Agricultural development policy and performance in Taiwan In Lessons from Taiwan: Pathways to follow and pitfalls to avoid, (Institute of Strategic and International Studies, Kuala Lumpur).

Morrison, C. J. (1993). A microeconomic approach to the measurement of economic performance: Productivity growth, capacity utilization and related performance indicators, (Springer, New York).

Park, A., & Johnston, B. (1995). Rural development and dynamic externalities in Taiwan's structural transformation. *Economic Development and Cultural Change, 44*(1), 181-208. http://dx.doi.org/10.1086/452205

Ray, S. C. (1982). A translog cost function analysis of U.S. agriculture, 1933-1977. *American Journal of Agricultural Economics, 64*(3), 490-98. http://dx.doi.org/10.2307/1240641

Shephard, R. W. (1970). *Theory of cost and production.* Princeton University Press, Princeton, NJ.

Solow, R. (1957). Technical change and the aggregate production function. *Review of Economics and Statistics,*

39(3), 312-320. http://dx.doi.org/10.2307/1926047

Tornqvist, L. (1936). The bank of Finland's consumption price index. *Bank of Finland Monthly Bulletin, 10*, 1-8.

Notes

Note 1. The six regions are Taipei, Hsinchu, Taichung, Tainan, Kaohsiung, and Taitung and the five size classes are 1 (less than 0.5 hectares), 2 (0.5-0.75), 3 (0.75-1.0), 4 (1.0-1.5), and 5 (1.5 and over). The details are to be explained in the next section.

Note 2. In this case, the rice farmer is assumed to equate the marginal revenue to the government-supported rice price, since the output price P includes the government subsidy payments.

Note 3. For a detailed discussion on the inclusion of the revenue share equation in the system of regression equations, see Ray (1982) and Capalbo (1988).

Note 4. Scale economies were not estimated because the test of the hypothesis of constant returns to scale was not rejected. That is, constant returns to scale existed in the Taiwanese rice sector for the study period 1976-93.

Note 5. Indeed, the same estimations were made using the data set for the second crop. The results were very similar in all parameters and economic indicators for the two crops. Thus it may be safe to stick to the analysis based on the data set only for the first crop.

Note 6. Due to the linear-homogeneity-in-prices property of the cost function, one factor share equation can be omitted from the simultaneous equation system for the statistical estimation. In this study, the capital share equation was omitted.

Note 7. These tendencies and the magnitudes of the coefficients are almost the same before and after the re-estimation of the system with the imposition of CRTS restrictions and no size dummies discussed next.

Note 8. Monotonicity and concavity were also checked and satisfied not only at the approximation point but also at all the samples observations.

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Agricultural Productivity and Macro-Economic Variable Fluctuation in Nigeria

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Abstract

The study established the empirical relationship between value of agricultural GDP as the ratio of total GDP (proxy as agricultural productivity) and some key macroeconomic variables in Nigeria. Augmented Dickey-Fuller unit root test and improved ADF-GLS unit root test conducted on the specified time series showed that all series were integrated of order one. The short-run and long-run elasticity of the agricultural productivity with respect to some key macro-economic variables were determined using the techniques of co-integration and error correction models. The empirical results revealed that in the short and long run periods, the coefficients of real total exports, external reserves, inflation rate and external debt have significant negative relationship with the agricultural productivity in the country; whereas industry's capacity utilization rate and nominal exchange rate have positive association with agricultural productivity in both periods. However, per capita real GDP influence on the agricultural productivity was positive and significant only in the ECM model. The empirical results were further substantiated by the variance decomposition and impulse response analysis of the dependent variable with respect to changes in the explanatory variables. Results obtained were in line with economic theory. The findings call for appropriate short and long term economic policy packages that should stimulate investment opportunities in the agricultural sector so as to increase agricultural component in the country's total export. Appropriate policy package to stabilize inflation rate in the country should be implemented. Also incentives should be given to the industrial sector to boast production in order to increase capacity utilization and promote backward integration policy of the sector. Diversification of the country's economy and a drastic reduction in external debt would boost agricultural productivity in the country.

Keywords: agricultural productivity, macroeconomic, variable, fluctuations, Nigeria

1. Introduction

Agricultural sector plays a vital role in the economy development of Nigeria. The agricultural sector contributes significantly to the gross domestic product (GDP) and employed about 86 percent of the rural households in the country (CBN, 2010; Fan *et al.,* 2008 and Akpan, 2012). It is increasingly obvious that improvement in the agricultural development and growth can offer a pathway from rural poverty, but evidence-based macroeconomic policies and instruments are prerequisite. The country's agricultural policies and programmes over the years have been inconsistent, poorly implemented and mostly emerged as ad hoc attempts. Such agricultural policies have stunted the realization of the sector's full potentials. A paradigm shift towards a sound evidence-based policies anchored on sound macroeconomic policies is needed to promote a more equitable and environmental sustainable growth in the agricultural sector. According to the Central Bank of Nigeria (2006), the agricultural sector accounted for about 41.8 percent of the overall growth of the economy in 2006 followed by the non-oil industry (26.1 percent), while crude oil only accounted for 21.9 percent. But until very recently, the sector had not performed as well as it should have, because of several decades of neglect mostly accredited to the misalignment of economic policies in the country. From 1970 to 2000, the sector's productivity grew at 1.7 percent per annum, very low when compared with the country's population growth rate of about 2.7 percent per annum (CBN, 2010). This is one of the key reasons why the country still has one of the highest poverty rates in

the world. Agricultural growth began to accelerate after 2000, and since 2003, the annual growth rate has been above the 6 percent mark, a target set under the National Empowerment and Economic Development Strategy (NEEDS) which is a poverty reduction programme founded in 2004. Agricultural policies under NEEDS were basically designed to allow certain level of protection to domestic investors. Concretely, the policies were translated into tariff escalation and lower import duties on raw materials and relatively high import duties on finished goods which compete with local production. Duty exemptions and concessions were some of the quantitative policy instrument adopted in favour of domestic producers. Despite the macroeconomic incentives to the agricultural sector, the agricultural GDP witnessed a negative growth rate of about -28.21% between 2004 and 2005. However, following the marginal increase in the agricultural output in recent years, many economic analysts have attributed the growth to the expansion in cultivated land which has implication on the sustainability and environment deterioration in the long run (Akinbile and Adekunle, 2000, Okiki *et al.,* 2001, Raufus, 2010 and Udoh *et al.,* 2011). In addition, this growth has not been able to trickle down to the poorest of the poor, and has not helped tackle the problem of unemployment and underemployment of the rural youth (Fan *et al.,* 2008 and Akpan, 2010).

Table 1. Macroeconomic variable fluctuations in various policy regimes in Nigeria.

INDICATOR	Policy periods						
	1970-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005
Inflation rate (%)	14.3	13.0	19.4	20.5	48.9	12.3	15.7
Official Exchange rate (₦/$)	0.66	0.69	0.77	5.90	19.16	54.78	127.84
External Reserve (₦b)	1.19	3.06	1.40	11.98	39.2	361.6	1869.7
Index of Energy Consumption (1985=100)	26.3	64.6	122.8	95.6	95.7	83.3	167.4
Real GDP per capita (₦/person) (1985=100)	177.2	735	3.25	962	674	547	819
Real FPI in Manu. and Processing (₦b)	2.79	3.17	2.74	2.20	1.53	1.09	1.26
Index of Agricultural Production (1990=100)	65.62	56.44	58.74	79.20	121.6	141.5	158.2
Index of Manufacturing Production (1985=100)	32.85	75.42	105.7	135.4	154.7	137.2	145.6
Non oil export (₦m)	358.4	574.9	328.4	2335.1	8468.3	26175.4	87356.4
Av. Industry Capacity Utilization Rate (%)	76.6	71.12	53.58	41.14	35.40	33.59	46.18

Source: Computed by authors, data from Central Bank of Nigeria Statistical Bulletin (2010)

Usually several factors can be said to be responsible for the gloomy performance of the Nigerian agricultural sector. Paramount among these factors is the uncertainty in the macroeconomic environment as presented in Table 1. The macroeconomic environment consists of the fiscal, monetary, exchange rate regimes and trade policies among other policies tended to regulate production activities in the real sectors and other sectors including the agricultural sector. Regrettably, macroeconomic policy outcomes in any economy vary greatly depending in part on the policy targets and instruments employed as well as operating environment (Agu, 2007). Sound macroeconomic policies are important to achieve national development targets through agricultural development (Fan *et al.,* 2008). Macroeconomic variables have serious economic and development implication for the sustenance of agricultural production and stimulation of export. Trade Import restrictions and trade barriers lead to less efficient use of scarce resources. Oil exports have led to large foreign exchange inflows. In turn, the foreign exchange inflows have not only depreciated the value of Nigeria's currency but have also eroded the competitiveness of domestic produced agricultural goods in comparison with low-priced imported goods, leading to a reduction in agricultural activities in the country (Fan *et al., 2008)*. The exchange rate regime adopted during the Structural Adjustment Programme (SAP) neither has not resulted in any meaningful export of agricultural produce over time (Table 1). For instance, in 1993 agricultural export amounted to only 1.7 percentage of the total export in the country (CBN, 2010). More must be done to ensure a favorable macroeconomic environment for pro-poor investments and growth. Many authors (Binswanger, 1989; Kwanashie and Ajilima, 1997 and Killick, 1990) have reported the influenced of macroeconomic variables fluctuations on the agricultural productivity. In Nigeria, Garba (2000) and Akpokodje, (2000) confirmed that

major macroeconomic policy shifts heighten agricultural policy instability in the country. Eyo (2008) established empirical linkages between macro economic growth and agricultural productivity in Nigeria. His results revealed that the exchange rate regime (-ve), nominal interest rate (+ve), government expenditure ((+ve) and foreign private investment ((+ve) in agricultural have significant effects on the index of agricultural output in Nigeria. This study differs from Eyo (2008) study because different measure of agricultural productivity is used and more reliable time series analysis is employed as well as extended macroeconomic variables in the model. Shombe (2008) in Tanzania discovered two-way causality relationship between agricultural GDP and total exports, and a one way causality relationship among manufacturing, export and agricultural GDP. In Cote d'voire and Zimbabwe, Bulanch and Verner, (2006), empirically supported the existence of the positive growth links between agriculture and industry. Memon*et al.,* (2008) found bi-directional Granger-causality relationship between total exports and agricultural GDP in the case of Pakistan.Hye and Zameer (2011) in Pakistan showed a significant positive long run relationship between trade openness and the real agricultural growth. While Salih (2006), present empirical evidence showing a significant long run relationship between agricultural output growth and economic growth that assumes bidirectional causation. It therefore implies that, the resilience of the agricultural sector depends largely on the level of economic growth in the country which is largely hinged on the stability of some key macroeconomic fundamentals. Therefore, this study specifically established the short and the long run links between agricultural productivity and some key macroeconomic fundamentals in the country. Such relationship is momentous and is a reliable tool needed to accelerate productivity in the agricultural sector in the country. The result of this study provides an alternative policy area that could be used to accelerate the sluggish growth rate in the agricultural sector in the country.

2. Research Methodology

2.1 Study Area and Data Source

The study was conducted in Nigeria; the country is situated on the Gulf of Guinea in the sub Saharan Africa. Nigeria lies between 4^0 and 14^0 north of the equator and between longitude 3^0 and 15^0 east of the Greenwich. Nigeria has a total land area of 923,768. 622 squared kilometers and a population of over 140 million (NPC, 2006). Secondary data derived from publications of the Central Bank of Nigeria (CBN) and National Bureau of Statistics was used in the analysis. Data covered the period 1970 to 2010.

2.2 Analytical Techniques

Agricultural productivity equation wasspecified based on the objective of the study as follows:

$$LnAGD_t=\delta_0+\delta_1 LnEXP_t+\delta_2 LnEXR_t+\delta_3 LnINF_t+\delta_4 LnPCR_t+\delta_5 LnCUR_t+\delta_6 LnEXD_t+\delta_7 LnINR_t+\delta_8 LnSAV_t+\delta_9 LnOIL_t+\delta_{10} LnEXC_t+U_t \quad (1)$$

Where;

AGD_t = Agricultural GDP as a ratio of total GDP (Used as a proxy for agricultural productivity)

EXPt = real value of total export (₦m)

EXR_t = real external reserves (₦m)

INF_t = inflation rate (%)

PCR_t = real per capita GDP as a proxy of aggregate demand shock (₦m/person)

CUR_t = industry's capacity utilization rate (%)

EXD_t = external debt as a ratio of GDP

INR_t = interest rate (lending rate)

SAV_t = domestic saving as a ratio of GDP

OILt = oil revenue as a ratio of GDP

EXC_t = nominal exchange rate

U_t= stochastic error term and $U_t \sim$ IID $(0, \delta^2_U)$.

Consumer price index (2003 = 100) was used to convert the nominal values to real values.

3. Results and Discussion

3.1 Unit Root Test

In time series analysis, stationarity of the series is examined by the unit root tests. One of the most commonly used tests in the literature to ascertain the stationarity level of series are ADF test developed by Dickey and

Fuller in (1979) and ADF-GLS unit root test developed by Elliott, Rothenberg and Stock in (1996) which is an improvement of the original ADF test. These two tests were used in this study for determining the stationarity level of series. PC-Give 10 and gretl econometric softwares were used to carry out the tests and the result is presented in Table 2. The result for both ADF and ADF-GLS unit root tests show that most specified variables were non stationary at levels but stationary at the first difference. However, the ADF-GLS unit root test (without trend) shows that all variables were non stationary at level. The result implies that the time series should be tested for the existence of cointegration among them (Johansen, 1988 and Johansen and Juselius, 1990).

Table 2. ADF and ADF-GLS unit root teston variables explained in equation 1

	ADF unit root test						ADF-GLS unit root test					
	With Trend			Without Trend			With Trend			Without Trend		
Logged Variables	level	1st diff.	OT	level	1st diff.	OT	level	1st diff.	OT	level	1st diff.	OT
AGD	-3.49	-7.03*	1(1)	-1.81	-6.80*	1(1)	-2.21	-7.21*	1(1)	-1.47	-6.57*	1(1)
EXP	-2.90	-7.83*	1(1)	-1.96	-7.94*	1(1)	-2.89	-7.67*	1(1)	-1.19	-7.03*	1(1)
EXR	-2.60	-6.46*	1(1)	-1.87	-6.55*	1(1)	-2.62	-6.62*	1(1)	-1.25	-6.62*	1(1)
INF	-3.85	-6.81*	1(1) 1(1)	-3.98*	-	1(0)	-3.26	-6.95*	1(1)	-2.44	-6.85*	1(1)
PCR	-1.96	-6.04*	1(1)	-2.43	--5.71*	1(1)	-1.56	-6.11*	1(1)	-0.45	-5.78*	1(1)
CUR	-0.69	-4.02*	1(1)	-1.24	-3.95*	1(1)	-0.85	-4.11*	1(1)	-0.98	-4.00*	1(1)
EXD	-0.98	-5.99*	1(1)	-1.41	-5.79*	1(1)	-1.23	-6.03*	1(1)	-1.33	-5.82*	1(1)
INR	-1.91	-8.72*	1(1)	-1.62	-8.70*	1(1)	-2.05	-8.91*	1(1)	-1.19	-8.78*	1(1)
SAV	-1.67	-5.65*	1(0)	-1.68	-5.79*	1(1)	-1.73	-5.71*	1(1)	-1.54	-5.51*	1(1)
OIL	-6.24*	-	1(1)	-5.52*	-	1(0)	-4.29	-	1(0)	-2.19	-5.80*	1(1)
EXC	-2.60	-5.05*	1(0)	0.03	-5.11*	1(1)	-1.58	-5.17*	1(1)	0.76	-4.92*	1(1)
Residual	-5.38*	-		-5.46*	-	1(0)	-5.49*	-	1(0)	-5.42*	-	1(0)
1%	4.20	-4.21		-3.60	-3.61		-3.77	3.77				

Note: OT means order of integration. Critical value (CV) is defined at 1% (*) probability level. Variables are as defined in equations (1) and are expressed in log.

3.2 Cointegration Test

The concept of cointegration as developed by Granger (1981) involved the determination of the static or long-run associations among non-stationary time series. The pre-condition for applying the standard procedure of the cointegration tests to any series is that the variables in consideration must be integrated of the same order or non-stationary individually. The study applied the Engle and Granger two-step technique and Johansen cointegration approach to examine cointegration relationship among time series.

Table 3. Results of Johansen Cointegration Test (unrestricted constant)

Rank	Eigen value	Trace Test	P-value	Lmax. Test	P-value
0	0.972	499.31	[0.000]	139.02	[0.000]
1	0.909	360.29	[0.000]	93.60	[0.000]
2	0.773	266.68	[0.000]	57.86	[0.052]
3	0.760	208.83	[0.000]	55.73	[0.017]
4	0.696	153.09	[0.000]	46.41	[0.044]
5	0.601	106.69	[0.006]	35.84	[0.141]
6	0.509	70.85	[0.039]	27.77	[0.231]
7	0.380	43.09	[0.131]	18.66	[0.454]
8	0.304	24.42	[0.189]	14.17	[0.365]
9	0.193	10.25	[0.267]	8.35	[0.352]
10	0.048	1.899	[0.168]	1.89	[0.168]

Note: The null hypothesis of no cointegration is rejected at 1% probability level

The result of the Engle and Granger two-step technique of the cointegration regression and the stationarity tests for the residual (ECM) generated in equation 1 is presented in Table 2. The results show that at the 1% probability level of significance, the Engle–Granger cointegration tests reject the null hypothesis of no cointegration. Hence, there exists a long run equilibrium relationship between the agricultural productivity and some major macroeconomic variables in Nigeria. For the Johansen cointegration approach, the trace and maximum eigenvalue test statistics were significant at various rank levels. The result as presented in Table 3 means that the calculated trace test and maximum eigenvalue test statistics are greater than the critical values at 10%, 5% and 1% probability levels. This implies that there is cointegration relationship among the specified variables. Table 4 presents the long run estimates for the equation 1. The estimated coefficients represent the agricultural productivity elasticity with respect to each specify macroeconomic variable.

Table 4. Long-run equation of real value of loan guaranteed by ACGSF in Nigeria

Variables	Coefficient	Std. error	t-value
Constant	1.328	0.618	2.147**
LnEXP	-0.206	0.057	-3.617***
LnEXR	-0.127	0.025	-5.084***
LnINF	-0.069	0.019	-3.459***
Ln PCR	0.047	0.034	1.393
LnCUR	0.343	0.098	3.483***
LnEXD	-0.045	0.018	-2.507**
LnINR	0.041	0.089	0.459
LnSAV	-0.009	0.061	-0.147
LnOIL	-0.001	0.071	-0.012
Ln EXC	0.166	0.020	8.126***
*R^2 = 0.864 Log-likelihood = 47.25 Akaike Criterion = -72.49 Hannan-Quinn = -65.63 DW- test = 1.750 F-statistic = 19.072*** Schwarz Criterion = -53.65 RESET test = 3.865**			

Note: Asterisks * and ** represent 10% and 5% significance levels respectively. Variables are as defined in equation (1).

3.3 Generating Optimal Lag- Length for the Co-Integrating Variables

Appropriate lag length for the co-integrating series is needed to generate the error correction model (ECM) for

the specified equation (i.e. equation 2). The following information criteria were used to select appropriate lag length for the co-integrating series: there are Akaike criterion (AIC), Schwarz Bayesian criterion (BIC) and Hannan- Quinn criterion (HQC). The test result as shown in Table 5 indicates that the optimum lag length appropriate for the specified variables is at the second lag indicated by asterisks in AIC and HQC information criterion. The lag length that minimizes the information criteria is 2. This means that in generating the short run dynamic model for agricultural productivity with respect to key macroeconomic variables in Nigeria, the optimum lag length of time series should be kept at 2 in order to obtain a more interpretable parsimonious ECM model.

Table 5. Optimal lag length of variables used in the analysis

Lags	loglike	p(LR)	AIC	BIC	HQC
1	*105.09*	*0.000*	*1.380*	*7.011**	*3.400*
2	*272.58*	*0.000*	*-1.004**	*9.787*	*2.868**

Note: Asterisk means optimum lag length.

3.4 Error Correction Model for Agricultural Productivity in Nigeria

Following the Granger Representation Theorem, we specify the ECM model for the co-integrating series in the study. The primary reason for estimating the ECM model is to capture the dynamics in the agricultural productivity equation in the short-run and to identify the speed of adjustment as a response to departures from the long-run equilibrium. The general specification of the ECM that was estimated for the agricultural productivity in Nigeria is shown below:

$$\Delta Loan_t = \delta_0 + \delta_1 \sum_{i=1}^{1} \Delta Loan_{t-1} + \delta_2 \sum_{j=1}^{1} \Delta X' s_{t-1} + \delta_3 ECM_{t-1} + \varepsilon_{1t} \quad (2)$$

The variables X's are as defined previously in equation (1) and the coefficient ($\boldsymbol{\delta_3}$) of the ECM_{t-1} ($-1 < \boldsymbol{\delta_3} < 0$) measures the deviations from the long-run equilibrium in period (t_{-1}). In order to obtain a parsimonious dynamic ECM for the agricultural productivity equation, the study adopted Hendry's (1995) approach in which an over parameterized model is initially estimated and then gradually reduced by eliminating insignificant lagged variables until a more interpretable and parsimonious model is obtained. The result of the exercise is presented in Tables 6.

The slope coefficient of the error correction term is negative and statistically significant at 1% probability level. The result validates the existence of a long-run equilibrium relationship among the time series in the agricultural productivity equation, and also indicates that the agricultural productivity is sensitive to the departure from it equilibrium value in the previous periods. The slope coefficient of the error correction term (*0.6076)* represents the speed of adjustment and also is consistent with the hypothesis of convergence towards the long-run equilibrium once the agricultural productivity equation is shocked. The coefficient of ECM_t suggests that in the absence of variation in the specified macroeconomic variables in the short run, that about 60.76 percent of the divergence between actual and equilibrium agricultural productivity is corrected annually in the country.

Table 6. ECM estimates for equation of real value of loan guaranteed by ACGSF in Nigeria (equation 2)

Variables	Coefficient	Robust Std. error	t-value
Constant	-0.007	0.0134	-0.536
*Δ*LnAGDt-1	-0.0870	0.1224	-0.711
*Δ*LnEXPt	-0.0974	0.0372	-2.622**
*Δ*LnEXRt	-0.1246	0.0177	-7.029***
*Δ*LnINFt	-0.0429	0.0147	-2.923***
*Δ*LnPCRt	0.0750	0.0355	2.116**
*Δ*LnCURt	0.3730	0.1367	2.728**
*Δ*LnEXDt	-0.0279	0.0160	-1.735*
*Δ*LnINRt-1	0.0213	0.0606	0.352
*Δ*LnSAVt-1	-0.0816	0.0633	-1.290
*Δ*LnOILt-1	0.0037	0.0425	0.086
*Δ*LnEXCt	0.1471	0.0445	3.306***
ECM_{t-1}	-0.6076	0.1659	-3.661***

R^2=0.734; F-statistic=5.977; Hanna-Quinn= -79.81; SchwarzCriterion = -65.94; Akaike Criterion = -87.57; Log-likelihood = 56.78; RESET test = 1.249; DW- test = 1.86; Normality test = 8.816****

Note: Asterisks *,** and *** represent 10%, 5% and 1% significance levels respectively. Variables are as defined in equation (1).

The diagnostic test for the ECM model revealed R^2 value of 0.734 which means that the specified explanatory time series explained about 73.40% of the adjusted total variations in the agricultural productivity. The F-statistic of 5.977 is significant at 1% probability level, indicating that the R^2 is significant and this implies that the equation has goodness of fit. The Durbin-Watson value of 1.86 however indicates that there exists a minor serial correlation. The ECM model has been shown to be robust against residual autocorrelation. Therefore, the presence of autocorrelation does not affect the estimates (Laurenceson and Chai, 2003).

The ECM model reveals that the agricultural productivity has a significant negative inelastic relationship with the real value of total export (EXP) in the country. The result is replicated in the long run period too. The reason for the result could be linked to the fact that; greater proportion of the country's exports is non-agriculture. As such increase in exports will means increase in non-agricultural based exports and consequently increase neglect of the agricultural sector in the country.

The slope coefficients of inflation both in the short and long run periods are negative and significant. This implies that agricultural productivity has a significant negative relationship with the rate of inflation in the country. The result satisfy the a priori expectation because increase in inflation will raise the price of agricultural commodities which could result in reduction in agricultural commodity demand and supply both in the short and long run periods.

The result also shows that the agricultural productivity has a significant negative inelastic correlation with the external reserve (EXR) in the country. It implies that as the country's external reserve increase, the agricultural productivity decreases. The result is however surprising; but we attempt to explain the cause of the outcome in two ways as follows: the first is that increase in external reserve will promote importation. This might introduced unhealthy competition in the domestic environment. As expected the infancy nature of our agricultural production activities will decline. The second reason is based on the fact that increase in the external reserve might indicate the present of insufficient investment opportunities in the real sector of the economy. This could be interpreted to mean that the productive sector might be producing below the optimum or frontier level and are not adequately generating investment opportunities to justify government financial investment. As a consequent, government as a policy could decide to save the excess revenue rather than injecting such in agriculture. This action has the tendency of decreasing the agricultural production in both periods.

In addition, increase in the real per capita income increases the agricultural productivity in both short and long

run periods in the country. The relationship however was only significant in the short run period. The result is in line with the a priori expectation, as increase in PCI increases the purchasing power of the populace. This has a tendency to stimulate demand and supply of agricultural commodity in the country. The coefficient of industrial capacity utilization rate (CUR) is positive and statistically significant in both short and long run periods. This implies that 10% increase in the industrial capacity utilization rate, would result in about 37.30% and 34.30% increase in agricultural productivity in short and long run periods respectively. The finding suggests that the backward integration policy of the manufacturing sector in the country actually works. This means that agro based manufacturing sub sector to an extent depended on the raw materials from the domestic agricultural sector. The result reveals that there is an additional incentive to both foreign and domestic investors in the agricultural sector in the country.

Furthermore, the coefficient of external debt (EXD) has a significant negative association with the agricultural productivity both in the short and long run periods. The result corroborates the *apriori* expectation. This is because increase in EXD will likely induced deficit budget which could lead to under allocation of resources to other sectors in the economy. This would likely result in the decline in the productivity in some real sectors of the economy. In Nigeria, some aspect of our agricultural production is still enjoying some form of subsidies from the governments. The subsidy programme can only be sustained if the economy is self reliance. Continuous borrowing to finance development in the real sector especially the agricultural sector might not lead to sustain productivity in the country. This is due to the fact that our technology is still at the infancy level and agricultural sector dominated by small scale farmers. Finally, the agricultural productivity has a positive inelastic influenced on the nominal exchange rate (EXC) in both periods. This means that increase in the nominal exchange rate increases the agricultural productivity in the country. The possible reason for the result is that increase in the nominal exchange rate (₦/$) will constrain importation by depreciating the domestic currency (₦) against appreciating US dollar. The reduced importation decrease unhealthy competition at the domestic environment and also creates incentives for farmers to increase productivity.

The causality test (using F-statistic) for both short and long run period models reveal that causality runs from macroeconomic variables to agricultural productivity (unidirectional). This means that total variation in agricultural productivity are induced by changes in macroeconomic variables

3.5 Variance Decomposition of Agricultural Productivity (AGD)

An examination of the variations in the agricultural GDP used as a proxy of agricultural productivity in both short and long run periods is further supplemented by the variance decomposition analysis results presented in Table 7. The result shows the relative contribution of various macroeconomic variables to the variation in the agricultural productivity. The result reveals that in the second period, industry capacity utilization (CUR), interest rate (INR) and oil revenue (OIL) were the major exogenous contributors to changes in the agricultural productivity (AGD). From the result, "own shocks" constitute a significant source of variation in agricultural productivity both in the short and long run forecast variance errors, over the 10 year horizon. In the long run, per capita real GDP, interest rate, and inflation rate are the major contributors to error variance in the agricultural productivity in the country. This result corroborates the findings earlier reported in the long and short run model analyses.

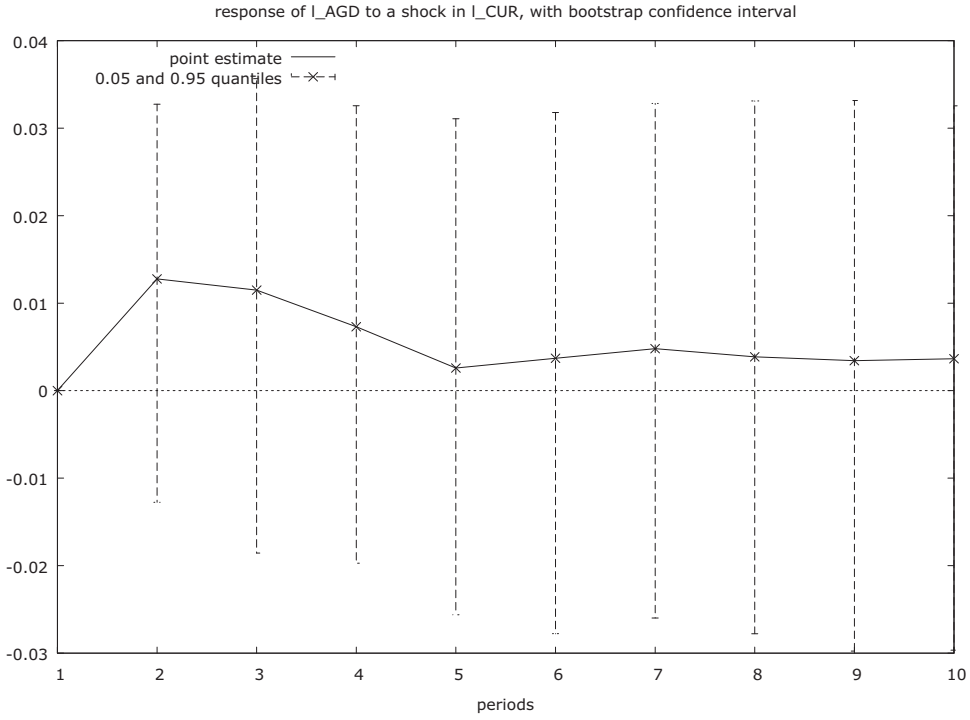
Table 7. Variance decomposition

Period	S.E	AGD	CUR	INF	SAV	EXD	OIL	PCR	EXC	EXR	INR	EXP
1	0.10	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.14	96.13	0.84	0.24	0.03	0.01	0.48	0.17	0.10	0.11	0.83	0.06
3	0.16	94.89	1.12	0.18	0.15	0.01	0.37	1.92	0.39	0.13	0.75	0.07
4	0.19	94.79	0.99	0.27	0.11	0.04	0.28	2.01	0.32	0.13	0.99	0.06
5	0.21	94.56	0.80	0.53	0.09	0.04	0.25	2.19	0.26	0.13	1.09	0.05
6	0.23	94.37	0.69	0.62	0.09	0.04	0.24	2.44	0.22	0.13	1.12	0.04
7	0.25	94.17	0.64	0.67	0.08	0.03	0.22	2.64	0.19	0.13	1.19	0.03
8	0.27	94.01	0.58	0.74	0.07	0.04	0.20	2.78	0.16	0.14	1.24	0.03
9	0.28	93.88	0.53	0.81	0.07	0.04	0.19	2.90	0.15	0.14	1.27	0.03
10	0.29	93.77	0.49	0.85	0.07	0.04	0.18	3.00	0.14	0.14	1.29	0.02

Source: Compiled by authors

The analysis of variance decomposition shows that industrial capacity utilization rate, per capita real GDP and interest rate are the most important factors that affect agricultural productivity in both periods in Nigeria.

To complement the analysis on the Variance Decomposition analysis, we further generate the Impulse Response Functions, as described in figure 1 to 3. Impulse Response Functions produced a time path of dependent variables attributed to shock from the explanatory variables. The result reveals that for the agricultural productivity, most shocks from the explanatory variables makes the impulse responses dies out to zero. This substantiates the fact that the system of equation developed in ECM and long run model, is a stable system. Furthermore, from figure1-3, the directions of agricultural productivity responses to innovations in the system are theoretically reasonable in most cases. The result reveals that a positive shock in the industrial capacity utilization stimulates agricultural productivity positively in both short and long run periods. However, the response seems to be consistent in the long run implying a stable relationship in the long run period. The result revalidates the earlier results reported in this study and agree with the economic thought given the fact that Nigeria over the years had promoted backward integration policy of the industrial sector to agricultural sector. The response of agricultural productivity to shock (increase) in external debt is negative in both short and long run periods. The response was close to zero in both short and long run periods implying a stable relationship in both time horizons. Also the response of agricultural productivity to changes (increase) in the real per capita income (PCR) is positive in all periods. The response took a sharp acceleration from period 1 to 3 and thereafter assumes almost constant fluctuations. However the response was further away from the origin signifying increasing instability in the long run period.



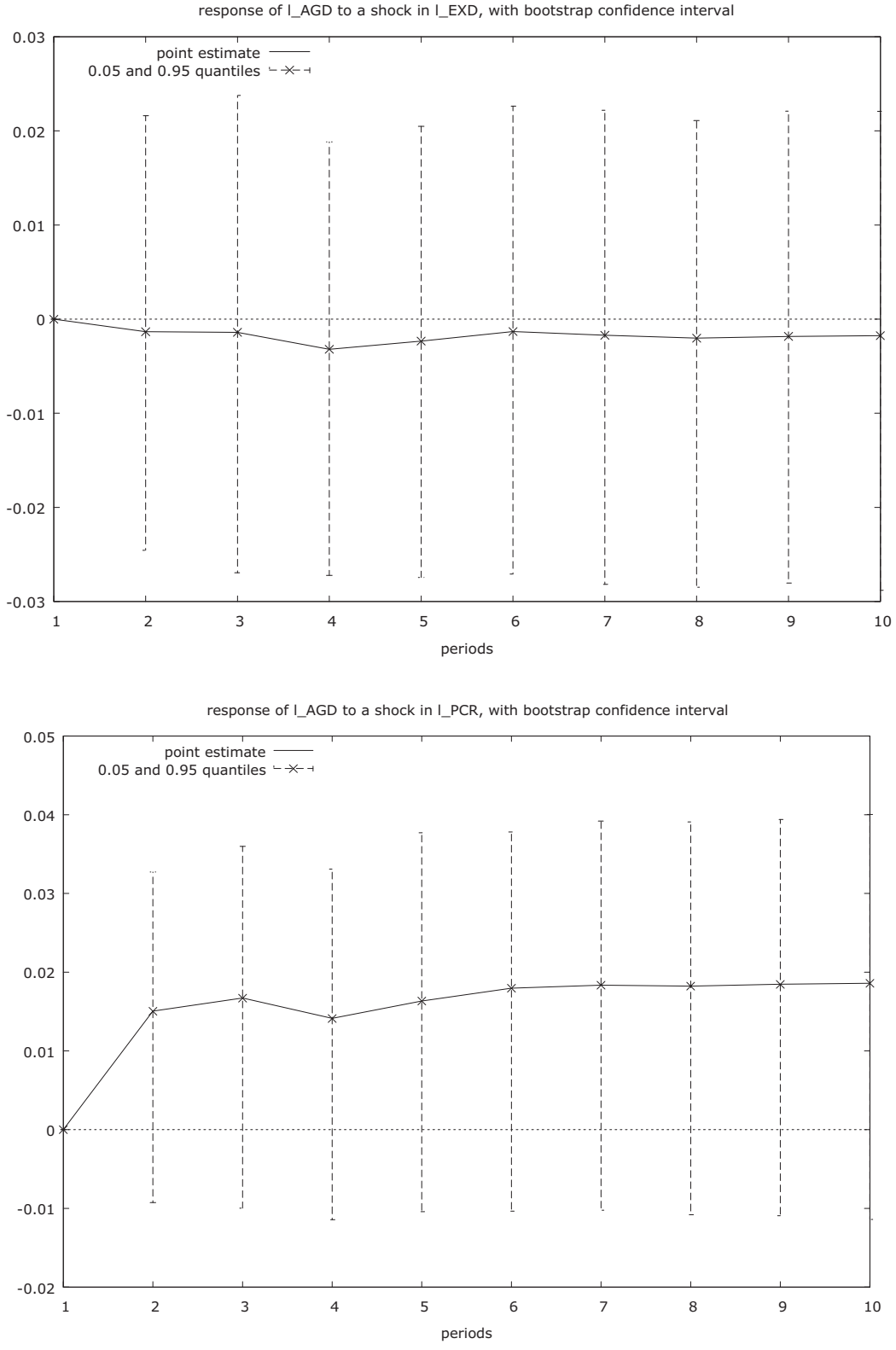


Figure 1.

4. Summary and Recommendations

The study established the relationship between agricultural productivity and key macroeconomic variables in

Nigeria using short and long run model methodologies. The data properties was analyzed to determine the stationarity of time series using the Augmented Dickey-Fuller unit root test and improved ADF-GLS unit root test. The result indicates that the series used in the analysis were I(1). The results of the Cointegration test based on the Engle-Granger two-step method and Johansen's procedure indicated the existence of Cointegration between the agricultural productivity and macroeconomic variables in the country. The ECM error term had the appropriate sign and was statistically significant at 1% probability level indicating a quick convergence to equilibrium in each period, with intermediate adjustments captured by the differenced terms. The findings show that some key macroeconomic fundamentals in Nigeria's economy interact in each period to re-establish the long-run equilibrium in the agricultural productivity following a short-run random disturbance. The empirical result from the estimation of the long run agricultural productivity equation in the country revealed significant inelastic relationship with respect to the total export, external reserve, inflation rate, and external debt; while industrial capacity utilization rate and nominal exchange rate of naira to US dollar have significant positive relationship. On the other hand, short run model for agricultural productivity reveals significant negative inelastic correlation with respect to total export, external reserve, external debt and inflation rate; while per capita real GDP, industrial capacity utilization and nominal exchange rate have positive inelastic influenced. Further analysis based on the variance decomposition and impulse response analysis revalidates the earlier results and provided more facts on the behavior of agricultural productivity over time. The result reveals that most macroeconomic variables produced impulse response in the dependent variable that approaches stability in the long run periods.

The findings call for stimulation of investment opportunities in the agricultural sector so as to increase agricultural component in the country's total export. Appropriate policy package to reduce or stabilize inflation rate in the country should be implemented. Also incentives should be given to the industrial sector to boast production in order to increase capacity utilization and promote backward integration policy of the sector. Diversification of the country's economy and a drastic reduction in external debt would boost agricultural productivity in the country and enhances resource allocation to sectors in the economy. Finally, the study supports the present deregulation or market determined nominal exchange rate system in the country, because it acts as a protector to the domestic investors against unhealthy competition from cheap imports.

References

Agu, C. (2007). What does the Central Bank of Nigeria Target? An analysis of monetary policy reaction functions in Nigeria. Final report submitted to the African Economic Research Consortium, Nairobi, Kenya.

Akinbile, M., & Adekunle, A. (2000). Land Administration in Nigeria: case studies of implementation of land use decree (Act) in OgunOndo and Oyo State of Nig. *Agricultural Administration, 17*(1)*,* 21-31.

Akpan, S. B. (2010). Encouraging Youth Involvement in Agricultural Production and Processing in Nigeria. *Policy Note*, *29*, International Food Policy Research Institute, Washington, D.C.

Akpan, S. B. (2012). Analysis of Food Crop Output Volatility in Agricultural Policy Programme Regimes in Nigeria. *Developing Country Studies, 2*(1), 28-35.

Akpokodje, G. (2000). The Effect of Export Earnings Fluctuations on Capital Formation in Nigeria. African Economic Research Consortium. *Research paper,* RP103 October 2000, Nairobi, Kenya.

Binswanger, H. (1989). The Policy Response of agriculture. In: Stanley F. and D. de Tray (Eds.), *Proceedings of the World Bank Conference on Development Economic*s. Washington DC. pp: 121-53.

Bulanch, N., & Verner, D. (2006). *Shared Growth versus the Dual Economy Module: Evidence from Cote d'Ivoire, Ghana and Zimbabwe*. African DevelopmentBank.

CBN. (2006, 2008 and 2010). *Statistical Bulletin of Central Bank of Nigeria*. http/www.cbn.org/out/publications.

Elliott, G. T., J. Rothenberg, & J. C. Stock. (1996). Efficient tests for an autoregressive unit root. *Econometrica 64,* 813-836. http://dx.doi.org/10.2307/2171846

Eyo, E. O. (2008). Macroeconomic Environment and Agricultural Sector Growth in Nigeria. *World Journal of Agricultural Sciences, 4*(6), 781-786.

Fan, S., B. Omilola, V. Rhoe, & Sheu A. S. (2008). *Towards a Pro-Poor Agricultural growth strategy in Nigeria.* International Food Policy Research Institute. Brief No. 1.

Garba, P. K. (2000). An Analysis of the Implementation and Stability of Nigerian Agricultural Policies. *1970-1993 African Economic Research Consortium Research Paper, 101*. Nairobi, Kenya.

Granger, C. W. J. (1981). Some properties of time series data and their use in econometric model specification, *Journal of Econometrics, 16,* 121-130. http://dx.doi.org/10.1016/0304-4076(81)90079-8

Hendry, D. F. (1995). *Dynamic Econometrics*, Oxford: Oxford University Press.http://dx.doi.org/10.1093/0198283164.001.0001

Hye, Q. M. A., & Zameer J. (2011). Trade, human capital and agricultural sector growth of Pakistan economy. *African Journal of Agricultural Research, 6*(27), 5999-6007

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration-with applications to the demand for money. *Oxford bulletin of economicsand statistics*, *52*(2), 169-210.

Johansen, Soren. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, *12*(2/3), 231-254.

Killick, T. (1990). Markets and Government in Agricultural and Industrial Adjustment. *ODI Working Paper,* 3, London.

Kwanashie, M., A. Garba, & I. Ajilima. (1997). Policy Modeling in Agriculture: Testing the response of agricultural adjustment Policies in Nigeria. *AERC Research Paper RP 57.*

Laurenceson, J., & Chai, J. C. H. (2003). *Financial Reform and Economic Development in China*. Edward Elgar, Cheltenham.

Memon, M. H, Baig W. S, & Ali M. (2008). *Causal Relationship Between Exports and Agricultural GDP in Pakistan*. Available at http://mpra.ub.uni-muenchen.de/11845/.

National Population Commission (NPC). (2006). *National Census Data.* www.population.gov.ng/. Retrieved 10-01-2012.

Okike, I., M. A. Jabbar, V. Mayong, J. W. Smith, J. A. Akniwumi, & S. K. Ehui. (2001). Agricultural intensification and efficiency in the West African savannahs; Evidence from northern Nigeria. *Socio Economic and policy Research working paper, 33*. International Livestock Research Institute.

Raufu, M. O. (2010). Pattern of Land use among selected crop farmers in Osun State. *Research Journal of Soil and water management, 1*(1), 1-4.

SalihTuran Katircioglu. (2006). Causality between agriculture and economic growth in a small nation under political isolation: A case from North Cyprus. *International Journal of Social Economics, 33*(4), 331–343. http://dx.doi.org/10.1108/03068290610651643

Shombe, N. H. (2008).Causality Relationships between Total Exports with Agricultural and Manufacturing GDP in Tanzania. IDE Discussion Paper.No. 136.

Udoh, E. U., S. B. Akpan, & E. R. Effiong. (2011). Economic Analysis of Land Allocation Use and Intensification among Arable Crop Farmers in Uruan Local Government Area of Akwa-Ibom State, Nigeria. *Journal of Economics and Sustainable Development, 2*(11&12), 1-10.

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The Measurement of Ocean Scientific and Technological Progress Contribution in China

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Abstract

Marine science and technology, which supports the development of marine economy, has entered the frontier of the international science and technology the effect is becoming increasingly evident. From the perspective of the role of marine S&T on the development of marine economy, this paper builds measurement model basing on C-D production function and Solow residual method to calculate the contribution rate of marine scientific and technological progress. It turns out that marine scientific and technological progress contributes approximately 23.35% to the entire marine economy during 2001 and 2010. This paper also analyzes the factors influencing the contribution rate marine scientific and technological progress, and then provides several policy proposals.

Keywords: ocean scientific and technological progress, contribution, C-D production function, solow residual method

1. Background of the Study

"Countries outstanding in the world first sing in the oceans, those who decline first lose in marine." Marine science and technology is increasingly becoming an important content of the development of national marine programs. Marine science and technology has entered the forefront of global technology competition and seizing the "high ground" of marine science and technology has become the main characteristic of struggle for the modern maritime rights and interests. All technology used for marine development of is almost capital-intensive and knowledge-intensive high and new technology. Some maritime powers of the world, such as the United States, Japan, Britain and France, attach great importance to the development of marine high-tech and investing a lot of money and human resources in marine high-tech. Progress of marine science and technology contributes more than 50% to the development of marine economy.

China pays more and more attention to the marine science and technology. China released the "China's Ocean Agenda of 21th Century" and Blue Book of "Marine Technology Policy", formulated "Outline of Implementation of National Revitalizing the Ocean through Science and Technology of Ninth Five-Year Program and 2010" and "National Outline of Marine Economy Development Plan", promulgated and implemented "Outline of National Marine Science and Technology Development Plan of Eleventh Five-Year" and "Outline of National Revitalizing the Ocean through Science and Technology Plan (2008-2015). China brings marine research into the national "907 Program" and "863 Program", increases the input of marine science and technology, emphasizes talent training on marine science and technology, and intensifies efforts to technology transformation of marine science and technology, comprehensive strength of the marine science and technology continuing to improve. Driven strongly by marine science and technology, the output of China's major marine industries increased to 3.8439 trillion RMB in 2010 from 0.1707 trillion RMB in 1994, an increase of more than 20 times. In 2010, gross marine product shares 9.7% of GDP and the marine economy has an increasingly prominent position in the national economy.

Although China's marine science and technology has made a great progress and the marine economy has got a considerable development, the contribution rate of the marine scientific and technological progress on the development of marine economy is still relatively low, still with a big gap with the world's maritime powers. Therefore, the research on contribution of marine science and technology meets the requirements of national strategy of strengthening the country through the ocean at present and has obvious practical significance for improving contribution rate of the marine scientific and technological progress, developing of marine economy

and building a maritime power.

1.1 Literature Review of Contribution Rate of Scientific and Technological Progress

Abroad, Tinbergen, a Dutch economist, (1942) first defined the problem of total factor productivity, listed the time trend with capital and labor inputs and constructed one of the first formulas of neoclassical theory. Davis (1954) first clearly proposed the connotation of total factor productivity and pointed out that total factor productivity should be estimated according to all input elements, and therefore known as the founder of total factor productivity. Subsequently, Fabulikan and Kendrick made a further supplement for the meaning of productivity.

Solow (1957) took technological progress into the production function, constructed the relationship among output growth rate, the input factors (capital, labor) growth rate and total factor productivity growth rate in quantity. On the Solow model, Dennison further depictured decomposition of the factors that affect total factor productivity as improvement of the allocation of resources, economies of scale and the advancement of knowledge, and used data of U.S. to show that the advancement of knowledge to explain about 2/3 of the contribution of technological progress on economic growth. In 1970s, Jorgenson, a U.S. economist, proposed beyond the logarithmic total production function, improve the estimation of technical progress to a new level. Griliches (1986) studied the data of about 1000 American largest manufacturing enterprises during 1957 to1977, and the results showed that investment in science and technology played an important role in improving productivity, of which investment in R & D played a particularly important role. Coe and Helpman (1995) studied the relationship of investment in science and technology and total factor productivity with a sample of 22 countries.

In the domestic, the quantitative study of the contribution rate of technological progress in China began in the early 1980s. Shi Qingqi, Qinbao Ting (1985), proposed the calculation model of the contribution rate of industrial structure and technological progress, introduced a variety of parameters to measure the correspondence relationship between the input and output in the national economy and the scientific and technological progress. According to the intrinsic relationship between the scientific and technological progress and efficiency, Feng Yingjun and Li Chenghong (1992, 1999), proposed equal efficiency surface method which is used to calculate contribution rate of technological progress. According to different characteristics of the logging industry and the business forestry, Huang Heyu and Li Zhiyong (1995), using production function method and the analytic hierarchy process analysis respectively, measured the contribution rate of technological progress and conversion rate of forestry achievements. Zhao Dawei (1998) using the method of Jiang Zhaohua, estimated the contribution rate of the industrial economy of China from 1953 to 1993. Wu Wenjiang (1999) proposed the possibility of special rate of technological progress with DEA. Wang Tianying (2003) measured the contribution rate of national science and technology from 1981 to 2002 based on the hypothesis of loosening constant returns to scale. Li Xieyi and Guo Yajun(2007) measured the contribution rate of scientific and technological progress of Shanxi Province. Wang Xiongjun Guo Xiaoqun (2008) measured the contribution rate of scientific and technological progress of Jiangxi Province on the basis of considering the cumulative effect and the lag effect of the scientific and technological progress. Yu Jie, Liu Runsheng and Cao Yan (2009) make a quantitative analysis of the contribution rate of China's scientific and technological progress based on the DEA method, using non-parametric DEA-the Malmquist index approach. Zhou Shaosen and Hu Delong (2010) proposed the scientific and technological progress is reflected by five major factors such as human capital, research and development, economic benefits of energy per unit, adjustment of the industrial structure, and the degree of market and on this base made an empirical analysis of the contribution of each factor on China' economic growth from 1980 to 2007.

1.2 Literature Review of Contribution Rate of Marine Scientific and Technological Progress

There are many researches on contribution rate of marine scientific and technological progress at present at home and abroad, but there are few specific researches on marine areas which are scattered among domestic scholars' research on the marine economy. Liu Xisong and Ye Xiangli (2004) mentioned that the current contribution rate of scientific and technological progress on the marine economy has been more than 50% in developed countries. Ye Xiangdong (2006) pointed out the contribution rate of marine technological progress has reached more than 80% in the United States, Japan, Britain, France and some other countries and the contribution rate of marine technological progress has reached 45% in China. Ma Zhilong and Zhang Li (2007) pointed out that technological innovation has contributed up to 80% or so in the development of marine economy in developed countries, while it is only 30% in China. Sun Linjie and Wu Zhuoliang (2008) pointed out that there is a gap between marine economic development in China and that of developed countries and contribution

rate of marine science and technology was 3.4%, which is below the level of 14% -17% in developed countries of marine economy, less the world's average of 5%. Liu Dahai and Li Long (2008), based on "Solow growth rate equation method", measured the contribution rate of marine scientific and technological progress in the period of China's Tenth Five-Year, and the average of the contribution rate of marine scientific and technological progress in the period of China's Tenth Five-Year is 35%. Qiao Junguo (2010) pointed out that China's marine scientific and technological progress leads new marine industries and promotes optimization of marine industrial structure.

In summary, in the existing research on contribution rate of scientific and technological progress, there are many different ways to measure contribution rate of scientific and technological progress with advantages and disadvantages, of which the most commonly used in terrestrial studies is the Solow balance method. There are few researches on contribution rate of marine scientific and technological progress and there are significant differences among the conclusions. Most researches did not give the data source, and calculation method. Therefore, using reasonable methods to get the contribution rate of marine scientific and technological progress and the correctly assessing of the contribution of marine science and technology is very tight, with very significant meaning and value.

2. Data and Methodology

2.1 The Collection and Processing of Data

2.1.1 Statistics Caliber Choice for Each Index

Economic indexes such as output, capital amount, and the amount of labor must have the unified regulations when measuring the influence of marine science and technology progress on ocean economic growth are being measured, otherwise, it will turn out different results, lack of comparability.

(1) Determination of the output. At present economic development scale, speed and level are mostly reflected by GDP. Therefore, the total output of marine production is taken as the substitution index in this article.

(2) Determination of labor capacity. The caliber of related ocean employment is adopted in course of the study.

(3) Determination of capital input. Capital inputs are obtained from the result that proportion of the ocean GDP in GDP is multiplied by the total investment amount for fixed assets.

2.1.2 Data Collection and Processing

There is hysteresis quality in the role of science and technology advance during economic growth, therefore a cycle measurement is more reasonable for contribution rate of marine science and technology advance. Due to inconformity of marine economic data statistics caliber, the ocean GDP, ocean industries added value, marine capital investment, etc. are subject to base determination processing before report, and the basis point is the year of 2001 under the condition that the calculated result is not influenced. Among them, fixed base index of the marine industry added value is converted from GDP based on the basis point of 1978 in *China statistical yearbook*, fixed assets investment convert index is from the fixed assets index based on the basis point of 1991 in *China statistical yearbook*.

2.2 Determination of the Model Parameters for Marine Science and Technology Progress

2.2.1 Assumption of the Solow Residual Method in the Ocean Output

Through Solow's strict mathematical derivation for the production function of output growth type, "growth residual value" is called for growth produced by other non-input elements besides material input elements in output growth. The residual value contains the effect of variable factors such as technology innovation, human capital accumulation, an increase in knowledge, learning effect and structure change. It is no longer narrow sense of technology innovation.

The general form of C-D production function is $Y_t = A_0 e^{rt} K_t^{\alpha} L_t^{\beta}$, among them, Y, K, L present marine output, the ocean capital inputs, labor inputs respectively, α, β are marine capital, labor output elasticity respectively, A_0 is a constant, indicating technology level of the base year, r is also a constant, showing the growth rate in marine science and technology progress, t signifies time, $A_0 e^{rt}$ means t years' comprehensive marine science and technology level.

Take logarithms for both sides of the marine production function, $\ln Y_t = \ln A_0 + rt + \alpha \ln K_t + \beta \ln L_t$ can be obtained, and then make derivation for time t on the both sides of the above equation at the same time, $y = r + \alpha k + \beta l$ is obtained.

If $\alpha + \beta > 1$, it means increasing scale returns, while $\alpha + \beta < 1$ means diminishing scale returns, $\alpha + \beta = 1$ says the unchanged scale returns, in the measure of article, unchanged scale return is used.

Neutral technology progress refers to the unchanged shape of yield curve when there is existing technology progress, namely the technology progress doesn't cause the changes of capital and labor investment proportion. The technology progresses are further classified through the comparison of marginal capital output rate and marginal labor output rate in the production function based on derivation for time. Among them, the hicks neutral shows that before and after the progress of science and technology, $\frac{\partial Y}{\partial K} \Big/ \frac{\partial Y}{\partial L}$ (the marginal production ratio of the capital and labor) is unchanged when the ratio $K \ / L$ of production elements capital and Labor remains the same, namely the marginal substitution rate does not change, but the relationship between input and output.

2.2.2 Determination of Model Parameters for Contribution Rate of Marine Science and Technology Progress

This paper adopts 1985-1991 years of major ocean industries, measurement data. To explain, because 2000 years ago major ocean industries without the added value of the data, so, this article with the major ocean industries instead of the earnings of the data, labor, capital input data comply with the provisions of the above, specific data see table 1.

Table 1. Related data of national major ocean industries 1985-1991

Year	Gross Output Value of Major Marine Industries (100 million Yuan)	Employed Personnel in the Major Marine Industries (10000 persons)	Investment in fixed assets of Marine Industries (10 thousand Yuan)
1985	147.60	97.07	34.12
1986	212.79	100.00	52.96
1987	249.24	107.84	101.42
1988	279.52	111.47	90.68
1989	240.17	105.43	76.78
1990	268.75	117.58	101.83
1991	311.01	127.68	135.21

Data sources: *the 1986-1992 China ocean statistical yearbook*

Due to the short time sequence, different forms of c-d production function are separately applied to measure and compare α, β in this paper:

(1) Application of $Y = AK^{\alpha}L^{\beta}$ for the regression

Take logarithms on both sides of the above model to get $\ln Y = \ln A + \alpha \ln K + \beta \ln L$, after logarithm process for the above data respectively make least-squares regression, homoscedastic as well as the related adjustment the to get the following results :

$$\ln Y = 4.8535 + 0.6033 \ln K - 0.4282 \ln L$$

$$(3.8939)(5.4398)\ (-1.1732)$$

$$\text{Adjusted } R^2 = 0.9814,\ F = 159.0000,\ D.W. = 3.3822$$

By the above results that the output elasticity coefficient of labor for negative, do not accord with the actual economic significance, and at the same time, labor output elasticity coefficient and failed to pass a parameter of the significant inspection, equation there since the related phenomenon in itself. Therefore, the above equation and can't correctly reflect the rule of marine economic growth.

(2) Application of $Y = A_0 e^{rt} K^{\alpha} L^{\beta}$ for the regression

Based on c-d production function, time is added to $Y = A_0 e^{rt} K^{\alpha} L^{\beta}$, among them, r says the average speed of technology progress. After the logarithm process and regression, the results are as follows:

$$\ln Y = 4.7995 + 0.0168\ t + 0.5180 \ln K - 0.3545 \ln L$$

$$(3.6726)(0.7026)(3.3924)\ (-0.9364)$$

$$\text{Adjusted } R^2 = 0.9910, \quad F = 110.4354$$

Compared with the results (1), the equation goodness-of-fit improves, but labor output elasticity coefficient is negative, the coefficient also fails to pass significant inspection. In general, the average growth speed of technology progress should be positive, namely technology progress is continuous, but the regression results do not support such conclusion, therefor it is also not reliable.

(3) Application of $\frac{Y}{L} = A(\frac{K}{L})^{\alpha}$ for the regression

Considering the relatively short time series, the unusual results of former two model form regression are probably because of too many estimated parameters. A new form $\frac{Y}{L} = A(\frac{K}{L})^{\alpha}$ can be gained from deformation for the model, which can save degree of freedom, at the same time include $\alpha + \beta = 1$, that is the assumption that the scale remuneration is unchanged. By regression, results are as shown in table 2:

$$\ln \frac{Y}{L} = 0.8959 + 0.3566 \ln \frac{K}{L}$$

$$(32.4054) \quad (4.3002)$$

$$\text{Adjusted } R^2 = 0.7872, \quad F = 18.4919, \quad D.W. = 2.3898$$

The results show that, for the marine economy, computing of its capital and labor output elasticity are subject to time series, so only choosing the model form that save the best degree of freedom can obtain the best regression results. Compare the regression results of the three kinds of models, only the form of $\frac{Y}{L} = A(\frac{K}{L})^{\alpha}$ has the best regression results , all the parameters pass the significant inspection and economic significance test, capital output elasticity is 0.357, labor output elasticity is 0.643, the conclusion is very close to the reference value ($\alpha = 0.35$, $\beta = 0.65$)given by the state planning commission, statistical bureau. Therefore, measurements on the contribution rate of ocean scientific and technological progress below is calculated on the basis of $\alpha = 0.357$ and $\beta = 0.643$.

Table 2. the regression result of $\frac{Y}{L} = A(\frac{K}{L})^{\alpha}$

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.895890	0.027646	32.40543	0.0000
KK	0.356613	0.082929	4.300218	0.0077
Weighted Statistics				
R-squared	0.787160	Mean dependent var		0.801307
Adjusted R-squared	0.744593	S.D. dependent var		0.409726
S.E. of regression	0.058322	Akaike info criterion		-2.610715
Sum squared resid	0.017007	Schwarz criterion		-2.626169
Log likelihood	11.13750	F-statistic		18.49188
Durbin-Watson stat	2.194079	Prob(F-statistic)		0.007714
Unweighted Statistics				
R-squared	0.814188	Mean dependent var		0.781652
Adjusted R-squared	0.777025	S.D. dependent var		0.168244
S.E. of regression	0.079445	Sum squared resid		0.031558
Durbin-Watson stat	2.389769			

3. Measurement on Contribution Rate of Marine Science and Technology Progress Based on the Method of Solow Residual Method

3.1 Measuring Process of Contribution Rate of Marine Science and Technology Progress

Marine production function can be expressed as $Y_t = A_t f(K, L)$, among them Y for marine GDP, t as the time variable, A_t says marine science and technology progress coefficient.

After series transformation of the function, make t the total differential and divided by Y :

$$\frac{\frac{dY_t}{d_t}}{Y} = \frac{\frac{dA}{d_t}}{A} + \frac{\partial f}{\partial K}\frac{\frac{dK}{d_t}}{Y} + \frac{\partial f}{\partial L}\frac{\frac{dL}{d_t}}{Y} \quad (1)$$

In equation 1, define $\alpha = \frac{\partial Y}{\partial K}\frac{K}{Y}$, $\beta = \frac{\partial Y}{\partial L}\frac{L}{Y}$, when t is very small, finite difference can be approximately instead of differential, that is

$$\frac{\frac{\Delta Y_t}{\Delta t}}{Y} = \frac{\frac{\Delta A}{\Delta t}}{A} + \alpha\frac{\frac{\Delta K}{\Delta t}}{K} + \beta\frac{\frac{\Delta L}{\Delta t}}{L} \quad (2)$$

If $\Delta t = 1$, make $y = \frac{\Delta Y}{Y}$, $k = \frac{\Delta K}{K}$, $l = \frac{\Delta L}{L}$, $a = \frac{\Delta A}{A}$

Then the equation turns into

$$y = a + \alpha k + \beta l \quad (3)$$

This is the so-called marine economic growth speed equation, among them, a stands for marine science and technology progress speed, y, k, l respectively represent marine GDP, marine fixed assets investment, average annual growth rate of ocean employee population, α, β stand for marine fixed assets investment, output elasticity of the ocean employee.

Marine science and technology advance $a = y - \alpha k - \beta l$, namely the ocean science and technology progress means part of output growth that can't be explained by investment increase. That is to say, $\frac{a}{y} = 1 - \alpha\frac{k}{y} - \beta\frac{l}{y}$, then the contribution rate of marine scientific and technology progress to economic growth can be expressed as $E_a = \frac{a}{y}\times 100\% = (1 - \alpha\frac{k}{y} - \beta\frac{l}{y})\times 100\%$,which is also the contribution rate of marine scientific and technology progress we need to calculate.

3.2 Measurement and Analysis for The Contribution Rate of Marine Science and Technology Progress

3.2.1 Estimates Range and Choice of Data

In the paper, the output data used for the contribution rate of science and technology are national marine GDP, labor data are the total related the employee of coastal areas, and the data caliber is consistent with marine GDP caliber. There are still no statistics for data of marine capital investment, therefore, it is based on the economic data of land region, which corresponds with marine GDP caliber, marine capital investment = fixed asset investment* (marine GDP/GDP), with the measure period of the year of 2001-2010, the specific data for measurement are shown in table 3.

Table 3. 2001-2010 national data for measuring contribution rate of marine science and technology progress

Year	Gross Output Value of Major Marine Industries (100 million Yuan)	Employed Personnel in the Major Marine Industries (10000 persons)	Investment in fixed assets of Marine Industries (100 million Yuan)
2001	9518.40	2107.60	3230.24
2002	11270.50	/	4074.25
2003	11952.30	/	4889.82
2004	14662.00	/	6463.29
2005	17655.60	2780.80	8554.60
2006	21260.40	2960.30	11035.14
2007	25073.00	3151.30	13798.44
2008	29718.00	3218.30	16354.69
2009	32277.60	3270.60	21265.61
2010	38439.00	3350.00	26842.02

Data sources: *the 2006-2010 China ocean statistical yearbook*, *2010 China ocean statistical bulleti.*

Due to the adjustment of 2006 statistical caliber, related employee caliber of coastal areas changes, the employment situation appears to have flaw from the year of 2002 to 2004.

3.2.2 The Results of Contribution Rate of Marine Science and Technology Progress

According to the calculation principle of the Solow residual method, marine economy contribution rate of science and technology progress for years of 2001-2010 are measured in this section, the results are shown in the following table.

Table 4. 2001-2010 overall marine economy contribution rate (%) of science and technology progress

Year	GDP growth rate	Capital growth	Capital contribution rate	Labor growth rate	Labor contribution rate	S&T progress contribution rate
2001-2005	16.70	27.57	58.94	7.18	27.66	13.40
2006-2010	16.84	25.70	54.48	3.79	14.47	31.05
2001-2010	16.78	26.52	56.42	5.28	20.23	23.35

4. Discussion

From above calculation results we can see, our national marine economy capital contribution rate is 58.94% for the years of 2001-2005, and the labor contribution rate is 27.66%, contribution rate of ocean science and technology progress is 13.40%. The capital contribution rate of marine economy declines to 54.48, % for the years of 2005-2010, labor contribution rate reduces to 14.47%, research and development of oceans science and technology make huge achievements, contribution rate of marine science and technology progress reaches 31.05%.

The development of ocean science and technology drive our national ocean economy to make the remarkable progress. In the "tenth five-year plan" period, annual average growth rate of national ocean economy is16.70%, 3% higher than the same period of the national economy, the marine economy becomes a new growth point of national economy. But there are still no obvious changes for problems such as national ocean economic growth mode and marine economic structure optimization during the "tenth five-year plan" period, the contribution rate of marine science and technology is much smaller than that of "eleventh five-year plan" period.

In August of 2008, the state oceanic administration together with the ministry of science and technology issued *"The national science and technology plan for developing the sea (2008-2015) "*, which required coastal regions to combine with local reality for pushing transformation and industrialization of marine science and technology achievements, that would surely led the ocean science and technology achievements to turn into productive forces better and faster, contribution rate of oceans science and technology progress would be further improved.

National ocean science and technology progress contribution rate is only 23.35% for the years of 2001-2010, there is still a big gap compared with 70%-80% of the science and technology advance contribution rate of the developed countries, which means we lags behind developed countries for 15 years. Hysteresis of marine science and technology development influence the depth and width of national ocean development directly, thus marine science and technology contribution rate is also much less than the world developed country.

5. Policy Proposals

To achieve sustained, stable and efficient development of marine economy, we must rely on the power of technological progress to improve the contribution rate of the marine scientific and technological progress in marine economic growth. Multi-pronged measures of should be taken to promote scientific and technological progress.

5.1 Accelerating the Development of Marine Economy

The ocean economy is the backing of the marine scientific and technological development. Only with a strong economic foundation, huge R & D investment in marine science and technology is guaranteed, marine science and technology can successfully achieve the industrial development and becomes practical productive forces. Accelerating the development of marine economy is the primary task to raise the contribution rate of marine science and technology.

(1) Adjust the emphasis of development and boost optimization and upgrading of marine industrial structure. We should speed up the development of marine industries and transform traditional industries. We must focus on

building a number of marine industry areas and emerging marine projects that can enhance the overall competitiveness of the marine economy. Meanwhile, we should use the traditional marine technology to update and transform technology which will improve the modernization of the entire marine industry.

(2) Integrate areas of strength and guide the industrial development of marine economy industry. Marine economy should develop in the way of industrialization and large-scale development. China's marine resources are unevenly distributed, poorly configured and the input-output efficiency is not high. We should integrate marine resources to lead marine economy into developing coordinated with land economy, lead coastal provinces (cities) into developing collaboratively, and marine industry developing collaboratively. At present, the integrative cooperation is an important way.

(3) Promote the recycling economy and improve the level of development and utilization of marine resources. Reasonable allocation of the waters of space and marine resources is a good way to promote the marine industry to develop coordinately. Development of marine resources and protection of marine environmental should be planning synchronously and the marine ecological environment should be protected effectively. We should construct a marine eco-environment system with a virtuous cycle, attaches great importance to marine development and protection, take sustainable development of marine economy as long-term development strategy, strengthen comprehensive marine management and construct a good marine ecological environment and resource economic system with a virtuous cycle.

5.2 Improve Strength of Marine Science and Technology

(1) The ocean is involved in several industries and covers many fields. The lack of investment in marine science and technology will certainly affect the China's goal of becoming a maritime power. The lack of investment in marine science and technology is one of the main bottlenecks that constrain the marine scientific and technological achievements transferred into practical productive forces. We should increase the financial invest in rejuvenating the ocean through science and technology by a large margin, increase the strength of support for the research of key technologies and core technologies with independent intellectual property. Departments at all levels should support the marine high-tech enterprises and marine research institutes and improve R & D capabilities. R & D expenditures are tilted to the marine science and technology. All Provinces (cities) should actively guide the marine small and medium-sized enterprise to increase their scientific and technological input, to get rapid growth and enrich the strength of marine scientific and research, improve the investment structure of the marine science and technology.

(2) Cultivate and accumulate marine human resources. We should increase the cultivation of marine professionals in regional colleges and universities as reserve of talents, attach great importance to the growth of personals in marine scientific research institutions, train young researchers by marine scientific research and subjects, train a group of marine science and technology disciplines to take the lead as a strategic task to improve the overall quality of personals of the marine science and technology, focus on training and bringing up talents who can enter the forefront of marine science with international influence, have a plan to select professionals on marine science and technology to study abroad to learn and build a streamlined, efficient, innovative personnel of marine science and technology.

5.3 Speed up Transformation of Scientific and Technological Achievements

Only translated into practical productive forces and by the promotion of market, marine scientific and technological achievements can achieve its economic effects. Establishment of bases of marine high-tech achievements transformation is a good form to promote integration of technology and economy and the main carrier of transformation of marine science and technology. Coastal provinces and cities should centralize certain financial and technical strength, establish of several paradigmatic marine hi-tech parks, attract enterprises and sectors of science and technology to enter the parks by policies and economic instruments and drive the development of high-tech industries in marine areas to promote marine economy grow rolling rapidly.

Strengthening construction of service system for industrialization of marine science and technology and the establishing teams for promotion of marine science and technology is also an important part of transforming marine science and technology achievements. Governments should set up specialized agencies to promote science and technology promotion program to promote advanced and applicable technologies, construct promotion team of marine science and technology and speed up the popularization and application of advanced and applicable marine scientific and technological achievements through experiment, demonstration, training, guidance, and consulting services to. We should cultivate a variety of intermediary organizations providing technology services, such as the foundation of the Engineering Technology Center, technical advice and high-tech information network to provide technical identification, screening, assessment and consulting services,

gradually forming marine science and technology service systems providing the whole process service including research, development and promotion.

5.4 Increase Government's Support

Government's efforts to support marine science and technology are very important to improve the contribution rate of the marine scientific and technological progress. Marine enterprises have not been truly become the main players in the market and the proportion of invest in marine technical is still small. The main body of China's marine science and technology R & D is still the Government and marine research institutions with government's support, which is related to the direction and focus of development of marine science and technology. The government is the main investor of invest in marine science and technology and government's support is very important when raising the contribution rate of marine technological progress.

The government should provide support on funding, tax incentives, science and technology collaboration to promote marine economic structure adjustment and industrial upgrading and speed up the process of industrialization of marine science and technology. The government should strengthen investment in the development of technology, especially the marine basic research. The government should improve the mechanism of marine science and technology development to create a favorable external environment for enterprises' technological progress and to create a good foundation for enterprises' technology development. In addition, the government should also provide appropriate tax incentives to enterprises of marine high-tech industries to encourage enterprises to conduct marine scientific and technological innovation, for the purpose of the formation of a good social atmosphere for the marine scientific and technological innovation.

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References

Charnes, A., Cooper, W., & Golang, B. (1985). Foundations of data envelopment analysis for Pareto-Koopmans efficient empirical Production Functions. *Journal of Econometrics, 6*, 45-62. http://dx.doi.org/10.1016/0304-4076(85)90133-2

Cheng, D. (2006). The Evaluation of Sustainable Development based on Ecological Footprint and Human Development Index--A Case of Marine Fishery Resources Utilization in China, *China Soft Science,* vol.18, pp.27-40. http://mall.cnki.net/magazine/Article/ZGRKX200605018.htm

Coe, D., & Helpman, E. (1995). International R&D spillovers. *European Economic Review*, *39*, 26-42. http://dx.doi.org/10.1016/0014-2921(94)00100-E

Denison, E. (1985). *Trends in American Economic Growth, 1929-1982.* Washington D.C.: The Brookings Institution.

Feng, Y., & Li, C. (1992). An expression of production function and measurement of the relative benefits. *The Journal of Quantitative & Technical Economics*, *9*, 67-70. http://mall.cnki.net/magazine/Article/SLJY199209067.htm

Feng, Y., & Li, C. (1999). Analysis and Reconstruction of science progress measurement method. *China Soft Science, 9*, 85-92. http://d.g.wanfangdata.com.cn/Periodical_zgrkx199909008.aspx

Griliches, Z. (1986). Productivity R&D and basic research at the firm level in the 1970's. *American Economic Review, 76*, 141-154. http://www.jstor.org/stable/1804132

Jan, T. (1939). Business Cycles in the United States, 1919-1932. *League of nations, Economic intelligence service*, *7*, 69-56. http://www.jstor.org/stable/1807628

Liu, X., Li, X., & Cao, H. (2004). Pilot evaluation of China's marine science and technology industry. *Science of Science and Management of S&T, 11*, 86-92. http://mall.cnki.net/magazine/Article/KXXG200411023.htm

Qiao, J. (2010). The Analysis of Marine Technological Innovation on the Basis of Marine Industry Structure Optimization in China. *Reformation & Strategy, 10, 23-32.* http://mall.cnki.net/magazine/article/GGZY201010046.htm

Shi, Q., & Qin, B. (1985). *Technology progress and economic growth*. Beijing: Science and technology literature press.

Solow, R. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *17*, 69-89.

Swan, Trevor W. (1956). Economic growth and capital accumulation. *Economic Record, 11*, 52-65. http://dx.doi.org/10.1111/j.1475-4932.1956.tb00434.x

Wang, T. (2003). The measurement of contribution rate of scientific and technological progress in China's economic growth. *Productivity Research, 24*, 39-48. http://mall.cnki.net/magazine/Article/SCLY200309010.htm

Wu, Y., & Shi, P. (2006), Evaluation and Analysis of the Competitiveness of Marine Science and Technology of Coastal Regions of China. *Shanghai Economic Review*, *2*, 79-85.

Ye, X. (2006). Allocation of scientific resources and the development of China's marine economy. *Ocean Development and Management*, *4*, 61-65. http://d.g.wanfangdata.com.cn/Periodical_hykfygl200902021.aspx

Yu, J. (2009). Research on contribution rate of scientific and technological progress in China. *Soft Science, 25*, 46-58. http://mall.cnki.net/magazine/Article/RKX200925046.htm

Zhao, D. (1998). The measurement of the human resource contribution. *Economic Science,25*, 55-60.

Zhou, S., & Hu, D. (2010). Research on Contribution Rate of Science and Technology Progress to Economy Growth. *China Soft Science, 2*, 65-82. http://d.g.wanfangdata.com.cn/Periodical_zgrkx201002010.aspx

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Non-traded Sector Inflation and Growth Potential: A Threshold Inflation Theory

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Abstract

A structural theory of inflation and growth potential is developed based on a two-sector model of the economy, the traded goods sector and the non-traded. Since the traded goods sector is directly exposed to international competition unlike the non-traded, the latter is more prone to inflation. As the non-traded products have inelastic demand, their consumption propensity rises with the sector's price level with the consequence that consumption propensity for traded products falls with inflation. As derived from the model, the threshold inflation rate is the upper bound for non-negative impact of non-traded goods sector on the growth of the traded goods sector, indicating the inflation tolerance level of the traded-goods sector of the economy. The model shows that the threshold inflation varies with the level of output, consumption propensity, investment expenditure ratio, and inflation rate in the non-traded sector. A ***growth potential indicator*** based on the inflation threshold rate is constructed for predicting an economy's growth potential or prospects.

As applied to Nigeria, the model confirms the expected negative impact of non-traded sector inflation rate on the output of traded goods. The empirical result shows wide yearly variation in the threshold inflation rates; but generally a 1% inflation rate above the threshold causes 0.32% fall in the output of the traded-sector and 0.27% fall in GDP.

Keywords: inflation rate, macroeconomic model, economic growth, development policy

JEL: C02, C13, C32, E31, 011.

1. Introduction

The relationship between inflation and economic growth has engaged the attention of many economists in recent times from the theoretical, empirical, and policy angles. The Phillips curve probably was the first empirical study of the relationship, though indirectly (Philips, 1958). The Phillips curve through a lengthy period of empirical study of the UK economy established a negative relationship between inflation rate and unemployment, implying that inflation rate is correlated positively with growing employment and hence with output expansion. Phillips' position has however been extensively challenged as not valid in the long run. The new classical version (Lucas, 1976; Friedman, 1977; and Phelps 1977, 1994) of the Phillips curve states that inflation rate is constant in the long run, and hence is independent of long run (potential) output and natural rate of unemployment, or non-accelerating inflation rate of unemployment (NAIRU) comprising only of frictional and structural unemployment; and that any negative relationship observed between inflation rate and unemployment is valid in the short run only.

In some new Keynesian dynamic stochastic general equilibrium models, inflation rate (and hence the general price level) has positive relationship with aggregate demand, thus upholding Philips curve, as in the model of Blanchard and Gali (2007). This position is actually consistent with neo-Keynesian macroeconomic theory of income determination in the short run (Lipsey and Ragan, 2001: 559-564).

Neo-classical theory, however, puts forward a contrary view, employing the same macroeconomic framework, but differing in assumptions about the adjustment process. During recession, it is the SRAS curve that shifts downwards to push intersection with AD curve towards the potential output, without any need for expansionary fiscal policy to shift AD curve upward. The neo-classical position may not be valid where expansionary fiscal policy is usually resorted to due to prolonged recession.

Recent empirical studies have however been throwing clearer light on the relationship between inflation and growth, indicating that we cannot conclude that the relationship is positive or negative monotonically in the short

or long run. The studies generally seem to conclude that inflation rate beyond a certain threshold has a negative relationship with economic growth in the long run. The earliest of such studies are probably those of Kormendi and Meguire (1985). Thereafter, extensive econometric studies on the relationship between inflation and economic growth were carried out by several authors in a pooled regression covering well over 100 countries for three or more decades, all coming to similar conclusion about the negative relationship between rapid inflation and economic growth. Ghosh and Phillips (1998) analysed 3,603 annual observations covering 145 countries for the period 1960 to 1996, and came to the conclusion that inflation rate around 2-3% has positive relationship, while inflation rates above that threshold has negative convex relationship with economic growth, even when the time series and cross section dimensions of the data are separated. Khan and Senhadji (2001) analysing data for 140 countries brought in the inflation "threshold" effects, which vary for industrial countries and less-developed countries. Beyond the threshold level, inflation rate bears very significant negative relationship with economic growth. For industrial countries, the threshold is 1% to 3% while it is 11% to 12% for less-developed countries. Dewan and Hussein (2001) analysing 41 middle-income countries also confirmed the negative relationship between inflation and economic growth in the short and long-run. Other notable empirical studies confirming the negative relationship between inflation and economic growth are Fischer (1993), De Gregorio (1993), Barro (1996) and Sarel (1996).

Most recently, Banerji (2005) has generally observed the phenomenon of high inflation rate with high unemployment or stagflation; while the study of Arato (2008) though confirming the significant negative relationship for high inflation rates, could not be definite about the low inflation rate, stating that "marginal growth effect is weakly negative or even positive at low inflation rates and convex at high inflation rates".

However the study of Brazil's data for 1980-98 by Faria and Carneiro (2001) concluded that the relationship between inflation and economic growth was negative only in the short run. This may not be disputed as Gokal and Hanif (2004) on the extensive literature reviews and econometric study of the Fiji data concluded that the result of the study for a country "obviously depends on the nature and structure of the economy, and will thus vary from country to country."

One is thus persuaded to believe that the relationship between inflation and growth will be negative after a certain inflation rate threshold, owing to some structural factors. This study intends to contribute not only to the on-going debate on the relationship between inflation and growth, it will also attempt to identify some structural factors of causality in the relationship between inflation and growth, especially as most studies have been looking into the nature and extent of correlation rather than causality. We also hope to show in line with the observations of Gokal and Hanif (2004) that the relationship between inflation and growth in respect of the inflation rate threshold depends on the nature and structure of the particular economy.

Towards these objectives, the economy is divided into two major aggregate sectors that are perhaps more functionally distinct that any other dichotomy. The division is in respect of the non-traded products sector and that of the traded. Tinbergen (1965, 1966) has referred to this dichotomy as the 'national' and 'international' sectors. The distinction is critical because demand and supply characteristics and price determinations differ considerably, and these may have substantial implications for the prospects of the economy depending on the market structure of the non-traded (or national) sector. For the traded products (or international) sector, there is substantial exposure to external competition such that the qualities and prices of tradable domestic products are subject to global checks. Consequently domestic production of such traded products must remain competitive globally to be sustainable. That implies that prices in the traded products economy must remain stable while maintaining global standards of quality. Failure to achieve this means non-sustainability of domestic production and continual decline of the traded products economy. Contrasted with this, the non-traded products economy is not facing global competition because its products cannot be imported and must be produced locally. Depending on the degree of market imperfection, price determination in the non-traded products economy may experience inflation rate much in excess of the traded products. But inflation in the non-traded sector, through certain mechanisms, is expected to have significant negative impacts on the traded-products sector and long-term prospects of the whole economy. Apart from global competition being a source of major distinction between the traded and non-traded sectors of the economy, elasticities of demand is another major source of distinction between the traded and non-traded products sectors. The non-traded products sector generates largely essential goods and services for which demand is relatively price and income inelastic, such as housing, local transportation, education, health care, electricity, water supply, waste disposal, and security of life and property. By contrast, the traded-goods sector produces largely industrial goods for which price and income elasticities of demand are absolutely and relatively elastic.

The effect of rising general price levels on aggregate demand will thus be more negative on demand for traded products than for non-traded products, thus altering the sectoral shares of gross national product and

consumption propensities in favour of non-traded products. But this is not favourable to the whole economy since the traded products sector has the greater potential of contributing more to national economic growth in view of its price and income elastic demands and access to vast global markets.

This study first establishes the macroeconomic framework and transmission mechanisms through which inflation in the non-traded sector of the economy affects the traded sector and long-term prospects of the economy. As a formal extension, a theory is developed setting forth a relationship between inflation rate and growth potential. Thereafter an empirical application to the Nigerian economy is carried out to investigate the postulated theories and their policy implications that may be applicable especially for less developed countries. In this respect, section two develops a simple two-sector macroeconomic model for the derivation of the relationship between inflation in the non-traded products sector and growth potential of the economy, which is also formalized into a theory. Section three is an empirical application to Nigeria while section four constitutes the summary and policy conclusion.

2. Theoretical Framework and Model

We recognize two sectors, namely sector 'N' denoting non-traded products, and sector 'T' for traded products. Real output (or income) of the non-traded and traded sectors are denoted by lower-case letters as y_N and y_T respectively, while the nominal output counterparts are denoted by capital letters Y_N and Y_T. The links between the real and nominal incomes are the indexes of general price levels P, P_N, and P_T respectively for total national income, income in the non-traded products sector, and income in the traded products sector.

The basic assumption about production function or aggregate supply is that output in the non-traded products sector follows a trend growth rate determined by exogenous technical progress and population growth in accordance with neo-classical growth model.[1] On the other hand, output in the traded products sector is determined by effective demand for traded products subject to output capacity constraint, which is determined by capital stock, in accordance with neo-Keynesian growth model.[2]

With respect to aggregate household demand, the basic assumption is that demand for non-traded goods and services, largely essential goods and services, is relatively price and income inelastic compared with the demand for traded products. The implication of this is that consumption propensity for non-traded products will rise with the general price level, resulting in a fall in the residual consumption propensity for traded products or savings propensity, given the budget constraints. What will offset this tendency is when per capita income growth rate exceeds inflation rate in the non-traded sector. Another way to look at consumption propensity for non-traded and essential goods and services is that the consumer will defend the aspiration levels of priority needs (such as food and shelter) so that even if price rises, the consumer will have to spend more to ensure that minimum requirements of his basic needs are fulfilled. Indeed the consumer may spend increasing amount of his income until the minimum amounts of such priority needs are met, thus encroaching on the demand for goods of lower priority. Teekens (1984) has presented an analytical model to explore such behaviour.[3]

2.1 A Two-sector Model of Inflation and Growth Potential

With the preliminaries given above, the two-sector model of inflation and growth potential is proposed as follows:

Aggregate Outputs:

Non-traded sector output:

$$y_{N,t} = (1+g_N)y_{N,t-1} \tag{1}$$

Traded output capacity constraint:

$$y_{T,t} \leq (1/u_{t-1})(1-\delta_T)y_{T,t-1} + (1/\sigma_T)\Delta i_{T,t-1} \tag{2}$$

Total output:

$$y_t = y_{N,t} + y_{T,t} \tag{3}$$

where y_t, $y_{N,t}$ and $y_{F,t}$ respectively denote real national income, real outputs for non-traded sector N and traded sector T, for period t; g_N is trend growth rate in the non-traded sector; 'u_{t-1}' the capacity utilization rate in the previous year, δ_T is impact of depreciation on output, 'i' is real investment in the traded products sector and 'σ_T' the investment ratio of income.

Aggregate Demand Constraints

Non-traded sector:

$$P_{N,t}y_{N,t} = c_{N,t}Y_t + I_N \tag{4}$$

Traded Sector:

$$P_{T,t}y_{T,t} = (1 - c_{N,t} - s)Y_t + P_{T,t}i_{f,t} + X_t - M_t \quad (5)$$

Where nominal (total) national income

$Y_t = Y_N + Y_T$ is given as:

$$Y_t = P_{N,t}y_{N,t} + P_{T,t}y_{T,t} \quad (6)$$

And I_N is given as:

$$I_N = \sigma_{N,t}P_{N,t}y_{N,t} \quad (7)$$

$P_{N,t}$ and $P_{T,t}$ are current price indices for non-traded (N) and traded (T) sectors respectively, Y_t is national income (GDP) at current prices, X_t is exports of goods and services at current prices (by the traded-goods sector only) and M_t is imports at current prices; $\boldsymbol{c}_{N,t}$ is national propensity to consume non-traded goods and services, $\sigma_{N,t}$ is investment ratio of income in non-traded products sector, and $\boldsymbol{s}$ is national savings propensity. It may be noted that equation (4) is derived from the equilibrium condition relating aggregate supply to aggregate demand as applicable to the two sectors. That is:

$$Y_N = C_N + I_N \text{ , where } C_N = c_{N,t}Y_t \text{ , and } \quad I_N = \sigma_{N,t}P_{N,t}y_{N,t} \qquad Y_T = C_T + I_T;$$

Considering our theoretical analysis of consumer behaviour, national propensity to consume non-traded goods and services c_N is given by:

$$c_{N,t} = (c_{N,t-1})(P_{N,t}/P_{N,t-1}), \quad (8)$$

This means that consumer demand for essential non-traded goods and services must not diminish in real terms and so has to be indexed by cost of living. When prices are constant, that is $P_{N,t} = P_{N,t-1}$, the propensity remains a constant parameter, otherwise not.

Furthermore, we make an additional assumption that gross investment ratio in the non-traded sector $\sigma_{N,t}$ is exogenous, considering the substantial government involvement and the necessity to maintain the infrastructures and improve upon them in the face of growing population and industrial activities.

2.2 Domestic Inflation and Growth Potential

Based on the model developed in subsection 2.1, this subsection derives the relationship between 'domestic' inflation and growth potential of the economy. The non-traded or 'national' sector exhibits relatively more price inelastic demand than the 'international sector'. By domestic inflation, we are referring to inflation originating from the non-traded products or 'national' sector and inflationary consequences of unstable exchange rates reflecting the depreciating domestic currency or excess foreign exchange demand. The prices of traded products is influenced by international competition and tend therefore to be more stable or less inflationary than the prices of non-traded products; any inflation observed in the traded products will be due to domestic currency depreciation and the corresponding decline in the exchange rate. And such devaluation is a consequence directly or indirectly of inflation in the non-traded goods and services, spilling over to external imbalance.

The relationship between non-traded sector inflation and growth potential can be established by obtaining the derivatives of the traded sector output y_T with respect to the price level P_N and output y_N of the non-traded sector, in order to determine the impact of non-traded sector on the traded sector and the whole economy. In order to obtain the appropriate expression of $y_{T,t}$ in terms of $P_{N,t}$ and $y_{N,y}$, we only require equations (4), (6), (7) and (8). First substitute equations (6) and (7) into (4) to derive the expression:

$$P_{N,t}y_{N,t} = c_{N,t}(P_{N,t}y_{N,t} + P_{T,t}y_{T,t}) + \sigma_{N,t}P_{N,t}y_{N,t}$$

$$= c_{N,t}P_{N,t}y_{N,t} + c_{N,t}P_{T,t}y_{T,t} + \sigma_{N,t}P_{N,t}y_{N,t}$$

Dividing through by $c_{N,t}$ and making $P_{T,t}y_{T,t}$ the subject of the expression, we have:

$$P_{T,t}y_{T,t} = P_{N,t}(1 - \sigma_{N,t})y_{N,t}/c_{N,t} - P_{N,t}y_{N,t}$$

Substituting equation (8) finally into the equation above, we have

$$P_{T,t}y_{T,t} = P_{N,t-1}(1 - \sigma_{N,t})y_{N,t} / c_{N,t-1} - P_{N,t}y_{N,t}$$

so that $y_{T,t}$ is given by:

$$y_{T,t} = P_{N,t-1}(1 - \sigma_{N,t})y_{N,t}/P_T c_{N,t-1} - P_{N,t}y_{N,t}/P_{T,t} \quad (9)$$

Taking partial derivatives of equation (9) we have:

$$\partial y_{T,t}/\partial P_{N,t} = -y_{N,t}/P_{T,t} < 0 \quad (10)$$

$$\partial y_{T,t}/\partial y_{N,t} = [P_{N,t-1}(1 - \sigma_{N,t})/c_{N,t-1} - P_{N,t}]/P_{T,t} \quad (11)$$

The first derivative (10) is definitely negative. This implies that inflation rate in the non-traded goods sector has negative impact on the traded-goods sector, other things being equal, so that the more rapid the inflation rate is in the non-traded sector, the more will growth of output be hampered in the traded-goods sector. The second derivative ($\partial y_{T,t}/\partial y_{N,t}$) is the more significant one, and can be positive or negative. It will tend to be positive, and hence favourable to growth prospects in the traded-goods sector, if current inflation rate, as reflected by $P_{N,t}/P_{N,t-1}$, is relatively low (but negative if current inflation rate is relatively high), given the values of the parameters $\sigma_{N,t}$ and $c_{N,t-1}$. That is, expansion in the non-traded sector will have positive impact on the traded-sector if $\partial y_{T,t}/\partial y_{N,t}$ is positive, requiring that:

$$P_{N,t}/P_{N,t-1} < (1 - \sigma_{N,t})/c_{N,t-1} \quad (12)$$

For a more formal analysis of the condition for positive impact of non-traded sector on growth potential, we note that the left side of inequality (12) will tend to be smaller and favourable to growth, the less rapid the inflation rate is, while the right side will tend to be bigger and favourable to growth, the smaller the consumption propensity for non-traded goods is. From this, we can articulate the condition for the existence of growth potential and construct an indicator to measure the growth potential of the economy, as a guide to policy. Subtracting 1.0 from both sides of inequality (12), we obtain below expression (13) indicating the upper bound for tolerable inflation rate in the non-traded goods sector:

$$G_P < (1 - \sigma_N)/c_{N,t-1} - 1.0 \quad (13)$$

where G_P ($=P_{N,t}/P_{N,t-1} - 1$) is non-traded sector inflation rate and σ_N is investment ratio of income in the non-traded goods sector. Beyond such an upper bound, inflation in the non-traded sector will have a negative impact on the growth of output in the traded-goods sector. This relation puts an upper bound on non-traded sector inflation rate, G_P, in terms of investment ratio of income in the non-traded sector and consumption propensity for non-traded goods. If the inflation rate exceeds this upper bound, then the international sector of the economy will cease to grow, and non-traded sector inflation will exert negative impact on the external sector. The condition (13) appears then to determine the ***threshold*** for non-traded sector inflation rate, above which the inflation rate exerts negative impact on growth. So the Threshold Inflation Rate (*TRI*) is given by

$$TIR = 1 - \sigma_{N,t})/c_{N,t-1} - 1.0 \quad (14)$$

Thus, when actual inflation rate G_P is less than the threshold inflation rate, *TRI*, the traded-goods sector has good prospects to grow; but if actual inflation rate G_P exceeds *TRI*, the economy has a tendency to stagnate or contract.

3. Empirical Application to Nigeria

For empirical application of the growth potential condition, we require some parameters or data that are not directly available. The parameters are:

(i) Investment ratio σ_N of output in the non-traded products sector;

(ii) Previous-year national consumption propensity $c_{N,t-1}$ for non-traded products; and

(iii) Inflation rate ($P_{N,t}/P_{N,t-1} - 1$) in the non-traded products sector.

So we have to devise some ways of estimating those parameters or generating the required data.

In respect of the dichotomy between non-traded and traded products sectors, we follow with minor modification the Central Bank of Nigeria national accounts five-sector classification of:

(i) Agriculture;

(ii) Industry (Crude Petroleum, Natural Gas, Mining and Manufacturing);

(iii) Building & Construction;

(iv) Wholesale and Retail Trade; and

(v) Services (including utilities – electricity, gas and water)

The last three sectors constitute predominantly the non-traded products sectors. Although agricultural sector is generally considered a traded-commodity sector, the sector is predominantly non-traded in Nigeria. This is because the largely subsistent peasant agriculture account for about 95% of the sector's output (CBN, 2000:31), while exports (traded part) has always been below 2% of the sector's output. Therefore we shall consider the sector to be 98% non-traded, producing predominantly non-tradable local food crops and livestock. In particular the value of exports was below 1.7% in 1997 and below 1.5% in 2004. Yet, the largest export components, namely, cotton, cocoa bean, and rubber, which are not food staples account for more than 80% of total agricultural export

earnings. In recent years, the sector's share of crops production has stabilized around 83% while the sector's combined shares of forestry and fishing has always been below 7%. But 99.4% of the crops production is locally consumed while 99.9% of the forestry and fishing is locally consumed. The sector's share of livestock, 100% of which is locally consumed, is 10%. In other words, the three basic non-traded-goods sectors (i.e. building & construction, internal trade, and services) in addition to the 98% agricultural sector constitute the ***non-traded products sectors*** (***Y_N***), which are largely essential goods and services.

Data used are largely time series figures for GDP and general price levels, broken in this manner into non-traded and traded components. Other series required are national investment expenditure, broken into non-traded and traded components, where the non-traded components (I_N) consist of investment in building and construction, land development, and costs of installation. The time series data are tabulated in Appendix I.

Time series data for non-traded investment expenditure $I_{N,t}$ are not directly available because total investment expenditure does not distinguish between the traded and non-traded. So we have obtained $I_{N,t}$ by subtracting imported capital goods from total investment expenditure, on the assumption that non-traded capital goods are largely imported so that the rest of investment expenditure consists of non-traded investment expenditure.

On the other hand, the (national) propensity to consume non-traded goods $c_{N,t}$ is obtained by taking the sum of private and public consumption expenditure (C_G+C_P) subtracting the value of imported consumer goods (M_C) and consumer manufactured (traded) goods (C_{manuf}), before dividing it by gross national product (at market prices). Manufactured consumer goods, C_{manuf}, is equal to the output (value-added) of manufactured goods (Q_{manuf}) less exports (X_{manuf}) of manufactured goods and less manufactured capital goods (I_{nmanuf}). That is:

$$c_{N,t} = [C_G + C_P - M_C - (Q_{MANUF} - X_{MANUF} - I_{MANUF})]/GDP \quad (15)$$

For the purpose of breaking down the general price level P_t into the non-traded sector price level $P_{N,t}$ and the traded sector price level $P_{T,t}$, the base year selected is 1990. That is:

P_{1990} = 1.0, $P_{N,1990}$ = 1.0, and $P_{F,1990}$ = 1.0 respectively.

In order to estimate the sectoral price levels, we need to adopt weights for the sectors. Denoting the weights for the traded products and the non-traded products respectively as w_T and w_N, the general price level or price deflator P is related to the sectoral price levels by the formula:

$$P_t = w_{T,t} P_{T,t} + w_{N,t} P_{N.t} . \quad (16)$$

Furthermore, we assume that the price level for traded products is determined by the exchange rate ($e_{xr,t}$) of Naira to US Dollar, in the sense that traded product prices remain stable on account of international competition, and any inflation observed in their prices are due to the depreciation of domestic currency.

Therefore, $P_{T,t}$ is given as

$$P_{T,t} = 100(e_{xr,t}/e_{xr,0}); \text{ where } P_{T,0} = 100(e_{xr,0}/e_{xr,0}) = 100$$

for base year price level. Thus, given the values of P_t , $P_{T,t}$, $w_{T,t}$, and $w_{N,t}$ derivable from national accounts statistics, $P_{N,t}$ can be estimated using equation (16) as follows:

$$P_{N,t} = (P_t - w_{T,t} P_{T.t})/w_{N,t} . \quad (16b)$$

The basic data as well as the derived variables and parameters for the calculation of the threshold inflation rate (*TIR*) are given in Appendix I.

We recall that the threshold inflation rate (*TIR*) G_P defines the inflation rate upper limit for the growth of an economy. That is, the economy is incapable of growth if inflation rate exceeds the limit. The farther G_P is from the upper limit, the greater is the growth potential. In other words, the growth potential condition defines the threshold beyond which inflation rate exerts negative influence on growth. As derived in expression (13), the tolerable level of non-traded sector inflation rate $G_{P(N)}$ has its upper limit given as:

$$G_P < (1 - \sigma_N)/c_{N,t-1} - 1.0$$

where G_P is inflation rate in the non-traded sector (i.e. $P_{N,t}/P_{N,t-1} - 1$), σ_N is investment ratio of income in the non-traded goods sector while c_N is the non-traded consumption propensity of national income. The c*ondition* puts an upper bound on inflation rate G_P in terms of investment ratio σ_N of income in the non-traded goods sector and consumption propensity c_N for non-traded goods and services (largely essential needs). If the inflation rate exceeds this upper bound, then the international sector of the economy will cease to grow, and inflation will exert negative impact on the external sector. The expression (13) determines the threshold inflation rate, above which the inflation rate in the non-traded sector will exert negative impact on growth of the traded-sector output for the type of economy modeled.

Computed values of the non-traded sector and traded-sector inflation rates as well as threshold inflation rates (*TIR*) with respect to non-traded and the traded for the period 1982 to 2009 are contained in Table 1. Also contained in the table are the corresponding growth rates of GDP and manufacturing sector output based on US$ valuation of the current outputs. The use of deflated national income accounts is considered not quite reliable on account of deliberate or non-deliberate errors in the estimation of inflation rates on which the GDP deflators are based.

In accordance with our theory, inflation rate in the non-traded sector is expected to have negative impact on the output of the traded sector. Secondly, inflation rates above the theoretical threshold inflation, referred to as "threshold inflation rate gaps", are expected to have negative impacts on growth rates of the manufacturing sector in particular and GDP as a whole. Growth rate is based on the equivalent U.S. Dollar value of domestic output at current prices considered a more reliable estimate of real output.

Demonstration regression analyses were carried out with the Nigerian data to explore the relationships between the dependent variables of growth rates of GDP and manufacturing sector output and the threshold inflation rate gaps as explanatory variables. We have calculated two threshold inflation rate gaps (columns 7 and 8 of Table 1), one referring to inflation rate in the non-traded sector and the other referring to inflation rate in the traded-sector.

The results are presented in the Tables 2(a) to (e). The threshold inflation rate gap [*TIRG(N)]* with respect to the non-traded sector exerts a negative but non-significant influence on the growth rates of GDP and manufacturing sector. However, the threshold inflation rate gap [TIRG(T)] with respect to the traded-sector exerts negative and significant impacts on the growth rates of GDP and manufacturing sector. A 1% increase in traded-sector inflation rate beyond the inflation rate threshold causes 0.32% fall in the output of the traded sector or 0.27% fall in GDP.

Table 1. Growth Rates and Threshold Inflation Rates for Nigeria 1982-2009

(1) YEAR	(2) Growth Rate % of GDP at current US$	(3) Growth Rate % of Manuf. Sector Output at current US$	(4) Threshold Inflation Rate %	(5) Inflation Rate % (Non-traded Sector)	(6) Inflation Rate % (Traded Sector)	(7) Threshold Inflation Rate Gap Non-traded Sector (col. 5 – col. 4)	(8) Threshold Inflation Rate Gap Traded Sector (col. 6 – col. 4)
1982	-6.59	-2.64	1.98	3.89	10.31	1.91	8.33
1983	0.58	2.05	12.50	12.13	7.61	-0.38	-4.90
1984	6.28	-17.21	19.25	5.56	5.63	-13.69	-13.61
1985	-2.53	13.39	13.35	6.38	16.85	-6.96	3.51
1986	-54.96	-54.61	11.00	-11.64	126.07	-22.64	115.07
1987	-23.47	-43.02	9.59	44.88	98.85	35.29	89.25
1988	17.07	30.65	22.11	27.59	12.91	5.48	-9.20
1989	-4.33	-30.50	12.27	39.20	62.93	26.93	50.66
1990	13.49	8.38	41.11	-35.90	8.74	-77.01	-32.37
1991	-5.37	6.79	45.96	99.31	23.29	53.35	-22.67
1992	-2.25	-20.08	59.86	53.90	74.56	1.20	14.71
1993	0.72	13.26	35.60	13.74	27.47	-21.86	-8.13
1994	32.58	62.55	19.25	33.76	-0.75	14.50	-20.00
1995	-41.97	-54.78	18.34	44.24	270.20	25.90	251.86
1996	39.41	25.86	20.02	75.03	0.28	55.01	-19.73
1997	3.17	7.91	12.34	0.16	0.49	-12.18	-11.85
1998	-5.83	-4.34	13.48	-13.62	2.64	-27.10	-10.84
1999	7.03	-3.18	-2.95	19.15	10.18	22.10	13.14
2000	31.42	1.98	18.27	66.75	9.16	48.48	-9.11
2001	-6.94	6.91	63.40	-14.43	10.81	-77.82	-52.58
2002	29.42	5.25	18.14	3.30	13.03	-14.84	-5.11
2003	15.65	14.45	16.25	22.29	6.16	6.04	-10.09
2004	36.15	22.93	14.10	14.76	-1.24	0.66	-15.35
2005	29.43	19.75	22.89	30.91	-1.34	8.02	-24.23
2006	29.70	18.05	27.74	25.96	-1.78	-1.78	-29.51
2007	13.39	10.93	35.46	4.85	-1.87	-30.61	-37.33
2008	24.56	19.06	11.22	15.97	-5.58	4.75	-16.80
2009	-18.71	-16.39	23.87	-16.50	25.13	-40.37	1.26

Source: Computed by the author from basic data contained in Appendix 1.

Table 2 (a). GDP Growth (GGDP) and Threshold Inflation Rate Gap [TIRG]

Dependent Variable: GGDP
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.467673	3.181380	2.347306	0.0268
TIRG	-0.267491	0.054054	-4.948615	0.0000
R-squared	0.485034	Mean dependent var		5.610714
Adjusted R-squared	0.465228	S.D. dependent var		22.85956
Durbin-Watson stat	1.704536	Prob(F-statistic)		0.000038

Source: Regression analysis carried out by the author based on data in Appendix 1.

Table 2 (b). Growth of Manufacturing Sector (GMAN) and Threshold Inflation Rate Gap (TIRG)

Dependent Variable: GMAN
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.810525	3.260359	1.168744	0.2531
TIRG	-0.325624	0.055396	-5.878154	0.0000
R-squared	0.570622	Mean dependent var		1.550000
Adjusted R-squared	0.554107	S.D. dependent var		25.65588
Durbin-Watson stat	1.616984	Prob(F-statistic)		0.000003

Source: Regression analysis carried out by the author based on data in Appendix 1.

Table 2 (c). GDP Growth Rate (GGDP) and Growth Potential Indicator (GPI) Regression Equation

Dependent Variable: GGDP
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.145125	3.131552	1.004334	0.3245
GPI	0.620330	0.120257	5.158384	0.0000
R-squared	0.505787	Mean dependent var		5.610714
Adjusted R-squared	0.486779	S.D. dependent var		22.85956
Durbin-Watson stat	2.369864	Prob(F-statistic)		0.000022

Source: Regression analysis carried out by the author based on data in Appendix 1.

Table 2 (d). Growth of Manufacturing Sector (GMAN) and Growth Potential Indicator (GPI)

Dependent Variable: GMAN
Included observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.530733	3.053767	-0.501261	0.6204
GPI	0.775097	0.117270	6.609533	0.0000
R-squared	0.626897	Mean dependent var		1.550000
Adjusted R-squared	0.612547	S.D. dependent var		25.65588
Durbin-Watson stat	2.103608	Prob(F-statistic)		0.000001

Source: Regression analysis carried out by the author based on data in Appendix 1.

Table 2 (e). Growth of Manufacturing Sector (GMAN) and Non-Traded Sector Inflation Rate (INFR)

Dependent Variable: GMAN				
Included observations: 28				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.41525	3.628433	3.146055	0.0041
INFR	-0.340710	0.057524	-5.922957	0.0000
R-squared	0.574339	Mean dependent var		1.550000
Adjusted R-squared	0.557967	S.D. dependent var		25.65588
Durbin-Watson stat	1.447317	Prob(F-statistic)		0.000003

Source: Regression analysis carried out by the author based on data in Appendix 1.

4. Summary and Policy Implication

4.1 Summary

The paper develops a theory of structural and threshold inflation and the impacts on growth prospects, based on two-sector division of the economy, one sector producing internationally traded goods and services, the other producing the non-traded. In principle, the traded goods sector (also referred to as the international sector) is directly exposed to international competition in its price formation while the non-traded sector is not. Thus inflation in respect of traded goods is checked by competitive imports subject to exchange rate movements while inflation in the non-traded sector is subject to domestic forces of demand and supply for non-traded goods and services. In addition, price and income elasticities of demand vary significantly between demand for the traded and the non-traded products. For the non-traded products, a lot of which are essential needs, demand tend to be much more inelastic, such that the aggregate consumption propensity for non-traded goods and services varies with price level. The consequence of this is for the aggregate consumption propensity for traded products to fall or for aggregate savings propensity to fall. Whatever the case, inflation rate in the non-traded products sector will tend to result in a depression. Output growth in the non-traded sector is assumed to follow neo-classical growth behaviour determined by population growth and exogenous technical progress, while output in the traded products sector is assumed to follow neo-Keynesian growth model governed by residual demand for traded and less essential goods and slack production capacity constraints.

A brief and highly simplified macroeconomic model is then built to reflect these basic principles and draw the implications of endogenous price determination on the prospects of the manufacturing sector that produces most of the traded goods.

The implications of the model are:

(i) That inflation in the non-traded products sector exerts negative impact on the output of the traded products.

(ii) That output in the non-traded products sector may have positive or negative impact on the traded products, depending on the consumption propensity for non-traded products and the ratio of investment expenditure to output in the non-traded products sector, both of which are subject to the price levels in the non-traded products sector. The condition for the positive impact defines the threshold inflation rate; in other words, the threshold inflation is the line separating the positive from negative impact.

From the implications described above, we construct a ***growth potential indicator*** for the purpose of measuring or predicting the growth prospects of the traded goods sector and guiding development policy. When the indicator is positive the prospects are good, otherwise not; and the larger the indicator the greater are the growth prospects not only for the traded-goods sector but also for the whole economy, since the traded goods sector has the greatest potential for contributing to economic development on account of its access to vast world market.

In the application of the model to Nigeria during the period 1981-2009, a 1% inflation rate above the threshold causes 0.32% fall in the output of the traded-sector and 0.27% fall in GDP.

4.2 Policy Implication

In order to promote the growth prospects of the traded-sector and the whole economy, as well as check inflation, it is necessary to adopt development and welfare policies that will lower the proportion of expenditure of the non-traded goods in total income. Such policies will include lowering the prices of food, rent, transportation, and other essential consumer goods, requiring the promotion of efficient production systems in agriculture, housing, transportation, energy, educational and health care services. This will free more income for patronizing the traded-goods sectors. In order to promote the competitiveness of domestic traded-goods industries, investment in

efficient infrastructural development to favour the nation's potential areas of comparative advantages and competitiveness in trade has to be vigorously promoted. Vibrant domestic markets for such competitive products will spur the rapid growth and enhance the competitiveness of the traded-goods sector. Rising corporate and personal income taxes due to more rapid industrial growth may be channeled to financing the prescribed infrastructure and social development. Initial budget deficits for these purposes may not be avoidable but the authorities have to be skilful in safeguarding price stability. There will also be need to check cost push inflation in the economy occasioned by arbitrary increases in factor incomes as a result of imperfections in product and factor markets.

References

Arato, I. (2008). Long-run relationship between inflation and growth in a New Keynesian Framework. *Munich Personal RePEc Archive (MPRA).*

Banerji, A. (2005). *The Relationship between Long-run Growth and Inflation: A Cyclical Viewpoint*. Economic Cycle Research Institute.

Barro, R. J. (1995). Inflation and Economic Growth. *NBER Working Paper, No. 5326,* National Bureau of Economic Research.

Blanchard, O., & Gali, J. (2007). Real Wage Rigidities and New Keynesian Model. *Journal of Money, Credit and Banking. 39*(1), 35-65. http://dx.doi.org/10.1111/j.1538-4616.2007.00015.x

De Gregorio, J. (1992). The Effects of Inflation on Economic Growth: Lessons from Latin merica. *European Economic Review*, 417-25. http://dx.doi.org/10.1016/0014-2921(92)90098-H

Dewan, E., & Hussein, S. (2001). Determinants of Economic Growth (Panel Data Approach). *Working Paper, 2001/04.* Suva. Department of Economics, Reserve Bank of Fiji.

Faria, J. R., & Carneiro, F. G. (2001). Does High Inflation Affect Growth in the Long and Short Run? *Journal of Applied Economics, 4*(1), 89-105

Fischer, S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics Elsevier, 32*(3), 485-512. http://dx.doi.org/10.1016/0304-3932(93)90027-D

Friedman, M. (1977). Inflation and Unemployment: Nobel Lecture. *Journal of Political Economy, 85*, 451-472. http://dx.doi.org/10.1086/260579

Ghosh, A., & Phillips, S. (1998). Warning: Inflation May Be Harmful. *IMF Staff Papers, 45*(4).

Gokal, V., & Hanif, S. (2004). Relationship between Inflation and Economic Growth. *Working Paper. 2004/4,* Economics Department, Reserve Bank of Fiji, Suva.

Khan, M. S., & Senhadji, A. S. (2001). Threshold Effects in the Relationship between Inflation and Growth. *IMF Staff Papers, 48*(1).

Kormendi, R. C., & Meguire, P. (1985). Macroeconomic determinants of growth: Cross-country evidence. *Journal of Monetary Economics*, *16*(2), 141-163. Elsevier. http://dx.doi.org/10.1016/0304-3932(85)90027-3

Lipsey, R. G., & Ragan, C. T. S. (2001). *Macroeconomics*. Toronto; Addison Wesley/Longman.

Lucas Jr., R. E. (1976). Econometric Policy Evaluation: A Critique. *Carnegie-Rochester Conference Series on Public Policy*, *1*, 19-46. http://dx.doi.org/10.1016/S0167-2231(76)80003-6

Phelps, E. S. (1977). Stabilizing Powers of Monetary Policy under Rational Expectations. *Journal of Political Economy*, *85*, 163-190.

Phelps, E. S. (1994). *Structural Slumps: The Modern Equilibrium Theory of Employment, Interest and Assets*. London; Oxford University Press. http://dx.doi.org/10.1086/260550

Phillips, A. W. (1958). The Relationship between Unemployment and Rate of Change of Money Wages in the United Kingdom 1861-1957. *Economica*, *25*(100), 283-299.

Sarel, M. (1995). Nonlinear Effects of Inflation of Economic Growth. *IMF Working Paper,* 95/56.

Solow, R. M. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics, 39*, 312-320. http://dx.doi.org/10.2307/1926047

Teekens, R. (1984). Aspiration level, consumption possibilities and transaction behaviour in the case of a basic needs commodity: an illustration. in Cohen, S. I., Cornelisse, P. A., Teekens, R., and Thorbecke, E. (eds.), *The Modelling of Socio-economic Planning Processes*. Aldershot/Vermont, Gower Publishing Co., 267-287

Tinbergen, J. (1965). International, National, Regional and Local Industries in Caves, R. E., Johnson, H. G., and Kenen, P. B., (eds.), *Trade, Growth and Balance of Payments*. Amsterdam, North Holland.

Tinbergen, J. (1966). Some Refinements of the Semi-input-output Method. *The Pakistan Development Review, 6*(2), 243-247.

Notes

Note 1. Adopting the Solow (1957) neo-classical growth model, the growth of output *Y* is given by

$$g(Y) = \alpha g(K) + \beta g(L) + v$$

where *g(K)* is growth of capital stock, *g(L)* is growth of labour (or population), α is output elasticity of capital stock, β is output elasticity of labour and *v* is total productivity growth (exogenous technical progress). With the assumption that $\alpha + \beta = 1$ (linearly homogeneous production function), and change in capital stock is financed out of national income mplying that *g(K)= g(Y)* in the long run, the growth of output *g(Y)* is reduced to:

$g(Y) = n + v/(1-\alpha)$, where *g(L) = n*, the population growth rate.

Note 2. In accordance with Kaldor and Mirrless (1962) technical progress function, productivity growth is a function of growth in investment per operative, such that productivity increases at decreasing rate until it reaches the optimal level **γ** at which the productivity growth rate equals the growth rate of investment per operative. That is:

$$dy/y = f(di/i),\ f(0) > 0,\ f' > 0,\ f'' > 0, \tag{17}$$

At equilibrium the growth of productivity equals the growth of investment per operative. That is:

$$dy/y = di/i = \gamma.$$

With modification from per capita unit to total income and total investment, and employing discrete format, we can render the expression as:

$$\Delta Y/Y = \Delta I/I \quad or \quad \Delta Y = (Y/I)\Delta I \tag{18}$$

Since investment ratio of income $\mathbf{I/Y = \sigma_f}$, the reciprocal $\mathbf{Y/I = 1/\sigma_f}$. So the second part of equation (18) can be rewritten as

$$\Delta Y = (1/\sigma_f)\Delta I \tag{19}$$

But ΔY is the planned increase in capacity output, that is, $\Delta Y = Y_t - Y^*_{t-1}$, where Y^*_{t-1} is capacity output for the previous year given by $Y^*_{t-1} = (1/\mathbf{u_{t-1}})Y_{t-1}$ where Y_{t-1} is actual output and $\mathbf{u_{t-1}}$ is corresponding capacity utilization rate.

Appendix I. Basic Times Series Data and Derivatives for Nigeria

YEAR	Y: GDP current Prices (Nb)	P: GDP Deflator [P(1990) = 100]	I: Total Investment Expenditure (Nb)	Non-traded Investment (Nb): I(N) = I - I(M)	Cp: Private Consumption Expenditure	Cg: Government Consumption Expenditure	Y(F): Traded Sector Output (Nb)	Non-traded Sector Output: Y(N) = Y-Y(F)
1981	47.62	37.57	18.22	11.84	28.57	7.58	15.80	31.82
1982	49.07	40.94	17.15	11.14	30.41	8.41	14.42	34.64
1983	53.11	47.77	13.34	8.67	35.22	8.89	13.60	39.51
1984	59.62	51.16	9.15	5.95	42.86	8.46	14.47	45.15
1985	67.91	53.19	8.80	5.72	49.30	9.36	18.23	49.68
1986	69.15	52.22	11.35	7.38	51.54	9.42	16.39	52.75
1987	105.22	75.44	15.23	9.23	75.98	8.06	34.48	70.75
1988	139.09	95.60	17.56	10.36	106.68	11.31	41.20	97.88
1989	216.80	129.54	26.83	16.73	126.19	12.44	89.60	127.20
1990	267.55	100.00	40.12	26.12	177.23	13.98	115.59	151.96
1991	312.14	166.04	45.19	5.69	206.81	15.90	136.63	175.51
1992	532.61	259.52	70.81	-12.09	373.53	33.12	274.76	257.86
1993	683.87	318.12	96.92	11.92	502.78	46.80	282.31	401.56
1994	899.86	405.44	105.58	65.68	610.34	169.67	283.56	616.30
1995	1,933.21	824.44	141.92	57.62	1,387.45	242.74	873.88	1,059.33
1996	2,702.72	1,098.07	204.05	72.15	2,124.27	280.38	1,293.23	1,409.49
1997	2,801.97	1,108.76	242.90	85.40	2,091.07	377.78	1,215.91	1,586.06
1998	2,708.43	1,026.97	242.26	103.46	2,371.33	393.55	882.03	1,826.40
1999	3,194.01	1,190.31	231.66	118.16	2,454.79	231.29	1,179.55	2,014.46
2000	4,582.13	1,628.20	331.06	132.26	2,478.78	393.55	2,359.31	2,222.81
2001	4,725.09	1,596.91	372.14	94.64	3,687.66	403.10	1,874.08	2,851.00
2002	6,912.38	1,725.54	499.68	110.58	5,540.19	478.29	2,042.72	4,869.66
2003	8,487.03	2,002.73	865.88	134.78	7,044.54	450.49	3,037.71	5,449.33
2004	11,411.07	2,162.91	863.07	191.17	8,111.13	785.82	4,610.08	6,800.98
2005	14,572.24	2,593.25	1,204.80	648.10	10,099.42	1,003.10	6,094.89	8,477.35
2006	18,564.59	3,115.80	1,546.53	660.83	11,834.58	1,283.40	7,488.74	11,075.85
2007	20,657.32	3,256.96	1,915.35	932.22	16,135.89	1,642.03	8,085.38	12,571.94
2008	24,296.33	3,614.44	2,030.51	988.39	17,166.51	1,400.20	9,719.51	14,576.82
2009	24,712.67	3,446.92	2,442.70	1,338.18	17,930.85	1,434.78	7,972.49	16,740.18

Appendix I (Contd.)

YEAR	Exr: Naira/US$ Exchange Rate	I(M): Capital Goods Imports Nb.	Traded Sector Output Deflator	Non-traded Sector Output Deflator	Non-traded investment ratio: σ(n)=I(N)/Y(N)	$Y: GDP current Prices (US$b)	C(T): Manufactured Consumer Goods (Nb)	C(N) = Cp+Cg - C(T): Non-traded Consumption Expenditure	C(N)/Y: Non-traded sector Consumption Propensity	Manufacturing Sector Output (US$b)
1981	0.61	6.38	7.6	52.46	0.37	78.0	4.48	31.67	0.67	7.70
1982	0.67	6.00	8.4	54.50	0.32	72.92	4.77	34.05	0.69	7.50
1983	0.72	4.67	9.0	61.11	0.22	73.34	5.44	38.67	0.73	7.65
1984	0.76	3.20	9.5	64.51	0.13	77.95	4.77	46.55	0.78	6.34
1985	0.89	3.08	11.1	68.62	0.12	75.98	6.04	52.62	0.77	7.19
1986	2.02	3.97	25.1	60.64	0.14	34.22	6.10	54.86	0.79	3.26
1987	4.02	6.00	50.0	87.85	0.13	26.19	7.00	77.05	0.73	1.86
1988	4.54	7.20	56.4	112.09	0.11	30.66	10.39	107.60	0.77	2.43
1989	7.39	10.10	91.9	156.03	0.13	29.33	11.40	127.23	0.59	1.69
1990	8.04	14.00	100.0	100.02	0.17	33.29	13.85	177.36	0.66	1.83
1991	9.91	39.50	123.3	199.35	0.03	31.50	18.30	204.42	0.65	1.95
1992	17.30	70.81	215.2	306.79	0.00	30.79	25.52	381.12	0.72	1.56
1993	22.05	85.00	274.3	348.95	0.03	31.01	37.22	512.35	0.75	1.77
1994	21.89	39.90	272.2	466.74	0.11	41.12	60.99	719.02	0.80	2.87
1995	81.02	84.30	1,007.7	673.22	0.05	23.86	101.85	1,528.33	0.79	1.30
1996	81.25	131.90	1,010.6	1,178.32	0.05	33.26	128.39	2,276.27	0.84	1.64
1997	81.65	157.50	1,015.5	1,180.22	0.05	34.32	139.58	2,329.27	0.83	1.76
1998	83.81	138.80	1,042.4	1,019.53	0.06	32.32	137.76	2,627.12	0.97	1.69
1999	92.34	113.50	1,148.5	1,214.77	0.06	34.59	146.23	2,539.86	0.80	1.63
2000	100.80	198.80	1,253.8	2,025.64	0.06	45.46	161.09	2,711.23	0.59	1.67
2001	111.70	277.50	1,389.3	1,733.37	0.03	42.30	182.05	3,908.71	0.83	1.78
2002	126.26	389.10	1,570.4	1,790.63	0.02	54.75	219.47	5,799.01	0.84	1.88
2003	134.04	731.10	1,667.1	2,189.81	0.02	63.32	266.14	7,228.90	0.85	2.15
2004	132.37	671.90	1,646.4	2,513.03	0.03	86.21	321.38	8,575.56	0.75	2.64
2005	130.60	556.70	1,624.4	3,289.81	0.08	111.58	375.17	10,727.36	0.74	3.16
2006	128.28	885.70	1,595.5	4,143.71	0.06	144.72	429.27	12,688.71	0.68	3.73
2007	125.88	983.13	1,565.7	4,344.67	0.07	164.10	464.61	17,313.31	0.84	4.14
2008	118.86	1,042.12	1,478.4	5,038.72	0.07	204.41	520.83	18,045.88	0.74	4.93
2009	148.73	1,104.52	1,849.9	4,207.50	0.08	166.16	539.10	18,826.54	0.76	4.12

Source: CBN Statistical Bulletin and Annual Reports and Statement of Accounts for basic data; the last eight columns were derived by the author.

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The Determinants of Real Exchange Rate in Nigeria

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Abstract

In this paper, an attempt is made to investigate the determinants of the real exchange rate in Nigeria. The objective of the study has been to present a dynamic model of real exchange rate determination and empirically test the implications of changes in possible determinants of the real exchange in Nigeria. With data covering 1970-2010, the parsimonious ECM result shows amongst others that the ratio of government spending to GDP, terms of trade and technological progress are not important determinants of the real effective exchange rate in Nigeria. The result showed that capital flow, price level and nominal effective exchange rate are important determinants of the real effective exchange rate in Nigeria. The paper suggests that the Dutch Disease syndrome holds in Nigeria. The Johansen cointegration test suggests a long relationship among the variables. It is thus recommended amongst others that policies have to be put in place to stabilize the problem of inflation.

Keywords: Real Exchange Rate, cointegration, parsimonious Error Correction model, Dutch disease

1. Introduction

The relationship between a country's exchange rate and economic growth is a crucial issue from both the descriptive and policy prescription perspectives. As Edwards (1994) puts it "it is not an overstatement to say that real exchange rate behaviour now occupies a central role in policy evaluation and design". A country's exchange rate is an important determinant of the growth of its cross-border trading and it serves as a measure of its international competitiveness (Bah and Amusa, 2003). The real exchange rate, in particular, defined as the relative price of foreign goods in terms of domestic goods, is of greater significance, as it is an important relative price signalling inter-sectoral growth in the long run and acts as a measure of international competitiveness. In other words, the real exchange rate plays a crucial role in guiding the broad allocation of production and spending in the domestic economy between foreign and domestic goods.

The role of international trade in economic development has been acknowledged worldwide. This is because it provides opportunities to expand both the production possibilities and consumption basket available to the people (Adewuyi, 2005). The Nigerian government has over the years engaged in international trade and has been designing trade and exchange rate policies to promote trade (Adewuyi, 2005). Although a number of exchange rate reforms have been carried out by successive governments, the extent to which these policies have been effective in promoting export has remained unascertained. This is because despite' government efforts, the growth performance of Nigeria non-oil export has been very slow. It grew at an average of 2.3% during the 1960 -1990 period, while its share of total export declined from about 60% in 1960 to 3.0% in 1990 (Ogun, 2004). Looking at the sectoral contribution to non-oil export in the period before the introduction of the Structural Adjustment Programme (SAP) (1975-1985), it can be seen that agricultural sector contributed about 4.0% and 67.0% to total export and non-oil export respectively (Ogun, 2004). The shares of manufacturing 'sector in these categories of exports are about 1.0 and 12.0% respectively during that same period (Ogun, 2004).

Overvalued RER has reduced profit in tradable good sector, thereby reducing investment in this sector. This has negative implications on exports and hence the trade balance. Persistent overvaluation of the RER may also lead to currency crisis (Xiaopu, 2002). The growing overvalued exchange rate that took off in Sub-Sahara Africa in the early 1980s contributed to the poor performance of the current account balances in the Region. Despite various efforts by the government to maintain exchange rate stability (as well as avoiding its fluctuations and misalignment) in the last two decades, the naira exchange rate to the American dollar depreciated throughout the

1980s. For example, the naira depreciated from N0.61 in 1981 to N2.02 in 1986 and further to N8.03 in 1990. Although the exchange rate became relatively stable in the mid 1990s, it depreciated further to N120.97, N129.36 and N133.50 in 2002, 2003 and 2004 respectively (Obadan, 2006). Thereafter, the exchange rate appreciated to N132.15, N128.65, N125.83 and N118.57 in 2005, 2006, 2007 and 2008 respectively (Central Bank of Nigeria, 2008). Some have attributed the recent deprecation to the decline in the nation's foreign exchange reserves, but others argue that the activities of speculators and banks are responsible for the recent decline in the value of the naira. Also, the recent global economic meltdown is forcing some banks to engage in 'round-tripping', a situation in which banks buy foreign exchange from the Central Bank of Nigeria (CBN) and sell to parallel market operators at prices other than the official prices. These practices have resulted in fluctuation and misalignment in the real exchange rate.

In his view, Obadan (2006) summed up the factors that led to the misalignment of the real exchange rate in Nigeria to include weak production base, import dependent production structure, fragile export base and weak non-oil export earnings, expansionary monetary and fiscal policies, inadequate foreign capital inflow, excess demand for foreign exchange relative to supply, fluctuations in crude oil earnings, unguided trade liberalization policy, speculative activities and sharp practices (round tripping) of authorized dealers. Others include over reliance on imperfect foreign exchange market, heavy debt burden, weak balance of payments position and capital flight. The important question is 'what are the determinants of the real exchange rate in Nigeria, taking into account both short run (actual) and long run determinants'?

The objective of this study is thus to present a dynamic model of real exchange rate determination and empirically test the implications of changes in possible determinants of the real exchange rate in Nigeria. The sub-objectives include: to assess the impact of terms of trade on the real exchange rate in Nigeria; to establish the extent to which the openness of the economy affects the real exchange rate in Nigeria; to analyze the relationship between the variation in capital flow and the real exchange rate in Nigeria; to ascertain the impact of nominal devaluation on the real exchange rate; to assess the relationship between fiscal policy and the real exchange rate and to assess the relationship between changes in the general price level and the real exchange rate in Nigeria.

Other than this introductory section, the rest of the paper is divided into three sections. The first section focuses on literature review which is made up of empirical literature and theoretical literature. The second deals with econometric procedure and the last section concludes this paper.

2. Literature Review

This is divided into empirical literature and theoretical literature

2.1 Empirical Literature

Edwards (1989) pioneered the fundamentals models of the determination of real exchange rates for developing countries. Edwards started by developing a theoretical model of the real exchange rate determination and then estimated its equilibrium value for a panel of 12 developing countries (Brazil, Columbia, El Salvador, Greece, India, Israel, Malaysia, Philippines, South Africa, Sri Lanka, Thailand and Yugoslavia) using conventional cointegration tests on time series data. To analyse the relative importance of real and nominal variables in the process of real exchange rate determination in the short and long run, he used the following partial adjustment model: RER = v(terms of trade, government consumption, capital controls, exchange controls, technical progress, domestic credit, real growth, nominal devaluation). The study found that in the long run only real variables affect the long run equilibrium real exchange rate. In the short run, however, real exchange rate variability was explained by both real and nominal factors. Obadan (1994) formulated a simple econometric model for Nigeria and empirically estimated it together with a random walk model of the real exchange rate determination. Both models were estimated in log-linear forms using the two-stage least squares regression methodology and data for the period 1970-1988. Although this study failed to test variables for stationarity and did not estimate the equilibrium real exchange rate, it found that both structural and short run factors were important determinants of variations in prevailing bilateral real exchange rates and multilateral real effective exchange rates. The study found that the most important factors were international terms of trade, net capital inflows, nominal exchange rate policy and monetary policy. Mungule (2004) investigated the determinants of real exchange rate in Zambia. He used the real exchange rate as a function of terms of trade, capital inflow, closeness of the economy and excess supply of domestic credit. Using the cointegration technique, he discovered that the REER and the fundamental determinants have a long run equilibrium relationship. Ogun (2004) examined the impact of real exchange rate on growth of non-oil export in Nigeria. Specifically, he analyzed the effects of real exchange rate misalignment and volatility on the growth of non oil exports. He employed the standard trade theory model of determinants of export growth and two different measures of real exchange rate misalignment, one of which

entailed deviations of purchasing power parity (PPP) and the other was model based estimation of equilibrium real exchange rate. He reported that, irrespective of the alternative measures of misalignment adopted, both real exchange rate misalignment and volatility adversely affected growth of Nigeria's non-oil export.

This study on the determinants of the real exchange rate in Nigeria however differs from most of the works reviewed because a critical examination of these works, particularly those from Nigeria, showed that most of them did not take into account the time series characteristics of the macroeconomic data used. Also most of the works also used the traditional methods of estimation such as the OLS or Two Stage Least Squares 2SLS. They did not also take into account recent experiences of the real exchange rate particularly from the time of the Structural Adjustment Programme (SAP). In this study, we have therefore adopted a cointegration approach to analyze the determinants and behaviour of real exchange rate in Nigeria. Moreover, the study provides a better assessment because it covers a wider duration of 39 years of inter-temporal change in the behaviour of economic agents taking as an aggregate. The review of empirical literature also showed that very few studies have been carried out in Nigeria in this area.

The empirical works revealed that while the real exchange rate is calculated using the nominal exchange rate and the price level, the nominal exchange rate has been included in models of real exchange rate, but the price level has not been included in these models. Thus, one of the departure points of this study from the previous studies is that it includes the direct effects of the price level on the real exchange rate.

This study adopts the Mungule (2004) model. However, unlike the Mungule's model, the study uses the degree of openness instead of closeness. The study, unlike Mungule's model also includes the nominal effective exchange rate as an explanatory variable. This research also included the impact of fiscal policy, through government expenditure which was not included in Mugule (2004) model. The impact of technological progress on the real exchange rate was also taken care of in this model. Mungule studied the Zambian economy, but this study is on the Nigerian economy and covered the period between 1970 to 2008.

2.2 Theoretical Literature

Edwards (1989) model assumes a small, open economy, which produces and consumes two goods-tradables and nontradables. Importables and exportables are aggregated into one tradable category. The government sector consumes both tradables and nontradables and finances its expenditures by non-distortionary taxes and domestic credit creation. The country holds both domestic money and foreign money. At a later stage of the study it is assumed that there are no capital controls, and that there are some capital flows in and out of the country. The nominal exchange rate of the economy is fixed with a basket of currencies of its major trading partners. It is also assumed that there is a tariff on imports. The price of tradables in terms of foreign currency is fixed and equal to unity, that is, $P_T = 1$. Finally, perfect foresight is assumed in this model.

The model is represented by the following equations:

Portfolio Decisions

$$B = M + FM \tag{1}$$

$$b = m + fm \text{ where } b = B/E,\ m = M/E,\ fm = FM/E \tag{2}$$

$$FM \neq 0 \tag{3}$$

Demand Side

$$c = E^*P_t/P_{NT} \tag{4}$$

$$C_T = C_T(e,\ b); \qquad \delta C_T/\delta e<0;\ \delta C_T/\delta_b>0 \tag{5}$$

$$C_{NT} = C_{NT}(e,\ b); \quad \delta C_{NT}/\delta e>0;\ \delta C_{NT}/\delta_b>0 \tag{6}$$

Supply Side

$$S_T = S_T(e); \qquad \delta S_T/\delta e<0 \tag{7}$$

$$S_{NT} = S_{NT}(e) \qquad \delta S_{NT}/\delta e<0 \tag{8}$$

Government Sector

$$G = P_{NT}G_{NT} + E^*G_T \tag{9}$$

$$g = g_T + g_{NT};\ \text{where } g = G/E;\ g_T = G_T;\ g_{NT} = P_{NT}G_{NT}/E = G_{NT}/e \tag{10}$$

$$E^*G_T/G = \lambda \tag{11}$$

$$G = t + DC \tag{12}$$

External Sector

$$CB = S_T(e) - C_T(e, b) - G_T \quad (13)$$

$$KB = f(i - i_f) \quad (14)$$

$$R = CB + KB \quad (15)$$

$$M = DC + ER \quad (16)$$

Equation 1 defines the total assets, B, as the sum of domestic money M and foreign money, FM. Equation 2 defines real assets (b) in terms of tradables, where E is the nominal effective exchange rate (foreign currency value in terms of domestic currency). Domestic money (m) and foreign money (fm) are also defined in terms of the nominal exchange rate in this equation. Equation 3 shows that there is international capital mobility, therefore, FM ≠ 0.

The demand side of the economy is given by Equations 4 to 6. The real exchange rate, e, is defined as the ratio of foreign price in terms of domestic currency to the price of domestic nontradables in Equation 4. Demand for tradables and nontradables are determined by the real exchange rate and the level of real assets. Demand for both tradables and nontradables is positively affected by the asset level whereas real depreciation reduces the domestic demand for tradables and increases the demand for nontradables, which is shown in Equations *5* and 6.

Equation 7 and 8 summarise the supply side of the economy. The supply of tradables and nontradables is solely determined by the real exchange rate. An appreciation of the real exchange rate reduces the supply of tradables and increases the supply of nontradables. To keep the model simple the tax function is not included (equations 5-8) in the demand function and the tariff function is not included in the demand for importables.

Equations 9 to 11 summarize (the government sector, where GN_T and G_T are government consumption of nontradables and tradables, respectively. Equation 9' is the real government consumption of tradables and nontradables in terms of tradable. Equation10 defines the share of government consumption of tradables to the total government expenditure as λ, which is equal to (g_T/g) in real terms. Equation 11 represents the government budget constraint where government consumption is financed by taxes (t) and domestic credit creation (DC).

The external sector is represented by Equations 12 to 15. Equation 12 defines the current account as the difference between the output of tradables and both private and public consumption of tradables expressed in foreign currency. Equation 13 indicates that there is inflow and outflow of capital. The capital account is defined as a function of interest rate differentials between domestic and foreign economics. Equation 14 defines the change in stock of international reserves. Finally the model is closed with Equation 15 which shows that the change in domestic money (m) is determined by changes in domestic credit creation and changes in international reserves.

Long run equilibrium is attained when the nontradable goods market and external sector are simultaneously in equilibrium, which implies that the current account is equal to the capital account in the long run. However, in the short and medium run, there can be departures from CB = KB, which will result in the accumulation and decumulation of international reserves. Therefore, the long run steady state is attained under four scenarios, which can be summarised as follows:

(1) there is internal equilibrium or equilibrium in the nontradable sector

(2) there is external equilibrium so that k = 0 = CB = KB = m

(3) the government runs a balanced budget such that G = t and DC = 0, that is, fiscal policy is sustainable; and

(4) portfolio equilibrium holds.

The real exchange rate attained under these steady-state conditions is known as the long run equilibrium real exchange rate, ERER, that is,

$$ERER = e^* = E^* P_T / P_{NT} \quad (17)$$

The nontradable market clears when

$$C_{NT}(e, b) + g_{NT}(e) = S_{NT}(c) \quad (18)$$

The real government consumption of nontradables in terms of tradables has been defined as $g_{NT.}$ Thus, the P_{NT} can be expressed as a function of b, g_{NT}, P_T and τ (trade restrictions).

$$P_{NT} = n(b, g_{NT} P_T, \tau) \quad (19)$$

where, $\delta n/\delta_b > 0$; $\delta n/\delta g_{NT} > 0$; $\delta n/\delta P_T > 0$, $\delta n/\delta \tau > 0$

Equilibrium in the external sector requires that m = 0.The following equation of m can be derived from earlier equations as:

$$m = \{S_T(e) - C_T(e, b)\} - KA + g_{NT} - t/E \quad (20)$$

When government expenditures are fully financed with taxes, the R = 0 will coincide with the m = 0

From Equations 18 and 19 it is possible to find an equilibrium relation between e, b, g_{NT} and τ.

$$ERER = e^* = x(b, g_{NT}, P_T \text{ and } \tau) \quad (21)$$

where, $\delta x/\delta_b < 0$; $\delta x/\delta g_{NT} < 0$; $\delta x/\delta P_T > 0$; $\delta x/\delta\tau < 0$

A rise in domestic money, m, in terms of foreign currency, results in higher real wealth and a current account deficit. To bring back equilibrium, real wealth, the price of nontradabes will rise (Equation 18). Thus, an increase in real assets increases the price of nontradebles and causes the RER to appreciate in order to ensure long run equilibrium. Increases in government expenditure on nontradables (g_{NT}) have the same effect on the ERER. A rise in the price of tradables causes the RER to depreciate, given, that the price of nontradablcs and the nominal exchange rate remain constant. However, if the increase in the P_T increases export earnings, and is spent on the nontradable sector, the demand for and price of nontradables will increase more than the P_T causing a RER appreciation. The total effect of an import tariff depends on the initial expenditure on domestic nontradables and importables. An increase in the tariff on importables worsens the current account by increasing import bills, lowers the demand for tradables, raises the demand and price for nontradables and tends to lead to an appreciation of the long run real exchange rate. But if an increase in tariff worsens the current account balance without any substitution effects, it will increase the composite P_T alone and may depreciate the real exchange rate. It is therefore, possible to observe, simultaneously, a real depreciation and a worsening of the current account. So the increase in the P_T and changes in trade policies can have either positive or negative impacts on the RER.

Equation 20 indicates that the long run equilibrium RER is a function of real variables only. The value of real assets, government consumption, price of tradables and trade restrictions in this equation are normally influenced by changes in other real variables such as terms of trade (TOT) shocks, changes in government expenditure, technological progress, and changes in trade and capital restrictions. Changes in these real variables can cause the actual RER to deviate from its equilibrium level. However, changes in nominal variables, such as domestic credit expansion, and changes in the values of nominal exchange rate, also affect the path of the actual RER in the short run.

3. Econometric Procedure

To guard against the possibility of estimating spurious relationships in the presence of some nonstationary variables, estimation is performed using a general-to-specific Hendry-type error correction modelling (ECM) procedure. This procedure begins with an over-parameterised autoregressive distributed lag (ADL) specification of an appropriate lag. The consideration of the available degrees of freedom and type of data determine the decision on lag length. With annual data, one or two lags would be long enough, while with quarterly data a maximum lag of four can be taken. Under this ECM procedure, the long run relationship is embedded within the dynamic specification.

Based on this theoretical background and on data availability, this study estimates the following relationship:

$$REER_t = \beta_0 + \beta_1 TOT + \beta_2 \text{OPEN} + \beta_3 \text{GSPGDP} + \beta_4 \text{NEER} + \beta_5 \text{TECHPRO}_t + \beta_6 \text{RGDP}_t + B_7 \text{P} + B_8 CAPFLGDP + \mu_t$$

where the following notation has been used:

REER = real effective exchange rate,

CAPFLGDP = ratio of capital flow to Gross Domestic Product(GDP)

TOT = terms of trade,

OPEN = an indicator of the degree of openness,

GSPGDP = the ratio of government spending (fiscal policy) to GDP,

TECHPRO = measure of technological progress (Balassa-Samuelson effect),

NEER = nominal effective exchange rate policy

RGDP = Real Gross Domestic Product

P = rate of inflation

μ = error term.

3.1 Definition and Sources of Variables

Conventionally, proxies have to be found for variables without time series data. Their construction is explained below.

REER: The real effective exchange rate of the naira, measured in foreign currency terms, thus an increase in this variable indicates an appreciation of the naira. The data was gotten from the World Bank Indicators-Nigeria-Exchange Rates and prices, 2010.

OPEN**:** This is a measure of the degree of openness. It is defined as the ratio of the sum of imports and exports of goods and services to GDP. Several other proxies ranging from the ratio of the tariffs to GDP to the ratio of tariff revenues to imports have been used, but this is the proxy that has been used by the majority of the studies (see Edwards, 1994, Aron, Elbadawi and Khan, 1997, Mkenda, 2001 and MacDonald and Ricci, 2003).The ata was gotten from the authors' computation.

TECHPRO**:** Technological progress data is also not readily available, so we have to find a proxy for it. We follow Edwards (1994) and MacDonald (1998) and use real GDP growth rate. The data was gotten from the authors' computation.

P**:** Represents the domestic rate of inflation. Excess domestic credit increases the price level which lead to an appreciation of the real exchange rate**.** The data was gotten from the CBN statistical bulletin, 2010.

CAPFLGDP: This is taken to be the ratio of capital to the GDP. The data was gotten from the CBN statistical bulletin and authors' computation.

NEER: Data for the Nominal Effective Exchange Rate was gotten from the CBN statistical bulletin.

TOT: Data on terms of trade was gotten from the World Bank development indicators for Africa.

RGDP: Data on the Real Gross Domestic Product was gotten from CBN statistical bulletin

Once the model that links the real exchange rate to its potential determinants has been specified and variables defined, the next step is to estimate the parameters of the specified model. There are several methods of parameter estimation that involve several steps.

3.2 Empirical Results

3.2.1 Tests for Stationarity

The Augmented Dickey Fuller (ADF) unit root test was used to test whether the variables are stationary and their other of integration. Table 1 shows the result of the ADF unit root test.

Table 1. Summary of ADF Unit Root Test Result

Variables	Level Data	1st difference	1% Critical Value	5% Critical Value	10% Critical Value	Order of Integration
TECHPRO	-3.81826*	-10.90863	-3.6228	-2.9446	-2.6105	I (0)
TOT	-1.748683	-6.489581*	-3.6228	-2.9446	-2.6105	I (1)
RGDP	1.74982	-3.920004*	-3.6228	-2.9446	-2.6105	I (1)
CAPFLGDP	-4.614763	-7.169453*	-3.6228	-2.9446	-2.6105	I (0)
NEER	-1.506039	-3.239245**	-3.6228	-2.9446	-2.6105	I (1)
OPEN	-2.204149	-7.202098	-3.6228	-2.9446	-2.6105	I (1)
REER	-2.076747	-4.282254*	-3.6228	-2.9446	-2.6105	I (1)
GSPGDP	1.624526	-3.919711*	-3.6228	-2.9446	-2.6105	I (0)
P	-3.410434	-5.972337	-3.6228	-2.9446	-2.6105	I (1)

NB:

* Indicates statistical significant at the 1 percent level

** Indicates statistical significant at the 5 percent level

*** Indicates statistical significant at the 10 percent level

The unit root test result shows that most of the variables are not stationary, while three of the variables (TECHPRO, P & CAPFLGDP) are stationary at the levels, all other variables become stationary after taking the

first difference. Assessing the short run dynamics of the real exchange rate, therefore make the test for cointegration necessary which forms the next stage of analysis.

3.2.2 Cointegration Test

If two or more time series are not stationary, it is important to test whether there is a linear combination of them that is stationary. This phenomenon is referred to as the test for cointegration. The evidence of cointegration implies that there is a long run relationship among the variables. Hence, the short-run dynamics can be represented by an error correction mechanism (Engle and Granger, 1987).

Table 3.2 shows the results of the cointegration test, using the Johansen methodology. The results show that trace test rejected the null hypothesis of no co-integration among the variables at the 5 percent level and 1 percent level of significance. The trace statistics indicates 2 and 1 cointegrating equations at the 5% and 1% level of significance respectively. Max-eigen test indicates 3 cointegration equations at the 5 percent level and 1 cointegrating equation at the 1% level. The cointegration test results are therefore uninformative about the number of cointegrating relations among the variables. However, Pesaran and Pesaran (1997) has pointed out that both the trace statistics and the maximum-Eigen value statistic give conflicting conclusions and decision about the number of cointegrating vectors and that it should be based on economic theory or other available information. We can therefore proceed with the fact that there is at least cointegration.

Table 2. Results of Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistics	5 Percent Critical Value	1 Percent Critical Value
None**	0.874494	239.0904	192.89	204.96
At most 1*	0.775629	162.3005	156.00	168.36
At most 2	0.724788	107.0057	124.24	133.57
At most 3	0.411528	59.26774	94.15	163.18
At most 4	0.355230	39.64939	68.52	76.07
At most 5	0.214647	23.41450	47.21	54.46
At most 6	0.198759	14.47151	29.68	35.65
At most 7	0.122014	6.272071	15.41	20.04
At most 8	0.038625	1.457454	3.76	6.65

(**) denotes rejection of the hypotheses at the 5% (1%) level

Trace test indicates 2 cointegrating equation(s) at the 5% level

Trace test indicates 1 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistics	5 Percent Critical Value	1 Percent Critical Value
None**	0.874494	76.78990	57.12	62.80
At most 1*	0.775629	55.29483	51.42	57.69
At most 2*	0.724788	47.73794	45.28	54.57
At most 3	0.411528	19.61835	39.37	45.10
At most 4	0.355230	16.23789	33.46	38.77
At most 5	0.214647	8.939990	27.07	32.24
At most 6	0.198759	8.199411	20.97	25.52
At most 7	0.122014	4.814617	14.07	18.63
At most 8	0.038625	1.457454	3.76	6.65

(**) denotes rejection of the hypotheses at the 5% (1%) level

Max-eigen value test indicates 3 cointegrating equation(s) at the 5% level

Max-eigenvalue test indicates 1 cointegrating equation(s) at the 1% level

3.2.3 The Short-run Dynamics of the Real Effective Exchange Rate

Since the real effective exchange rate and most of the regressors of the model are not stationary and cointegration is established, the appropriate mechanism for modelling the short run real effective exchange rate for Nigeria is an error correction mechanism (ECM). An ECM of the Real Effective Exchange Rate is therefore estimated. In the error correction model the first difference of all the variables were used because most of the variables were stationary at the first difference and none was stationary at the second difference.

Table 3. Summary of Parsimonious Error Correction Model for Real Effective Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.796904	0.116837	-6.820621	0.0000
DLRGDP	0.819245	0.050425	16.24678	0.0000
DLOPEN	-0.085214	0.039559	-2.154078	0.0436
DLNEER	5.004878	0.106223	47.11670	0.0000
DLNEER(-1)	0.005976	0.001691	3.534637	0.0016
DLCAPFLGDP(-1)	-0.010880	0.001123	-9.687744	0.0000
P	-10.04362	1.131649	-8.875203	0.0000
P(-1)	-11.63743	1.614833	-7.206581	0.0000
C	-0.198702	0.078271	-2.538639	0.0172

R-squared	0.634859	Akaike info criterion	0.481259
Adjusted R-squared	0.613145	Schwarz criterion	0.916642
Log likelihood	1.096716	F-statistic	15.60542
Durbin-Watson stat	1.992257	Prob (F-statistic)	0.000001

Table 3 shows the result of the Parsimonious error correction model. In this model, while most of the variables are significant at the 1% level. The least statistically significant and statistically insignificant variables were deleted from the model. The log likelihood and Akaike information criterion suggest that the deletion of the variable is useful. Appendix Table 1 shows the result of the overparameterized error correction model.

The result of the error correction model shows that nominal effective exchange rate depreciation leads to a depreciation of the real effective exchange rate of Nigeria and this effect holds both in the contemporaneous sense and after a year and the contemporaneous effect is higher than the effect after a year. The result also shows that the price level has negative effect on the real effective exchange rate of Nigeria. This implies that as the price level increases, the real effective exchange rate of Nigeria appreciates. This effect also holds after a year, though it decreases in magnitude. The one period lag value of capital flow has a negative impact on the real effective exchange rate, though the contemporaneous value is insignificant and hence not included in the parsimonious model. This implies that an increase in capital flow to Nigeria in a particular year appreciates the real effective exchange rate in the following year. This implies that the Dutch Disease Syndrome holds in Nigeria with a lag effect. This is not surprising with the over-reliance of the Nigerian economy on petroleum revenue. The openness of Nigeria to international trade has a negative impact on the real effective exchange rate. Thus, commercial policies that encourage trade liberalization in Nigeria depreciate the real effective exchange rate. The result also shows that real GDP has a positive effect on the real effective exchange rate. This is in contrast to the prediction of the Ricardo-Balassa thesis. This result implies that in the short run, real GDP growth comes from the non-tradable goods sector of Nigeria. The ratio of government spending to GDP is insignificant in the model and was not included in the parsimonious ECM Model. This insignificance could be as a result of the fact that the investment variable has both private and government sector components; government expenditure is made up of consumption and investment; and investment is significant in the model. This reflects the fact that over the period 1970 to 2010, government investment was higher than private investment in Nigeria. The terms of trade is also found to be insignificant in the real effective exchange rate model. The insignificance of the terms of trade implies that terms of trade as an external factor has not been an important player in the determination of the real effective exchange rate and hence the determination of the international competitiveness of Nigeria. The significance and negative ECM is an indication that the speed of adjustment has been satisfactory. This further confirms the long run relationship suggested by the Johansen cointegration test.

3.2.4 Diagnostic Tests

Various diagnostic tests were carried out in order to determine the robustness of the real effective exchange rate model. Appendix table 2 shows the results of the residual diagnostics tests and the model stability test. The null hypotheses in this case are that there is no serial correlation, the model is homoskedastic and that the errors are normally distributed. The statistical insignificance of the tests is an indication of a validation of the null hypotheses. The results thus show that the residuals of the model are normally distributed, there is no autocorrelation problem, there is no heteroskedasticity problem and there is no autoregressive conditional heteroskedasticity. The cumulative sum of squares (CUSUM) test statistic is updated recursively and plotted against the break points in the data. For stability of the short run, dynamics and the long run parameters of the determinants of real exchange rate, it is important that the CUSUM statistic stay within the 5% critical bound (represented by the straight lines). The CUSUM figure in the appendix shows that the model is stable.

4. Conclusion

The real effective exchange rate is a measure of the international competitiveness of an economy and an overvalued real exchange rate increases the price of domestic goods abroad, leading to lower demand for exports. This deteriorates the trade balance. In Nigeria, nominal effective exchange rate increased in the 1970s, 1980s, 1990s and 2000s by either the activity of the government (during the fixed exchange rate regime) or a combination of government intervention and market forces (in the managed floating exchange rate regime which took off in 1986). However, the real effective exchange rate of Nigeria did not follow the trend of the nominal exchange rate. This therefore forms the basis of the investigation of the determinants of the real exchange rate in Nigeria using data covering the period of 1970 to 2008. The variables were tested for unit root as well as cointegration and their short dynamic run relationship using Hendry's general to specific modelling was estimated. The long run equilibrium real exchange rate was analysed using the Johansen maximum likelihood technique. The result from the error correction model shows that increase in the price level, capital inflow, capital accumulation and trade openness appreciates the real effective exchange rate of Nigeria. This is a major contribution of the this paper because other studies including that by Mungule failed to realise the important influence of the price level on the real exchange rate. Also, an increase in the nominal effective exchange rate and output depreciate the real effective exchange rate.

These empirical findings have implications for measures to improve the competitiveness of Nigeria in international trade. First, increases in domestic policies that ameliorate inflation are imperative since increase in domestic price level appreciates the real effective exchange rate. Second, since capital accumulation appreciates the real effective exchange rate, there is need for the creation of enabling environment that encourages investment in the tradable goods sector, rather than the non-tradable goods sector. This can be done by reforming the Nigerian agricultural and industrial sectors to attract investment for the purpose of export and reforming the mining sector for increased investment. Third, given the fact that trade openness appreciates the real effective exchange rate, there is need to integrate Nigeria with other economies in the West African sub-region. Fourth, since real output has a positive impact on the real effective exchange rate, to generate a substantial real exchange rate depreciation, supply side policies that will improve productivity will be useful in Nigeria. This will include human capital development in form of education and health as well the improvement in basic infrastructural facilities like electricity amongst others.

References

Adewuyi, A. O. (2005). Trade and exchange rate policy reform and export performance of the real sector: The case of Nigeria. *Selected Papers for the 2005 Annual conference of the Nigerian Economic society.*

Bah, I., &Amusa, H. A. (2003). Real exchange rate volatility and foreign trade: Evidence from South Africa's exports to the United States. *The African Finance Journal*, *5*(2), 1-20.

Balassa, B. (1964). The Purchasing Power Parity doctrine: A reappraisal. *Journal of Political Economy, 72*, 584-96. http://dx.doi.org/10.1086/258965

Box, G. E. P., & G. M. Jenkins. (1970). *Time series analysis, forecasting and control*, San Francisco: Holden-Day.

CBN. (2008). *Statistical Bulletin*, Golden Jubilee Edition.

CBN. (2009). *Statistical Bulletin*, December Edition.

CBN. (2010). *Statistical Bulletin*

Davidson, J., Hendry, D., Sbra, F., & Yeo, S. (1978). Econometric modelling of the aggregate time series relationship between consumers' expenditure and income in the United Kingdom. *Economic Journal, 88*(352), 661 –92.

Edwards, S. (1989). *Real exchange rates, devaluation and adjustment: Exchange rate policy in developing countries*. Cambridge: The MIT Press.

Edwards, S. (1994). Real and monetary determinants of real exchange rate behaviour: Theory and evidence from developing countries. In: Williamson, J. (ed.). *Estimating Equilibrium Exchange Rates*. Washington: Institute for International Economics.

Engle, R. F., & Granger, C. W. F. (1987).Cointegration and error correction: representation and testing, *Ecometrica*, *55*, 251-76. http://dx.doi.org/10.2307/1913236

Gbosi, A. N. (2002). *Financial sector instability and challenges to nigeria's monetary authorities.* Lagos: African Heritage Publication

Granger, C. W., & Newbold, P. (1977). The time series approach to econometric model building, In Obadan, M.I. and Iyoha, M.A. eds. (1996). *Macroeconomic analysis: Tools, techniques and applications*. NCEMA, Ibadan: Polygraphics Venture Ltd.

Hendry, D. F. (1986). Econometric modelling with cointegrated variables: an Overview. *Oxford Bulletin of Economic and Statistics*, *48*(3), 201–12. http://dx.doi.org/10.1111/j.1468-0084.1986.mp48003001.x

Hendry, D. F., & Mizon, G. (1978). Serial correlation as a convenient simplification, not a nuisance: A comment on a study of the demand for money of the bank of England. *Economic Journal, 88*(351), 549-63. http://dx.doi.org/10.2307/2232053

Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford: Oxford University Press. http://dx.doi.org/10.1093/0198774508.001.0001

Mungule, K. O. (1997). The impact of the real exchange rate misalignment on macroeconomic performance in Zambia. MA Thesis, University of Malawi, Zomba, Malawi.

Mungule, K. O. (2004). The determinants of the real exchange rate in Zambia. *African Economic Research Consortium, Paper 146 Nairobi.*

Obadan, I. M. (1994). Real exchange rates in Nigeria, *6*, 53-70. National Centre for Economic Management and Administration (NCEMA). Ibadan, Nigeria.

Obadan, M. I. (2006). Overview of exchange rate management in nigeria from 1986 to date, in the Dynamics of exchange rate in Nigeria. *Central Bank of Nigeria Bullion, 30*(3), 17-25.

Ogun, O. (2004). Real exchange rate behaviour and non-oil export growth in Nigeria. *African Journal of Economic Policy*, *11*(1), June.

Oxford dictionary of Economics. Oxford: Oxford University Press

Pesaran, H. M., & Pesaran, B. (1997). *Working with microfit, 4.0*, Oxford University Press.

Sargan, J. D. (1964). Wages and prices in the UK: A study in econometric methodology, in P. Hart, G. Mills and J. Whittaker (eds.), *Econometric analysis for national planning,* London: Butterworths..

Xiaopu, Z. (2002). Equilibrium and misalignment: an assessment of the RMB Exchange rate from 1999, *Centre for Research on Economic Development and Policy Reform. Working Paper* 127

Appendix 1. Summary of Overparamterized Error Correction Result for Real Effective Exchange Rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.101729	0.023410	-4345431	00002
DLTOT	-0.007717	0.017749	-0.434805	0.6686
DLTECHPRO	-0.006500	0.033714	-0.192798	0.8492
DLRGDP	0.133133	0.051155	2602563	0.0126
DLRGDP(-1)	-0.038824	0.099507	-0.390160	0.7008
OLOPEN	-0.073214	0.025428	-2.879235	0.0062
DLOPEN(-1)	-0.004009	0.089342	-0.044873	0.9647
DLNEER	0.939993	0.115227	8.157780	0.0000
DLNEER(-1)	0.861709	0.143721	5.995693	0.0000
DLGSPGDP	0.052982	0.065322	0.811091	0,4274
DLGSPGDP(-1)	-0,012721	0.082357	-0.154464	0,8789
DLCAPFLGDP	-0.020364	0.030082	-0.676957	0.5066
DLCAPFLGDP(-1)	-14.52595	5.933952	-2.447938	0,0204
P	-0960240	0,058651	-16.37203	0.0000
P(-1)	0.004102	0.003942	1,040775	0,3110
C	-0.192428	0.084000	-2.290802	0.0336

R-squared	0.553949	Akaike info criterion	0.534992
Adjusted R-squared	0.544850	Schwarz criterion	1.318682
Sum squared resid	1.398024	F-statistic	10.38800
Log likelihood	8.102643	Prob (F-statistic)	0 000024
Durbin-Watson stat	2.426668		

Appendix 2. Results of Model-Residual Diagnostic Tests

Breush-Godfrey Serial Correlation LM Test			
F Statistic	0.576281	Probability	0.569275
Obs* R-squared	1.630616	Probability	0.442503
White Heteroskedasticity test			
F Statistic	0.808577	Probability	0.696940
Obs* R-squared	34.49081	Probability	0.444292
ARCH Test			
F Statistic	0.004997	Probability	0.944061
Obs* R-squared	0.005290	Probability	0.942020
Jarque Bera	1.293938	Probability	0.1253637

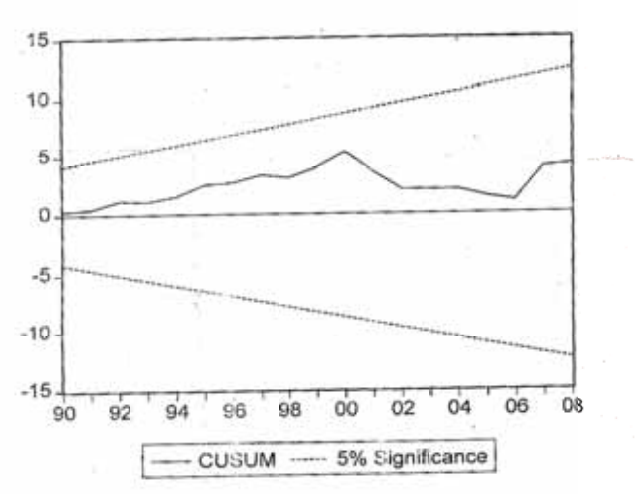

Figure 1. Cusum Stability Test

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Modelling Stock Market Volatility Using Univariate GARCH Models: Evidence from Sudan and Egypt

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Abstract

Stock market volatility in two African exchanges, Khartoum Stock Exchange, KSE (from Sudan) and Cairo and Alexandria Stock Exchange, CASE (from Egypt) is modelled and estimated. The analysis is based on using daily closing prices on the general indices in the two markets over the period of 2nd January 2006 to 30th November 2010. The paper employs different univariate specifications of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model, including both symmetric and asymmetric models. The empirical results show that the conditional variance (volatility) is an explosive process for the KSE index returns series, while it is quite persistent for the CASE index returns series. The results also provide evidence on the existence of a positive risk premium in both markets, which supports the hypothesis of a positive correlation between volatility and the expected stock returns. Furthermore, the asymmetric GARCH models find a significant evidence for asymmetry in stock returns in the two markets, confirming the presence of leverage effect in the returns series.

Keywords: volatility, stock returns, GARCH models, heteroscedasticity, volatility clustering, leverage effect

1. Introduction

Over the last few years, modelling and forecasting volatility of financial time series (i.e. asset returns) has become a fertile area of research in finance, and has been receiving considerable attention from academics and practitioners. This is because volatility is an important concept for many economic and financial applications, like portfolio optimization, risk management and asset pricing. A special feature of volatility, which according to Tsay (2010) is "the conditional variance of the underlying asset returns", is that it is not directly observable. Consequently, financial analysts are especially keen to obtain good estimates of this conditional variance in order to improve portfolio allocation, risk management or valuation of financial derivatives. Since the 1980s a number of models has been developed that are especially suited to estimate the conditional volatility of financial assets. Well-known and frequently applied models of this type are the (generalized) conditional heteroscedastic models.

Among these models, the Autoregressive Conditional Heteroscedastic (Note 1) (ARCH) model proposed by Engle (1982) and its extension, the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model developed independently by Bollerslev (1986), and Taylor (1986) have been the first models introduced into the literature and have become very popular (Enders, 2004). Since then, there have been a great number of empirical applications of modelling the conditional variance (volatility) of financial time series by employing different specifications of these models and their many extensions (Note 2). For example, Chou (1988), Nelson (1991), Bollerslev et al. (1992), Engle and Patton (2001), and Brooks and Burke (2003) provide an extended methodological framework that can be applied to various problems in finance. On the empirical level, several applications have been found on both developed and developing stock markets, see for example De Santis and Imrohoroglu (1997), Husain and Uppal (1999), Bekaert and Wu (2000), McMillan et al. (2000), Engle and Patton (2001), Poshakwale and Murinde (2001), Brooks and Burke (2003), Balaban et al. (2004), Ogum et al. (2005), Shin (2005), Chukwuogor (2006), Bali (2007), Edel and Brian (2007), Floros (2007), Leaon (2007), Ocran and Biekets (2007), Alberg et al. (2008), Samouilhan and Shannon (2008), Shamiri and Isa (2009), Olowe (2009), Kalu (2010) and Mishra (2010)). These models were designed to explicitly model and forecast the time-varying conditional second order moment

(variance) of a series by using past unpredictable changes in the returns of that series, and have been applied successfully in economics and finance, but more predominantly in financial market research. For the case of Egypt there are some studies concerned with the issue of modelling stock market volatility (see for example Tooma (2003), Mecagni and Sourial (1999), Ebeid and Bedeir (2004), and Floros (2008)), but to the best of our knowledge, there are no such empirical studies for the Sudanese stock market. Thus, one of the contributions of this paper is to provide empirical evidence on the fit of conditional volatility models for the Sudanese stock market.

The main objective of this paper is to model stock returns volatility in two African markets; the Sudanese stock market (Khartoum Stock Exchange, KSE), and the Egyptian stock market (Cairo and Alexandria Stock Exchange, CASE) by employing different univariate specifications of GARCH type models for daily observations on the index returns series of each market over the period of 2nd January 2006 to 30th November 2010, as well as describing special features of the markets in terms of trading activity and index components and calculations. The volatility models employed in this paper include both symmetric and asymmetric GARCH models. While the CASE might be considered as one of the most advanced stock markets within the African continent, the KSE has been established only recently and exhibits a limited track record. Therefore, it might be of particular interest to compare the volatility on both markets.

The remaining of this paper is organized as follows: Section 2 provides a general overview of the stock exchange in Sudan and Egypt. Section 3 describes the data and provides summary statistics. In the fourth section the GARCH methodology is presented, while the estimations results are discussed in Section 5. Finally, Section 6 concludes the paper.

2. Literature Review

There has been a large amount of literature on modelling and forecasting stock market volatility in both developed and developing countries around the world. Many econometric models have been used to investigate volatility characteristics. However, no single model is superior. Pindyck (1984) demonstrates that the increases in variance of stock returns can explain much of the decline in stock prices. Whitelaw (1994) offers empirical evidence for a positive relation between a lagged volatility measure and future expected returns. For Asian stock markets, Koutmos (1999) and Koutmos and Saidi (1995) found that the conditional variance is an asymmetric function of past innovations. Positive past returns are on average 1.4 times more persistent than negative past returns of an equal magnitude. Lee et al. (2001) examined time-series features of stock returns and volatility in four of China's stock exchanges. They provided strong evidence of time-varying volatility and indicated volatility is highly persistent and predictable. Moreover, evidence in support of a fat-tailed conditional distribution of returns was found. By employing eleven models and using symmetric and asymmetric loss functions to evaluate the performance of these models, Balaban, Bayar, and Faff (2003) forecasted stock market volatility of fourteen stock markets. According to symmetric loss functions the exponential smoothing model provides the best forecast. However, when asymmetric loss functions are applied ARCH-type models provide the best forecast. Balaban and Bayar (2005) used both symmetric and asymmetric ARCH-type models to derive volatility expectations. The outcome showed that there has a positive effect of expected volatility on weekly and monthly stock returns of both Philippines and Thailand markets according to ARCH model. The result is not clear if using the other models such as GARCH, GJR-GARCH and EGARCH. For emerging African markets, Ogum, Beer and Nouyrigat (2005) investigate the market volatility using Nigeria and Kenya stock return series. Results of the exponential GARCH model indicate that asymmetric volatility found in the U.S. and other developed markets is also present in Nigerian stock exchange (NSE), but Kenya shows evidence of significant and positive asymmetric volatility. Also, they show that while the Nairobi Stock Exchange return series indicate negative and insignificant risk-premium parameters, the NSE return series exhibit a significant and positive time-varying risk premium. By using asymmetric GARCH models, Alberg et al. (2006) estimate stock market volatility of Tel Aviv Stock Exchange indices, for the period 1992-2005. They report that the EGARCH model is the most successful in forecasting the TASE indices. Various time series methods are employed by Tudor (2008), including the simple GARCH model, the GARCH-in-Mean model and the exponential GARCH to investigate the Risk-Return Trade-off on the Romanian stock market. Results of the study confirm that E-GARCH is the best fitting model for the Bucharest Stock Exchange composite index volatility in terms of sample-fit.

3. Overview of Stock Market in Sudan and Egypt

3.1 Sudanese Stock Market

The Khartoum Stock Exchange (KSE) is the principal stock exchange of Sudan located in Khartoum. The KSE started its activities officially in January 1995 with the assistance of the Common Market for Eastern and Southern Africa (CoMESA) (Note 3), with the objective of regulating and controlling the issuance of securities, and

mobilizing private savings for investment in securities. Securities traded in the KSE are ordinary shares and investment units (Note 4). Furthermore, a substantial number of mutual funds and Government Investment Certificates (GICs) (Note 5) are also traded (KSE Annual report, 2010). Orders are handled through brokers during trading hours and share prices are quoted in Sudanese Pound (SDG). Trading is processed manually by continuous auction from Sunday to Thursday for one hour from 10.00 am to 11.00 am. Thereby, buy and sell orders are passed on to floor-based representatives of registered brokers for execution. Trading in securities is taking place in two markets, the so called primary and secondary markets (Note 6).

As a part of the financial system of Sudan, KSE operates on the basis of Islamic Shariaa and is supervised and regulated by the Central Bank of Sudan (Note 7). The key feature of Islamic Shariaa practices in Khartoum Stock Exchange is that it is aimed to offer investment portfolios from common stocks of listed companies which ideally satisfy three basic criteria: (i) legitimate field of economic activity; (ii) interest-free dealings in both assets and liabilities, and (iii) the dominance of real assets. Thus, e.g., a company must not be engaged in the production of illegitimate goods like alcoholic drinks; it must not deal with interest rate financing as a means to leverage its capital structure through fixed debt liabilities, or generate interest income from investment securities; and since a company's shares represent equity rights in its assets, the latter should be real assets, not liquid money or receivable debt as they cannot be sold freely at a profit like real goods, real estate and machinery (Hassan and Lewis, 2007).

As consequences of these rules, the composition of assets traded at the KSE differs substantially from other stock markets. In particular, due to the regulations imposed by Islamic Shariaa (Note 8) practices a separate class of investment vehicles on the KSE is provided by the so called Government Musharakah (Note 9) Certificates (GMCs), which represent an Islamic equivalent to conventional bonds (also known as Shahama bonds). Shahama bonds offer a way for the government to borrow money in the domestic market instead of printing more banknotes. After one year, holders of GMCs can either liquidate them or extend their duration. These bonds are backed by the stocks of various companies owned by the Ministry of Finance. Consequently, they might be considered as asset-backed securities. The profitability of GMCs depends on the financial results of the companies in the underlying portfolio. It can reach up to 33 per cent per annum. Hence, the profit of GMCs is variable rather than fixed. The government issues these bonds on a quarterly basis and their placement on the market is done usually very fast- in just six days.

The overall performance of the Khartoum stock market is measured by the KSE Index, which is a market capitalization-weighted index. In September 2003, the KSE index was established and listed in the Arab Monetary Fund database. At the end of the first month the index closed at 961.74 points. In December 2005, the index closed at the highest level of 3259.17 points. In November 2010, it was fluctuating around an average value of 2365.66.

3.2 Egyptian Stock Market

In contrast to the KSE, the Egyptian exchange is one of the oldest stock markets established in the Middle East and Africa. Egypt's stock exchange has two locations: the main location is in Cairo (established 1903) and the other one is in Alexandria (established 1883).These two exchanges were competing with each other before they merged in recent years. Today, both exchanges are governed by the same chairman and board of directors. They are commonly referred to as the Cairo and Alexandria Stock Exchange (CASE) and share the same trading, clearing and settlement systems, so that market participants have access to stocks listed on both exchanges.

The overall performance of the Egyptian stock market is measured by the Capital Market Authority (CMA) Index, which covers all listed stocks weighted in relation to their market capitalization. It can be viewed as an all share index that covers the broadest base of stocks. It is calculated and released daily by the CMA (Note 10).

3.3 Key Numbers of the KSE and CASE

Table 1 provides some key figures of both exchanges. It is obvious that considering any of the indicators used like number of listed companies or market capitalization, the Khartoum stock exchange represents a much smaller market compared to the Cairo and Alexandria stock exchange. While the number of listed companies comes close to one quarter of the CASE in 2012, the number of transactions falls short of 0.1 percent and market capitalization is below 5 percent of the corresponding values of CASE. The relatively large number of listed companies at the KSE appears to be due rather to a massive decline of the number of listed companies on the CASE since 2006 than to an increase of activities on the KSE. Considering the volume of trading relative to market capitalization, both markets exhibit some similarities, i.e. the yearly trading volume reaches about 30 percent of market capitalization in recent years.

Table 1. Summary of Trading Activity in KSE and CASE, 2006 – 2010

	No. Of Listed companies*		No. Of traded shares (In Million)		Volume of trading ($ millions)		No. of transactions		Market Capitalization ($ millions)	
	KSE	CASE	KSE	CASE	KSE	CASE	KSE	CASE	KSE	CASE
2006	52	595	7,567.78	NA	833.89	NA	5,842	NA	3,912.61	NA
2007	53	435	9,411.56	10,512.79	749.58	49,388.19	7,195	8,161,607	4,048.64	134,903.52
2008	53	373	289.00	21,071.82	751.60	65,166.14	8,177	12,321,523	3,416.60	83,185.00
2009	53	306	164.71	28,243.25	891.27	50,812.70	8,069	13,300,653	2,784.76	86,267.22
2010	53	212	166.55	27,336.99	972.69	36,867.80	8,266	9,606,668	3,166.89	85,725.96

Source: Compiled by the authors based on data from the KSE website and AMF annual reports.

4. Research Methods

Autoregressive conditional heteroscedasticity (ARCH) (Note 12) and its generalization (GARCH) models represent the main methodologies that have been applied in modelling and forecasting stock market volatility (Note 13) in empirical finance. In this paper different univariate GARCH specifications are employed to model stock returns volatility in Khartoum stock exchange and Cairo and Alexandria stock exchange, these models are GARCH (1,1), GARCH-M (1,1), which will be used for testing symmetric volatility and EGARCH(1,1), TGARCH(1,1) and PGARCH (1,1) for modelling asymmetric volatility (Note 14). These models will be shortly discussed in the following subsections. For all these different models, there are two distinct equations, the first one for the conditional mean and the second one for the conditional variance. We are mainly interested in the second equation as it provides estimates and conditional forecast of volatility.

4.1 Symmetric GARCH Models

4.1.1 The Generalized Autoregressive Conditional Heteroscedastic (GARCH) Model

In this model, the conditional variance is represented as a linear function of a long term mean of the variance, its own lags and the previous realized variance. The simplest model specification is the GARCH (1,1) model:

$$\text{Mean equation} \qquad r_t = \mu + \varepsilon_t \ , \tag{1}$$

$$\text{Variance equation} \qquad \sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \tag{2}$$

where $\omega > 0$, $\alpha_1 \geq 0$ and $\beta_1 \geq 0$, and:

r_t = return of the asset at time t,

μ = average return,

ε_t = residual returns, defined as:

$$\varepsilon_t = \sigma_t z_t \tag{3}$$

where z_t are standardized residual returns (i.e. realization of an iid random variable with zero mean and variance 1), and σ_t^2 stands for the conditional variance. For GARCH (1,1), the constraints $\alpha_1 \geq 0$ and $\beta_1 \geq 0$ are needed to ensure that σ_t^2 is strictly positive (Poon, 2005). The conditional variance equation models the time varying nature of volatility of the residuals generated from the mean equation. This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted average of a long term average (the constant), the forecast variance from last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period, while the GARCH-term generates persistence of volatility.

4.1.2 The Generalized Autoregressive Conditional Heteroscedastic-in-Mean (GARCH-M) Model

In finance, the return of a security may depend on its volatility. To model such a phenomenon one may consider the GARCH-M model developed by of Engle, Lilien, and Robins (1987), where "M" stands for GARCH in the mean (Tsay 2010). This model is an extension of the basic GARCH framework which allows the conditional mean of a

sequence to depends on its conditional variance or standard deviation. A simple GARCH -M(1,1) model can be written as :

$$\text{Mean equation} \qquad r_t = \mu + \lambda\sigma_t^2 + \varepsilon_t \tag{4}$$

$$\text{Variance equation} \qquad \sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \tag{5}$$

The parameter λ in the mean equation is called the risk premium parameter. A positive λ indicates that the return is positively related to its volatility. In other words, a rise in mean return is caused by an increase in conditional variance as a proxy of increased risk. Engle, Lilien, and Robins assume that the risk premium is an increasing function of the conditional variance of ε_t; in other words, the greater the conditional variance of returns, the greater the compensation necessary to induce the agent to hold the asset (Enders 2004).

4.2 Asymmetric GARCH Models

An interesting feature of asset prices is that bad news seems to have a more pronounced effect on volatility than do good news. For many stocks, there is a strong negative correlation between the current return and the future volatility. The tendency for volatility to decline when returns rise and to rise when returns fall is often called the leverage effect (Enders, 2004).

The main drawback of symmetric GARCH models is that the conditional variance is unable to respond asymmetrically to rises and falls in ε_t, and such effects are believed to be important in the behaviour of stock returns. In the linear GARCH (p,q) model the conditional variance is a function of past conditional variances and squared innovations; therefore, the sign of returns cannot affect the volatilities (Knight and Satchell, 2002). Consequently, the symmetric GARCH models described above cannot account for the leverage effect observed in stock returns, consequently, a number of models have been introduced to deal with this phenomenon. These models are called asymmetric models. This paper uses EGARCH, TGARCH and PGARCH for capturing the asymmetric phenomena.

4.2.1 The Exponential Generalized Autoregressive Conditional Heteroscedastic (EGARCH) Model

This model captures asymmetric responses of the time-varying variance to shocks and, at the same time, ensures that the variance is always positive. It was developed by Nelson (1991) with the following simple specification:

$$Ln(\sigma_t^2) = \omega + \beta_1 Ln(\sigma_{t-1}^2) + \alpha_1\left\{\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}}\right\} - \gamma\frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad , \tag{6}$$

where γ is the asymmetric response parameter or leverage parameter. The sign of γ is expected to be positive in most empirical cases so that a negative shock increases future volatility or uncertainty while a positive shock eases the effect on future uncertainty (Note 15).

4.2.2 The Threshold Generalized Autoregressive Conditional Heteroscedastic (TGARCH) Model

Another volatility model commonly used to handle leverage effects is the threshold GARCH (or TGARCH) developed by Zakoian (1994). In the TGARCH (1,1) version of the model, the specification of the conditional variance (Note 16) is:

$$\sigma_t^2 = \omega + \alpha_1\varepsilon_{t-1}^2 + \gamma d_{t-1}\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2 , \tag{7}$$

where d_{t-1} is a dummy variable, that is:

$$d_{t-1} = \begin{cases} 1 & if \quad \varepsilon_{t-1} \prec 0, \quad bad \quad news \\ 0 & if \quad \varepsilon_{t-1} \geq 0, \quad good \quad news \end{cases} \tag{8}$$

Again, the coefficient γ is known as the asymmetry or leverage parameter. When $\gamma = 0$, the model collapses to the standard GARCH forms. Otherwise, when the shock is positive (i.e., good news) the effect on volatility is α_1, but when the news is negative (i.e., bad news) the effect on volatility is $\alpha_1 + \gamma$. Hence, if γ is significant and positive, negative shocks have a larger effect on σ_t^2 than positive shocks (Carter, 2007).

4.2.3 The Power Generalized Autoregressive Conditional Heteroscedastic (PGARCH) Model

Ding, Granger and Engle (1993) also introduced the Power GARCH (PGARCH) specification to deal with asymmetry. Unlike other GARCH models, in this model, the standard deviation is modelled rather than the variance as in most of the GARCH-family. In Power GARCH an optional parameter γ can be added to account

for asymmetry (Floros, 2008). The model also offers one the opportunity to estimate the power parameter δ instead of imposing it on the model (Ocran and Biekets, 2007).

The general asymmetric Power GARCH model specifies σ_t as of the following form:

$$\sigma_t^{\delta} = \omega + \beta_1 \sigma_{t-1}^{\delta} + \alpha_1 (|\varepsilon_{t-1}| - \gamma_1 \varepsilon_{t-1})^{\delta} \quad (9)$$

where α_1 and β_1 are the standard ARCH and GARCH parameters, γ_1 is the leverage parameter and δ is the parameter for the power term. When $\delta = 2$, equation (9) becomes a classic GARCH model that allows for leverage effects, and when $\delta = 1$, the conditional standard deviation will be estimated. It is possible to increase the flexibility of the PGARCH model by considering δ as another coefficient that also has to be estimated (see Zivot 2008).

5. Data and Empirical Results

5.1 The Data and Basic Statistics

5.1.1 The Data Used for the Analysis

The time series data used for modelling volatility in this paper are the daily closing prices of the Khartoum Stock Exchange (KSE) index and the Capital Market Authority (CMA) index over the period from 2nd January 2006 to 30th November 2010, resulting in a total of 1326 observations for the KSE index and 1287 for the CMA index excluding public holidays. These closing prices have been taken from the KSE website (http://www.kse.com.sd) and the CASE website (http://www.egyptse.com).

Daily returns r_t were calculated as the continuously compounded returns corresponding to the first difference in logarithms of closing prices of successive days:

$$r_t = \log\left(\frac{P_t}{P_{t-1}}\right) \quad (10)$$

where P_t and P_{t-1} denote the closing market index of KSE and CASE at the current (t) and previous day (t-1), respectively.

It is very important to note that since October 18, 2009, the index on the Khartoum Stock Market has been declining. In only 16 trading days, the stock market index fell from 3077.12 October 18, 2009 to 2363.30 on November 10, 2009. Since that time, the KSE index was reporting to fluctuate around an average value of 2363.23. In order to see the impact of this sharp fall on the volatility modeling, the full data set is divided into two sub-periods: the first sub-period covers Jan. 2, 2006 to Oct. 18, 2009 with 1042 total observations, while the second sub-period ranges from Nov. 10, 2009 to Nov. 30 2010 resulting in 269 observations. So, the results will be presented separately for three periods; for the period before the sharp fall, the period after that fall and for the whole data set.

5.1.2 Descriptive Statistics of KSE and CASE Returns Series

To specify the distributional properties of the daily returns series in KSE and CASE markets during the period of this study, some descriptive statistics are reported in Table 2.

Table 2. Descriptive statistics of the KSE and CMAI return series

Statistics	**KSE return series**			**CMAI return series**
	First sub-period	Second sub-period	Full sample period	
Mean	0.01%	0.00%	-0.02%	0.01%
Median	0%	0%	0.00%	0.01%
Maximum	21%	1%	21.12%	6.55%
Minimum	-11%	-1%	-11.61%	17.43%
Standard Deviation	1.47%	0.71%	1.37%	1.83%
Skewness	2.57	3.52	1.76	-1.17
Kurtosis	65.31	82.71	73.72	11.59
Jarque-Bera	169550.4	71496.33	276573.2	4246.72
Prob. of Jarque-Bera	0.000	0.000	0.000	0.000
No. of observations	1042	269	1326	1287

Sample period: January 2, 2006 – November 30, 2010.

As we can see from Table 2, the average returns for the CMA index is higher than the average of the KSE index. The distribution of returns differs markedly from normality given the observed skewness and excess kurtosis. Consequently, based on the Jarque-Bera (J-B) statistic, the null hypothesis of normality for the daily KSE and CASE returns has to be rejected at the 1% significance level. Moreover, Figure 1 presents the pattern of the price index series and its returns for the CASE and the KSE during the study period.

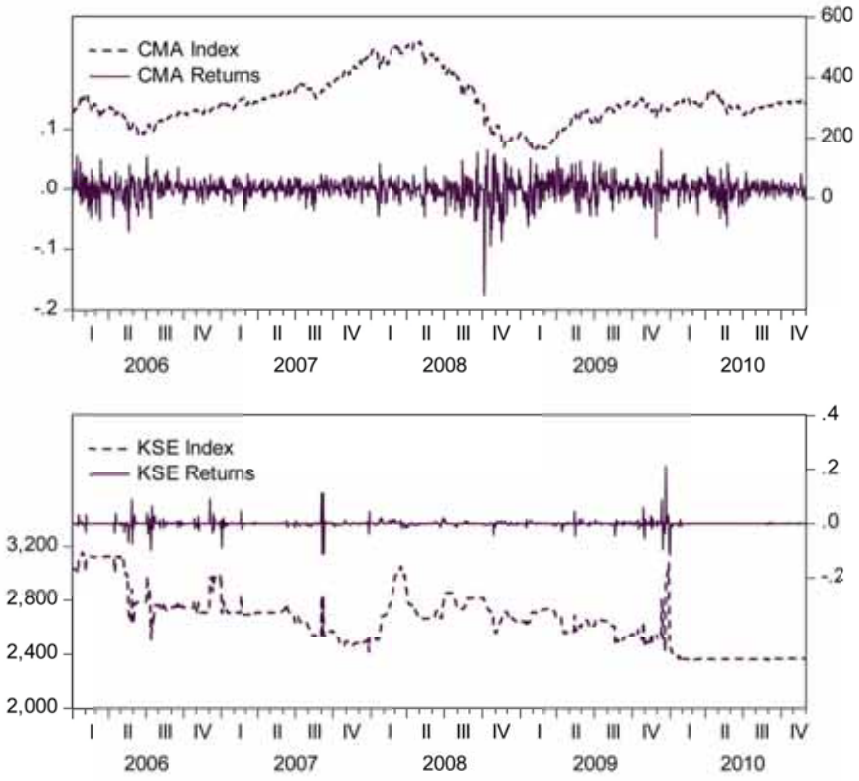

Figure 1. Daily prices and returns for the CMA and KSE indices (Jan. 2006 – Nov. 2010)

While the time series for CMA (upper part) resemble qualitatively those found for other stock exchanges, the time series for KSE exhibit different patterns. In particular, the dependence in the volatility of returns as shown in Figure 1 (lower part) appears much more pronounced, at least up to the end of 2009. Afterwards, the price series becomes almost flat with very small returns. We will consider this obvious structural break in our empirical analysis although it turned out to be difficult to identify a specific reason for this change.

5.1.3 Quantile-Quantile (Q-Q) Plots

As a further instrument for analyzing the distributional properties, we apply the Q-Q graphical examination to check whether the KSE index and CMA index returns series are normally distributed. The Q-Q plot is a scatter plot of the empirical quantiles (vertical axis) against the theoretical quantiles (horizontal axis) of a given distribution (Alexander, 2001). If the sample observations follow approximately a normal distribution with mean equal to the empirical mean (μ) and standard deviation equal to the empirical standard deviation σ , then the resulting plot should be roughly scattered around the 45-degree line with a positive slope. The greater the departure from this line, the greater the evidence against the null hypothesis of a normal distribution. The results of this graphical examination are provided in Figure 2.

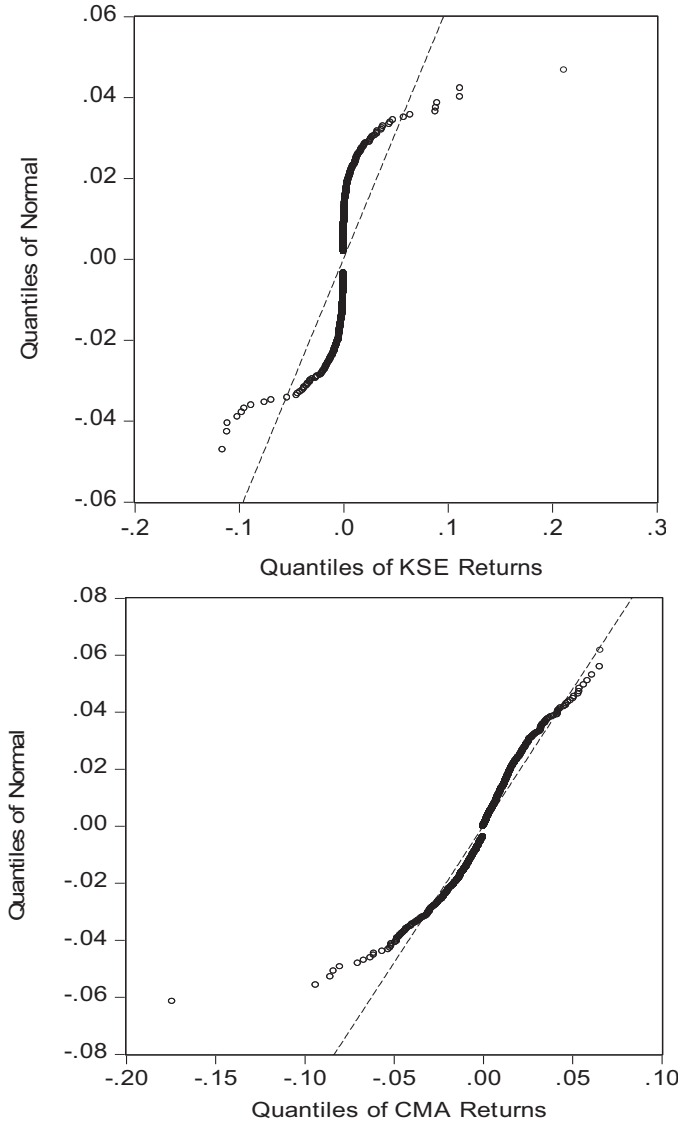

Figure 2. Normal Quantile-Quantile Plots for the Daily Stock Returns 2006 – 2010

The QQ-plot in Figure 2 confirms the findings from Table 2 that the KSE and CASE returns data do not follow a distribution similar to a normal distribution.

5.1.4 Testing for Stationarity

To investigate whether the daily price index and its returns are stationary series, the Augmented Dickey–Fuller (ADF) test (Dickey and Fuller, 1981) has been applied. Thereby, the lag length has been selected automatically based on the Schwarz information criterion with a preset maximum lag length of 22. The results are reported in Table 3.

Table 3. ADF unit root test output for the price index and returns series in KSE and CASE

ADF unit root test for the price index series					
Index		**ADF statistic**	**Critical values**		
			1%	**5%**	**10%**
KSE index	First sub-period	-2.671(5)*	-3.436	-2.864	-2.568
	Second sub-period	-7.469(0)**	-3.455	-2.872	-2.572
	Full period	-2.390(6)	-3.438	-2.864	-2.568
CMAI		-1.456(1)	-3.435	-2.864	-2.568
ADF unit root test for the return series					
Return		**ADF statistic**	**Critical values**		
			1%	**5%**	**10%**
KSE index return	First sub-period	-29.419(1)**	-3.463	-2.864	-2.568
	Second sub-period	-20.352(2)**	-3.455	-2.872	-2.572
	Full period	-18.590(5)*	-3.438	-2.864	-2.568
CMA index		-30.571(0)*	-3.435	-2.864	-2.568

Notes: 1- Figures in parentheses denote the optimal lag lengths, which were automatically selected based on the Schwarz Information Criterion (SIC).

2- Critical values for unit root tests are taken from MacKinnon (1996).

3- * and ** Indicate that the results are statistically significant at the 1% and 5% levels respectively.

4- ADF test includes a constant term without trend.

Table 3 reports the results of the ADF test for a lag length of 6 and 1 for the two indices in levels and a lag length of 5 and 0 for the two returns series. The ADF tests for the level data indicate that they have to be considered as non-stationary series for both markets (Note 11). When applying the same test for the returns series, the results allow rejecting the null hypothesis of a unit root at all conventional levels of significance for both series. Therefore, we conclude that the returns series might be considered as stationary over the specified period.

5.1.5 Testing for Heteroscedasticity

Given that we are interested in analyzing volatility on both markets, a first step consists in testing for (conditional) heteroscedasticity. To this end we apply the Lagrange Multiplier (LM) test proposed by Engle (1982) to the residuals of simple time series models of the returns.

In summary, the test procedure is performed by first obtaining the residuals e_t from the ordinary least squares regression of the conditional mean equation which might be an autoregressive (AR) process, moving average (MA) process or a combination of AR and MA processes, i.e. an ARMA process. For example, in the ARMA (1,1) process the conditional mean equation will be:

$$r_t = \phi_1 r_{t-1} + \varepsilon_t + \theta_1 \varepsilon_{t-1} \quad . \tag{11}$$

After obtaining the residuals e_t, the next step consists in regressing the squared residuals on a constant and q lags as in the following equation:

$$e_t^2 = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 e_{t-2}^2 + ... + \alpha_q e_{t-q}^2 + \nu_t \tag{12}$$

The null hypothesis that there is no autoregressive conditional heteroscedasticity (ARCH) up to order q can be formulated as:

$$H_0 : \alpha_1 = \alpha_2 .. = \alpha_q = 0$$

against the alternative:

$$H_1 : \alpha_i > 0$$

for at least one i = 1, 2, …, q.

The test statistic for the joint significance of the q-lagged squared residuals is given by the number of observations times the R-squared (TR^2) of the regression (12). TR^2 is evaluated against the $\chi^2_{(q)}$ distribution. This represents an asymptotically locally most powerful test (Rachev et al., 2007, 294).

In our case, we first employ an autoregressive moving average ARMA (1,1) model for the conditional mean in the returns series as an initial regression, then, test the null hypothesis that there are no ARCH effects in the residual series up to lag 5 corresponding to one trading week. The results of this examination are summarized in Table 4.

Table 4. ARCH-LM Test for residuals of returns on the KSE and CASE markets

	KSE index return	CMAI return
ARCH-LM test statistic	59.872	37.432
Prob. Chi-square (5)	0.0000	0.0000

Note: H_0 : There are no ARCH effects in the residual series.

The ARCH-LM test results in Table 4 provide strong evidence for rejecting the null hypothesis. Rejecting H_0 is an indication of the existence of ARCH effects in the residuals series of the mean equation and therefore the variance of the returns series of KSE and CASE indices are non-constant.

5.2 Empirical Results

As reported in the data description part, when the residuals were examined for heteroscedasticity, the ARCH-LM test provided strong evidence of ARCH effects in the residual series of both markets. To model this conditional heteroscedasticity, we proceed by applying the GARCH models. The results of estimating different GARCH specifications for the KSE index and the CMA index returns are presented in this section. The models are estimated using the maximum likelihood method under the assumption of Gaussian distributed error terms. The log likelihood function is maximized using Marquardt's numerical iterative algorithm to search for optimal parameters (Note 17). To account for the sharp decline of the KSE index in the second half of October 2009, a dummy variable (DUM) will be introduced into the mean equation, which is set equal to 0 for the period before that sharp decline and 1 thereafter. Thus, for the KSE, the mean equation is specified as:

$$\text{Mean equation} \quad r_t = \mu + DUM + \varepsilon_t \tag{13}$$

Beside the estimation output of different GARCH models, diagnostics test results for these models are also provided, in particular for testing whether there are still ARCH effects left in the residuals of the estimated models (Note 18). Table 5 and Table 6 show the parameter estimates of different GARCH models for the returns of the KSE (Full sample period) and CASE indices for the period under study. Estimation results of subperiods for the KSE returns are reported in Table 1 in the Appendix.

Table 5. Estimation results of different GARCH models for Khartoum stock exchange

Coefficients	GARCH (1,1)	GARCH-M (1,1)	EGARCH (1,1)	TGARCH (1,1)	PGARCH (1,1)
			Mean equation		
μ	0.000352	-	-	-	0.000736**
DUM	-0.000316**	-0.000194	9.27E-05	-0.000223	-0.000759
λ		0.027819	-	-	-
			Variance equation		
ω	2.69E-05*	2.99E-05*	-5.523160*	3.02E-05*	0.000241**
α	0.893622*	0.532562*	0.183655*	0.656067*	0.438671*
β	0.419774*	0.440366*	0.417255*	0.429398**	0.522363*
γ	-	-	-0.017766*	0.189720*	-0.038586
δ	-	-	-	-	1.587719*
$\alpha + \beta$	1.313396	0.972928	0.600910	1.085465	0.961034
Log likelihood	4412.983	4399.383	4059.788	4405.295	4354.494
			ARCH-LM test for heteroscedasticity		
statistic	0.116251	0.086276	27.03379	0.093170	0.236021
Prob.	0.9998	0.9999	0.0001	0.9999	0.9987

Note: * Denotes significance at the 1% level, and ** at 5% level

Table 6. Estimation results of different GARCH models for Egypt stock market

Coefficients	GARCH (1,1)	GARCH-M (1,1)	EGARCH (1,1)	TGARCH (1,1)	PGARCH (1,1)
			Mean equation		
μ	0.000956**	-	0.000652	0.000594	0.000567
λ	-	0.062186**	-	-	-
			Variance equation		
ω	2.38E-06*	2.49E-06*	-0.196748*	3.67E-06*	3.70E-05
α	0.074550*	0.073983*	0.109970*	0.032598*	0.062493*
β	0.921309*	0.921285*	0.986334*	0.917797*	0.932108*
γ	-	-	-0.069011*	0.072128*	0.447800*
δ	-	-	-	-	1.434551*
$\alpha + \beta$	0.995859	0995268	1.096304	0950395	0994601
Log likelihood	3495.092	3494.695	3506.924	3505.850	3507.067
			ARCH-LM test for heteroscedasticity		
statistic	3.627696	3.825191	4.740746	2.473876	3.448986
Prob.	0.6042	0.5748	0.4483	0.7804	0.6311

Notes: * Denotes significance at the 1% level, and ** at 5% level

In the results for the variance equation reported in Tables 5 and 6, the first three coefficients ω (constant), ARCH term (α) and GARCH term (β) for the GARCH (1,1) model are statistically significant and exhibit the expected sign for both markets. The significance of α and β indicates that, lagged conditional variance and lagged squared disturbance have an impact on the conditional variance, in other words this means that news about volatility from the previous periods have an explanatory power on current volatility. Moreover, Table 5 shows that the sum of the two estimated ARCH and GARCH coefficients $\alpha + \beta$ (persistence coefficients) in the GARCH (1,1) model for the KSE is larger than one, suggesting that the conditional variance process is explosive. However, for the CASE returns the sum of the ARCH and GARCH coefficients is very close to one which is required to have a mean reverting variance process, indicating that volatility shocks are quite persistent, but not explosive. Thus, for CASE the findings correspond to those for many developed stock exchanges, while we find a departure for the KSE.

The GARCH-M (1,1) model is estimated by allowing the mean equation of the return series to depend on a function of the conditional variance. From estimation results in Table 5 and Table 6, the estimated coefficient (risk premium) of σ^2 in the mean equation is positive for the two markets, which indicates that the mean of the return sequence depends on past innovations and the past conditional variance. In other words, conditional variance used as a proxy for risk of returns is positively related to the level of returns. These results show that as volatility increases, the returns correspondingly increase with a factor of 0.028 and 0.062 for KSE and CASE, respectively. These results are consistent with the theory of a positive risk premium on stock indices which states that higher returns are expected for assets with higher level of risk. The effect turns out to be significant for CASE.

Furthermore, the asymmetric models EGARCH (1,1) and TGARCH (1,1) are used to investigate the existence of leverage effects in the returns of the KSE and the CASE indices during the study period. The main difference between these two models is that in the EGARCH model, there is no need of nonnegative restriction of the parameters while in the TGARCH model parameters must satisfy the positive condition (Irfan 2010). The asymmetrical EGARCH (1,1) estimated for the returns of the KSE index in Table 5 and the CASE index in Table 6 indicates that all the estimated coefficients are statistically significant at the 1% confidence level. The asymmetric (leverage) effect captured by the parameter estimate γ is also statistically significant with negative sign, indicating that negative shocks imply a higher next period conditional variance than positive shocks of the same sign, which indicates the existence of leverage effects in the returns of the Khartoum stock market index and Cairo and Alexandria Stock Exchange during the study period.

An alternative model to test for asymmetry in KSE and CASE returns is the TGARCH (1,1) model. From estimation results of this model reported in Table 5 and Table 6, the coefficient for the leverage effect is significant and positive for both markets. The significance of this coefficient indicates that negative shocks (bad news) have a larger effect on the conditional variance (volatility) than positive shocks (good news) of the same magnitude.

The other version of asymmetric GARCH model applied in this paper is the (PGARCH). From the results for the PGARCH (1,1) in Table 5 and Table 6, the estimated coefficient γ is significant and positive for the case of Egypt , indicating that positive shocks are associated with higher volatility than negative shocks. In case of Sudan, the estimated coefficient is negative, but insignificant.

The results of diagnostic tests (test for ARCH effects) are reported below the estimation results in Table 5 and Table 6. The ARCH-LM test statistic for all GARCH models (where ARCH and GARCH terms are taken to be of order 1) did not exhibit any additional ARCH effect remaining in the residuals of the models. This shows that the variance equations are well specified for the two markets. (except for the EGARCH (1,1) model for the KSE).

6. Summary and Concluding Remarks

Modelling and forecasting volatility of returns in stock markets has become a fertile field of empirical research in financial markets, because volatility is considered as an important concept in many economic and financial applications like asset pricing, risk management and portfolio allocation.

In this paper we have modeled and estimated stock return volatility in two African markets; the Sudanese stock market (Khartoum Stock Exchange, KSE), and the Egyptian stock market (Cairo and Alexandria Stock Exchange, CASE) by applying different univariate specifications of GARCH type models for daily observations on the index series of each market over the period of 2nd January 2006 to 30th November 2010, as well as describing special features of the markets in terms of trading activity and index components and calculations.

A total of five different models were considered in this paper. The volatility of the KSE and CASE returns have been modelled by using univariate Generalized Autoregressive Conditional Heteroscedastic (GARCH) models including both symmetric and asymmetric models that capture most common stylized facts about index returns such as volatility clustering and leverage effects. These models are GARCH(1,1), GARCH-M(1,1), exponential GARCH(1,1), threshold GARCH(1,1) and power GARCH(1,1). The first two models imply a symmetric effect of past shocks whereas the second group of models allows capturing asymmetric effects. Based on the empirical results presented, the following can be concluded: First, the paper finds strong evidence that daily returns could be characterized by the above mentioned models for the two markets, KSE and CASE data showed a significant departure from normality and the existence of heteroscedasticity in the residuals series. Second, the parameter estimates of the GARCH (1,1) models (α and β) indicate that the conditional volatility of stock returns on the Khartoum Stock Exchange is an explosive process, while it is quite persistent for the CASE index returns series. Third, the parameter describing the conditional variance in the mean equation, measuring the risk premium effect for GARCH-M(1,1), is statistically significant in the two markets, and the sign of the risk premium parameter is positive. The implication is that an increase in volatility is linked to an increase of returns, which is an expected result. Fourth, based on asymmetrical EGARCH (1,1) and TGARCH(1,1) estimation, the results show a significant evidence for the existence of the leverage effects in the two markets, the same result is confirmed only for the CASE by using the PGARCH(1,1) model.

It is left to future research to study in more detail the causes of the structural break in the KSE time series and how it can be taken into account explicitly in the volatility equations. Furthermore, it might be studied to what extent volatility forecasts based on the present models are useful in the context of risk management for the stock markets considered.

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References

Alberg, D., Shalit, H., & Yosef, R. (2008). Estimating stock market volatility using asymmetric GARCH models. *Applied Financial Economics, 18*, 1201-1208. http://dx.doi.org/10.1080/09603100701604225

Alexander, C. (2001). *Market Models: A Guide to Financial Data Analysis.* Chichester. John Wiley and Sons Ltd.

Aly, H., Mehdian, S., & Perry, M. (2004). An Analysis of the Day-of-the-Week Effects in the Egyptian Stock Market. *International Journal of Business, 9*(3), 301-308.

Ayub, M. (2007). *Understanding Islamic Finance*. Chichester, England, John Wiley & Sons Ltd.

Balaban E., & Bayar A. (2005). Stock returns and volatility: empirical evidence from fourteen countries. *Applied Economics Letters, 12*, 603-611. http://dx.doi.org/10.1080/13504850500120607

Balaban E., Bayar, A., & Faff, R. (2003). Forecasting Stock Market Volatility: Evidence from 14 Countries. 10th Global Finance Conference 2003, Frankfurt/Main, June 15-17, 2003.

Balaban, E., Bayar, & A. Faff, R. (2004). *Forecasting Stock Market Volatility: Further International Evidence.* ASAC, Quebec, Canada.

Bali, T. G. (2007). Modeling the dynamics of interest rate volatility with skew fat-tailed distributions. *Annals of Operations Research, 1*, 151-178. http://dx.doi.org/10.1007/s10479-006-0116-6

Bekaert, G., & Wu., G. (2000). Asymmetric volatility and risk in equity markets. *Review of Financial Studies, 13*, 1– 42. http://dx.doi.org/10.1093/rfs/13.1.1

Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroscedasticity. *Journal of Econometrics, 31*, 307-327. http://dx.doi.org/10.1016/0304-4076(86)90063-1

Bollerslev, T., Chou, R., & Kroner, F. (1992). ARCH modeling in finance. *Journal of Econometrics, 52*, 5-59. http://dx.doi.org/10.1016/0304-4076(92)90064-X

Brooks, C., & Burke, S. P. (2003). Information Criteria for GARCH Model Selection: An Application to High Frequency Data. *European Journal of Finance*, *9*(6), 557-580. http://dx.doi.org/10.1080/1351847021000029188

Carter, R. Hill, William, E., & Lim, C. (2007). *Principles of Econometrics*, 3rd Edition, New York. John Wiley and Sons, Inc.

Chou, R. Y. (1988). Volatility Persistence and Stock Valuations: Some Empirical Evidence Using GARCH. *Journal of Applied Economics*, *3*, 279-294. http://dx.doi.org/10.1002/jae.3950030404

Chukwuogor-Ndu, C. (2006). Stock market returns analysis, day-of-the-week effect, volatility of returns: Evidence from European financial markets 1997-2004. *International Research Journal of Finance and Economics, 1*, 112-124.

De Santis, G., & Imrohoroglu, S. (1997). Stock Returns and Volatility in Emerging Financial Markets. *Journal of International Money and Finance, 16*, 561-579. http://dx.doi.org/10.1016/S0261-5606(97)00020-X

Dickey, D. A., & Fuller, W. A. (1981). Distribution of the estimators for autoregressive time series with a unit root. *Econometrica, 49*, 1057-1072. http://dx.doi.org/10.2307/1912517

Ding, Z., Engle, R. F., & Granger, C. W. J. (1993). Long Memory Properties of Stock Market Returns and a New Model. *Journal of Empirical Finance, 1*, 83-106. http://dx.doi.org/10.1016/0927-5398(93)90006-D

Ebeid, S. T., & Bedeir, G. B. (2004). Volatility Modelling and Forecasting of the Egyptian Stock Market Volatility Index using ARCH models. working paper, 1-15.

Edel T., & Brian M. L. (2007). A Power GARCH examination of the gold market. *Research International Business and Finance, 21*, 316-325. http://dx.doi.org/10.1016/j.ribaf.2006.07.001

El-Gamal, M. A. (2006). *Islamic Finance: Law, Economics, and Practice*. Cambridge, Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511753756

Enders, W. (2004). *Applied Econometric Time Series*, 2nd Edition. Wiley Series in Probability and Statistics.

Engle, R. F., & Bollerslev, T. (1986). Modeling the persistence of conditional variances. *Econometric Reviews, 5*, 1-50. http://dx.doi.org/10.1080/07474938608800095

Engle, R. F., & Patton, A. J. (2001). What good is a volatility model? *Quantitative Finance, 1,* 237-245. http://dx.doi.org/10.1088/1469-7688/1/2/305

Engle, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica, 50*(4), 987-1007. http://dx.doi.org/10.2307/1912773

Engle, R. F., Lilien, D. M., & Robins, R. P. (1987). Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model. *Econometrica, 55,* 391–407. http://dx.doi.org/10.2307/1913242

Floros, C. (2007). The use of GARCH models for the calculation of Minimum Capital Risk Requirements: International Evidence. *International Journal of Managerial Finance, 3*(4), 360-371. http://dx.doi.org/10.1108/17439130710824361

Floros, C. (2008). Modelling volatility using GARCH models: evidence from Egypt and Israel. *Middle Eastern Finance and Economics, 2*, 31-41.

Glosten, L. R, Jagannathan, R., & Runkle, D. E. (1993). On the Relation between the Expected Value and the Volatility of the Nominal Excess Returns on Stocks. *Journal of Finance, 48*(5), 1779-1791.

Hassan, M. K., & Lewis, M. K. (2007). *Handbook of Islamic Banking*. Edward Elgar Publishing, Inc.

Husain, F., & Uppal. J. (1999). Stock Returns Volatility in an Emerging Market: The Pakistani Evidence. *Pakistan Journal of Applied Economics, 15*(1), 19-40.

Irfan M., Irfan M., & Awais M. (2010). Modelling Volatility of Short Term Interest Rates by ARCH Family Model: Evidence from Pakistan and India. *World Applied Sciences Journal, 9*(10), 1089-1094.

Kalu O. E. (2010). Modelling Stock Returns Volatility in Nigeria Using GARCH Models. *Munich Personal RePEc Archive, MPRA* Paper No. 22723.

Knight, J., & Satchell, S. (2007). *Forecasting Volatility in the Financial Markets*. 3rd Edition, Butterworth Heinemann.

Koutmos, G., & R. Saidi R. (1995). The leverage effect in individual stocks and the debt to equity ratio. *Journal of Business Finance and Accounting*, *7*, 1063-1073. http://dx.doi.org/10.1111/j.1468-5957.1995.tb00894.x

Koutmos, G. F. (1999). Asymmetric price and volatility adjustments in emerging Asian stock market. *Journal of Business Finance & Accounting*, *26*, 83-101. http://dx.doi.org/10.1111/1468-5957.00249

Lee, C. F., Chen, G. M., & Rui, O. M. (2001). Stock returns and volatility on China stock markets. *Journal of Financial Research*, *24*, 523-543.

Leon, N. K. (2007). Stock market returns and volatility in the BRVM. *African Journal of Business Management, 15*(1), 07-112, August.

MacKinnon, J. G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics, 11*, 601-618. http://dx.doi.org/10.1002/(SICI)1099-1255(199611)11:6<601::AID-JAE417>3.0.CO;2-T

Maringer, D., & Winker, P. (2009). The Convergence of Estimators based on Heuristics: Theory and Applications to a GARCH model. *Computational Statistics, 24*, 533-550. http://dx.doi.org/10.1007/s00180-008-0145-5

McMillan, D., Speight, A., & Gwilym, O. (2000). Forecasting UK Stock Market Volatility. *Applied Financial Economics, 10*, 435-448. http://dx.doi.org/10.1080/09603100050031561

Mecagni, M., & Sourial, M. S. (1999). The Egyptian Stock Market: Efficiency Tests and Volatility Effects. IMF Working Paper WP/99/48, Washington, D.C.

Mills, T. F., & Markellos, R. N. (2008). *The Econometrics Modeling of Financial Time Series*. 3*rd* Edition, Cambridge University Press.

Mishra, P. K. (2010). A GARCH Model Approach to Capital Market Volatility: The Case of India. *Indian Journal of Economics and Business, 9*(3), 631-641.

Nelson, D. B. (1991). Conditional Heteroscedasticity in Asset Returns: A New Approach. *Econometrica, 59*(2), 347-370. http://dx.doi.org/10.2307/2938260

Ocran, M. & Biekets, N. (2007). Forecasting Volatility in Sub-Saharan Africa's Commodity Markets. *Investment Management and Financial Innovations*, *4*(2), 91-102.

Ogum, G., Beer, F., & Nouyrigat, G. (2005). Emerging Equity Market Volatility: An Empirical Investigation of Markets in Kenya and Nigeria. *Journal of African Business, 6*(1), 139-154. http://dx.doi.org/10.1300/J156v06n01_08

Olowe, R. A. (2009). Modelling Naira/Dollar Exchange Rate Volatility: Evidence from GARCH and Asymmetric Models. *International Review of Business Research Papers, 5*(3), 377-398.

Perron, P. (1989). The Great Crash, the Oil Price Shock and the Unit Root Hypothesis. *Econometrica, 57*, 1361-1401. http://dx.doi.org/10.2307/1913712

Pindyck, R. (1984). Risk, inflation, and the stock market. *American Economic Review*, *74*, 335-351.

Poon, S. H. (2005). *A Practical Guide to Forecasting Financial Market Volatility*. Wiley Finance, England.

Poshakwale, S., & Murinde, V. (2001). Modeling the volatility in East European emerging stock markets: evidence on Hungary and Poland. *Applied Financial Economics, 11*, 445-456. http://dx.doi.org/10.1080/096031001300314009

Rachev, S. T., Mittnik, S., Fabozzi, F. J., Focardi, S., & Jasic, T. (2007). *Financial Econometrics: From Basics to Advanced Modelling Techniques.* John Willey and Sons, Inc.

Samouilhan, N. L., & Shannon, G. (2008). Forecasting Volatility on the Johannesburg Stock Exchange. *Investment Analysts Journal, 67*, 19-28

Shamiri, A., & Isa, Z. (2009). Modeling and Forecasting Volatility of the Malaysian Stock Markets. *Journal of Mathematics and Statistics, 5*(3), 234-240. http://dx.doi.org/10.3844/jmssp.2009.234.240

Shin, J. (2005). Stock Returns and Volatility in Emerging Markets. *International Journal of Business and Economics 4*(1), 31-43.

Taylor, S. J. (1986). *Modelling financial time series*. John Wiley & Sons, Chichester.

Tooma, E. A. (2003). Modeling and Forecasting Egyptian stock market volatility before and after price limits. Working Paper 0310, *Economic Research Forum, Cairo,* Egypt.

Tsay, R. S. (2010). *Analysis of Financial Time Series*. 3*rd* Edition New York, United States of America, John Wiley & Sons, Inc. http://dx.doi.org/10.1002/9780470644560

Tudor, C. (2008). An Empirical Study on Risk-Return Tradeoff Using GARCH-Class Models: Evidence from Bucharest Stock Exchange. International Conference on Business and Economy ICBE Constanta - Romania, November 6-8.

Usmani, T. (1998). *An Introduction to Islamic Finance*. Idaratul Maarif, Karachi.

Venardos, Angelo M. (2010). *Current Issues in Islamic Banking and Finance: Resilience and Stability in the Present System.* Singapore: World Scientific Publishing. http://dx.doi.org/10.1142/9789812833938

Whitelaw, R. (1994). Time variations and covariations in the expectation and volatility of stock market returns. *Journal of Finance*, *49*, 515-541.

Zakoian, J. M. (1994). Threshold Heteroscedastic Models. *Journal of Economic Dynamics and Control, 18*, 931-944. http://dx.doi.org/10.1016/0165-1889(94)90039-6

Zivot. E. (2008). Practical Issues in the Analysis of Univariate GARCH Models. *Handbook of Financial Time Series*, Springer, New York.

Notes

Note 1. A time series is said to be heteroscedastic if its variance changes over time, otherwise it is called homoscedastic.

Note 2. To mention only a few of the most frequently used: GARCH-M model by Engle, Lilien, and Robins (1987), IGARCH model by Engle and Bollerslev (1986), Exponential GARCH model by Nelson (1991), Threshold GARCH model by Zakoian (1994) and Glosten et al. (1993) and Power ARCH model by Ding et al. (1993).

Note 3. Member states are: Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe.

Note 4. An investment unit is a proportional accounting share in the total net assets of an open end investment fund (Investment funds are the institutions of collective investment which serve as framework for collection of money funds. Collected money funds are then invested in various assets). The investment unit value is an indicator of how successful a fund is, and the changes of this value depend on the fluctuation of prices of securities and other property that the fund has invested in.

Note 5. Government investment certificates (GICs) are medium-term securities, based on various contracts financed by the Ministry of Finance of Sudan via the *istisna*, *murabaha* and *ijara* tools. Issuance of these *sukuk* is similar to the conventional securitization, where the Ministry of Finance acts as the originator. GICs are based on a limited *mudarabah*, which means that the raised money is invested solely in the projects stipulated in the original contract.

Note 6. The Primary Market deals with the trading of new securities. When a company issues securities for the first time (i.e. IPO), they are traded in the Primary Market through the help of issuing houses, dealing /brokerage firms, investment bankers and or underwriters. The acronym IPO stands for Initial Public Offering, which means the first time a company is offering securities to the general public for subscription. Once the securities (shares) of a company are in the hands of the general public, they can be traded in the Secondary Market to enhance liquidity amongst holders of such financial securities. Thus, the Secondary Market facilitates the buying and selling of securities that are already in the hands of the general public (investors).

Note 7. For more explanations about the ideas of Islamic banking see for example, Venardos (2010).

Note 8. For a detailed discussion of the Islamic Shariaa principles and its practices on stock exchange see for example, El-Gamal (2006) and Ayub (2007).

Note 9. 'Musharakah' is a word of Arabic origin which literally means sharing. In the context of business and trade it means a joint enterprise in which all the partners share the profit or loss of the joint venture. It is an ideal alternative to the interest-based financing with far reaching effects on both production and distribution (Usmani, 1998).

Note 10. For a detailed discussion of the Egyptian Stock Market see for example, Sourial and Mecagni (1999) and Aly, et al. (2004).

Note 11. It is very important to point out that, there might be some bias towards accepting the null hypothesis of a unit root for the index series in level form for the case of Sudan, this simply because of the clear existence of the break points in the series at the end of October 2009 (see Figure1). ADF test fails in case of structural break and it has low power. As one way to account for these structural breaks, Perron (1989) introduced a dummy variable to the ADF test. For a detailed discussion of the structural breaks in unit root test see for example Mills and Markellos (2008). In order to check the robustness of our finding, we repeat the test for KSE for the two subperiods.

Note 12. The main feature of ARCH model is to describe the conditional variance as an autoregression process. However, most empirical time series require using long-lag length ARCH models and a large number of parameters must be estimated. As a potential solution of the problem, GARCH models have been proposed (see Engle and Bollerslev 1986; Nelson 1991) which exhibit higher persistence.

Note 13. Volatility can be defined as a statistical measure of the dispersion of returns for a given security or market index. Volatility can either be measured by using the standard deviation or variance between returns from that same security or market index. Commonly, the higher the volatility, the riskier the security.

Note 14. In the symmetric models, the conditional variance only depends on the magnitude, and not the sign, of the underlying asset return, while in the asymmetric models shocks of the same magnitude, positive or negative, might have different effects on future volatility.

Note 15. This is in contrast to the standard GARCH model where shocks of the same magnitude, positive or negative, have the same effect on future volatility.

Note 16. The model uses zero as its threshold to separate the impacts of past shocks. Other threshold can also be used; see (Tsay, 2010) for the general concepts of threshold models.

Note 17. For potential issues regarding the numerical solution of the maximum likelihood estimators for GARCH models, the interested reader might consult Maringer and Winker (2009).

Note 18. If the variance equation of GARCH model is correctly specified, there should be no ARCH effect left in the residuals.

Appendix. Estimation results of different GARCH models for Khartoum stock exchange (Sub-periods)

Coefficients	**GARCH (1,1)**		**GARCH-M (1,1)**		**EGARCH (1,1)**		**TGARCH (1,1)**		**PGARCH (1,1)**	
	First sub-period	Second sub-period	First sub-period	Second sub-period	First sub-period	Second sub-period	First sub-period	Second sub-period	First sub-period	Second sub-period
Mean equation										
μ	0.000192	-1.18E-05	-0.002410*	-7.09E-05*	0.000572*	-1.90E-05	7.72E-05	-2.18E-05	0.000128	-1.31E-05
λ			0.282394*	0.127631*						
Variance equation										
ω	3.52E-05*	6.00E-08*	3.70E-05*	6.05E-08*	-3.952504*	-1.581487*	3.55E-05**	5.82E-08**	8.64E-07	4.01E-08
α	0.739287*	0.124267*	0.714649*	0.128282*	0.862935*	0.171235*	0.487554**	0.083005**	0.865**	0.122**
β	0.406875*	0.650981*	0.377463*	0.646581*	0.605742*	0.900153*	0.399900**	0.657500**	0.327**	0.640**
γ					-0.127306*	-0.123552*	0.524922**	0.086663*	0.190**	0.058**
δ									2.794**	2.057**
$\alpha + \beta$	1.146162	0.775248	1.092112	0.774863	1.468677	1.071388	0.887454	0.740505	1.192	0.762
Log likelihood	3303.647	1627.045	3309.044	1627.207	3309.860	1608.297	3307.803	1627.809	3307.977	1636.926
ARCH-LM test for heteroscedasticity										
statistic	0.171356	3.341550	0.120292	2.982367	0.205917	0.901964	0.151712	1.741300	0.161	2.633
Prob.	0.9994	0.6475	0.9997	0.7027	0.9990	0.9701	0.9995	0.8837	0.999	0.756

* and ** indicate significant at 5% and 1% respectively.

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Interplay of Foreign Aid, External Debt and Economic Growth: The Nigeria Experience

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Abstract

This work studied the interplay of foreign aid, external debt and economic growth. Given the likely simultaneity between foreign aid, external debt and economic growth, we used the seemingly unrelated regression estimation (SURE) model to examine the interplay between these variables using Nigerian data. We found that foreign aid has positive impact on growth and that external debt has negative impact on economic growth in Nigeria. A novelty in this study is that there is evidence of complex interplay between the level of external debt and aid inflows. These findings, therefore, have some policy implications as discussed in the work.

Keywords: foreign aid, external debt, economic growth, interplay, Nigeria

1. Introduction

Official Development Assistance (ODA) commonly referred to as foreign aid or resource transfer is a channel in which grants, wealth and loans are transferred from developed to developing or poor countries at concessional financial terms.

The millennium declaration adopted in the year 2000, World Leaders stated, “we will spare no effort to free our fellow men, women and children from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected”. And they resolve “to grant more generous development assistance, especially to countries that are genuinely making effort to apply their resources to poverty reduction” (Phelan and Yoshino, 1995). As a result, the effort is to mobilize billions of dollars of aid to help countries, especially those with good policies and institutions.

External capital inflows could also be non-debt-creating flows (as in official transfers of grant in aids and direct investment flows), debt creating flows (as in official development finance), commercial bank loans and international bank offerings, or could also be a hybrid.

In the late 1970s and early 1980s, most developing countries of Africa (including Nigeria) experienced unprecedented and severe economic crisis. These crisis manifested in several ways such as persistent macroeconomic imbalances, widening savings – investment gap, high rates of domestic inflation, chronic balance of payment problems and huge budget deficit (Akpokodje, 1998).

When Nigeria gained independence in 1960, the entire world believed that the economy will usher in economic prosperity for her populace. The thinking was not misplaced since oil, the money spinning machine was discovered and exported and huge petro-dollar was earned in return. The agricultural sector was booming, cash crops such as cocoa, groundnut and palm oil and the mining industry such as coal and tin were produced in large quantity and foreign exchange was gained through diversification of resources. The then head of state (1966-1975), Yakubu Gowon said that Nigeria does not have cash problem but how to spend the money. Fiscal policy was introduced in form of ways and means through Udoji award and this led to rural-urban migration and influx in search of white collar jobs. Soon agriculture was abandoned for petro-dollar and the nation’s treasury became empty and recourse was made to foreign inflows.

In Nigeria, for example, Akpokodje (1998), maintained that domestic investment as a ratio of gross domestic product (GDP) declined from an average of 24.4% during 1973-1981 period to 13.5% during 1982-1996 period. The average investment rate during the 1982-1996 period implies that the country barely replaced its dwindling capital. In the same vein, private investment rate depreciated from 8.6% in 1973-1981 periods to 4.3% in

1982-1996. Due to the fact that investment determines the rate of accumulation of physical capital, it then becomes a vital factor in the growth of productive capacity of the nation and contributes to growth generally.

The question of whether aid helps poor countries grow in a sustained way is still mired in controversy. Foreign aid has always been treated as cheap monies and in the past, studies implicitly assumed that the economic impact of foreign loans is negligible (Phelan and Yoshino, 1995). Many studies have tried to access if aid reaches its main objective, that is growth and development in developing countries. But some argue that the question of aid effectiveness is still unsettled.

While aid carries softer terms that reduces the burden of a given debt; it may be obvious that the repayment regime will produce a larger debt out of a given flow of loans and give rise to higher interest charges. Many developing countries have over the years relied very much on the inflow of financial resources from outside in various forms, official and private capital flows as well as direct foreign investment, as a means of speeding up their economic development (Ekpo, 1997; Odozi, 1995; Olanuyi, 1988; Uremadu, 2006). But poor countries with enormous amounts of debt, known as "heavily-indebted countries" are strapped economically, and are less able to meet the basic needs of their people, particularly if the burdensome of repayment keeps money flowing out of the country rather than investing.

It is pertinent to understand the implications of external finance in developing countries and this paper concentrates on foreign aid, debt and its implications on economic growth.

2. Theoretical Issues and Literature Review

The model developed independently by R. Harrod and E. Domar in the 1940s which explained the relationship between growth and employment in the advanced capitalist countries, has been used extensively in developing countries as a simple way of looking at the relationship between growth and capital requirements. The assumption of the model is that the output of any economic unit, whether a firm, an industry or the whole economy, depends upon the amount of capital investment in that unit. Thus if we call output Y and capital stock K, then output can be related to capital stock by $Y = \frac{K}{k}$ where k is a constant, called the capital-output ratio. The basic Harrod-Domar relationship for an economy is $g = \frac{S}{K}$, where g is the view that capital created by investment in plant and equipment is the main determinant of growth and that it is savings by people and co-operation that make the investment possible (Malcolm, 1987).

Investment, as explored in Harrod-Domar model, plays a dual role of creating productive capacity as well as effective demand. When attention has been focused directly on problems of underdevelopment in post-war era, capital shortage has been singled out by economists as a major cause of underdevelopment.

The standard model used extensively to justify aid was the two gap model of Chenery and Strout (1966). This model identified two gaps, first is the gap between the amount of investment necessary to attain a certain rate of growth and the available domestic savings. In other words, a savings gap arises when the domestic savings rate is less than the investment required to achieve the targeted growth. While the second is between import required for a given level of production and foreign exchange earnings. That is, if net export earning fall short of foreign exchange requirement, a foreign exchange gap appears. At any point in time, one is binding and foreign aid fill the gap.

In another study, the traditional neoclassical model postulates that a reasonable level of external borrowing contributes positively to economic growth. It considers external debt as a substitute for domestic savings and investment and therefore domestic savings and investment are crowded out as a result (Krugman, 1988, Alasina, 2000, Maghyereh et al, 2002).

In related studies by Cohen and Sachs (1986) and Cohen (1992), present that endogenous growth models were the driving force for growth and capital accumulation. According to Cohen (1992), debt is positively related to economic growth. Although at higher level the requirements of debt servicing obligation complicate debt accumulation for capital formation and growth. Growth is therefore high at early stages as country borrows, but falls to a lower level. There is no crowding out investment at this level because lenders are more patience and value growth more than debtor countries themselves. These depend on whether the debtor countries are able to implement optimal rescheduling policies to avoid debt overhang. Rescheduling of debt had not solved the problem rather it postpones the doomsday.

Based on the neoclassical principles of marginal returns to capital, developing countries ought to generate higher returns on investment than advanced countries, creating the incentive for more capital inflows and hence for these group of countries to catch up with the advanced countries (Lucas, 1990). Even though the inflow of

capital leads to a build up in eternal debt, the resources generated by higher growth should be sufficient to service the debt. However, the logic of capital scarcity in neoclassical model seems to be different with the experience of poor low-income countries. Debt crisis in poor countries cropped up as a result of corruption, poor institution, uncertainty nature of macroeconomic environment, poor debt management strategies, political, social instability and high level of financial recklessness.

In Nigeria between the 1970s and early 1980s, monetary policies were difficult to achieve. The management of the country's debt was the responsibility of the Central Bank as a result, there were inefficiency which led to borrowing with reckless abandon at high interest rate. External debt as well could not promote growth because loans received were embezzled by corrupt leaders instead of its real purpose (infrastructure).

The theory of debt overhang follows that if debt will exceed the country's ability to pay with some probability, expected debt servicing is most likely to be increasing function of the output of the debtor's country. Accordingly, any returns from investment will act as foreign tax, reducing the incentive to save for future investment and promote capital flight (Serven and Salimano, 1993, Sachs, 1989, Patillo, 2002). The debt overhang theory implies that large debt stocks would lower growth through the channel of reduced investment according to Patillo et al (2002). It maintains that the current debt stock is capable of stimulating growth while past debt accumulation impacts negatively on growth. The indirect effect works through the channel of debt service repayment which reduces the amount of export earnings available for expenditures thereby impacting negatively on growth.

For the Nigerian economy, significant scholarly efforts have gone into the impact of aid and external debt. For instance Akande and Sodipe (2009), explored the relevance and application of the theoretical prescriptions of the two-gap model to the Nigerian economic growth from 1970-2007. A co-integration test confirmed that long run relationship exists between the variables, giving an indication that they have the tendency to reach equilibrium in the long run.

Eregha and Irughe (2009) examined the impact of foreign aid inflow on domestic savings in Nigeria. Necessitated by the fact that most studies examined the issue with either panel data analysis or cross-country analysis framework which do not really show specific country characteristics and more so, there is no time series analysis on the impact of foreign aid on domestic savings in Nigeria. The study revealed that both at the short run and steady state, foreign aid inflow to Nigeria has positive effect on domestic savings and total debt service repayment has negative impact on domestic savings.

3. Method

3.1 Theoretical Framework

That foreign aid is positively correlated with economic growth is situated in growth theory that emphasizes the role of improved technology, efficiency and productivity in promoting growth (Lim, 2001). The potential contribution of foreign aid to growth depends strictly on the circumstances in recipient countries. Certain host country conditions are necessary to facilitate the spillover effects. The effect of foreign aid on economic growth is analyzed in the standard growth accounting framework. To begin with, the capital stock is assumed to consist of two components: domestic and foreign owned capital stock. So,

$$K_\tau = K_{\delta\tau} + K_{\phi\tau}$$

We adopt an augmented Solow production function (Solow, 1956) that makes output a function of stocks of capital, labour, human capital and productivity (see Mankiw et al., 1992). However, we specify domestic and foreign owned capital stock separately in a Cobb–Douglas production function (Cobb and Douglas, 1928).

$$\Psi_{\iota\tau} = A_{\iota\tau}\ K^{\alpha}_{\delta\iota\tau}\ K^{\lambda}_{\phi\iota\tau}\ \Lambda^{\beta}_{\iota\tau}\ H^{\gamma}_{\iota\tau} \quad (1)$$

where Y is the flow of output, K_{dt} , K_{ft} represent the domestic and foreign owned capital stocks, respectively, L is the labour, H is the human skills capital stock, and A is the total factor productivity, which explains the output growth that is not accounted for by the growth in factors of production specified.

Taking logs and differentiating Equation (1) with respect to time, we obtain the familiar growth equation:

$$\Psi_{\iota\tau} = a_{\iota\tau} + \alpha K_{\delta\iota\tau} + \lambda K_{\phi\iota\tau} + \beta_{\lambda\iota\tau} + \gamma y_{\eta\iota\tau} \quad (2)$$

where lower case letters represent the growth rates of output, domestic capital stock, foreign capital stock, and labour and human capital, and α, λ, β and y represent the elasticity of output, domestic capital stock, foreign capital stock, labour and human skill capital, respectively.

Following the established practice in the literature, K_d and K_f are proxied by domestic investment to GDP ratio (I_d) and foreign aid to GDP ratio (I_f), respectively in view of problems associated with measurement of capital stock. The use of rate of investment is hinged on the assumption of a steady state situation or a linearization around a steady state.

The final form of Equation 2 therefore is

$$\Psi_{\iota\tau} = a_{\iota\tau} + \alpha\ I_{d\ \iota\tau} + \lambda\ I_{f\ \iota\tau} + yh_{\iota\tau} + \varepsilon_{\iota\tau} \quad (3)$$

where $\varepsilon_{\iota\tau}$ is an error term.

Equation 3 therefore is the basis for our empirical model estimation.

3.2 The Model

$$\text{LnODA} = \partial_o + \partial_1 \text{FD1/GDP} + \partial_2 \text{INST} + \partial_3 \text{EXR} + \partial_4 \text{EDT} + \partial \text{OPN} + \mu_{1t} \quad (4)$$

$$\text{LnEDT} = b_o + b_1 \text{GDP} + B_2 1\text{NF} + B_3 \text{GFCF} + b_4 \text{EXR} + b_5 \text{OPN} + \mu_{2t} \quad (5)$$

$$\text{LnGDP} = C_o + C_1 \text{EDT} + C_2 \text{INF} + C_3 \text{INST} + C_4 \text{EXR} + C_5 \text{ODA} + \mu_{3t} \quad (6)$$

Where;

ODA = Official development assistant or foreign aid

FDI/GDP = Foreign private investment as a percentage of gross domestic product.

INF = Inflation rate

INST = Institutional quality (Proxy for regime shift in favour of democracy.

GFCF = Gross fixed capital formation (a proxy for investment)

EXR = Exchange rate

EDT = External debt

OPN = Openness to trade

μ = error term

Equation 4, 5 and 6 will be estimated using seemingly unrelated regression estimation model. The choice of the model is because it accounts for disturbance correlation between equations, summary of the goodness of fit and the estimation of coefficients of each equation.

3.3 Data Source

The data for the study will be obtained from the Central Bank of Nigeria (CBN) statistical bulletin (various issues), World Bank, World Development Indicators, and CBN annual reports for various years. All data series are annual and span through the period, 1970 – 2008.

4. Empirical Results and Discussions

Table 3.1 in the appendix presents the results of the seemingly unrelated regression estimation.

In the equation of foreign aid, the R^2 of 0.6716 is relatively high. This shows that about 67 per cent variation in ODA (foreign aid) is explained by the included regressors. The test of joint significance of all the regressors in the equation excluding the constant has a value of 77.73 with a probability value of zero. This shows that the regressors are jointly significant.

However, individually not all variables in the regression equation for the foreign aid have statistically significant impact at 5 per cent. Foreign direct investment as a percentage of gross domestic product variables (LnFDIGDP) has a positive and statistically significant coefficient at 5 per cent level. The result indicates that 1 per cent increase in FDIGDP (FDI as a % of GDP) lead to about 0.79 per cent increase in ODA (foreign aid). As the ratio increase, the larger is the ODA that the country receives. Invaluably, increase in the productivity of FDI in Nigeria leads to more aid allocation by donors.

The independent variable INST enters the regression negatively and highly insignificant at 5 per cent level. This variable was introduced to determine the average ODA inflow into the country in the two different regimes (Civilian and Military Regimes). Thus, INST is a dummy variable representing a political regime or the form of government which we have had in Nigeria over the years. We assigned the value of 0 for period of military rule and 1 for the period of civilian rule. We expected INST to assume a positive sign but it turned out negative. However, since the coefficient of the dummy variable is significantly equal to zero, then foreign aid flow to the country in the civilian regime is not statistically different from the flow in the military regime.

Similarly, the variable for exchange of the naira to a dollar (EXR) enters the regression highly insignificant. Clearly, it reveals that exchange rate has no significant association with foreign aid.

The coefficient of LnEDT is statistically significant at 5 per cent level. It shows that 1 per cent rise in external debt will lead to 0.27 per cent increase in ODA. An explanation could be that indebtedness attracts aid inflows targeted at achieving accelerated economic growth. This is to help countries that are suffering from capital deficiency like Nigeria.

Openness of the economy can be argued to be an important determinant of ODA, for example, a more rapidly growing economy provides greater development opportunities than a slowly growing economy. Similarly, countries with higher international trade are likely to grow faster than other. The coefficient of openness of the economy (LnOPEN) has the opposite sign of what is expected. The sign of the (LnOPEN) is worrisome as it suggests that an increase in the (LnOPEN) leads to a decrease in the ODA, which contrary to economic theory and conventional wisdom that ODA can be increased by the increase in (LnOPEN). However, this can be attributed to error from the data as other variables are well behaved. The coefficient is -0.22, implying that 1 per cent increase in trade would decrease ODA by 0.22% annually.

The equation of external debt has a very high R^2 of 0.9007. This shows that about 90 per cent variation in external debt (EDT) is explained by the included regressors. The test of joint significance of all the regressors in the equation excluding the constant has a value of 351.28 with a probability value of zero. This shows that the regressors are jointly significant.

The result shows that GDPR is not significant at 5 per cent levels, and the estimate suggests a negative relationship between economic growth rate and external debt. This implies that country like Nigeria with a low GDP growth rate tends to demand less borrowing overseas. This result should not be a surprise because, in the CIA World Fact Book, 2010, the estimated debt-GDP ratio shows that developed countries tends to have higher debt-to-GDP ratios , compared to the less developed countries. This implies that economies with higher growth rate tend to borrow more than the economies with low growth rate. On the other hand, such a result may also be the outcome of a credit ceiling from the part of creditors. This may be, for example, because Nigeria with unsustainable export revenue does have less incentive to pay back its past debt and this may worsen it access to the borrowing market.

We note that our coefficient estimate of the effect of OPN on EDT is positive and significant at 5 per cent level. The estimate suggests that 1 per cent increase in openness of trade to Nigeria economy leads to about 0.78 per cent increase in her external debt. From the result, it implies that opening the Nigeria economy to international trade increases its tendency to borrow overseas.

We find evidence that inflation has a positive impact on external debt, but the degree of impact is minimal. The estimate is not significant at 5 per cent level, showing that does not impact on the Nigeria external debt growth.

We find that coefficient on gross fixed capital formation (a proxy for investment) has the opposite sign of what is expected. Its negative sign actually implies that GFCF has a negative impact on the external debt of Nigeria. This result should be interpreted with caution because the savings gap reflects the inability of Nigeria to save sufficient amount of resources to finance the desired level of investment necessary for self-sustained growth. Overseas borrowing is meant to fill this gap. Unfortunately, in Nigeria there has been unproductive public investment and it increased foreign debt, which must be serviced. From this standpoint, it is possible to argue that the deficit in Nigeria is simply a development deficit that is inevitable if the country is to achieve long-run positive economic growth.

We also find that the coefficient of EXR (exchange rate of the naira to a dollar) is positive and significantly different from zero. Its significance is confirmed at 5 per cent level. This is a highly plausible result. The implication is that exchange rate has a significant positive impact on external debt. One important justification behind the overseas borrowing of Nigeria is that of the foreign exchange gap. Assuming there were no capital deficiency and no savings gap, the growth rate of Nigeria may still be hindered by foreign exchange gap. This seems to suggest that domestic saving is necessary but not a sufficient condition for raising investment in Nigeria to a desired level. This is again linked to the import structure of Nigeria where imports of capital goods are vital for the further expansion of the tradable sector. Moreover, export earnings (terms of trade are generally unfavorable to LDCs) are usually insufficient to generate enough foreign exchange to finance imports making overseas borrowing the indispensable means of gaining access to the technology that is vital for the expansion of the export sector that ultimately leads to rapid economic growth.

The equation of external debt has a low R^2 of 0.3117. This shows that only 31 per cent variation in EDT is explained by the included regressors. The test of joint significance of all the regressors in the equation excluding the constant has a value of 21.36 with a probability value of 0.0007. This shows that the regressors are jointly significant.

In the results of the estimation for economic growth in Nigeria, the coefficients of EDT is highly significant at 5 percent and depict an inverse relationship between external debt and the GDP growth rate in Nigeria. Estimates predict that an overall rise of 1 percent increase external debt to GDP will lead to 0.98 per cent fall in economic growth. This result is consistent with the debt overhang hypothesis which states that current stock of external debt will slow down the economic growth.

It is expected that foreign aid inflow would play an important role in the economic growth and external debt relationship. The need to borrow will be reduced and economic growth will be accelerated if foreign aid comes at substantial rates. The estimation results show that the coefficient of ODA is correctly signed (positive) but insignificantly different from zero. The result depicts the positive effect of foreign aid on the GDP growth during the period 1970-2008 in Nigeria and showing that the GDP growth rate increases as the foreign aid inflow increase. Foreign aid would be reversed, and the funds are invested in projects that generate higher rate of returns. This result appears to support some views expressed in the aid literature that foreign aid is effective at raising growth rates in low income countries. However, the insignificance of the ODA coefficient shows that the variable should not be included in the model. This may be because its overall impact on growth is so insignificant.

INF gives an indication of the extent of volatility in inflation over the period of our study and is expected to show the general macroeconomic instability in the country. We expect that this variable will be negatively related to growth. According to our regression result, the coefficient of INF is not significantly different from zero but it has the expected a priori sign (negative). The results show that inflation rate does not economic growth in Nigeria.

We find that INST is significant at 5 percent level. To interpret this, we obtain the semi-elasticity for the dummy regressor following Halvorsen and Palmquist. If we take the anti-log of the coefficient of the dummy which is -11.35043, we obtain 0.000011765.Then 100(0.000011765-1) = -99.9. This implies that the median economic growth is about 100 per cent lower in civilian regime than the military regime.

The impact of real exchange rate on growth was found to be statistically significant at 5 per cent level and depicted a positive coefficient. We expect that the exchange rate is positively related to debt service. This is because the weaker a country's currency is, the less likely it is that foreign capital will be invested in that country. Nigeria with weak currency is associated with an exchange rate risk. This will in turn increase the need for foreign borrowing to finance investment projects. The increase in debt stock will result in increase in debt servicing which in turn affects economic growth.

The correlation matrix for the fitted residuals shows a positive correlation between errors in ODA and EDT, a negative correlation between errors in ODA and GDPR, and a positive correlation between errors in EDT and GDPR.

5. Policy Recommendations

The following recommendations are the implications of our findings and if applied would improve not only growth but economic development in Nigeria.

Government should create conducive environment for foreign investment to come in. Over the years the uncertainty nature of macroeconomic environment like boko haram bombing, hostage taking and arm robbery has been on the increase and if checked could attract foreign investment inflow and their loss will certainly have a severe impact on the ability of the country to meet their financial needs in the short to medium term.

Indiscriminate external borrowing with reckless abandon for investment that do not add to the productive capacity of the economy or for selfish interest should be discouraged. Because higher borrowing cost result in a permanent decline in country's gross domestic product.

Weak institutions, policy inconsistency and corruption are major political economy issues. Improvements in governance encourage investment and could be means to accelerate the process of external inflows and growth.

Diversification should be encouraged in the economy to attract foreign exchange earnings rather than over dependency on only one source of export of raw material (oil) to avoid the repeat of the unholy trinity "The Dutch disease syndrome".

Foreign aid should be used wisely to increase output by devoting the aid resources to real sector such as agriculture and industries for employment generation and poverty reduction.

6. Conclusion

The important conclusion from this study is that there are some evidence of positive impact of aid on growth rate of gross domestic product and negative effect of debt on growth. This is consistent with most of the findings in the literature. Foreign aid are critical to the smooth functioning of the economy, and the level of domestic intermediation depending on the economic, institutional, political, social and technological condition of the recipient country. Also, there is an inverse relationship between external debt and gross domestic product in Nigeria because large debt stocks lowers growth as a result of reduced investments through the channel of debt service repayment.

References

Akande, E., & Sodipe, O. (2009). *The Two-Gap Model of Economic Growth in Nigeria: Vector Antoregression (Var) Approach*.

Akpokodje, G. (1998). Macroeconomic policies and private investment in Nigeria. In Ben E. Aigbokham (ed.), *Rekindling Investment for Economic Development in Nigeria*. Selected papers for the 1998 Annual Conference, the Nigeria Economic Society.

Alesina, A., & D. Dollar (2000). Who Gives Foreign Aid to whom and why? *Journal of Economic Growth* (March), 33-63. http://dx.doi.org/10.1023/A:1009874203400

Chenery, H., & Strout, A. (1966). Foreign aid and Economic Development. *American Economic Review,* Lvi, No. 4, Part 1.

Cobb, C. W., & P. H. Douglas (1928). A Theory of Production. *American Economic Review*, *18*(1), 139-65.

Cohen, D. (1992). Low Investment and Large LDC debt in the 1980s. *American Economic Review*, *83*, 437-449.

Ekpo, A. H. (1997). Foreign Direct Investment in Nigeria: Evidence from Time Series Data. C.B.N. *Economic and Financial Review*, *35*(1), 59-78.

Eregha, P. B., & Irughe, I. R. (2009). An Empirical Analysis of the Short Run and Long Run Impacts of Foreign Aid on Domestic Savings in Nigeria. *Journal of Economic Theory, 3*(3), 53-56.

Gujarati, D. (2007). *Basic Econometrics*, 4th ed. McGraw-Hill.

Krugman, P. (1988). Financing versus forgiving a debt overhang: some analytical notes. *Journal of Development Economics, 29*, 253-268. http://dx.doi.org/10.1016/0304-3878(88)90044-2

Lim, E. (2001). Determinants of and Relationship between Foreign Direct Investment and Growth: A Summary of Recent Literature. *IMF working paper*, No. 175. Washington DC.

Lucas, R. E. (1990). Why does capital flow from rich to poor countries? *The American Economic Review, 80*(2), 92-96.

Malcolm, D. J. (1987). *Strategies for Economic Growth and Development: The Bank's Role in Indonesia*. 4 Vols. Asia Development Bank.

Mankiw, G. N., D. Romer, & D. N. Weil. (1992). A Contribution to the Empirics of Growth. *Quarterly Journal of Economics*, *107*(2), 407-37. http://dx.doi.org/10.2307/2118477

Odozi, V. A. (1995). An Overview of Foreign Investment in Nigeria 1960-1995. Occasional Paper No. 11, Research Department, Central Bank of Nigeria.

Olaniyi, O. (1988). An Econometric Analysis of Domestic Savings and Investment Financing in Nigeria. *Journal of Teacher Education*, *4*(1), 132-33.

Patillo, C. (2002). External Debt Burden in Nigeria: An Investigative Analysis. A Paper presented at the Nigeria Economic Society, Annual Conference, 1994.

Phelan, B. E., & Yoshino, N. (1995). A Simulation of Macroeconomic Impact of ODA with the Debt Factor: The Philippine Experience. *Journal of Philippine Development, 22*(2).

Sachs, J. D. (1989). The debt overhang of developing countries. In J. B. de Macedo and R. Findlay (eds). Debt, Growth and Stabilization: Essay in Memory of Carlos F. Diaz Ale.

Serven, L., & Solimano, A. (1993). Debt crisis, adjustment policies and capital formation in Developing countries: where do we stand? *World Development, 21*, 127-140. http://dx.doi.org/10.1016/0305-750X(93)90141-U

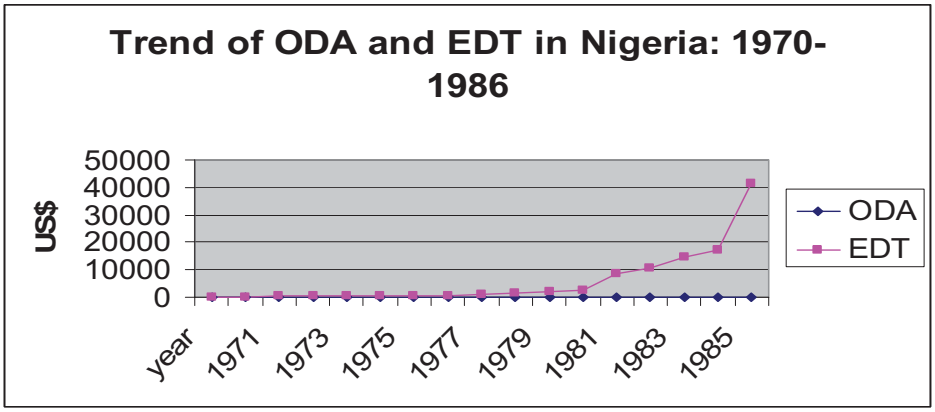
Solow, R. (1956). A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics, 70*(1), 65-94. http://dx.doi.org/10.2307/1884513

Uremadu, S. O. (2006). The Impact of Real Interest Rate on Savings Mobilization in Nigeria. Unpublished Ph.D Thesis submitted to the Department of Banking and Finance, UNN, Enugu, Campus.

Appendix 1. Models' Result

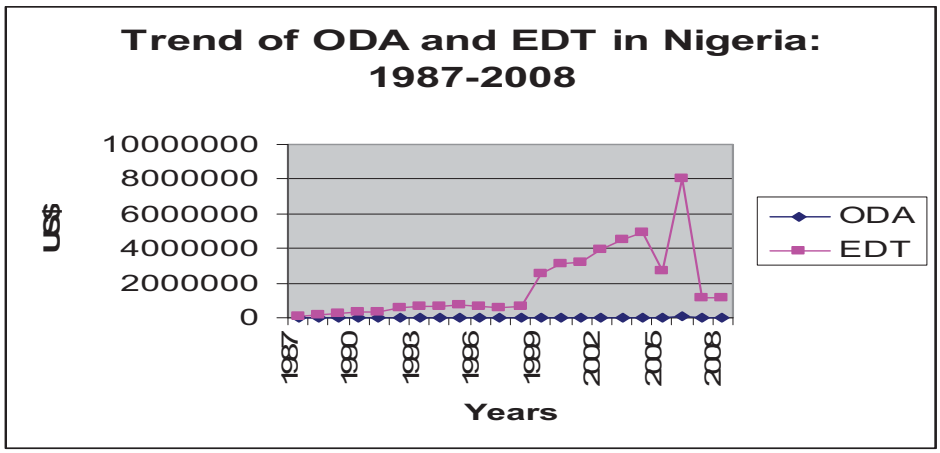
Variables	Foreign Aid		External Debt		Economic Growth	
	Coefficients	z-statistic	Coefficients	z-statistic	Coefficients	z-statistic
Lnfdigdp	.7890998	3.87	-.0166503	-0.69	-.9781374	-2.09
Inst	-.1802002	-0.38	.015661	1.28	-.0312057	-0.45
Exr	.0061175	1.00	-2.051246	-3.78	-11.35043	-3.41
Lnedt	.2270901	2.17	.0271509	5.50	.1011836	2.30
Lnopen	-.2188272	-1.86	.7756545	8.47	1.753338	1.81
_cons	2.026634	2.02	5.914999	6.31	6.769645	1.31
	R^2 =0.6716		R^2 =0.9007		R^2 =0.3117	

Appendix 2.



Source: Plotted by the Author.

Appendix 3.



Source: Plotted by the Author.

Appendix 4. Descriptive Statistics: Equation 1

	*Ln*ODA	*Ln*FDIGDP	INST	EXR	*Ln*EDT	*Ln*OPEN
Mean	3264.545	3.875128	0.384615	36.43528	1047583.	30.05359
Median	152.0000	2.390000	0.000000	7.391600	240393.7	3.150000
Maximum	114340.0	29.50000	1.000000	145.7500	8073508.	180.7300
Minimum	26.80000	-0.810000	0.000000	0.546400	175.0000	0.020000
Std. Dev.	18282.59	6.003109	0.492864	52.35999	1785926.	54.12416
Skewness	5.973928	3.050525	0.474342	1.119771	2.207175	1.864131
Kurtosis	36.79841	11.85782	1.225000	2.437620	7.795881	4.950484
Jarque-Bera	2088.261	187.9862	6.582266	8.664208	69.04130	28.76952
Probability	0.000000	0.000000	0.037212	0.013140	0.000000	0.000001
Sum	127317.2	151.1300	15.00000	1420.976	40855720	1172.090
Sum Sq. Dev.	1.27E+10	1369.418	9.230769	104179.6	1.21E+14	111318.1

Source: Computed by author using Eview 4.1

Note: *Ln* stands for natural log

Appendix 5. Descriptive Statistics: Equation 2

	EDT	GDPR	INF	GFCF	EXR	OPEN
Mean	1047583.	3.938462	19.82564	0.233538	36.43528	30.05359
Median	240393.7	4.400000	13.80000	0.224000	7.391600	3.150000
Maximum	8073508.	22.10000	72.80000	0.860000	145.7500	180.7300
Minimum	175.0000	-26.80000	3.200000	0.096000	0.546400	0.020000
Std. Dev.	1785926.	7.665666	16.43619	0.116695	52.35999	54.12416
Skewness	2.207175	-1.173244	1.576075	4.048686	1.119771	1.864131
Kurtosis	7.795881	8.899651	4.817190	22.63043	2.437620	4.950484
Jarque-Bera	69.04130	65.50682	21.51213	732.7472	8.664208	28.76952
Probability	0.000000	0.000000	0.000021	0.000000	0.013140	0.000001
Sum	40855720	153.6000	773.2000	9.108000	1420.976	1172.090
Sum Sq. Dev.	1.21E+14	2232.972	10265.63	0.517478	104179.6	111318.1
Observations	39	39	39	39	39	39

Source: Computed by author using Eview 4.1

Note: *Ln* stands for natural log

Appendix 6. Descriptive Statistics: Equation 3

	GDPR	EDT	INF	INST	EXR	ODA
Mean	3.938462	1047583.	19.82564	0.384615	36.43528	3264.545
Median	4.400000	240393.7	13.80000	0.000000	7.391600	152.0000
Maximum	22.10000	8073508.	72.80000	1.000000	145.7500	114340.0
Minimum	-26.80000	175.0000	3.200000	0.000000	0.546400	26.80000
Std. Dev.	7.665666	1785926.	16.43619	0.492864	52.35999	18282.59
Skewness	-1.173244	2.207175	1.576075	0.474342	1.119771	5.973928
Kurtosis	8.899651	7.795881	4.817190	1.225000	2.437620	36.79841
Jarque-Bera	65.50682	69.04130	21.51213	6.582266	8.664208	2088.261
Probability	0.000000	0.000000	0.000021	0.037212	0.013140	0.000000
Sum	153.6000	40855720	773.2000	15.00000	1420.976	127317.2
Sum Sq. Dev.	2232.972	1.21E+14	10265.63	9.230769	104179.6	1.27E+10
Observations	39	39	39	39	39	39

Source: Computed by author using Eview 4.1

Note: *Ln* stands for natural log

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Euro Area Sovereign Debt Crisis: What Economic Policy Consequences and Implications for the Franc Zone African Countries?

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Abstract

The recent notation degradation of the sovereign debt of the Euro area countries was at the origin of some confusing rumours on the effects of the loss of "Triple-A rating" for these countries as well as for the Franc Zone African Countries (PAZF). The need to protect the European Financial Stability Fund (EFSF) together with the lack ofeconomic competitiveness of the PAZF caused by the structural overvaluation of the CFAFranc and the no optimality of the Franc Zone are some of the destabilizing factors of the CFAlikely to induce queries about the zone including that which concerns the revision of the currency parity. The financial forfeiture of the Euro countries in general, and in France in particular, provides the opportunity to reconsider the current monetary anchoring by envisaging several happier perspectives for the PAZF, beginning with the keeping of the status quo o the building of the competitiveness of the African economies with the creation of a "CEMAC Franc" or a "WAEMU Franc" within the framework of a system of fixed exchange rates with margins of fluctuations. Irrespective of the policy adopted, the ultimate objective shall be to gradually move towards the "post- CFA" era which shall be followed by the creation of a unique African currency before 2020. This discussion goes well beyond the traditional analyses on the need to revise the 1972 and 1973 agreements between France and PAZF as it incorporates elements of the 2011 financial crisis in the debate.

Keywords: competitiveness, monetary crisis, devaluation, euro, EFSF, CFA Franc, Post- CFA, Euro area, franc zone

1. Introduction

Several conclusions can be drawn from the downgrading of the sovereign debt note of some Euro countries including France (note 1). Apart from the risk of recession, other risks can be identified such as the persistent degradation of the notes of States facingeconomic hardship, the adoption of a new European Treaty and the implosion of the Euro area, just to name a few. Any of these scenarios shall have an impact on the economies of the Franc Zone African Countries (PAZF), most especially with the status of the CFA Franc.

First of all, this deterioration is proof of the economic and financial difficulties that these countries are experiencing now, as it reveals the persistence of the imbalance of their public finances and the competitiveness lacunas of their respective economies and the financial effort of France in rescuing the eurowhich has helped countries facing economic challenges such as Italy, Spain and Greece.

Secondly, the major consequences of this downgrading go far beyond the increase of the country's risk and the mistrust of investors and markets. Slow growth perspectives, more expensive sovereign debt, concomitant increase of the credit charges and heavy consequences on employment rate and wealth creation are to be expected.The chain of the reduction of the financial note of Euro countries has direct consequences on the PAZF economies (note 2)

Assuming that the CFA Franc is a datum and that everything remains equal in the temporal horizon of the implementation of the development plans of the PAZF based on the Poverty Reduction Strategies (DSRP of the second generation), the question is to know whether it is reasonable to consider the current monetary Franc anchoring of the zone as a threat or as an opportunity in terms of growth, jobs and social well-being.

In order to answer this question, it will be germane to endeavour to prove that the sovereign debt crisis raging in the Euro area is a threat for the PAZF economies.

Then, considering the direct and potential consequences (note 3) of the sovereign debt crisis in the Euro areaon the PAZF which are being fed by a model of anachronistic development (note 4), associated with the permanent overvaluation of the F.CFA which slows down exports and overbids imports, compromising considerably the competitiveness of these economies, it will be necessary to find out whether the next move is towards a status quo, the decline of the CFA Francleading to the explosion of the zone, a new devaluation of the CFA Franc, or again, whether the next move is towards the creation of sub-regional currencies (note 5).

Answering this second question calls for the estimationand anticipation of the effects of the active solidarity between France and Euro countries (thus in favor of the EFSF) to the detriment of the Franc zone, on one hand and for the examination of the consequences of an implosion of the Euro area due to the dysfunctions of this fund, whichmay arise from its incapacity to reach the objectives set at the time of its creation in May 2010 on the other hand.

The paper aims at assessing the impact of the European financial crisis on the PAZF generally and on the stability of the CFA Franc in particular, the likelihood of its transmission and the opportunity which it gives to these countries to renegotiate the current monetary framebuilt on the CFA Franc.

2. The Sovereign Debt Crisis of the Euro Area: A Threat for the PAZF Economies

The most immediate consequence of the Euro area debt crisis is the trust crisis that befalls on the national debts of the member States of the zone with together with its impact on mechanisms set up by the European Union to mitigate that crisis and the European Financial Stability Fund (EFSF). In effect, the AAA note of this fund depends on that of the countrieswhich support it, and in this case, Germany and France. It allowed the affected countries (Portugal, Greece, Spain) to borrow on the same conditions as Germany (2%) or France (3%). Since January 13th, 2012, Aid plans in these countries have become more expensive. It may thus have a reverse effect on the sustainability of anti-crisis measures griped in September 2011. In so far as it continues to weaken the European currency position, and consequently that of the CFA Franc, a domino effect is to be feaded. Banks had announced the events of January 13th, 2012 when they suspended negotiations with Greece on the modalities of the restructuring of its national debt which meant that they could come back on their promise to reduce Greece's debt by half!

As the capacity of the PAZF to meet their development goals depends on the status of the currency among other things, several questions arise: the first is to know whether the need to protect the EFSF might lead the European Central Bank (ECB) and Germany to impose new institutional arrangements to France such as the revision of the agreements governing the Franc zone and, in particular, the unlimited guarantee granted to the CFAFranc. According to the terms of the monetary cooperation agreement of November 23rd, 1972 between the Bank of the States of Central Africa and France on one hand, and those of the monetary cooperation agreement of December 04th, 1973 between France and the member States of theWest Africa Economic and Monetary Union (WAEMU) on the other hand, the French State guarantees the convertibility of the currency emitted by the BEAC by granting it an unlimited right to draw on an"Operation Account (note 6)"opened in the French Treasury. In exchange of this, he BEAC and the BCEAO have to deposit a fraction of their clear outer exchange reserves on the"Operation Account".

The European Relief Fund (EFSF) aims at collecting funds in order to finance the loans of the Euro member States facing financial difficulties which cannot borrow on capital marketsat affordable rates. It raises funds more easily when rating agencies give the maximal note whichis AAA. The reduction of the note of several Euro countries led to the EFSF'striple A being downgradedto AA +. A brief analysis of the activities of the fund shows that its balance sheet was very thin in February 2012, and that it did not meet the expected goals (note 7). This makes it possible to foresee that some risks related to the dysfunctions of this fund whose operation margins are already reduced due to the difficulties that it meets in carrying out its activities without the maximal note.

In the case where there is no significant change, the EFSFwill not collect as much funds as needed to pay off the debt of Euro countries and simultaneously implement Greece's aid plan. Such a situation which will certainly occur can further weaken this zone which would then implode with a domino effect on the CFA Franc.

In taking into account the pace at which the French budget deficit is increasing (note 8), the question arises as to whether the current parity of the CFA Franc will resist. In other words, under the pressure of the markets and of other Euro countries, will France be able to resist to a devaluation of the CFA Franc in order to strengthen the balance of its exchanges with the PAZF economies, considering the fact that in spite of its significant reduction, the level of exchanges between the PAZF and European Union countries is still high (note 9).

Of the low level of trade between the Franc zone countries and Euro countries' exchanges with emerging countries co-exists with the increasing importance in the trade between emerging countries and Franc zone countries. For example, from 2002 to2008, the Chinese part in the trade of the PAZF has increased to 4% of the total of the trades of the zone to 14,5%, with an average part of about 10% of the exchanges. The positions of India, Brazil, Russia and South Africa are more moderated (note 10). This is to say that the current difficulties of the Euro area present risks because the PAZF economies are exposed both to the consequencesthe slowness of European growth and the possible slowdown of Chinese, Indian and Brazilian growth.

In addition, the strong appreciation of the eurois accompanied with another risk driven by the Chinese presence: the underestimation of the Yuan which reduce the competitiveness of trade between the PAZF and China.

The first preliminary conclusion is that the potential dysfunctions of the EFSF and the abyssal budget deficit of France associated to the slow down of the world growth that can contribute to a revision of the current status of the CFA Franc towards the Euro.

Had the reasoning been based on the basic economics of the PAZF, factors which are likely to justify a refitting of the current monetary device can seem derisory in comparison to the situation that has prevailed in the beginning of the 1990s when the CFA Franc was devaluated, even if the Franc zone is less competitive with regard to other African countries (Myburgh and Fall, on 2011). Indeed, in spite of the overvaluation of the CFA Franc, the rate of exports of raw products is constantly increasing in the CEMAC and WAEMU zone, and this was not the case in 1994. Likewise, the growth rates are positive, with an average of 6,5% in the CEMAC zone in the last 10 years, and 3,5% in the WAEMU zone (figure 2). The latter is still influenced by the low growth potential of Ivory Coast (note 11).

A good number of scholarly works (TchundjangPouemi, 1980; Monga and Tchatchouang, 1996, etc.) show that the monetary relations between France and the PAZF benefits more to the former than to the latter, through the"Operation Account"opened in the Bank of France (note 12), and special economic relations that it has with all these countries via the CFA Franc, for other scholars on the other hand (Guillaumont and Guillaumont, 1988 and 1992; Lelart, 2003; Vinay, 1988). The monetary cooperation between France and PAZF provides many advantages to the latter (note 13). In addition, they assert that the mechanism of the Franc zone providesprotection (note 14) and useful railings against the food, energy and financial crisis of 2008 and 2009 (note 15).

In spite of these advantages and in the light of the functioning of the Franc zone, its optimal character has not been demonstrated (note 16). Indeed, notwithstanding the type of approach taken, whether it is traditional(note 17) or new (note 18), most empirical works on the optimal character of the Franc Zone conclude that the revenue to be gained from the adoption of a common currency such as the CFA Franc, or a regime of fixed exchange rates cannot compensate the costs of renunciation of the exchange rate as an adjustment instrument within the zone so long as there is more mobility within the zones than out of it for the workforce and for the financial flows or direct investment (Bayoumi, on 1994).

Likewise, the McKinnon theory, which makes arbitrating fixed exchange rates - floating exchange rates depend on the volume of trade in the same way as Kenen's theory on the diversification of State's economies (1969) seems not to apply to the PAZF (note 19). The analysis of the degrees to which these countries carry out transactions (ratio of intra-community exports/GDP in percentage) as well as the ascendancy of the monocultures of export is enough to achieve demonstration (note 20).

Furthermore, Prao (2010) demonstrated that apart from the failure of the CFA Franc to achieve the PAZF development, the principles of the Franc zone canamply explain their economic regression.

For example, ananalysis of the economic trajectories of PAZF and non PAZF between 2003 and 2009 shows that the economic performances of the PAZF were below those of non-PAZF over the same period. The estimatesare 6,5% the average increase of the GDP of other Africa sub-Saharan countries for an average of 3% and approximately 4,2% for the PAZF of the WAEMU and CEMAC groupings. The difference in the growth of the GDP during the period under review are sometimes very high, as in 2006 and 2007, when the growth of PAZF was 6,5% and 6,9% and 2,9% and 3,2% in 2006, 3,2% and 4,7% in 2007, respectively for WAEMU and CEMAC (Note 21).

However, and during the same period, the results in terms of inflation control were much better in the WAEMU and CEMAC, even if in 2008, the level of consumption prices was exceptionally high: 7,4% and 6,9% in WAEMU and CEMAC respectively as comparedwith an average of about 2,5% for the WAEMU zone and 2,7%

for the CEMAC zone between 2003 and 2007 (figure 1), while the level of Africa sub-Saharan countries was 8,1% (IMF, Perspectives of the world economy, April, 2010).

As far as thecontribution of the Franc zone to the regional integration is concerned, the debate and the position revolve around three main standpoints. First of all, those who propound the idea that the Franc zone balance sheet is positive, (Guillaumont and Guillaumont, 1988; Hugon , 1999; Gerardin, 1994, 1999; etc.) and that it is not possible to envisage the Franc zone without France (Yondo, 1997); then those who underline the pernicious effects of the current monetary anchoring policy (Ondo Ossa, 2003; Monga and Tchatchouang, 1996; Tchundjang Pouemi, 1980; etc.) and those who recommend a monetary structuring that promotes the creation and strengthening of national (Nzemen, 1997) or regional currencies in the process of integration (Bekolo-Ebe, 1997).Some economists (Dramani, 2010) assert that the integration in Franc zone is"institutional"and that the outcomes are different in WAEMU or in CEMAC. The macroeconomic instability prevailing within the PAZF led to an important flight of capital estimated by Ndikumana and Boyce (2007) at about 50 billion dollars between 1970 and 2004. These authors, quoted by Ndiaye (2011), assert that for every dollar lent to the PAZF, 60 hundreds leave these countries under capital flight.

The cover rate of the CFA currency should be at 20%.However, the cover rate is now at 112%. There is a margin of important operation, whichcould have been used to finance the structuring projects for PAZF economic development.

As a matter of fact, the foreseeable economic and institutional transfers in the Euro area with possible consequences on the status of the CFA Franc strengthen these traditional analyses on whether or not the existence of the Franc zone is relevant. Hence, questions remain as to the appropriate monetary strategy for the PAZF.

3. The Sovereign Debt Crisis of the Euro Area: An Opportunity to Reorganize the Current Monetary Framework of the CFA Franc

As in 1994, the sovereign debt crisis of the Euro area has nurturedexpectations of devaluation from an economic variable proportion of agents leading tocapital flight (Myburgh and Fall, on 2011). In spite of the reassuring comments of the respective monetary authorities of both monetary unions, the fear of devaluationis still pregnant and it may lead to anuncontrollable spiral. It is worthy to Note that monetary crises cannot be entirely explained by solvency problems or by slow growth. The risk to which the PAZF are exposed today may well be explained by other vulnerabilities that are mostly institutionaland which may amplify or result in a monetary crisis. µIt therefore becomes urgent thatthe PAZF should react (Note 22) and work towards ending the current monetary cooperation between the PAZF and France (Gankou and Bondoma, 1998).

What is currently taking place in the Euro area shows that a system of fixed exchange rates - such as that of the Franc zone - is vulnerable. The reason is that the monetary anchoring can be questioned on the basis of factors that do not depend on satellite countries. For example, doubts as to the capacity of experimental countries to finance an outside deficit (first generation crisis) or the anxieties generated by the activity trends and unemployment rate (second generation crisis).

Therefore, economic policy recommendations aim at ensuring the realization of the PAZF development goals which are:

- In the short term, to examine the scenario developed in the second cycle of programming of the DSRP (Note 23), and reasonably move towards a continental currency; while improving efforts to manage the public finances system, according to budgetary issues and in consideration of the financial fragility of the governance systemwhile accelerating the implementation of the PAZF competitiveness strategy to limit the inconveniences of a strong Euro as reference currency. The potential advantages linked to the access of the PAZF to the large European market will not be as effective as the evanescent effects of the devaluation of January, 1994.

- to undertake a monetary structuringwithin CEMAC and WAEMU by setting up the"CEMAC Franc"and the "WAEMU Franc"within the framework of a system of stable exchange rates with fluctuation margins. Choosing this type of regime would likely beprompted by considerations relating to the revamping of regional integration, on one hand, and to the existence of a dominant State on both sides (Cameroon and Ivory Coast, respectively), that are used to stabilize such monetary strategies which should be able to impose rules on other members and support the related costs.

This floating administered regime, the preliminary floating in a continental currency possibly connected with other currencies refers to the concept of -target-zone or "-objective-zone", as defined by Williamson (1986) as a margin of fluctuation in the exchange rates on both sides of a rate of balance fixed according to the real data.

Sotherefore, due to variations, the central bank can let its currency depreciate in the short term, without running neither the risk of a flight of capital, nor the loss of exchange reserves, especially if there are anticipations of the future appreciation of the currency with regard to the central course. The -target-zone thus reduces the volatility of the exchange rates which is due for the main part to the behavior of the speculators who, in such a system, is very different from that which will obtain in the presence of perfectly flexible exchange rates (Krugman, on 1995).

For Williamson, the system of -target-zone is a viable alternative to both polar systems (fixed exchange rates and floating exchange rates). Indeed, this regime of administered fluctuations:

- Contributes to postpone the relative desires of a sovereign monetary strategy in a context where additional efforts must be provided to set up the budgetary discipline n the long run as is still the case with CEMAC and WAEMU groupings.
- Moves closer to the inconveniences/advantages of the fixed and floating regimes;
- Reconciles the various inflation rates through the automatic adjustment of the nominal target.
- Facilitates the adjustment of the balances of payments with the modification of the real central rate;
- Ensures the degree of dependence of the monetary policy due to the wider margins;
- Absorbs the speculative shocks by the existence the aforementioned margins.

Nevertheless, the institution of slippery parities in this new context has to follow some modalities: the determination of the exchange rate of fundamental balance (towards an experimental or reference currency (the euro) followed by the post-determination of the width of fluctuations margins.

One of the uncontested gains of this new regime of exchange is the role whichit could play to accelerate the process of regional integration in Africa generally. It is useful to keep in mind that for a country like Cameroon to reflect on the relationship between Euro andFCFA in the concept of regional integration and international recognition of the country (Vision 2035, p. 75) shows that the will of domestic public authorities to opt for a unique continental common currency by 2020, through the implementation of three African financial institutions. In relation to this, the General Secretary of the New Partnership for the Development of Africa (NEPAD) reaffirmed the will of Africa to have a single currency, taking into account the fact that this process goes through the sub-regional organizations, which have to work at gathering quickly around common currencies as a prelude to an African single currency.

As a matter of fact, these currencies, which would be part of the regime of slippery parities, would strengthen economic integration in regionsby providing solutions to the problems related to the risk of exchange and of shortage of reserves due to the creation of payment unions. 50 years after their accession to independence, the time has come for the PAZF to attain the monetary sovereignty by steadily getting out of a currency which eventually be subjected to devaluation bearing into mind that it is not a panacea.

Creatinga unique African currency on the basis of regional experiences is one of the objectives of the African Union (AU) created in 2001. To achieve this, the AU would use monetary unions of the five existing regional economic communities as intermediates towards the establishment of a central African bank and a common currency. While simulating the succession of a single currency in Africa, Masson and Pattillo (2004) demonstrated that CEMAC countries suffer from a loss in general well-beingif such a currency is created due to the accompanying rigorous management of their budgetary policy. Therefore, in the prospect a unique African currency, they propose that the Franc zone besubjected to selective extension as the practices of the neighboring countries converge on the members who already have a common monetary policy and currency.

Some of the new issues to be addressed by this new monetary strategy including the question as to whether the new CFA Franc should be disconnected to the euro with the significant suppression of the “Operation Account", and the consequential loss of the French guarantee of convertibility of the CFA Franc. The solutions will depend on the capacity of member states to undertake, jointly and equally, the necessary measures for the convergence of economic, financial and social policies in the new monetary territory. After all and by paraphrasing Hugon (1999), the choice that the PAZF is that of the universal and potentially benefits of multilateralism, and the cooperative multilateralism learned from historic and colonial links leading to a “reprimairisation” of economies. The current crisis callsfor more boldnessfrom the PAZF, a proof that, contrary to the Malian and Malagasy experiences (1973), monetary freedom is not”freedom to go bankrupt”.

The second preliminary conclusion is that the current Euro financial crisis an opportunity for the PAZF to reach a monetary autonomy through a process that will end in the establishment of the "CEMAC Franc" and the "WAEMU Franc" to be used in CEMAC and WAEMU respectively.

4. Conclusion

It is unnecessary to demonstrate the importance of finance in the process of development, several studies having shown bidirectional links between finances and economic growth (Murinde, 2010; Ahmed, 2010; Akinlo and Egbetunde, 2010). The PAZF development project may only come true only if the status of the currency is prevails in Europe gives a unique opportunity for the political authorities of these countries to take measures likely to favor their monetary independence within the framework of the UA which is to reach a create a unique African currency by 2021. The foregoing arguments developed have revealed the difficulties the PAZF could meet, if the current *statu quo* persisted; well beyond the loud voices raised for pro-devaluation in the last quarter 2011, the PAZF should stay stillwhen faced with the potential dysfunctions of the EFSF.

References

Ahmed, A. D. (2010). Financial liberalization, financial development and growth linkages in Sub-Saharan African countries: An empirical investigations. *Studies in Economics and Finance*, *27*(4), 314-339. http://dx.doi.org/10.1108/10867371011085156

Akinlo, A-E., & Egbetunde, T. (2010). Financial development and economic growth: The experience of ten Sub-Saharan African countries revisited*. The Review of Finance and Banking*, *2*(1), 17-28.

Banque de France. (2009). Les échanges commerciaux de la zone Franc avec les pays émergents. *Rapport annuel de la zone Franc*, Paris.

Banque de France. (2009). *Rapport annuel de la zone Franc, 2009*, Paris.

BCEAO. (2005). *Stabilité financière e gestion macroéconomique dans l'UMOA*, 3e Colloques BCEAO – Universités – Centres de recherche, Dakar.

BEAC. (2007). Echanges commerciaux des pays de la CEMAC au cours des dix dernières années, in *Banque de France, Rapport de la zone Franc 2006*, Paris.

Bekolo-Ebe, B. (1997). Monnaies régionales, monnaies nationales: Quelle structure monétaire pour le développement de l'Afrique*? Zone Franc face à la monnaie unique européenne: Quel avenir?* Fondation Friedrich-Ebert/ISMP, Yaoundé, pp.65-87.

Codesria. (1996). *Symposium international sur l'avenir de la zone franc avec l'avènement de l'Euro*, Dakar, Novembre.

Davanne O. (2000). *Origine, déroulement et prévention des crises monétaires*, collection des rapports du conseil d'analyse économique, La Documentation française.

Devarajan, S., & De Melo, J. (1992). Membership in the CFA zone: Odyssey an journey or Trojan horse. *Economic reform in sub-Saharan Africa*, pp. 25-31.

Dramani Latif, A-G. (2010). *Convergence and economic integration in Africa: the case of the Franc Zone countries*, AERC, RP 200, Nairobi.

Engone Mve S. (2004). La politique monétaire et l'intégration sous-régionale. *Laboratoire d'Economie Appliquée*, Gabon.

FMI. (2010). *Perspectives de l'économie mondiale*, mise à jour juillet 2010, Washington, D.C.

Fondation Friedrich Ebert. (1997). *La zone Franc face à la monnaie unique européenne: Quel avenir?* Institut Supérieur de Management Public.

Fondation Friedrich Ebert. (1993). *L'impact d'une dévaluation du FCFA: le cas du Cameroun*, CRETES.

Friedman, C. (1991). Exchange rate policy, in "Monetary policy instruments for developing countries, (edited by CaprioJr, G and Honohan, P.), *A World Bank Symposium*, The World Bank, Washington, pp. 125-130.

Gankou, J-M., & Bondoma Yokono, D. (1998). Gestion du taux de change et politique d'ajustement dans les pays africains membres de la zone Franc. *Economica*, Paris.

Gerardin, H. (1994). *La zone Franc, Tome 2: La dynamique de l'intégration monétaire et ses contraintes*,.l'Harmattan, Paris.

Gullaumont, P., & Guillaumont, S. (eds). (1988). Stratégies de développement comparées zone Franc et hors zone Franc. *Economica,* Paris.

Gullaumont, Pet Guillaumont, S. (1992). Exchange rate policies and the social consequences of adjustment in Africa. *Economic reform in sub-Saharan Africa*, pp. 12-24.

Herlin, P. (2012). *La France, la faillite ? Après la perte du AAA*, 2ème édition. Groupe Eyrolles, Paris.

Hugon, P. (1999). *La zone Franc à l'heure de l'euro*. Karthala, Paris.

Hugon, P. (nd). *Les avatars de la zone France face à l'Euro*, pp. 239-261.

Krugman, P. (1995). Globalization and the inequality of nations. *The Quarterly Journal of Economics*, *110*(4), 857-80, November, MIT Press.

Lelart, M. (1996). *Un exemple d'intégration institutionnelle: l'évolution de la zone Franc*, Orléans, Doc de recherche, Institut orléanais de finance.

Masson, P., & Pattillo, C. (2004). Une monnaie unique pour l'Afriqu*. Finance et Développement*, FMI, pp. 9-15.

Minepat. (2009). *Vision Horizon 2035*, Yaoundé, 85 p.

Monga, C., & Tchatchouang, J-C. (1996). Sortir du piège monétaire. *Economica*, Paris.

Murinde, V. (2010). Financial development and economic growth: Global and African evidence*. Journal of African Economics*, *21*, i10-i56. http://dx.doi.org/10.1093/jae/ejr042

Myburgh, L., & Fall, C. (2011). Assessment on potential CFA Franc devaluation. *CitiFx and Strategy*, Johannesburg, December, 10 p.

Ndiaye Saloum, A. (2001). *Capital flight and its determinants in the Franc zone*, AERC, RP 215, Nairobi.

Ndikumana, L., & Boyce, J-K. (2007). New estimates of capital flight from sub-Saharan African countries. Linkages with external borrowing and policy options, paper prepared for Seminar on capital flight in Pretoria, November 2007.

Nzemen, M. (1997). Monnaie régionale, monnaie nationale: Quel moyen pour la promotion du développement de l'Afrique? Le processus du Bon sens monétaire*,* Zone Franc face à la monnaie unique européenne: Quel avenir? *Fondation Friedrich-Ebert / ISMP,* Yaoundé, pp.53-64.

Ondo Ossa A. (2000). Zone monétaire et crise de change: le cas de la zone franc africaine. *Laboratoire d'Economie Appliquée*, Gabon.

Plane, P., & Tanimoune, N-A. (2004). Performances et convergence des politiques économiques : la zone Franc en Afrique de l'Ouest, Document de travail de la série *Etudes et documents*, CERDI, 28 p.

Prao, S. (2010). *Les pays africains de la zone Franc sont toujours colonisés, 50 ans après leurs indépendances*, Webographie.

Tamba, I. (1994). Mesures d'accompagnement à la dévaluation du F.CFA: le cas du Cameroun, Revue Techniques Financières et Développement, No 35, *Epargne Sans Frontières*, pp. 36-41.

Tamba, I. (2005). L'Etat et le développement dans les pays de la CEMAC: une perspective historique, in *Revue Etudes et StatistiquesBEAC,* no 2997, juillet 2005, pp. 1-29.

Tchundjang Pouemi, J. (1981). *Monnaie, servitude et liberté : la répression monétaire de l'Afrique*, Les Editions J.A/Editions Conseil, 285 p.

Theret B. (éd). (2008). La monnaie dévoilée par ses crise*s*, Collections, *Civilisations et sociétés*, vol I et II, Paris.

Touna Mama, Bekoko Ebe, B., & Hakim B-H. (sd). (2003). *Intégration économique en Afrique centrale*, L'Harmattan.

Vinay, B. (1981). *Zone Franc et coopération monétaire*, La Documentation française, Paris.

Williamson, S-D. (1986). Costly monitoring, financial intermediation and equilibrium credit rationing. *Journal of Monetary Economics*, *18*, 159-179. http://dx.doi.org/10.1016/0304-3932(86)90074-7

Yondo, M. (1997). La zone Franc sans la France*? Zone Franc face à la monnaie unique européenne: Quel avenir*, Fondation Friedrich-Ebert / ISMP, Yaoundé, pp.17-23.

Notes

Note 1. January 13th, 2012, Standard and Poor degraded the Note of France's sovereign debt and at the same time lowered that of eight other countries of the Euro area, among which Italy, Spain and Austria. Germany,

Finland, Luxembourg kept their “triple A”, as proof of strength of their resilience when faced with the ongoing financial crisis, and especially the confidence placed by markets in the policies formulated and implemented by these countries.

Note 2. Apart from other economic effects, the potential reduction in the flows of money of the Diaspora in Europe generally because of the economic slowdown, among other consequences.

Note 3. In particular, the reduction in the orders of European companies to their PAZF counterparts, the concomitant reduction of exports to Europe, cuts it with the volume of the financial aid because of their budgetary difficulties, etc.

Note 4. This is due to the fact that the PAZF takes part in the international market with raw material.

Note 5. By holding that the best option for Africa would be to move gradually towards a continental currency by 2020, it will appear that the choice of the”improved status quo”current or sub-regional currencies seems to be more noticeable than that of national currencies when compared with the indiscipline which still prevails in the management of the PAZF public finances.

Note 6. The”operation account”is a tool that makes it possible to implement of the cooperation principles. Operation accounts are current accounts opened with the French Treasury in the name of each of the three emission establishments: the BCEAO, the BEAC and the central Bank of the Comoros. They are remunerated and offered the possibility of unlimited overdrafts. The economist Tchundjang Pouemi (1980) used this mechanism to prove the unbalanced character of the relations between France and PAZF. He considered among other things that the assets of the PAZF deposited in this account being placed in American vouchers of treasure on financial markets paid by superior rates from 4 to 5 points to those practiced in France. Nowadays, they are paid by the French Treasury at the profitable rate of the marginal ease of loan of the ECB. For the BCEAO and the BEAC, the amount of the deposits exceeding the share which must be formally maintained at the expense of operations leading to reduced remuneration, namely the rate of the main operations of refinancing of the ECB.

Note 7. Indeed by that time, only eight bond subscriptions were emitted, for some25 billions euro volume at an average rate close to 3%. At the same time, loans towards Ireland and Portugal, at the average rate of 5,3%were made. A margin of more than 2,2% is so required from countries which need financing, in exchange for the guarantee offered by the fund.

Note 8. According to the INSEE (National Institute for Statistics and Economic Studies), the national debt of France reached 1 700 billion euro, more exactly 1 692.7 billions on June 30th, 2011. On March 31st, 2011, it amounted to 1 646,3 billion euro, is a progress of 46,4 billions in three months, in other words 515 million euro a day. France incurs debts at the rate of 500 million euro a day (Herlin, 2012)!

Note 9. Indeed, it was reduced from 45% in 1995 to approximately 30% in 2008, in front of the United States (17%) and China (14%).

Note 10. Their respective average is 1,8%, 1,1%, 1,0% and 0,4% of the total of the exchanges of the PAZF.

Note 11. The IMF plans for 2012, an 8,5% growth rate, what will contribute to re-revitalize the regional growth.

Note 12. The free convertibility of the currency of each of the sub-zone is ensured by the operations account on which central banks have unlimited right to draw in the case of an exhaustion of their currency reserves. In exchange of this right to draw, central banks have to put down at the expense of operations a part of their clear outer assets (exchange reserves) and must meet some requirements. For the BCEAO, the part of the outer assets that must be deposited at the operation account is fixed to 50% since the reform of *September* 2005. For the BEAC, the quota was reduced from 65 to 60% on July 1st, 2007 then further lowered to 50% on July 1st, 2009. For the Comoros, it is 65%.

Note 13. In this case, history shows that inflation has been better managed in the PAZF than non-PAZF, because of their monetary and financial stability, the strengthening of the credibility of the CFA. F, the abolition of the foreign exchange risk intra PAZF, the convergence of economies by means of the fixed exchange rate and the implementation of the solidarity principle through compensation between member countries …

Note 14. In effect, the anchoring of the CFA Franc in the Euro limited the volatility of the courses of raw materials, the regulations of exchange limited the outside exposure of the financial system, and the monetary stability reduces inflation pressures.

Note 15. They were not sufficient to check, or to say the least, stabilize the escalation of the deficit of the PAZF trade balance. For example, Cameroon’s trade balance records historic deficits for six years that went as high as approximately6% of the GDP in 2010. In the context of strong structural rigidity and (lengths) deadlines of

reaction of an economic policy to improve the competitiveness of the economy, the «rule of affectation"of Mundell consisting in affecting the monetary policy - via the instrument that is the exchange rate - in the only task of the external rebalancing is inoperative in Franc zone.

Note 16. Ondo Ossa (2000) for example, admits the optimality of the Franc zone by its end and proposed a new CFA Franc over a long period.

Note 17. Introduced by Mundell (1961), McKinnon (1963) and Kenen (1969), the theory of the optimal Monetary area concentrated on the costs of a monetary union and on the definition of the optimal goals of the monetary areas.

Note 18. They relate to the criteria of Ingram and Scitovsky as well as those of Bourguinat and Kindleberger, on one hand and on the more recent work of Bayoumi, Ghosh and Wolf, Melitz, Devarajan, Minford, Ricci, on the other hand.

Note 19. The modern criteria establish the necessary conditions of optimality, as any monetary area, which fulfills these conditions, is not necessarily optimal. Neither the nearness of the national preferences giving rise to a consensus between the member countries of the zone on the essential determiners of their economies (Bourguinat), nor the intensity of the exchanges and the existence of identical preferences (Kindleberger) are enough to protect the monetary area from exogenous shocks.

Note 20. The ratio trades intra zonal / total foreign trade is of little significance and the ratio exports intra zones / GDP is very low. According to the BEAC, the intracommunity commercial transactions considered partially relatively little important global flows: they represent about 3% of the total value of t exchanges (that is FCFA 119 billions a year). The WAEMU's participation does not exceed 1% of trade with of CEMAC Countries (BEAC, 2006).

Note 21. IMF: perspectives of the world economy in April 2010, updated in July 2010

Note 22. Devarajan and Melo (1992) already showed the cost of the waiting-game (in terms of loss of competitiveness and points of growth) observed in the PAZF in the 1980s because due to the delay in achieving the process of currency adjustment.

Note 23. They incorporate the relation Euro-CFA.F within the framework of regional integration.

Note 24. Namely, the African central Bank to be installed in Nigeria, the African Bank of investment in Libya and the African monetary Fund in Cameroon.

Note 25. In 2003, the Association of the governors of the African central banks announced that it would try to set up a single currency and a common central bank by 2021.

Note 26. These are the Arabic Monetary Union, the Common market of East and southern Africa (COMESA), the Economic Community of the States of Central Africa (CEEAC), the Economic Community of the States of western Africa (ECOWAS), the southern Africa Development Community (SADC).

Note 27. 10.000 billion CFA. F (that is near million euros) are deemed to be the amount of assets that both African central banks provided to the Bank of France, who serve finally only to guarantee the fixed parity of the CFA Franc.

Note 28. After the retreat of Mali and Madagascar of the Franc Zone, respectively in 1962 and 1973, these two countries experienced heavy difficulties, which forced to reinstate the zone in 1984!

Note 29. The 1994CFA Franc devaluation in and the coming into being of the Economic and Monetary Union in Europe in 1999 were historic opportunities for the PAZF to reflect on currency status in their respective economies.

Appendix

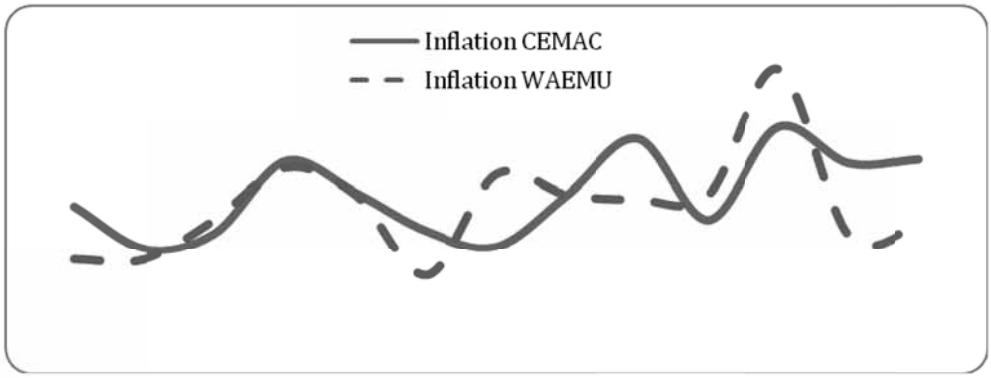

Figure 1. Inflation in the CEMAC et UEMOA groupings

Sources: IMF (2011), Report on the common policies of the CEMAC member countries, Washington, D.C., 71p.
BCEAO (2011), Annual Report 2010.

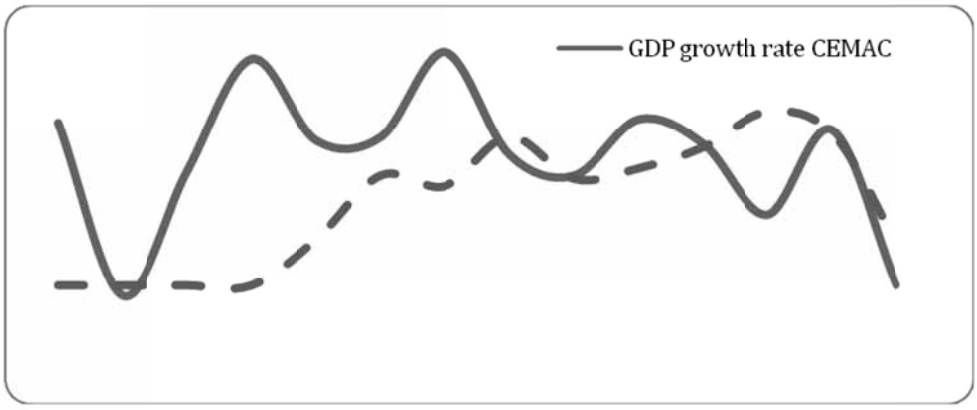

Figure 2. Growth rate in the CEMAC and WAEMU groupings

Source: Ibidem

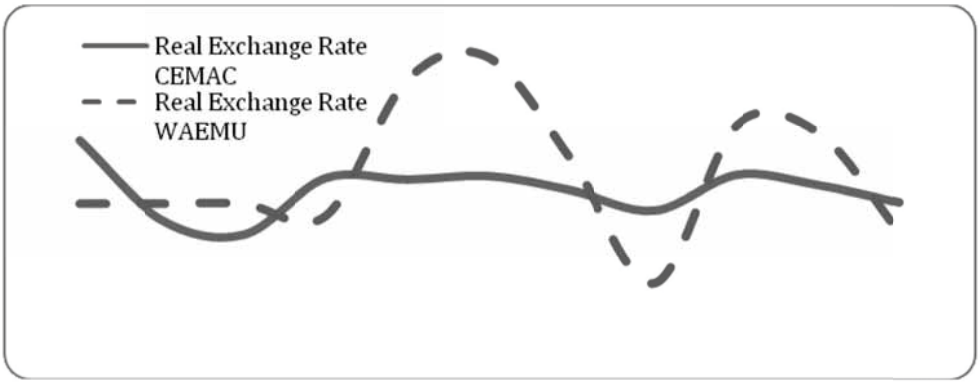

Figure 3. Real exchange in CEMAC and WAEMU groupings

Source: Ibid

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