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PROFITABILITY IN THE BANKING SECTOR AND DIFFERENCE IN EXCHANGE RATE REGIMES: THE CASES OF SELECTED SUB-SAHARAN AFRICAN COUNTRIES

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Abstract: This paper investigated whether profitability in banking sectors is sensitive to differences in exchange rate regimes in selected Sub-Saharan African countries: Cameroon, Cote d'Ivoire, Gabon, Ghana, Kenya, Mauritius, Nigeria, Senegal, and South Africa. It compares the behaviors of specific production, structure, and efficiency variables along with macroeconomic variables as determinants of banks' ROAs, ROEs, and interest spreads in both fixed and flexible exchange rate regimes The model estimated using aggregated national banking data in panel regressions provided better results with the interest spread as the dependent variable. Globally, banks' foreign liabilities, assets, and liabilities are weakly sensitive to differences in exchange rate regimes. Specifically, the bank management quality variable is found to be significant for Ghana and South Africa while the exchange rate is significant for Cameroon, Gabon, and Mauritius. This leads to mixed results as the exchange rate is not significant for Cote d'Ivoire, Senegal which are fixed exchange rate countries. Bank assets are revealed significant determinants of their profitability for Ghana. Bank liabilities are found significant determinants for Cameroon Gabon, Mauritius, Nigeria, and South Africa.

INTRODUCTION

Economic literature has identified several determinants of bank profitability, of which country specific factors [Lolos & Papapetrou (1998)] such as monetary policy [Bagliano & al (2000)], fiscal policy [Poghosyan & al (2009)], regulatory framework [Spong (1994)], and political and legal settings [Beck and Levine (2004); Chinn and Ito (2005); etc.] While accounting for the influence of national macroeconomic environments in the analysis is popular, the impact a country's exchange rate arrangement exerts on bank profitability is yet to be investigated. This paper compares the profitability in the banking sectors in nine Sub-Saharan African countries with different exchange rate regimes. Cameroon, Cote d'Ivoire, Gabon, and Senegal have fixed exchange rate regimes while Ghana, Kenya, Mauritius, Nigeria, and South Africa have flexible exchange rates. The theoretical model links the profitability in a banking sector to its production, structure, and efficiency variables and macroeconomic variables. The variable exchange rate is used to control for the impact exchange rate regimes exerted on banks profitability. The model is estimated using aggregated national banking data and panel regressions.

Globally, the results of the regressions with interest spread as the dependent variable provided better results than those with the Return on Assets (ROA) and the Return on Equity (ROE). Exchange rate is revealed to be a statistically significant determinant of interest rate spread in Cameroon, Gabon, and Mauritius suggesting a mixed result as to the importance of exchange rate regimes in explaining profitability in banking sectors. The fact that the exchange rate is statistically significant in only two of the fixed exchange rate countries suggests that profitability may be more sensitive to other factors such as trade and debt flows than to exchange rate regime. Management quality is revealed as a statistically significant determinant of the profitability in Ghana and South Africa but not in any of the fixed exchange rate countries. The other explanatory variables: domestic assets, domestic liabilities, and foreign liabilities are generally weak determinants of the profitability in the nine banking sectors.

The rest of the paper is organized in four sections. Section II reviews the literature. Section III sets the methodological background and develops the theoretical model. Section IV presents the empirical analysis and Section V the conclusion.

LITERATURE REVIEW

Previous studies have identified factors such as management [Bryan (1971); Revell (1972); etc.] industry specific characteristics [Bryan (1971); Short (1977); etc..], market structure [Honohan & Kinsella (1982); Kwast & Rose (1982), etc.], regulations [Short (1979); Hancock (1985); etc.], ownership type [Bourke (1988); Molyneux & Thornton (1992); etc.], regional environment [Kwast & Rose (1982)], technological change and innovation [Hannan & McDowell (1984); Aoki (1994); etc.], and economies of scale [Mullineaux (1978); Murray & White (1983); etc.] as determinants of commercial banks profitability. The accounting for the influence of macroeconomic environments in the analysis of banks profitability also started earlier [Kwast & Rose (1982), Bourke (1988); Liang (1989); Molyneux & Thornton (1992); etc.] But, it was sustained with studies of the influences the changes in national economic environments, due to the unification of European economies, could have exerted on the behaviors and profitability of banks [Bagliano & al (2000); Dietsch & Lozano-Vivas (2000); De Bandt & Davis (2000); etc.] For example, Hondroyiannis & al (1998) investigated the impact changes in the macroeconomic environment may have on the competition level in the Greek banking industry. They found that the new measures adopted from 1993 to facilitate the adhesion of Greece to the European Monetary System (EMS) had positively affected the competition level of the banking sector and improved firms' performances. Bagliano & al (2000) investigated the potential impact of the implementation of the European Monetary Union (EMU) on collusion among banks. Using a model of oligopolistic competition they analyzed the possible effects the European Central Bank (ECB) policy criteria may exert on the cost of credit in national markets. They suggested that the increasing integration of national economic environments will modify the market structure of credit markets in member countries but also the shift from national central banks to the ECB may have specific effects on banks' behavior. Dietsch & Lozano-Vivas (2000) compared French and Spanish banking industries in order to set how differences in national economic environments affect bank performances. They selected macroeconomic variables as well as variables explaining the peculiar features of each country's banking industry such as regulatory conditions, banking structure and accessibility of banking services to identify the common frontier. Their findings suggest that countries with a higher per capita income have a banking system that operates in a mature environment resulting in more competitive interest rates and profit margins. Also, banks operating in markets with a lower density of demand incur higher expenses because this demand factor may impose a ceiling on the reachable efficiency level of their branches. Athanasoglou & al. (2006) study the profitability behavior of the Southeastern European banking industry over the period 1998–02 and concluded that the enhancement of bank profitability in those countries requires new standards in risk management and operating efficiency, which, according to the evidence presented in their paper, crucially affect profits. A key result is that the effect of market concentration is positive, while the picture regarding macroeconomic variables is mixed.

The impact of the macroeconomic environment is also routinely tested in the analysis of banks profitability in Africa. Using accounting decompositions, as well as panel regressions, Al-Haschimi (2007) studied the determinants of bank net interest rate margins in 10 Sub-Saharan African countries and found that credit risk and operating inefficiencies, a signal of market power, explain most of the variation in net interest margins across the region. In addition, macroeconomic and regulatory conditions have a pronounced impact on margins and profitability. In another study of the determinants of commercial banks profitability in Sub Saharan Africa, Flamini & al (2009) found that bank specific and macroeconomic risk factors are the most important explanations for banks' high returns though not conclusive as to whether market power influences bank returns.

Earlier authors used various proxies to capture the influence of the macroeconomic environment on banks profitability but with time the research interest is being geared towards assessing the impact a specific macroeconomic variable may exert on it. David Hauner (2006) investigated the impact the use of bank credit to finance public debt as a substitute for external financing can have on the profitability and efficiency of banks and in the long run on the quality of financial development. Using a panel data, he tested this relationship for banks in 73 middle income countries and found that the financing of public debt with bank credit harm bank profitability and efficiency. Poghosyan & al (2009) attempted to measure the impact oil shock have on MENA countries bank profitability directly and indirectly via macroeconomic and country specific variables. Applying GMM panel data technique to 145 banks, they found that oil shocks have an indirect impact on banks profitability. More recently, de Blas & Russ (2010) measured the impact of Foreign Direct Investments (FDI) on bank interest gain. Using heterogeneous, imperfectly competitive lenders, they found that that FDI can cause markups to increase at the same time efficiency gains and local competition keep the interest rates that banks charge borrowers from rising.

Though the literature had not systematically analyzed the impact exchange rate or an exchange rate regime may exert on bank profitability, findings by Hondroyiannis & al (1998) suggest that the gradual removal of exchange control has benefited the competition in the Greek banking industry. Aizenman & Hausmann (2000) explored the links between exchange rate regimes and financial market imperfections and found that when the welfare gain due to lower interest rate associated with lower flexibility of the exchange rate is reduced, a fixed exchange rate regime is desirable. Inversely, when the real interest rate gain due to exchange rate stability is reduced because of a greater integration to the global capital market, an optimal flexible exchange rate is desirable. Analyzing the ongoing reforms of the international financial system at the aftermath of the 1998 East Asian crisis, Citrin and Fisher (2000) discussed the importance of exchange rate regimes as a source of volatility in the financial system. They show that both short term volatility and medium-term swings in exchange rates among the three central currencies had caused capital inflows in emerging countries to be too large and interest rate spread to be too narrow to depress their financial markets. This, according to them, raises concerns over the right choice of exchange rate regime, a matter of controversy for well over a century.

It is clear from the review that assessment of the impact exchange rate regimes may exert on profitability in the banking sector can only contribute effectively to the literature.

METHODOLOGY

The Model

It is assumed a developing economy which banking sector holds domestic and foreign liabilities, supplies only domestic assets, and conducts all of its interest related operations in domestic currency. In the reality, the foreign demand for bank assets is very marginal while the foreign demand for bank liabilities is significant. Thus, profitability in the banking sector depends on foreign liabilities which, in turn is determined by the level of foreign savings, foreign deposits rate and the exchange rate of the domestic currency into the foreign currency. On that basis, the ability of the banking sector to intermediate and ultimately maximize its profit depends on the movements in the exchange rate, ceteris paribus. That impact will be null in case the exchange rate between the two currencies is fixed.

Further, it is assumed that the banking sector is competitive in both assets and liabilities markets and its profit function which is similar to that of the typical banking firm can be written as:

$$\Pi = rA - iL \quad (1)$$

Π is the profit, *A* is the total assets, *L* is the total liabilities, *r* is the domestic rate of interest on assets (credit rate), and *i* is the domestic rate of interest on liabilities (deposits rate). Due to regulations, banks hold part of their liabilities as required reserves and their total assets is determined as:

$$A = (1-\beta)L \quad (2)$$

ß is the required reserve ratio. Total liabilities are the sum of domestic and foreign liabilities and can be written as:

$$L = L_d + L_f \ (3)$$

L_d is the foreign demand for domestic bank liabilities and L_f is the domestic demand for domestic bank liabilities. The rate of interest on domestic banks assets is determined by the total demand for their assets, the domestic and foreign demands for domestic banks liabilities and the national production (Y).

$$r_d = r_d(\overset{-}{A}, \overset{-}{L_d}, \overset{-}{L_f}, \overset{+}{Y}) \ (4)$$

The rate of interest on banks liabilities depends on the total demand for banks assets, the domestic and foreign demands for domestic banks liabilities, and the exchange rate of the domestic currency in the foreign currency (*e*).

$$i_d = i_d(\overset{+}{A}, \overset{-}{L_d}, \overset{-}{L_f}, \overset{+}{e}) \ (5)$$

The domestic demand for domestic banks liabilities is determined by the domestic rate of interest on liabilities and the domestic savings (S_d).

$$L_d = L_d(\overset{-}{i_d}, \overset{+}{s_d}) \ (6)$$

The foreign demand for domestic banks liabilities is determined by the domestic rate of interest on liabilities and the exchange rate.

$$L_f = L_f(\overset{-}{i_d}, \overset{-}{e}) \ (7)$$

Banks maximize their profit by maximizing Equation (1) constrained by Equations (2) through (7) using the Lagragean function as:

$$\mathcal{L} = [r_d A - i_d L] + \lambda_1[A - (1-\beta)L] + \lambda_2[(L_d - L_d(i_d, s_d) + \lambda_3[L_f - L_f(i_d, e)]$$
$$+ \lambda_4[r_d - r_d(A, L_d, L_f, Y_d)] + \lambda_5[i_d - i_d(A, L_d, L_f, e)] (8)$$

Resolving the Lagragean function leads to the domestic banks interest spread and profit rate as:

$$\frac{r_d}{i_d} = \frac{[(1-\beta)(1+E_{e/L_f})]^2[e - A - L_d - L_f]}{(1-\beta)(1+E_{r_d/A}]^2[Y - A - L_d - L_f]} (9)$$

and

$$\Pi = \frac{[(1-\beta)E_{i_d/L}E_{L/A} + a]^2[e - A - L_d - L_f]L - [(1-\beta)(1+E_{r_d/A})]^2[Y - A - L_d - L_f]A}{[(1-\beta)(1+E_{r_d/A})][(1-\beta)E_{i_d/L}E_{L/A} + a]]} (10)$$

$E_{i/L}$ is the inverse elasticity of bank liabilities with respect to the rate of interest on liabilities, $E_{r/A}$ is the inverse elasticity of bank assets with respect to the rate of interest on assets, $E_{L/A}$ is the elasticity of bank liabilities with respect to their assets, and (*a*) is the transformation ratio. Equations (9) and (10) indicate that domestic banks' interest spread and profits are determined by the size of their assets, their intermediation ratio, the elasticity of their liabilities with respect to the rate of interest on liabilities, the elasticity of their assets with respect to the rate of interest on assets, the elasticity of their assets with respect to their liabilities, the domestic demand for their liabilities, the foreign demand for their liabilities, the exchange rate, and the level of the national production. Thus:

$$\frac{r_d}{i_d}=\frac{r_d}{i_d}[\overset{+}{A},\overset{+}{a},\overset{+/-}{e},\overset{-}{L_d},\overset{-}{L_f},\overset{+}{E}_{A/r_d},\overset{-}{E}_{L/i_d},\overset{+}{E}_{L/A},\overset{+}{Y}] \quad (11)$$

and

$$\Pi=\Pi[\overset{+}{A},\overset{+}{a},\overset{+/-}{e},\overset{-}{L_d},\overset{-}{L_f},\overset{+}{E}_{A/r_d},\overset{-}{E}_{L/i_d},\overset{+}{E}_{L/A},\overset{+}{Y}] \quad (12)$$

The impact of the exchange rate will be positive in the case of a depreciation of the domestic currency leading to an increase in the foreign demand for domestic banks assets. The impact will be reversed in the case of an appreciation of the exchange rate. Assuming a linear relationship between the interest rate spread and the profit rate and their respective determinants, the actual relationships are:

$$\frac{r_d}{i_d}=\alpha_0+\alpha_1\overset{+}{A}+\alpha_2\overset{+}{a}+\alpha_3\overset{+/-}{e}+\alpha_4\overset{-}{L}_d+\alpha_5\overset{-}{L}_f+\alpha_6\overset{+}{E}_{A/r_d}+\alpha_7\overset{-}{E}_{L/i_d}+\alpha_8\overset{+}{E}_{L/A}+\alpha_5\overset{+}{Y} \quad (13)$$

and

$$\Pi=\beta_0+\beta_1\overset{+}{A}+\beta_2\overset{+}{a}+\beta_3\overset{+/-}{e}+\beta_4\overset{-}{L}_d+\beta_5\overset{-}{L}_f+\beta_6\overset{+}{E}_{A/r_d}+\beta_7\overset{-}{E}_{L/i_d}+\beta_8\overset{+}{E}_{L/A}+\beta_9\overset{+}{Y} \quad (14)$$

In order to capture the impact each banking sector's specific features exert on banks profitability, we extended the model by adding three additional variables to control for concentration, efficiency and management quality (Table 1). The expected signs of their coefficients are set respectively on the basis of the following underlying assumptions. (i) Firms in a concentrated market gain extra profit as they set prices above the equilibrium level. Thus a positive relationship is assumed between concentration level and profitability. (ii) Cost efficient firms tend to be more profitable. (iii) Firms that exhibit good management quality reduce their cost and consequently increase their profits.

The extended model was estimated using data obtained from various sources. Financial data are extracted from the World Bank's (i) Financial Structure database and (ii) African Development and Financial Indicators. Country data on lending rate, deposit rate, foreign liabilities, and exchange rate are those published in the IMF International Financial Statistics (Table 2.) Country data on debt currency composition and destinations of trade are obtained from the IMF Direction of Trade. The data on (i) debt currency composition and (ii) destination of trade were used to determine the foreign currency in which each country had exchanged the most with the rest of the world during the period 1995-2008. The underlying assumption is that banks' profitability will be most sensitive to fluctuations in that specific foreign currency than others. Based on that, their profitability can also be explained by fluctuations in the exchange rate of the domestic currency into that specific foreign currency.

In order to determine the foreign currency to which each banking industry was most sensitive, we computed the weighted average of the shares of the country debt and trade relative to their currencies of denomination. Table 3 presents the estimated values and specifies exchange rate arrangements. As suggested by the values, it is logical to assume that the profitability in the banking sectors of Cameroon, Cote d'Ivoire, Gabon, and Senegal have been most sensitive to fluctuations in the Euro currency as their common currency; the CFA franc is pegged to the Euro.

As a consequence and also because of enduring post colonial ties, they have traded essentially with countries in the Euro zone and particularly with France. Referring to our theoretical framework, the impact of the exchange rate on banks profitability in such cases should be null. For, we considered testing the significance of both dollar and Euro currencies as determinants of the profitability in the banking sector in all the targeted countries.

Finally, depending on their specific nature, the exogenous variables can be set in four categories: (i) production variables (EARAT, ELRATE, ELIAS, INTMED), (ii) structure variables (ASSETS, LIAB, FORLIAB), (iii) performance variables (STRUC EFFIC, MGT), and macroeconomic variables (EXCHGE ($), EXCHGE (€), NATPRO.) EXCHGE ($) an EXCHGE (€) are respectively the dollar based and Euro based exchange rate variables.

EMPIRICAL RESULTS

In order to capture each country's specific features and avoid losing degrees of freedom, given the short nature of the data, we used panel regressions. Initially, the tests for stationarity in the series using the (i) Levin, Lin & Chu (LLC) and (ii) Im, Pesaran & Shin (IPS) tests including individual effects suggest a rejection of the null hypothesis of a common unit root in the series EARAT, ELRATE, ELIAS, EXCHGE ($), EXCHGE (€), STRUC, and ROE. Inversely, they suggest an acceptance of the null hypothesis for the series FORLIAB, EFFIC, LIAB, MGT, NATPRO, and ROA (Annex 1). Specifically, the LLC tests suggest a rejection of the null hypothesis for the series INTMED, ASSETS, and SPREAD. We then performed cointegration testsof the series using the Johansen test substituting successively the dependent variables ROA, ROE, and SPREAD in the set of variables. Both Trace and Maximum Eigen Value tests suggest the existence of at least 5 cointegrating equations leading to a rejection of the null hypothesis of no cointegration among the series (Annex 2.)

Table 1. Definition of variables

Symbol	Definition	Expected sign
Π	Profit	
r_d/i_d	Spread	
A	Total assets	+
L_d	Domestic liabilities	-
A	Intermediation ratio	+
L_f	Foreign demand for domestic banks liabilities	-
$E_{l/id}$	Elasticity of the demand for domestic banks liabilities with respect to the rate of interest on liabilities	-
$E_{A/rd}$	Elasticity of the domestic demand for banks assets with respect to the rate of interest on assets	+
$E_{A/L}$	Elasticity of the demand for banks assets with respect to the demand for banks liabilities	+
E	Exchange rate	+/-
Y	National production	+
Extended	Concentration ratio	+
Extended	Financial efficiency	+
Extended	Management quality	+

Table 2. Measures of the variables

Name	Measure	Source
ROA	Net income/Total assets	1
ROE	Net income/Total equity	1
SPREAD	Interest rate spread	1
ASSETS	Deposit money bank assets/GDP	1
LIAB	Bank deposits/GDP	1
INTMED	Bank credit/Bank deposits	1
FORLIAB	Bank foreign liabilities (current LCU)	3
ELRATE	Computed elasticity of domestic banks liabilities with respect to the rate of interest on liabilities	2; 4
EARATE	Computed elasticity of domestic banks assets with respect to the rate of interest on assets	2; 4
ELIASS	Computed elasticity of banks assets with respect to banks liabilities	1; 4
EXCHGE ($)	Change in real exchange rate (LCU per US$, period average)	3; 4
EXCHGE (€)	Change in Real exchange rate (LCU per FF/EURO, period average)	2; 4
NATPRO	Per capita GDP	2
STRUC	Assets of three largest banks/Total assets of all banks.	1
EFFIC	Bank overhead/Total assets	1
MGT	Liquid liabilities/GDP	1

(1) World Bank Financial Structure database; (2) World Bank African Development Indicators; (3) IMF International Financial Statistics; (4) Author’s calculations.

Table 3. Countries foreign trade and debt currencies composition

	Averaged weight			Currency Sensitivity			ERA[3]	
Country	Euro	USD[1]	Rest[2]	Euro	USD	Rest	Fixed	Flexible
Cameroon	75.2	15.1	9.7	Most	-	-	Yes	No
Cote d'Ivoire	55.5	33.0	11.5	Most	-	-	Yes	No
Gabon	48.4	41.2	10.4	Most	-	-	Yes	No
Ghana	34.6	40.8	24.6	-	Most	-	No	Yes
Kenya	31.2	31.5	37.3	Equally	Equally	-	No	Yes
Mauritius	47.7	21.3	31	Most	-	-	No	Yes
Nigeria	32.6	51.7	15.7	-	Most	-	No	Yes
Senegal	52.8	25.7	21.5	Most	-	-	Yes	No
South Africa	40.8	34.1	25.1	Most	-	-	No	Yes

(1) USD: US Dollar; (2) Rest: Others, Pound Sterling, Swiss Franc, Yen; (3) ERA: Exchange Rate Arrangement / Source: IMF Direction of Trade and author’s calculation.

We ran the regressions of the independent variables by category with each dependent variable (Tables 4a-4b) and selected the statistically significant variables from each group. Then we ran new regressions of the selected variables with the initially specified dependent variable. The Hausman specification tests applied to the new estimation outputs suggest a rejection of the null hypothesis of no correlation among the regressors and the random effect for the regression with the ROA, i.e., the suitability of the random effect specification panel model. Inversely, it suggests an acceptation of the null hypothesis for the regression with the ROE and the SPREAD, i.e., the suitability of the fixed panel model specification (Annex 3.) The results of the estimations based on these specifications are compiled in Tables 5.

Globally, regressions with the dependent variable SPREAD generated better results than both the ROA and the ROE, suggesting a better fit of the data to the theoretical model. The superiority of interest spread as dependent variable may be an indication that, in most of the targeted countries, bank activities are essentially interest-related. Non-interest related activities are marginal or nonexistent. The coefficient of the variables ASSETS, LIAB, and MGT are statistically significant with the dependent variable SPREAD. Also, the coefficients of the variables ELRATE, EFFIC, and MGT are statistically significant with the dependent variable ROA. Though the coefficient of the variable EXCHGE ($) is statistically non-significant, it is more significant with ROE and SPREAD and comparatively more significant than that of EXCHGE (€). The comparatively very weak statistical significance of the variable EXCHGE (€) shows that banks profitability is more sensitive to changes in the value of the dollar regardless of a country's trade and debt currency compositions or exchange rate regime.

To capture country specific effects, we reran the regressions with the ROE and SPREAD holding successively the coefficients of (i) the dollar-based exchange rate variable and then (ii) each of the revealed statistically significant variables as a cross section (Annex 4.)

The variable EXCHGE ($) is more statistically significant with the dependent variable SPREAD than the ROE. Its coefficient is statistically significant and bears the positive sign with SPREAD for Cameroon, Gabon, and Mauritius. Surprisingly, the coefficient of EXCHGE ($) is statistically significant for Cameroon and Gabon and not Cote d'Ivoire and Senegal, all fixed exchange rate regime countries. Such a result may be in part due to capital controls in the WAEMU while supports for the benefits of capital liberalization abound in the literature. For example, Hondroyiannis, et al. (1998) found that the gradual removal of exchange control has benefited the competition in the Greek banking industry. Thus, our results relative to the sensitivity of profitability in the banking sector to exchange rate regimes are mixed.

It is only for Cote d'Ivoire that the coefficient of FORLIAB is statistically significant and bears the expected sign when estimated with the ROE. This finding reflects the fact that Cote d'Ivoire is the financial center of the eight-member countries economic and monetary union (WAEMU). In addition to hosting the regional stocks market, the country had benefited from significant FDI inflows evidenced by the 4359% increase in the size of the foreign liabilities held by its banking sector from 1995 to 2006. The impact of foreign liabilities is weak in the rest of the countries and no evidence is offered as to whether it is sensitive to differences in exchange rate regimes.

The variable MGT performed better with the dependent variable SPREAD than ROE. Its coefficient is statistically significant and carries the expected sign for Ghana and South Africa, both flexible exchange rate regime countries. Bank management in these two countries had generated important exchange rate gains and fuelled the national economies with significant liquid liabilities. The weak significance of the coefficient of MGT for the fixed exchange rate countries is no strong evidence relative to banks interest spread sensitivity to differences in exchange rate regimes.

Though, the coefficient of ASSETS bears the expected sign for Gabon, Ghana, Kenya, and South Africa, it is only statistically significant for Ghana. This result suggests that interest spreads in the country's banking sector are highly sensitive to changes in banks assets sizes evidenced by a period (1995-2008) average price elasticity of assets of 0.71 compared to 0.28 for the other eight countries combined. The impact of banks assets on their profitability is weak in the rest of the countries and no evidence is offered as to whether it is sensitive to differences in exchange rate regimes.

The coefficient of LIAB carries the expected sign for all the countries except Ghana but is only is statistically significant for Cameroon Gabon, Mauritius, Nigeria, and South Africa. This is an indication that interest spreads in these countries banking sectors are rather more sensitive to changes in the sizes of banks liabilities. Peculiarly, neither banks assets nor their liabilities are found to be significant determinants of interest spread in the banking sectors of Cote d'Ivoire and Senegal. This may be due to the facts that over the period, nominal deposit rates have been officially set within the CFA zone countries but adjusted six times in the CEMAC and never in the WAEMU. The impact of banks liabilities on banks profitability is weak in the rest of the countries and no evidence is offered relative to its sensitivity to exchange rate regimes. Thus, given an exchange rate regime, it is the choice of monetary policy instruments and their effectiveness that impact the profitability of banks. Our conclusion provides a support to the view that strong policies and institutions are needed for economic stability no matter the exchange rate system [Citrin & Fisher (2000).]

CONCLUSION

This paper investigated the impact differences in exchange rate regime exerted on profitability in nine sub-Saharan countries banking sectors. It linked banking sector's production, structure, and efficiency variables along with macroeconomic variables to their ROA, ROE, and interest spread. The variable is used to control for difference in exchange rate regimes. Generally, the results differed with the ROA, the ROE, and interest spread as dependent variable. Consistently, interest spread as a measure of profitability provided the best results suggesting that banks profitability in these countries is mainly interest related. On one hand, Banks assets, liabilities, and management quality are statistically significant determinants of their spread. On the other hand, the elasticity of the demand for banks assets with respect to their rate of interest, efficiency, and management quality are statistically significant determinants of their ROA while none of the variable is revealed statistically significant with the ROE.

Cross-country comparisons of the coefficients of the exogenous variables indicate that foreign liabilities are only statistically significant in explaining banks profitability in the case of Cote d'Ivoire. Similarly, bank assets are only statistically significant in explaining banks profitability in Ghana while their liabilities are statistically significant in explaining bank profitability in Cameroon, Nigeria, Mauritius, Gabon, and South Africa. Neither banks assets nor their liabilities are statistically significant determinants of their profitability in Cote d'Ivoire and Senegal. The exchange of domestic currencies in the dollar is statistically significant for Cameroon, Gabon, and Mauritius leading to a mixed result relatively to the importance of the exchange rate regime in explaining bank profitability. Finally, neither exchange rate nor the exchange rate regime influences banks profitability significantly.

Table 4a. Estimation results of independent variables tested by specified groups

	ROA	ROE	SPR	ROA	ROE	SPR	ROA	ROE	SPR
Constant	0.02	0.16	11.31	0.02	0.2	13.72	0.03	0.27	13.89
	(1.7)	*(1.9)*	*(5.9)*	*(2.8)*	*(5.6)*	*(12.2)*	*(2.2)*	*(2.8)*	*(6.2)*
EARATE	0.00	0.01	0.04						
	(-0.4)	(0.6)	(0.1)						
ELRATE	*0.00*	*0.00*	*0.02*						
	(-1.5)	(0.3)	(0.5)						
ELIAS	0.00	0.00	0.00						
	(0.5)	*(-0.0)*	*(-0.1)*						
INTMED	0.00	0.00	-0.14						
	(-0.1)	*(-0.0)*	*(-0.1)*						
ASSETS				-0.02	0.00	13.34			
				(-0.4)	*(0.0)*	*(2.0)*			
LIAB				0.00	-0.2	-24.43			
				(0.0)	*(-0.5)*	*(-2.9)*			
FORLIAB				0.00	0.00	0.00			
				(1.8)	*(1.4)*	*(-0.1)*			
STRUC							0.02	0.01	-2.65
							(1.6)	*(0.1)*	*(-1.3)*
EFFIC							-0.36	-0.92	21.43
							(-3.7)	*(-1.1)*	*(1.3)*
MGT							-0.03	-0.2	-5.74
							(-1.6)	*(-2.1)*	*(-1.9)*
			Cross-section random						
S.D.	0.01	0.06	2.36	0.01	0.05	2.16	0.01	0.04	1.98
Rho	0.22	0.12	0.44	0.41	0,1	0.43	0.41	0.05	0.37
			Idiosyncratic random						
S.D.	0.02	0.16	2.65	0.02	0.16	2.51	0.02	0.15	2.58
Rho	0.78	0.88	0.56	0.59	0.9	0.57	0.59	0.95	0.63
			Weighted Statistics						
R-squared	0.02	0	0	0.03	0.03	0.1	0.12	0.03	0.06
Adjusted R-squared	-0.01	-0.03	-0.03	0	0.01	0.08	0.09	0.01	0.04
F-statistic	0.65	0.1	0.07	1.13	1.34	4.38	5.26	1.41	2.51
Prob(F-statistic)	0.63	0.98	0.99	0.34	0.27	0.01	0	0.24	0.06
Durbin-Watson stat	0.93	1.75	0.83	1.06	1.8	0.92	1.15	1.76	0.82
			Unweighted Statistics						
R-squared	0	0	0.01	0.01	0.04	0.2	-0.09	0.03	0.17
Durbin-Watson stat	0.68	1.61	0.49	0.74	1.67	0.61	0.66	1.65	0.55

Numbers in parentheses are t-statistics values.

Table 4b. Estimation results of independent variables tested by specified groups

	ROA	ROE	SPR	ROA	ROE	SPR
Constant	0.02	0.16	10.58	0.02	0.16	10.51
	(4.2)	*(6.6)*	*(10.5)*	*(3.5)*	*(5.3)*	*(10.0)*
EXCHGE ($)	0.00	0.00	0.02			
	(0.9)	*(2.2)*	*(2.4)*			
EXCHGE (€)				0.00	0.00	0.00
				(0.4)	*(-0.1)*	*(1.0)*
NATPRO	0.00	0.00	0.00	0.00	0.00	0.00
	(0.4)	*(0.0)*	*(1.1)*	*(0.4)*	*(0.1)*	*(1.0)*
		Cross-section random				
S.D	0.01	0.04	2.38	0.01	0.06	2.5
Rho	0.17	0.07	0.47	0.23	0.13	0.48
		Idiosyncratic random				
S.D	0.02	0.15	2.54	0.02	0.16	2.59
Rho	0.83	0.93	0.53	0.77	0.87	0.52
		Weighted Statistics				
R-squared	0.01	0.04	0.06	0	0	0.02
Adjusted R-squared	-0.01	0.02	0.04	-0.01	-0.02	0
F-statistic	0.48	2.33	3.6	0.18	0.01	1.15
Prob(F-statistic)	0.62	0.1	0.03	0.84	0.99	0.32
Durbin-Watson stat	1.04	1.77	0.86	1.05	1.75	0.86
		Unweighted Statistics				
R-squared	0.04	0.04	0.10	-0.01	0.00	0.07
Durbin-Watson stat	0.80	1.64	0.51	0.77	1.58	0.52

Numbers in parentheses are t-statistics values.

Table 5. Estimation results of core determining variables

	ROA[1]	ROE[2]	SPREAD[2]
Constant	0.04	0.25	12.66
	(2.4)	*(2.5)*	*(7.7)*
ELRATE	(-0.00)		
	(-2.1)		
ASSETS			(15.58)
			(2.0)
LIAB			-53.24
			(-4.0)
FORLIAB	0.00	0.00	
	(1.6)	*(1.6)*	
STRUC	0.02		
	(1.5)		
EFFIC	-0.38		
	(-3.9)		
MGT	-0.04	-0.32	25.48
	(-2.0)	*(-1.0)*	*(3.3)*
EXCHGE ($)		0.00	0.01
		(1.8)	*(1.8)*
Cross-section random			
S.D.	0.02		
Rho	0.55		
Idiosyncratic random			
S.D.	0.02		
Rho	0.45		
Weighted Statistics			
R-squared	0.18	0.18	0.56
Adjusted R-squared	0.14	0.10	0.51
F-statistic	5.09	2.27	11.70
Prob(F-statistic)	0.00	0.02	0.00
Durbin-Watson stat	1.19	1.96	1.12
R-squared	-0.10		
Unweighted Statistics			
Log likelihood		62.51	-276.83
Akaike info criterion		-0.82	4.67
Schwarz criterion		-0.55	4.97
Hannan-Quinn criter		-0.71	4.79

Numbers in parentheses are t-statistics values. (1) Estimated using a random effect model specification. (2) Estimated using a fixed effect model specification

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Annexure I

Table X. Debt currency composition (average percentage 1995-2007)

	Others[1]	Euro	Yen[2]	MC[3]	PS[4]	SF[5]	USD[6]	Total
Cameroon	3.3	67.9	0.6	5.0	1.7	0.9	20.5	100
Cote d'Ivoire	2.1	41.8	1.3	9.0	0.6	0.2	45.0	100
Gabon	4.7	56.5	0.8	6.9	5.9	0.6	24.7	100
Ghana	4.1	5.4	10.4	5.6	2.4	0.2	71.9	100
Kenya	3.9	12.8	20.7	7.5	2.4	1.6	51.0	100
Mauritius	7.0	38.1	4.5	7.8	1.7	0.3	42.8	102
Nigeria	4.1	22.8	10.1	9.4	1.0	0.8	51.9	100
Senegal	12.0	16.4	3.3	10.3	11.0	0.2	48.4	102
South Africa	0.9	9.0	2.9	0.0	0.1	0.0	87.2	100

(1) All other currencies. (2) Japanese yen. (3) Multiple currencies. (4) Pound Sterling. (5) Swiss Franc. (6) US Dollars. Source World Bank PPG debt currency composition

Table Y. Trade by partner (percentage average 1995-2007)

Country	Euro Area	Japan	Switzerland	UK	USA	Total
Cameroon	84.9	2.4	0.4	4.6	7.8	100
Cote d'Ivoire	80.0	2.2	1.0	5.1	11.7	100
Gabon	42.7	2.7	0.2	1.7	52.7	100
Ghana	58.9	5.4	1.4	19.3	15.0	100
Kenya	45.4	11.3	2.3	24.5	16.5	100
Mauritius	51.1	4.8	2.6	28.0	13.5	100
Nigeria	38.1	3.4	1.3	5.5	51.6	100
Senegal	84.7	4.1	1.4	4.0	5.8	100
South Africa	50.3	14.8	3.0	13.7	18.2	100

Table Z. Selected countries exchange rare arrangements

Fixed exchange rate regime	Flexible exchange rate regime
Cameroon	Ghana
Cote d'Ivoire	Kenya
Gabon	Mauritius
Senegal	South Africa

Annexure II

Trend assumption: Linear deterministic trend
Series: EARATE ELRATE ELIAS FORLIAB INTMED EXCHGE ASSETS LIAB MGT STRUC EFFIC NATPRO ROA

Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.937679	948.9198	334.9837	0.0000
At most 1 *	0.890201	735.2095	285.1425	0.0000
At most 2 *	0.843912	565.1087	239.2354	0.0000
At most 3 *	0.824431	422.0937	197.3709	0.0000
At most 4 *	0.698230	288.1349	159.5297	0.0000
At most 5 *	0.631336	195.8820	125.6154	0.0000
At most 6 *	0.449176	119.0459	95.75366	0.0005
At most 7 *	0.328103	73.12780	69.81889	0.0266
At most 8	0.278409	42.50877	47.85613	0.1450
At most 9	0.162666	17.38393	29.79707	0.6116
At most 10	0.045652	3.713974	15.49471	0.9252
At most 11	0.001506	0.116021	3.841466	0.7334

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**

None *	0.937679	213.7103	76.57843	0.0000
At most 1 *	0.890201	170.1008	70.53513	0.0000
At most 2 *	0.843912	143.0150	64.50472	0.0000
At most 3 *	0.824431	133.9588	58.43354	0.0000
At most 4 *	0.698230	92.25289	52.36261	0.0000
At most 5 *	0.631336	76.83604	46.23142	0.0000
At most 6 *	0.449176	45.91812	40.07757	0.0099
At most 7	0.328103	30.61904	33.87687	0.1166
At most 8	0.278409	25.12484	27.58434	0.1000
At most 9	0.162666	13.66996	21.13162	0.3927
At most 10	0.045652	3.597953	14.26460	0.8992
At most 11	0.001506	0.116021	3.841466	0.7334

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Trend assumption: Linear deterministic trend
Series: EARATE ELRATE ELIAS FORLIAB INTMED EXCHGE ASSETS LIAB MGT STRUC EFFIC NATPRO ROE
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.973742	940.1632	334.9837	0.0000
At most 1 *	0.930534	659.8994	285.1425	0.0000
At most 2 *	0.780952	454.5467	239.2354	0.0000
At most 3 *	0.770443	337.6250	197.3709	0.0000
At most 4 *	0.698697	224.3115	159.5297	0.0000
At most 5 *	0.504583	131.9393	125.6154	0.0194
At most 6	0.328919	77.85795	95.75366	0.4389
At most 7	0.259571	47.14534	69.81889	0.7554
At most 8	0.187244	24.00484	47.85613	0.9424
At most 9	0.067009	8.040834	29.79707	0.9968
At most 10	0.030402	2.700128	15.49471	0.9788
At most 11	0.004184	0.322882	3.841466	0.5699

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.973742	280.2638	76.57843	0.0001
At most 1 *	0.930534	205.3527	70.53513	0.0000
At most 2 *	0.780952	116.9217	64.50472	0.0000

At most 3 *	0.770443	113.3135	58.43354	0.0000
At most 4 *	0.698697	92.37223	52.36261	0.0000
At most 5 *	0.504583	54.08133	46.23142	0.0060
At most 6	0.328919	30.71262	40.07757	0.3782
At most 7	0.259571	23.14050	33.87687	0.5197
At most 8	0.187244	15.96401	27.58434	0.6689
At most 9	0.067009	5.340705	21.13162	0.9927
At most 10	0.030402	2.377247	14.26460	0.9793
At most 11	0.004184	0.322882	3.841466	0.5699

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.

Trend assumption: Linear deterministic trend
Series: EARATE ELRATE ELIAS FORLIAB INTMED EXCHGE ASSETS LIAB MGT STRUC EFFIC NATPRO ROE
Lags interval (in first differences): 1 to 4
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.934985	900.8085	334.9837	0.0000
At most 1 *	0.910990	690.3573	285.1425	0.0000
At most 2 *	0.836229	504.0939	239.2354	0.0000
At most 3 *	0.758656	364.7788	197.3709	0.0000
At most 4 *	0.654675	255.3208	159.5297	0.0000
At most 5 *	0.634038	173.4491	125.6154	0.0000
At most 6 *	0.370533	96.04682	95.75366	0.0477
At most 7	0.274264	60.40488	69.81889	0.2231
At most 8	0.204353	35.72110	47.85613	0.4105
At most 9	0.112812	18.11890	29.79707	0.5573
At most 10	0.085315	8.902118	15.49471	0.3745
At most 11	0.026090	2.035620	3.841466	0.1537

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.934985	210.4512	76.57843	0.0000
At most 1 *	0.910990	186.2634	70.53513	0.0000
At most 2 *	0.836229	139.3151	64.50472	0.0000
At most 3 *	0.758656	109.4580	58.43354	0.0000
At most 4 *	0.654675	81.87170	52.36261	0.0000
At most 5 *	0.634038	77.40231	46.23142	0.0000

At most 6	0.370533	35.64194	40.07757	0.1454
At most 7	0.274264	24.68377	33.87687	0.4067
At most 8	0.204353	17.60220	27.58434	0.5285
At most 9	0.112812	9.216781	21.13162	0.8146
At most 10	0.085315	6.866498	14.26460	0.5051
At most 11	0.026090	2.035620	3.841466	0.1537

Max-eigenvalue test indicates 7 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Annexure III

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	3.960727	5	0.5551

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
ELRATE	-0.000522	-0.000483	0.000000	0.3046
FORLIAB	0.000000	0.000000	0.000000	0.7446
STRUC	0.020918	0.019391	0.000054	0.8351
EFFIC	-0.420191	-0.384342	0.000615	0.1482
MGT	-0.061071	-0.044681	0.000629	0.5133

Cross-section random effects test equation:
Dependent Variable: ROA
Method: Panel Least Squares
Date: 03/03/10 Time: 15:14
Sample: 1995 2008
Periods included: 14
Cross-sections included: 9
Total panel (unbalanced) observations: 123

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.042153	0.018875	2.233292	0.0276
ELRATE	-0.000522	0.000230	-2.273907	0.0249
FORLIAB	3.69E-08	2.45E-08	1.503577	0.1356
STRUC	0.020918	0.015048	1.390139	0.1673
EFFIC	-0.420191	0.100509	-4.180622	0.0001
MGT	-0.061071	0.033257	-1.836310	0.0690

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.459794	Mean dependent var	0.016118
Adjusted R-squared	0.395366	S.D. dependent var	0.019634
S.E. of regression	0.015267	Akaike info criterion	-5.419415

Sum squared resid	0.025407	Schwarz criterion	-5.099329
Log likelihood	347.2940	Hannan-Quinn criter.	-5.289397
F-statistic	7.136531	Durbin-Watson stat	1.280089
Prob(F-statistic)	0.000000		

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	10.008381	3	0.0185

** Warning: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
FORLIAB	0.000000	0.000000	0.000000	0.1308
MGT	-0.315389	-0.161464	0.089548	0.6070
EXCHGE	0.000711	0.000868	0.000000	0.1488

Cross-section random effects test equation:
Dependent Variable: ROE
Method: Panel Least Squares
Date: 03/03/10 Time: 15:19
Sample: 1995 2008
Periods included: 14
Cross-sections included: 9
Total panel (unbalanced) observations: 123

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.250392	0.101267	2.472595	0.0149
FORLIAB	3.94E-07	2.45E-07	1.607216	0.1108
MGT	-0.315389	0.307451	-1.025819	0.3072
EXCHGE	0.000711	0.000397	1.789937	0.0762

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.183825	Mean dependent var	0.157953
Adjusted R-squared	0.102943	S.D. dependent var	0.161779
S.E. of regression	0.153225	Akaike info criterion	-0.821344
Sum squared resid	2.606064	Schwarz criterion	-0.546985
Log likelihood	62.51268	Hannan-Quinn criter.	-0.709900
F-statistic	2.272755	Durbin-Watson stat	1.959403
Prob(F-statistic)	0.015327		

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	6.791561	4	0.1473

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
ASSETS	15.580658	14.474274	16.720836	0.7867
LIAB	-53.237740	-43.909430	51.042234	0.1917
MGT	25.480462	20.701834	8.424169	0.0997
EXCHGE	0.011496	0.012316	0.000003	0.6389

Cross-section random effects test equation:
Dependent Variable: SPREAD
Method: Panel Least Squares
Date: 03/03/10 Time: 15:24
Sample: 1995 2008
Periods included: 14
Cross-sections included: 9
Total panel (unbalanced) observations: 124

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	12.66070	1.642895	7.706334	0.0000
ASSETS	15.58066	7.645834	2.037797	0.0439
LIAB	-53.23774	13.33114	-3.993488	0.0001
MGT	25.48046	7.686712	3.314871	0.0012
EXCHGE	0.011496	0.006235	1.843765	0.0679

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.558425	Mean dependent var	11.12910
Adjusted R-squared	0.510688	S.D. dependent var	3.408771
S.E. of regression	2.384464	Akaike info criterion	4.674752
Sum squared resid	631.1095	Schwarz criterion	4.970427
Log likelihood	-276.8346	Hannan-Quinn criter.	4.794862
F-statistic	11.69777	Durbin-Watson stat	1.124306
Prob(F-statistic)	0.000000		

Annexure IV

TABLE a: Foreign liabilities

	ROE
Constant	0.22
	(1.9)
MGT	0.01
	(0.0)
EXCHGE	0.00
	(2.5)
Cameroon	0.00
	(-0.4)
Cote d'Ivoire	0.00

	(-2.8)
Gabon	0.00
	(0.7)
Ghana	0.00
	(-1.8)
Kenya	0.00
	(1.2)
Mauritius	0.00
	(-0.1)
Nigeria	0.00
	(-0.4)
Senegal	0.00
	(-0.3)
South Africa	0.00
	(1.4)
Fixed Effects (Cross)	
_CAM—C	-0.05
_CIV—C	0.50
_GAB—C	-0.14
_GHA—C	0.13
_KEN—C	-0.15
_MUS—C	-0.12
_NGA—C	0.02
_SEN—C	-0.03
_ZAF—C	-0.16
R-squared	0.27
Adjusted R-squared	0.14
S.E. of regression	0.15
Sum squared resid	2.33
Log likelihood	69.35
F-statistic	2.00
Prob(F-statistic)	0.01
Mean dependent var	0.16
Akaike info criterion	-0.80
Schwarz criterion	-0.35
Hannan-Quinn criter.	-0.62
Durbin-Watson stat	2.16

Numbers in parentheses are t-statistics values.

TABLE b: management

	ROE	SPREAD
C	0.20	13.16
	(1.6)	(6.6)
FORLIAB	0.00	
	(1.6)	
ASSETS		1.24
		(0.2)
LIAB		-25.48
		(-1.6)
EXCHGE	0.00	0.01
	(1.9)	(1.6)
Cameroon	1.42	-57.76
	(0.7)	(-1.9)
Cote d'Ivoire	-0.70	17.15
	(-0.4)	(0.7)
Gabon	1.55	-17.97
	(0.9)	(-0.7)
Ghana	-1.45	89.76
	(-1.2)	(4.7)
Kenya	0.42	-16.19
	(0.3)	(-0.8)

Mauritius	-0.24	14.24
	(-0.5)	(1.2)
Nigeria	-1.56	-1.23
	(-1.2)	(-0.1)
Senegal	-0.42	26.40
	(-0.5)	(1.7)
South Africa	-0.16	39.06
	(-0.2)	(3.0)
Fixed Effects (Cross)		
_CAM—C	-0.28	12.60
_CIV—C	0.07	-4.38
_GAB—C	-0.28	6.94
_GHA—C	0.42	-17.36
_KEN—C	-0.29	11.44
_MUS—C	0.08	0.84
_NGA—C	0.31	1.97
_SEN—C	0.07	-6.37
_ZAF—C	-0.06	-8.17
R-squared	0.22	0.66
Adjusted R-squared	0.07	0.60
S.E. of regression	0.16	2.16
Sum squared resid	2.50	482.31
Log likelihood	65.01	-260.16
F-statistic	1.50	10.11
Prob(F-statistic)	0.10	0.00
Mean dependent var	0.16	11.13
Akaike info criterion	-0.73	4.53
Schwarz criterion	-0.27	5.01
Hannan-Quinn criter.	-0.55	4.73
Durbin-Watson stat	2.07	1.42

Numbers in parentheses are t-statistics values.

Assets

	SPREAD
C	11.34
	(4.3)
LIAB	-32.73
	(-2.0)
MGT	26.08
	(2.7)
EXCHGE	0.02
	(2.6)
Cameroon	-80.24
	(-0.80
Cote d'Ivoire	-27.91
	(-1.4)
Gabon	7.88
	(0.3)
Ghana	37.30
	(4.0)
Kenya	40.30
	(1.6)
Mauritius	-1.93
	(-0.2)
Nigeria	-18.69
	(-1.5)
Senegal	-8.02
	(-0.3)
South Africa	6.00
	(0.4)

Fixed Effects (Cross)	
_CAM—C	11.77
_CIV—C	2.17
_GAB—C	1.46
_GHA—C	-5.76
_KEN—C	-13.37
_MUS—C	0.93
_NGA—C	3.06
_SEN—C	-1.16
_ZAF—C	0.07
R-squared	0.64
Adjusted R-squared	0.57
S.E. of regression	2.23
Sum squared resid	512.01
Log likelihood	-263.87
F-statistic	9.23
Prob(F-statistic)	0.00
Mean dependent var	11.13
Akaike info criterion	4.59
Schwarz criterion	5.07
Hannan-Quinn criter.	4.79
Durbin-Watson stat	1.42

Numbers in parentheses are t-statistics values.

TABLE d: Liabilities

	SPREAD
C	10.87
	(4.4)
ASSETS	9.82
	(1.2)
MGT	29.77
	(2.8)
EXCHGE	0.01
	(1.2)
Cameroon	-134.78
	(-4.0)
Cote d'Ivoire	-53.96
	(-1.5)
Gabon	-91.82
	(-3.1)
Ghana	24.06
	(0.8)
Kenya	-8.31
	(-0.2)
Mauritius	-53.54
	(-3.1)
Nigeria	-81.23
	(-3.4)
Senegal	-34.68
	(-1.7)
South Africa	-33.95
	(-2.0)
Fixed Effects (Cross)	
_CAM—C	13.43
_CIV—C	-2.52
_GAB—C	8.52
_GHA—C	-10.30
_KEN—C	-12.05
_MUS—C	5.07

_NGA—C	4.55
_SEN—C	-4.92
_ZAF—C	-3.26
R-squared	0.65
Adjusted R-squared	0.58
S.E. of regression	2.20
Sum squared resid	499.24
Log likelihood	-262.30
F-statistic	9.59
Prob(F-statistic)	0.00
Mean dependent var	11.13
Akaike info criterion	4.57
Schwarz criterion	5.05
Hannan-Quinn criter.	4.76
Durbin-Watson stat	1.43

Numbers in parentheses are t-statistics values.

Table e. Exchange rate

	ROE	SPREAD
C	0.23	10.84
	(2.0)	(6.3)
FORLIAB	0.00	
	(1.2)	
LIAB		-62.12
		(-4.2)
ASSETS		17.74
		(2.2)
MGT	-0.25	36.39
	(-0.7)	(3.9)
Cameroon	0.00	0.03
	(1.9)	(2.5)
Cote d'Ivoire	0.00	-0.01
	(0.9)	(-0.9)
Gabon	0.00	0.03
	(0.2)	(2.9)
Ghana	0.00	-0.03
	(0.5)	(-0.4)
Kenya	0.00	-0.14
	(0.4)	(-1.9)
Mauritius	0.01	0.73
	(0.4)	(2.3)
Nigeria	0.00	0.04
	(0.5)	(1.5)
Senegal	0.00	0.00
	(0.5)	(-0.3)
South Africa	-0.01	-0.51
	(-0.5)	(-1.4)
Fixed Effects (Cross)		
_CAM—C	-0.05	3.04
_CIV—C	-0.06	-4.53
_GAB—C	0.00	2.72
_GHA—C	0.10	1.00
_KEN—C	-0.05	-0.54
_MUS—C	0.06	-0.39
_NGA—C	0.04	-0.91
_SEN—C	0.00	-2.96
_ZAF—C	-0.03	2.72
R-squared	0.20	0.64
Adjusted R-squared	0.06	0.57
S.E. of regression	0.16	2.23
Sum squared resid	2.55	512.27
Log likelihood	63.96	-263.90
F-statistic	1.38	9.22
Prob(F-statistic)	0.15	0.00
Mean dependent var	0.16	11.13
Akaike info criterion	-0.71	4.60
Schwarz criterion	-0.26	5.07
Hannan-Quinn criter.	-0.53	4.79
Durbin-Watson stat	1.96	1.47

Numbers in parentheses are t-statistics values.

Annexure IV

Table Z. Destinations of exports (percentage average 1994-2008)

Country	Euro Area	Japan	Switzerland	UK	US	Total
Cameroon	87.5	0.4	0.1	4.6	7.4	100
Cote d'Ivoire	79.7	0.3	0.6	4.8	14.6	100
Gabon	27.3	3.1	0.1	0.5	68.9	100
Ghana	61.2	5.6	2.2	17.7	13.2	100
Kenya	50.8	2.2	1.9	31.4	13.7	100
Mauritius	41.7	0.8	1.5	39.0	17.0	100
Nigeria	32.5	2.5	1.0	1.4	62.5	100
Senegal	90.7	2.5	2.8	2.4	1.5	100
South Africa	43.9	16.9	3.8	16.2	19.3	100

Table W. Sources of imports (percentage average 1994-2008)

Country	Euro Area	Japan	Switzerland	UK	USA	Total
Cameroon	80.1	5.4	0.9	3.9	9.8	100
Cote d'Ivoire	79.7	5.6	1.7	5.6	7.4	100
Gabon	80.3	3.3	0.4	4.7	11.3	100
Ghana	57.2	5.4	1.0	20.1	16.4	100
Kenya	43.3	16.6	2.4	19.9	17.8	100
Mauritius	66.2	11.2	4.5	10.9	7.2	100
Nigeria	56.5	5.5	1.5	16.5	20.0	100
Senegal	83.0	4.6	0.9	4.6	6.9	100
South Africa	55.4	12.7	2.5	12.0	17.4	100

DO COMMODITY PRICES FOLLOW A RANDOM WALK? AN APPLICATION OF JOINT VARIANCE RATIO TESTS

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Abstract: This paper investigates the random walk behavior of twelve commodity prices namely— aluminum, copper, gold, iron ore, lead, nickel, oil, silver, steel, tin, uranium, and zinc using an array of individual and joint variance ratio tests. The results from the various variance ratio procedures indicate that the null hypothesis that the commodity prices under study are random walks should be rejected. These results reveal that weak-form market efficiency does not hold in the twelve commodity markets and thus present opportunities for investors to earn abnormal returns.

INTRODUCTION

Despite the fact that prices of commodities such as precious metals, agricultural products, and natural resources have been taught to be predictable, their price behaviors over time are still impacted by a mixture of systematic and random factors. Paresh Narayan and Ruipeng liu (2011) study acknowledged that commodity prices are volatile and numerous studies have shown same findings as well. Economists have thought that the ability to accurately predict the pricing behavior of these commodities will aid in making profitable investment decisions. However, the prediction accuracy question continues to linger and demands answers as to whether commodity markets are efficient. In essence, are the commodity prices stationary or non-stationary (random walk)? Since profitability in commodity markets depends on accurate predictability, can investors predict the price behavior of these selected commodities accurately?

A thorough understanding of the effect of information on security prices must indeed commence by understanding efficient market theory. The theory states that a well functioning financial market must have prices that reflect all relevant information. In essence, the current market price of a security must incorporate all relevant information. When market is efficient, then the best measure of the security's value is the true worth which must be given by its current market price. Consequently, competition in the security markets must bring prices to their true or equilibrium value. Where that is not the case, current prices become independent of the historical prices and random walk. It becomes necessary to note that the term random walk describes the movements of a variable whose future changes cannot be predicted. An important implication is that the security prices should approximately follow a random walk because other factors besides past historical prices do impact the current prices and returns. Consequently, the ultimate goal of an investor is to maximize returns. However, for this condition to be realized, there must be a clear understanding of financial market behaviors, arbitrage and profit relationships. In a nutshell, investors and analysts must understand the theory of efficient capital markets. For the sake of emphasis, all unexploited profits and opportunities will be eliminated if the market is efficient. However, many studies have shown that the security markets are not efficient and they follow a random walk because other factors besides past historical prices do impact the current prices and returns.

Svetlana Maslyuk and Russell Smyth (2008) clearly stated that commodity prices, especially that of crude oil tends to fluctuate reflecting rising demand, geopolitical disturbances, extraction cost and reserves and accurate prediction will not be totally possible. It is even worst during uncertain times such as this when different economies are facing recessions or downturns. Investing can be more frightening, but there are still gains to be made if an investor is able to predict accurately. Despite the fact that many have in the past considered investing in some precious metals such as gold and silver as secure security instruments, investors must be sure of what they are investing in before proceeding. History has shown that investors have widely considered these moves as avenues to weather bad economic times.

As the global financial crisis worsens and persists, many investors will be turning to commodity markets like crude oil, gold, silver, agricultural products and other precious metals to hedge against inflation and currency depreciation. However, the price behaviors of these commodities over time are still impacted by a mixture of systematic and random factors. Also, debates continue to rage as to whether the Commodity markets are efficient. In essence, are the commodity prices stationary or non-stationary (random walk)? Profitability in the commodity markets depends on accurate predictability; therefore, can we predict the price behavior of some of these selected commodities accurately? The study will focus on determining whether commodity prices are random walk (non-stationary) or stationary. If commodity returns are characterized by a pattern of random work behavior, then disturbances to these returns attributable to any shock will have a permanent effect; otherwise, the revise becomes the case indicating stationarity or transitory effect.

The paper is organized as follows. Following the present introduction, Section 2 provides the literature review. Section 3 furnishes the methodology. Section 4 presents the data and descriptive statistics. Section 4 discusses empirical results. Section 6 presents the summary and implications of the study.

LITERATURE REVIEW

One will definitely suspect that many of the time series data that we encounter in business and economics are not generated by stationary process. Does it mean then that the underlying stochastic process that generated the time series data will be invariant with respect to time? Invariance therefore implies that the stochastic process will not change over time. If the characteristics of the stochastic process should change over time, the process is non-stationary. According to Pindyck (1998), non-stationarity makes it very difficult to represent the time series over past and future intervals of time by a simple algebraic model. In contrast, if the stochastic process is fixed in time (stationary), one can model the process via an equation with fixed coefficients that can be estimated from past data. Remember that a stationary process is one whose joint and conditional distributions are both invariant with respect to displacement of time.

Ahrens and Sharma (1997) looked at a large number of commodity prices to test for trend stationarity. They used real commodity prices for 11 series for the time period of 1870-1990 to test for unit root null hypothesis. They applied the ADF and Perron unit test on a one exogenous structural break model. Their results revealed that five series-Copper, Iron, Nickel, Petroleum, and Silver are trend stationary. A time series that is stationary is also deterministic and predictable. The series will normally revert back to its fixed mean after a random shock. Lee et al (2006) examined the time series properties of 11 commodity prices. They applied the minimum Lagrange Multiplier (LM) test proposed by Lee and Strazicich (2003). They found strong evidence of commodity prices being stationary around deterministic trends with structural breaks.

However, all studies do not share the view that commodity prices exhibit stationary behavior (transitory effect). For instance, Narayan and Liu (2011) suggested that shocks to Gold, Silver, Platinum, Aluminum, and Copper are persistent. In other words, these metal prices are non-stationary implying that they are random walks. This finding is contrary to many economists' consensus view that many commodity prices are stationary, especially those of energy variables. Based their finding, Narayan and Liu concluded that shocks to commodity prices do not have persistent effects. Narayan and Liu further suggested that commodity prices via many other economic interactions are believed to be volatile. They attributed the prevalent volatility in the commodity markets to macroeconomic factors such as, changes in interest rates, exchange rates, business cycle phases of recession and expansion and followed by political events such as threats of wars and terrorist attacks.

Smith and Rogers (2006) investigated whether stock returns are independently and identically distributed, (iid). In other words they examined whether stock returns follow an iid random walk or form a Mattingale difference sequence (mds). They found that 4 stock index futures and 25 out of 36 single stocks followed a random walk. The assets also exhibited a high degree of weak-form efficiency. They utilized Wild boot strapping developed by Chow and Denning (1993) Joint Variant Ratio tests and other Unit root tests in their study. The tests are based on the fact that with uncorrelated returns, the variance of the q –period return is q times the variance of the one period return. According to Smith and Roger, earlier random walk tests were performed using asymptotic distribution theory making the results valid especially in large samples. However, their variance ratio tests were based on ranks and signs and wild bootstrapping.

Slade (1988) was the first to dabble into the study of the integrational property of commodity prices using a Hotelling-type linear trend model in line with a random walk stationary model. Slade found that 7 out of 8 commodity prices were random walk processes. However, this study has been seriously criticized of having many limitations. One of these limitations was the lack of a constant and a time trend in the models and the other was that the model did not allow for structural changes in the data series.

Given the mixed results provided by the earlier studies on the behavior of commodity prices, the present study applies a battery of joint variance ratio tests. Unlike the conventional variance ratio tests, the joint variance ratio techniques tend to have more power and do not focus on testing the hypothesis that an individual variance ratio is one.

THEORETICAL BACKGROUND AND METHODOLOGY

The theoretical background begins with the Variance ratio test first used by Lo and Mackinlay in 1988. This methodology has become a popular technique to test patterns and behavior of financial time series data. The foundation of the tests is based on the fact that with uncorrelated returns, the variance of that period's return is the periods return times the variance of the one period return.

A large or significant assumption in relation to the random walk theory can be determined using these variance ratio tests. If R_t is a random walk, the ratio of the variance of the j^{th} difference to the σ^2 of the first difference must have a propensity value of 1; hence

$$\mathbf{VR(j)} = \sigma^2(j)/\sigma^2(i) = 1 \quad (1)$$

where $\sigma^2(j) = 1/j^{th}$ 'variance of j differences. The null hypothesis of the **VR(j)** must be close to 1 at best. However, Mackinlay (1988) used the following model to test for random walk:

$$\boldsymbol{\sigma^2}(j) = 1/_K \, \Sigma_{t-j}\{Rt-R_{t-1} - j\mu\}^2 \quad (2)$$

Where μ shows the mean of the sample of the distribution and

$$\mathbf{K} = j\,(m_j - j + 1)(1 - j/m_j) \quad (3)$$

$$\boldsymbol{\sigma^2}(1) = 1/(mj-1)\, \Sigma_{t=1}\{Rt - R_{t-1} - \mu\}^2 \quad (4)$$

They also designed the asymptotic distribution of the estimated variance ratios and utilized two tests Z(j) which tested for homo-skedastic increase random walk and Z*(j) that tested for hetero-skedastic increase random walk. It is important to note that:

Z(j) = VR(j) - 1/∏₀(j) ≈ N(0,1) ………………………………………………………….. (5)

This very study implements the Chow and Denning (1993) and Whang and Kim (2005) joint variance ratio techniques to determine whether commodity prices including gold, silver, steel, copper, uranium, aluminum, iron ore, lead, nickel, tin, and zinc exhibit random walk behavior. These estimation methodologies are also the modified versions of Lo and Mackinlay's (1988) variance ratio test techniques. The Chow and Denning (1993) (CD) multiple variance ratio tests call for jointly testing the null hypothesis that $V(ki) = 1$ for $i = 1, \ldots, l$; against the alternative that $V(ki) \neq 1$ for a given holding period such as a ki. The CD test statistic is given by the following expression:

$$MV = \frac{\max}{tsset}\left|M(x;ki)\right| \quad \ldots\ldots (6)$$

The CD test statistic is predicated on the studentized maximum modulus distribution with l and T degrees of freedom. Stoline and Ury (1979) provide the relevant critical values for the CD joint variance ratio tests.

Whang and Kim (2003) improve on Wrights (2000) by converting the individual variance ratio tests to joint tests. The tests consist of selecting the maximum absolute value of the test statistic. The procedure involves calculating the Ri(q) for m different values of q and the maximum absolute values of the selected test statistic. The joint variance ratio technique is given by the following expression:

$$JR_1 = \max\left|R_1(q_i)\right| \quad \ldots\ldots (7)$$

They also show that the test statistic JR_1 has exact sampling distribution and finite sample properties. Kim (2005) provides the critical values for the various joint variance ratio tests.

$$JR_2 = \max\left|R_2(q_i)\right| \quad \ldots\ldots (8)$$

and

$$JS_1 = \max\left|S_2(q_i)\right| \quad \ldots\ldots (9)$$

The study next applies the bootstrap joint variance ratio test developed by Kim (2006). This procedure builds on the Chow and Denning (1993) joint variance ratio tests. The bootstrap joint variance ratio testing procedure requires the selection of the maximum absolute value from a set of m test statistics. The CD joint variance ratio test is given by following expression:

$$JM_2 = \max\left|M_2(q_i)\right| \quad \ldots\ldots (10)$$

Kim (2006) shows that the unknown sampling distribution of the JM_2 test is better handled through the application of the wild bootstrap procedure. The null hypothesis is rejected if the computed test static is greater than the critical values at the conventional levels.

DATA AND DESCRIPTIVE STATISTICS

The data set consists of namely gold, silver, platinum, steel, copper, uranium, aluminum, iron ore, lead, nickel, tin, and zinc. The data consist of monthly observations spanning the time period January 1986 through December 2010. The data were obtained from International Financial Statistics published by IMF. The data were expressed in the natural logarithm. Table 1 presents the summary statistics for the logarithms of the nominal commodity prices including — gold, silver, steel, copper, uranium, aluminum, iron ore, lead, nickel, tin, and zinc. From Table 1 it can be observed that the mean values of commodity prices varied from a high of 9.15 for nickel to a low of 2.78 for uranium. The standard deviations presented in Table 1 show that uranium (0.71) exhibited the most dispersion from the mean, while aluminum (0.26) recorded the least. From the maximum and minimum values presented in Table 1, it can be inferred that the commodity prices have fluctuated during the period under consideration. The results from the Kurtosis tests suggest that the normality assumption relative to the distribution of gold, iron, lead, silver, tin, uranium, and zinc prices should be rejected as the test statistics are greater than 3. However, the results from the Jarque-Bera test statistics indicate that the null hypothesis that the commodity prices are normally distributed should be rejected at the 1 percent level of significance. The results further indicate that the commodity prices are positively skewed as suggested by the skewness test statistics presented in column 6 of Table 1.

EMPIRICAL RESULTS

The paper first applies the conventional unit root tests including the augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) procedures. The results from the ADF and PP unit root tests are presented in Table 2. The results show that the twelve commodity prices including gold, silver, steel, copper, uranium, aluminum, iron ore, lead, nickel, oil, tin, and zinc are not stationary. In each case, the test statistic is less than the critical values at the conventional levels. For instance, in the case of aluminum, the ADF (-2.62) and PP (-2.77) test statistics are less than the critical value (-3.14) at the 10 percent level. The standard unit root tests such as the augmented Dickey-Fuller (Dickey and Fuller 1981) and the Phillips-Perron (Phillips-Perron, 1988) are basically designed to determine whether time series are level or first difference stationary. In other words these procedures do not have the ability to differentiate integer order of integration from fractional order of integration.

To this effect, the study next implements the joint variance ratio procedures advanced by Lo and MacKinlay (1988) and Wright (2000). The results from the variance ratio tests are presented in Table 3. The test statistics labeled M1 and M2 are the results from the variance ratio techniques proposed by Lo and MacKinlay (1988). While R1, R2, and S1 represent results from the rank and sign variance ratio procedures proposed by Wright (2000). Four different aggregation intervals (i.e. K = 2, 4, 6, and 8 months) were considered in conducting the variance ratio tests. The M1 and M2 test results displayed in columns 2 and 3 of Table 3 indicate that the null hypothesis that the variance ratios for commodity prices namely gold, silver, steel, copper, uranium, aluminum, lead, nickel, oil, tin, and zinc are equal to 1 should be rejected at least at the 5 percent significance level. For iron ore, the null hypothesis that the variance ratio is unity could not be rejected at the conventional levels.

The results from the rank-based variance ratios tests including R1 and R2 are presented in Columns 4 and 5 of Table 3. The results reveal that the null hypothesis that the returns for gold, silver, steel, copper, uranium, aluminum, lead, nickel, oil, tin, and zinc are random walk processes should be rejected at least at the 5 percent level of significance. For iron ore, the results from the rank-based suggest that null hypothesis that variance ratio is equal to 1 should not be rejected. These results corroborate those provided by the conventional variance ratio tests of Lo and MacKinlay. The results obtained from the sign-based variance ratio test (S1) are presented in column 6 of Table 3. The results from the sign-based test reject the null hypothesis that gold, silver, iron ore steel, copper, uranium, aluminum, lead, nickel, tin, and zinc prices are random walks should be rejected at least at the 5 percent significance level. These results suggest that the series are not mean-reverting since the computed test statistics are different from 1 at the conventional levels. However, for oil the sign-based variance ratio tests failed to reject the null hypothesis variance ratio is unity. Taken together, the results from the conventional variance ratio tests (M1 and M2) and the nonparametric variance ratio procedures (J1, J2 and S1) indicate that the commodity prices are not random walk processes. These results suggest that the twelve commodity prices under study are not mean-reverting since the test statistics are different from 1 at the conventional levels. This finding implies that future movements in commodity prices cannot be predicted based on their past behavior.

Table 4 presents the results from the joint variance ratio tests namely the CD1, CD2, JR1, JR2, and JS1. Columns 1 and 2 presents the results from the joint variance ratio tests based on the Lo and MacKinlay. These two procedures are designed to test the existence of iid random walk hypothesis. While Columns 3 through 6 display the results from the martingale difference sequence (mds) procedures given by JR1, JR2, and JS1. The mds procedures are less restrictive than the heteroscedastic random walk models. The mds procedures test the null hypothesis that the commodity prices follow a heteroscedasticity consistent random walk. In other words, they test the hypothesis that the commodity prices are a mds. The test statistics from the CD1 and CD2 procedures indicate that the null hypothesis that gold, silver, steel, copper, uranium, aluminum, lead, nickel, oil, tin, and zinc are random walk processes should be rejected at least at the 10 percent level of significance. However, the CD1 and CD2 test statistics fail to reject the null hypothesis suggest that iron ore price follow a random walk. These findings are consistent with those obtained from the individual variance ratio tests.

The results from the martingale dependence sequence (mds) test procedures are presented in Table 4. Columns 2 and 3 display the CD1 and CD2 joint variance ratio tests proposed by Kim (2006). The results from the CD1 and CD2 joint variance ratio tests suggest that the null hypothesis that the commodity prices follow a heteroscedasticity consistent random walk should be rejected for gold, silver, steel, copper, uranium, oil, aluminum, lead, nickel, tin, and zinc at least at the 10 percent level of significance. For iron ore, the two tests were not able to reject the null hypothesis at the conventional levels. The results from the JR1, JR2, and JS1 joint variance ratio tests advanced by Whang and Kim (2003) are presented in Columns 4 through 6. Based on the results from the JRI and JR2 the null hypothesis that the commodity prices follow a heteroscedasticity consistent random walk is rejected at least at the 10 percent level for gold, silver, steel, copper, uranium, aluminum, lead, nickel, oil, tin, and zinc. However, the results from JR1 and JR2 reject the null hypothesis that commodity prices follow a heteroscedasticity consistent random walk in the case of iron ore.

The results from the JS1 presented in Column 6 suggest that the null hypothesis that the commodity prices follow a heteroscedasticity consistent random walk should be rejected at least at the 10 percent significance level for gold, silver, steel, iron ore, copper, uranium, aluminum, lead, nickel, tin, and zinc. However, for oil the JS1 test failed to reject the null hypothesis that the commodity prices form an mds. The results from the joint variance ratio test based on Wald statistics are presented in Column 7 of Table 4. The results indicate that the null hypothesis that the commodity prices follow a heteroscedasticity consistent random walk should be rejected for gold, silver, steel, copper, uranium, aluminum, lead, nickel, oil, tin, and zinc at least at the 10 percent level. For iron ore, the Wald joint variance ratio test fail to reject the null hypothesis that the commodity price series do not form an mds.

In all, the results from the variance ratio tests including M1, M2, R1, R2, CD1, CD2, JR1, JR2, JS1 and Wald testing procedures suggest that the twelve commodity prices — namely aluminum, copper, gold, lead, nickel, oil, silver, steel, uranium, tin, and zinc are not walks. This finding implies that future movements in the commodity prices under consideration can be predicted using their past information. From investment perspective, it is possible for investors to develop profitable strategies in commodity markets.

CONCLUSION

This paper has examined the random walk behavior of commodity prices namely – aluminum, copper, gold, lead, nickel, oil, silver, steel, uranium, tin, and zinc. Specifically, the paper applies the conventional unit root tests of ADF and the Phillips-Perron procedures in addition to a variety of individual and joint variance ratio procedures. The individual variance ratio tests include those proposed by Lo and MacKinlay (1988) and Wright (2000). The joint variance ratio tests include those developed by Kim (2006), Chow and Denning (1993) and Whang and Kim (2003). It must be pointed out that the standard unit root tests such as the ADF and Phillips-Perron procedures lack the ability to differentiate integer order of integration from fractional order of integration.

The test results from both the ADF and Phillips-Perron unit root testing techniques, suggest that aluminum, copper, gold, lead, nickel, oil, silver, steel, uranium, tin, and zinc prices are not trend stationary, implying that commodity prices are walks. The results from the individual variance ratio tests reject the null hypothesis that the twelve commodity prices are random walks. The results from the joint variance ratio tests are consistent with those obtained from the individual variance ratio procedures by rejecting the null hypothesis that the commodity prices follow a random order.

Taken together, the results from both the individual and joint variance ratio tests suggest that the twelve commodity prices- namely aluminum, copper, gold, lead, nickel, oil, silver, steel, uranium, tin, and zinc are not walk processes. This finding implies that future movements in the commodity prices can be predicted using past information. It also indicates that the weak-form market efficiency does not hold for these commodity markets. In other words, the twelve commodity markets studied are inefficient and as such provide arbitrage opportunities to investors.

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Annexure

Table 1: Descriptive Statistics

Series	Mean	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
ALUMIUM	7.41	8.18	6.95	0.26	0.62	2.60	21.45	0.00
COPPER	7.88	9.12	7.17	0.53	0.89	2.75	40.18	0.00
GOLD	6.05	7.24	5.55	0.39	1.33	4.00	100.75	0.00
IRON ORE	3.68	5.36	3.19	0.55	1.45	3.79	112.68	0.00
LEAD	6.60	8.22	5.90	0.54	1.16	3.44	69.72	0.00
NICKEL	9.15	10.85	8.17	0.58	0.66	2.87	21.79	0.00
OIL	3.91	5.52	2.91	0.61	0.83	2.53	37.10	0.00
SILVER	6.46	7.99	5.90	0.45	1.27	3.58	85.17	0.00
STEEL	6.21	7.00	5.63	0.31	0.30	2.80	4.94	0.08
TIN	8.86	10.17	8.22	0.42	1.27	3.93	91.57	0.00
URANIUM	2.78	4.91	1.96	0.71	1.16	3.21	67.84	0.00
ZINC	7.12	8.39	6.41	0.40	1.09	3.76	66.85	0.00

Table 2:ADF and Phillip-Perron Unit Root Test Results

Series	Lag(s)	ADF	Lag(s)	PP
ALUMIUM	1	-2.62	8	-2.77
COPPER	1	-1.86	6	-1.56
GOLD	0	0.73	8	0.83
IRON ORE	0	-0.84	0	-0.84
LEAD	1	-1.70	6	-1.67
NICKEL	1	-2.45	7	-2.31
OIL	2	-2.83	7	-3.06
SILVER	1	-0.78	9	-0.40
STEEL	1	-1.65	10	-1.83
TIN	2	-1.49	5	-1.16
URANIUM	1	-1.62	8	-1.58
ZINC	1	-2.33	8	-2.31

The 10, 5, and 1% critical values for the ADF and the PP unit root procedures are -3.14, -3.42 and -3.99, respectively.. The lags for the ADF procedure were determined by the Schwarz (SIC). The lags for the PP procedure were determined by the Bartlett kernel.

Table 3
Variance Ratio Test Results for the Logarithms of Commodity Prices

K	M1	M2	R1	R2	S1
ALUMIUM					
2	3.04***	1.92*	3.48***	3.65***	1.56
4	3.57***	2.25**	3.35***	3.74***	2.01**
6	3.62***	2.37**	3.55***	3.94***	1.99**
8	3.43***	2.32**	3.63***	3.90***	1.95**
COPPER					
2	7.27***	3.93***	5.92***	6.34***	5.49***
4	6.66***	3.99***	5.34***	5.57***	5.53***
6	5.76***	3.75***	4.88***	4.88***	5.44***
8	5.04***	3.47***	4.61***	4.40***	5.50***
GOLD					
2	2.37***	1.82*	3.03***	2.75**	2.26***
4	1.05	0.84	1.42	1.03	1.70*
6	0.99	0.81	1.22	0.80	1.43
8	0.99	0.82	1.43	0.88	1.51
IRON ORE					
2	0.03	0.18	1.05	0.95	13.24***
4	0.15	0.33	0.30	0.23	20.93***
6	0.29	0.45	0.25	0.19	26.24***
8	0.12	0.17	0.06	0.02	30.59***
LEAD					
2	3.78***	2.46**	4.21***	4.09***	2.49**
4	3.34***	2.33**	4.00***	3.73***	2.35**
6	3.07***	2.25**	3.98***	3.55***	2.75**
8	3.29***	2.46**	4.14***	3.67***	3.07**
NICKEL					
2	5.84***	4.92***	6.14***	6.09***	4.11***
4	5.46***	4.67***	5.92***	5.55***	4.17***
6	5.17***	4.36***	5.25***	5.00***	3.77***
8	4.82***	4.09***	4.97***	4.64***	3.58***
OIL					
2	4.84***	2.91**	2.68**	3.66***	1.56
4	4.02***	2.68**	2.18**	3.11***	1.14
6	2.86**	2.03***	1.54	2.22**	0.85
8	1.25	0.92	0.67	0.99	0.49
SILVER					
2	3.14***	2.39**	1.97**	2.24***	2.02**
4	1.74**	1.30	0.95	0.96	1.76*
6	1.01	0.78	0.83	0.50	2.08**
8	0.47	0.38	0.76	0.19	2.17**
STEEL					
2	3.96***	2.08**	8.38***	7.81***	9.08***
4	4.11***	2.63***	10.91***	9.95***	12.46***
6	4.94***	3.51***	12.21***	11.20***	14.29***

K	M1	M2	R1	R2	S1
8	5.48***	4.14***	13.04***	12.01***	15.55***

K	M1	M2	R1	R2	S1
TIN					
2	5.71***	4.59***	5.30***	5.65***	3.99***
4	6.90***	5.32***	6.01***	6.38***	3.71***
6	6.03***	4.74***	5.53***	5.64***	3.58***
8	5.05***	4.04***	5.15***	4.97***	3.59***
URANIUM					
2	6.66***	4.54***	8.73***	8.22***	8.39***
4	6.33***	4.52***	10.72***	9.33***	11.16***
6	6.04***	4.38***	11.56***	9.71***	12.70***
8	6.30***	4.57***	12.46***	10.36***	13.73***
ZINC					
2	5.54***	4.71***	5.35***	5.50***	3.41***
4	5.64***	4.87***	5.67***	5.72***	3.65***
6	5.68***	4.92***	5.64***	5.70***	3.94***
8	5.64***	4.91***	5.51***	5.59***	3.87***

***, ** and * indicate level of significance at the 1, 5 and 10 percent, respectively. K = number of lags. The 10, 5, and 1% critical values for M1 and M2 are 2.23, 2.49 and 3.02, The 10, 5, and 1% critical values for R1 and R2 are 1.96, 2.22 and 2.77,

Table 4
Joint Variance Ratio Test Results for the Logarithms of Commodity Prices

Series	CD1	CD2	JR1	JR2	JS1	JM2
ALUMIUM	3.29***	2.13	3.62***	3.94***	2.01*	11.61**
COPPER	7.11***	3.84***	5.92***	6.35***	5.51***	52.39***
GOLD	2.22*	1.70	3.04**	2.74**	2.26**	8.07*
IRON ORE	0.15	0.51	1.05	0.95	30.57***	1.42
LEAD	3.63***	2.34*	4.23***	4.10***	3.25***	17.24***
NICKEL	6.68***	4.78***	6.14***	6.09***	4.42***	33.88***
OIL	4.68***	2.81**	2.67**	3.66***	1.56	49.05***
SILVER	3.02***	2.30**	1.97*	2.26**	2.13**	13.48***
STEEL	4.97***	3.74***	13.05***	12.02***	15.55***	30.97***
TIN	6.58***	5.07***	6.00***	6.38***	3.99***	48.79***
URANIUM	6.49***	4.41***	12.46***	10.36***	13.73***	52.98***
ZINC	5.39***	4.62***	5.67***	5.71***	4.22***	34.82***

***, ** and * indicate level of significance at the 1, 5 and 10 percent, respectively. The 10, 5, and 1% critical values for CD1 and CD2 are 2.23, 2.49 and 3.02, The 10, 5, and 1% critical values for JR1 and JR2 are 1.96, 2.22 and 2.77, The 10, 5, and 1% critical values for JS1 are 1.93, 2.26 and 2.83, The 10, 5, and 1% critical values for Wald (JM2) test are 7.78, 9.49 and 13.28,

Savings and Investment Nexus in the Perspective of Foreign Capital: The Feldstein-Horioka Paradox

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Abstract: Savings and investment are considered as the most important macroeconomic instruments to enhance the economic growth of any country. Thus, this paper is an attempt to examine the fundamental relationship between domestic savings and investment in the perspective of foreign capital thereby explaining the Feldstein and Horioka paradox in the context of Indian economy over the sample period spanning from 1990-91 to 2009-10. The application of cointegration test indicates that the variables of the study have long-run equilibrium relationships among themselves. Furthermore, the application of vector error correction models with and without foreign capital provides the evidence of the existence of bi-directional causality between domestic savings and investment with and without foreign capital. This supports the findings of Feldstein and Horioka while indicating greater level of international capital mobility.

INTRODUCTION

The role of capital accumulation in the process of economic growth of a developing country like India has received a considerable attention since last few decades. Capital accumulation involves three mutually dependent activities - first, an increase in the volume of real savings; second, an efficient financial and credit mechanism for resource mobilization; and third, capital formation so that resources are used in the production of capital goods (Meir and Baldwin, 1957). Thus, savings and investment have been considered as two critical macro-economic variables with micro-economic foundations for achieving price stability and promoting employment opportunities thereby contributing to sustainable economic growth. In this context, the relation between domestic savings and investment keeps an important relevance. Gutierrez and Solimano (2007) argued that the difference between planned savings and preferred investment may cause macroeconomic fluctuations and business cycles in an economy. Now, if we look for the reasons of the differences between domestic savings and investment, one plausible cause may be the cross-border flight of capital.

According to macroeconomic theory, if we assume that investors that are able to easily invest anywhere in the world, they invest in countries that offer the highest return per unit of investment which would drive up the price until the return per unit of investment across different countries is similar. Under this model, a saver in India will have no incentive for investing in the Indian economy, but rather would invest in the economy with the highest productivity return to his/her capital (the highest marginal productivity of capital). Therefore, increased domestic saving rates need not result in increased investment in an economy. Precisely, the standard economic theory advocates that in the absence of regulation in international financial markets, the savings of any country would flow to countries with the most productive investment opportunities and thus, domestic saving rates would be uncorrelated with domestic investment rates. Feldstein and Horioka (1980) observed that, for OECD countries, domestic savings rates and domestic investment rates are, instead, highly correlated, in contrast to standard economic theory. And, thereafter this has been widely discussed as the *Feldstein-Horioka (F-H) paradox or puzzle* in macroeconomics and international finance.

Yasutomi and Horioka (2010) in a recent discussion paper argued that Adam Smith pointed out the existence of the F-H paradox and even gave an explanation for it more than 200 years before the publication of the seminal paper by Martin Feldstein and Charles Horioka in 1980. Smith argued that it is the search of their own safety that shows the way to owners of capital to invest their capital in their own country to as great an extent as possible and that it is the pursuit of security rather than the pursuit of profit that leads individuals to promote the good of society as a whole via the '*invisible hand*' (Yasutomi and Horioka, 2010). Thus, domestic savings and investment are highly correlated.

About three decades ago, Feldstein and Horioka studied the empirical association between domestic savings and investment for a period of 1960 to 1976 for 16 OECD countries and came to the conclusion that around 85 to 95% of national savings were invested domestically. Such findings may be interpreted as an evidence of low international capital mobility. This lead to the controversial conclusion of the existence of strong home bias the way domestic savings are allocated. Obviously, this went against the conventional wisdom that industrialized economies had fewer restrictions on the across border movement of capital. Thus, in the face of international financial markets integration, F-H finding of capital immobility or low mobility for OECD countries has been called a 'puzzle or paradox' (Obstfeld and Rogoff, 2000).

Therefore, this paper is an attempt to reinvestigate the F-H paradox in the context of Indian economy. Since Indian economy is an open economy, at least a part of the domestic investment is financed by foreign capital. Thus, it is quite imperative to examine the savings and investment relationship in the perspective of foreign capital. The most important implication of the F-H puzzle is the international capital immobility which keeps little relevance in an open economy like India. There can be two reasons: first, the restrictions imposed on international capital mobility have been declining since early 1980s; and second, the increasing volatility of exchange rates since the abandonment of the Bretton Woods' system has been providing persuasive evidence of capital mobility. Recently, it has been observed that India has become the safe-haven for foreign investments. The total foreign investment inflow to India has been increased from $103 million in 1990-91 to $69,557 million in 2009-10. This tremendous growth in foreign capital inflow is mainly due to substantial increase in foreign direct and portfolio investments. The proportion of foreign direct investment in total foreign capital inflow increased from $97 million in 1990-91 to $37,182 million in 2009-10, and that of portfolio investment increased from $6 million to $32,375 million in 2009-10. This shows that gross investment in India could be largely influenced by foreign capital and thus, may have low association with the domestic savings.

Hence, realizing the importance of the foreign capital in the economic growth of India, this paper revisits the F-H paradox or puzzle by considering the variable investment as the combination of domestic and foreign investments. It is with this objective, the rest of the paper is organized as follows: Section 2 reviews the literature, Section 3 outlines the data and methodology of research; Section 4 makes the empirical analysis; and Section 5 concludes.

LITERATURE REVIEW

The empirical findings of Feldstein and Horioka (1980) and Feldstein (1983) indicate that savings and investment are highly correlated across countries. This finding may be interpreted as the evidence of a lack of perfect capital mobility (Caprio and Howard, 1984; Murphy, 1984; Obstfeld, 1986a, 1986b; and Wong, 1990). This interpretation of the savings and investment comovement has been very controversial and a significant number of studies disagree with it as it is in contrast with the general deregulation of capital markets and increased integration of world financial markets that took place over the last two to three decades (Tobin, 1983; Westphal, 1983; Obstfeld, 1986a, 1986b; Frankel and MacArthur 1988; Ghosh, 1990; Tesar, 1991; and Baxter and Crucini, 1993).

Subsequently researchers have found a high savings-investment correlation in large as well as small economies, although, this correlation is found to be relatively weaker for the latter (Dooley, Frankel and Mathieson, 1987; Wong, 1990; Mamingi, 1997; Vamvakidis and Waczairg, 1998; Coakley, Kulasi and Smith, 1999; Kasuga, 2004; Sinha and Sinha, 2004). However, a few recent studies employing panel data model in augmented F-H specification concluded that financial openness has increased capital mobility in the world (Isaksson, 2001; Georgopoulos and Hejazi, 2005; Younas, 2007; Younas and Chakraborty, 2009). The literature also provides the empirical evidence of non-existence of the F-H paradox. Miller (1988) found that savings and investment in the US economy are cointegrated throughout the fixed exchange-rate regime, but not during the flexible exchange-rate time. Otto and Wirjanto (1989) exposited that savings and investment in the US and Canadian economy are not cointegrated. Montiel (1994) elaborated about the vulnerability of F-H test for indirect correlations between domestic savings and investment that did not reflect capital mobility.

Thus, it is inferred that the F-H puzzle has remained a controversial issue since last three decades. This study is important for India as it takes the post-liberalization period as the sample period. Second, it is unique in considering the savings and investment relationship in the perspective of foreign capital. Third, it applies the vector error correction modeling to explore the savings and investment relationship.

DATA AND METHODOLOGY

This paper aims at investigating the long-run impact of savings on investment in India over the period 1990-91 to 2009-10. The study has been divided into two parts: first, the link between savings and investment has been examined in which investment includes foreign investment; and second, the link between savings and investment has been examined in which investment does not include foreign capital. Thus, the variables of the study are gross domestic savings, gross domestic capital formation (proxy for investment without foreign capital) and investment (gross domestic capital formation plus total foreign investment inflows). So the models can be specified as follows:

$$I_t = f(GDS_t, \varepsilon_{1t}) \;\&\; IF_t = f(GDS_t, \varepsilon_{2t})$$

Model-1 estimates the long-run relation between gross domestic savings and investment without foreign capital, and Model-2 estimates the relation with foreign capital. In above specifications, I_t stands for domestic investment in the economy that excludes foreign capital, IF_t denotes the investment in the economy that includes foreign capital, GDS_t stands for the gross domestic savings, and ε_{1t} & ε_{2t} are error terms. All the variables have been expressed in their natural logarithms to avoid the problems of heteroscedasticity. All the time series data have been collected from the Economic Survey 2010-11 published by Government of India, and Handbook of statistics on Indian economy published by RBI.

To serve the purpose, cointegration and causality between variables in both the models have been examined. And, as a necessary step all the time series have been tested for stationarity by Augmented Dickey-Fuller (ADF) unit root test. Then the cointegration between variables has been tested in both the models to investigate the existence of long-run equilibrium relation between them by Johansen's cointegration test. Finally, the Granger causality test in the vector error correction framework has been performed to examine the short-run relation between variables of the study.

Unit Root Test

The econometric methodology, first examines the stationarity properties of each time series of consideration. The present study uses Augmented Dickey-Fuller (ADF) unit root test to examine the stationarity of the data series. It consists of running a regression of the first difference of the series against the series lagged once, lagged difference terms and optionally, a constant and a time trend (Dickey and Fuller, 1979). This can be expressed as follows:

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \alpha_2 Y_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta Y_{t-j} + \varepsilon_t \quad \text{........................(1)}$$

The additional lagged terms are included to ensure that the errors are uncorrelated. In this ADF procedure, the test for a unit root is conducted on the coefficient of Y_{t-1} in the regression. If the coefficient is significantly different from zero, then the hypothesis that Y_t contains a unit root is rejected. Rejection of the null hypothesis implies stationarity. Precisely, the null hypothesis is that the variable Y_t is a non-stationary series ($H_0 : \alpha_2 = 0$) and is rejected when α_2 is significantly negative ($H_a : \alpha_2 < 0$). If the calculated value of ADF statistic is higher than McKinnon's critical values, then the null hypothesis (H_0) is not rejected and the series is non-stationary or not integrated of order zero, I(0). Alternatively, rejection of the null hypothesis implies stationarity. Failure to reject the null hypothesis leads to conducting the test on the difference of the series, so further differencing is conducted until stationarity is reached and the null hypothesis is rejected. If the time series (variables) are non-stationary in their levels, they can be integrated with I(1), when their first differences are stationary.

Cointegration Test

Once a unit root has been confirmed for a data series, the next step is to examine whether there exists a long-run equilibrium relationship among variables. This is called cointegration analysis which is very significant to avoid the risk of spurious regression. Cointegration analysis is important because if two non-stationary variables are cointegrated, a VAR model in the first difference is misspecified due to the effects of a common trend (Engle and Granger, 1987). If cointegration relationship is identified, the model should include residuals from the vectors (lagged one period) in the dynamic VECM system. In this stage, Johansen's cointegration test is used to identify cointegrating relationship among the variables (Johansen, 1988; Johansen, 1989; Johansen, 1991; Johansen 1992; Johansen, 1995; Johansen and Jusellius, 1990) The Johansen method applies the maximum likelihood procedure to determine the presence of cointegrated vectors in non-stationary time series. The testing hypothesis is the null of non-cointegration against the alternative of existence of cointegration using the Johansen maximum likelihood procedure.

In the Johansen framework, the first step is the estimation of an unrestricted, closed p^{th} order VAR in k variables. The VAR model as considered in this study is:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + BX_t + \varepsilon_t \quad \text{......................(2)}$$

Where Y_t is a k -vector of non-stationary I(1) endogenous variables, X_t is a d -vector of exogenous deterministic variables, $A_1 ....A_p$ *and* B are matrices of coefficients to be estimated, and ε_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

Since most economic time series are non-stationary, the above stated VAR model is generally estimated in its first-difference form as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + BX_t + \varepsilon_t \qquad (3)$$

Where, $\Pi = \sum_{i=1}^{p} A_i - I, \quad and \quad \Gamma_i = -\sum_{j=i+1}^{p} A_j$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank $r < k$, then there exist $k \times r$ matrices α *and* β each with rank r such that $\Pi = \alpha\beta'$ *and* $\beta' Y_t$ is I(0). r is the number of co-integrating relations (the *co-integrating rank*) and each column of β is the co-integrating vector. α is the matrix of error correction parameters that measure the speed of adjustments in ΔY_t.

The Johansen approach to cointegration test is based on two test statistics, viz., the trace test statistic, and the maximum eigenvalue test statistic.

Trace Test Statistic

The trace test statistic can be specified as: $\tau_{trace} = -T \sum_{i=r+1}^{k} \log(1-\lambda_i)$, where λ_i is the $i\,th$ largest eigenvalue of matrix Π and T is the number of observations. In the trace test, the null hypothesis is that the number of distinct cointegrating vector(s) is less than or equal to the number of cointegration relations (r).

Maximum Eigenvalue Test

The maximum eigenvalue test examines the null hypothesis of exactly r cointegrating relations against the alternative of $r+1$ cointegrating relations with the test statistic: $\tau_{\max} = -T \log(1-\lambda_{r+1})$, where λ_{r+1} is the $(r+1)^{th}$ largest squared eigenvalue. In the trace test, the null hypothesis of $r = 0$ is tested against the alternative of $r+1$ cointegrating vectors.

It is well known that Johansen's cointegration test is very sensitive to the choice of lag length. So first a VAR model is fitted to the time series data in order to find an appropriate lag structure. The Akaie Information Criterion (AIC), Schwarz Criterion (SC) and the Likelihood Ratio (LR) test are used to select the number of lags required in the cointegration test.

Vector Error Correction Model (VECM)

Once the cointegration is confirmed to exist between variables, then the third step requires the construction of error correction mechanism to model dynamic relationship. The purpose of the error correction model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state.

A Vector Error Correction Model (VECM) is a restricted VAR designed for use with non-stationary series that are known to be cointegrated. Once the equilibrium conditions are imposed, the VECM describes how the examined model is adjusting in each time period towards its long-run equilibrium state. Since the variables are supposed to be cointegrated, then in the short-run, deviations from this long-run equilibrium will feedback on the changes in the dependent variables in order to force their movements towards the long-run equilibrium state. Hence, the cointegrated vectors from which the error correction terms are derived are each indicating an independent direction where a stable meaningful long-run equilibrium state exists.

The VECM has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationship while allowing for short-run adjustment dynamics. The cointegration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. The dynamic specification of the VECM allows the deletion of the insignificant variables, while the error correction term is retained. The size of the error correction term indicates the speed of adjustment of any disequilibrium towards a long-run equilibrium state.

In this study the error correction model as suggested by Hendry(1995) has been used. The general form of the VECM is as follows:

$$\Delta X_t = \alpha_0 + \lambda_1 EC^1_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta Y_{t-j} + \varepsilon_{1t} \qquad (4)$$

$$\Delta Y_t = \beta_0 + \lambda_2 EC^2_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \Delta X_{t-j} + \varepsilon_{2t} \qquad (5)$$

Where Δ is the first difference operator; EC_{t-1} is the error correction term lagged one period; λ is the short-run coefficient of the error correction term ($-1 < \lambda < 0$); and ε is the white noise. The error correction coefficient (λ) is very important in this error correction estimation as greater the co-efficient indicates higher speed of adjustment of the model from the short-run to the long-run.

The error correction term represents the long-run relationship. A negative and significant coefficient of the error correction term indicates the presence of long-run causal relationship (Granger, 1998). If the both the coefficients of error correction terms in both the equations are significant, this will suggest the bi-directional causality. If only λ_1 is negative and significant, this will suggest a unidirectional causality from Y to X, implying that Y drives X towards long-run equilibrium but not the other way around. Similarly, if λ_2 is negative and significant, this will suggest a unidirectional causality from X to Y, implying that X drives Y towards long-run equilibrium but not the other way around.

EMPIRICAL ANALYSIS

At the outset, the stationarity of all the time series have been tested by the ADF unit root test and the results are reported in Table-1.

It is clear from the Table-1 that the hull hypothesis of no unit roots for both the time series are rejected at their first differences since the ADF test statistic values are less than the critical values at 5%, 5% and 1% levels of significance respectively. Thus, the variables are stationary and integrated of same order, i.e., I(1).

In the next step, the cointegration between the stationary variables has been tested by the Johansen's Trace and Maximum Eigenvalue tests. The results of these tests are shown in Table-2.

The Trace test indicates the existence of one cointegrating equation at 5% level of significance. And, the maximum eigenvalue test makes the confirmation of this result. Thus, the variables of the study have long-run equilibrium relationship between them. The results that appear in Table-2 suggest that the number of statistically significant cointegrating equation is one and is the following:

$$I_t = -1.272 \; IF_t + 0.283 \; GDS_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The significant positive coefficient of GDS_t term shows that gross domestic investment and gross domestic savings move in the same direction in the long-run. But in the short-run there may be deviations from this equilibrium and we have to verify whether such disequilibrium converges to the long-run equilibrium or not. And, vector error correction model can be used to generate this short-run dynamics. The following sets of VEC models have been estimated.

$$\begin{aligned} \Delta I_t &= \alpha_0 + \lambda_1 EC_{t-1}^1 + \alpha_1 \Delta I_{t-1} + \alpha_2 \Delta GDS_{t-1} + \varepsilon_1 \\ \Delta GDS_t &= \beta_0 + \lambda_2 EC_{t-1}^2 + \beta_1 \Delta I_{t-1} + \beta_2 \Delta GDS_{t-1} + \varepsilon_2 \end{aligned} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6)}$$

$$\begin{aligned} \Delta IF_t &= \mu_0 + \kappa_1 EC_{t-1}^1 + \mu_1 \Delta IF_{t-1} + \mu_2 \Delta GDS_{t-1} + u_1 \\ \Delta GDS_t &= \nu_0 + \kappa_2 EC_{t-1}^2 + \nu_1 \Delta IF_{t-1} + \nu_2 \Delta GDS_{t-1} + u_2 \end{aligned} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(7)}$$

The estimation of a Vector Error Correction Model (VECM) requires selection of an appropriate lag length. The number of lags in the model has been determined according to Schwarz Information Criterion (SIC). The lag length that minimizes the SIC is 1. Then an error correction model with the computed t-values of the regression coefficients is estimated and the results are reported in Table-3 and Table-4.

The error correction term represents the long-run relationship. A negative and significant coefficient of the error correction term indicates the presence of long-run causal relationship. If both the coefficients of error correction terms in both the equations are significant, this will suggest the bi-directional causality, otherwise unidirectional causality is indicated. It is clear from both the models that the error correction terms in both the equations are statistically significant. It means long-run bi-directional causality holds in both the models. But it is indicated that no causality exists in the short-run as no lagged term is statistically significant.

The results of the vector error correction models with and without foreign capital, therefore, provide a very interesting evidence for India. It is inferred that domestic savings Granger Cause investment with and without foreign capital in the long-run. Also, investment with and without foreign capital Granger causes domestic savings in the long-run. Such empirical evidence not only supports the F-H findings for 16 OECD countries, but also provides the evidence of increased level of international capital mobility. Thus, this study puts forward another problem which requires much investigation by including more number of appropriate variables and applying more appropriate econometric techniques.

CONCLUSION

This paper examined the F-H puzzle in the perspective of foreign capital inflows to India over the period 1990-91 to 2009-10. The data properties are analyzed to determine the stationarity of time series using the Augmented Dickey-Fuller unit root test which indicates that the variables are I(1). The results of the Cointegration test based on Johansen's procedure indicate the existence of the Cointegration, i.e., the long-run relationship between variables of the study. Furthermore, the estimation of vector error correction models with and without foreign capital provides the evidence of the existence of bi-directional causality between domestic savings and investment with and without foreign capital. This supports the findings of Feldstein and Horioka (1980) while indicating greater level of international capital mobility. The findings suggest that economic openness and financial market integration have led to increased capital mobility in India. Such finding is in line with the results of Younas, and Chakraborty (2009). The empirical results also support the previous findings that foreign capital supplements domestic savings for investment in developing countries like India. Thus, this is the pioneer study to reinvestigate the F-H puzzle thereby suggesting another problem. The examination of this new problem is left for further research.

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Annexure

Table 1: Results of Augmented Dickey-Fuller Unit Root Test

Variables in their First Differences with trend and intercept	ADF Statistic	Critical Values	Decision
GDS_t	- 4.143	At 1% : -4.57 At 5% : -3.69 At 10% : -3.28	Reject Null hypothesis of no unit root at 5% level
I_t	- 4.359	At 1% : -4.57 At 5% : -3.69 At 10% : -3.28	Reject Null hypothesis of no unit root at 5% level
IF_t	- 4.627	At 1% : -4.57 At 5% : -3.69 At 10% : -3.28	Reject Null hypothesis of no unit root at 1% level

Table 2: Results of Johansen's Cointegration Test

Hypothesized Number of Cointegrating Equations	Eigen Value	Trace Statistics	Critical Value at 5% (p-value)	Maximum Eigen statistics	Critical Value at 5% (p-value)
None*	0.781029	31.42883	24.27596(0.005)	25.81984	17.79730(0.002)
At Most 1	0.191400	5.608988	12.32090(0.485)	3.611663	11.22480(0.690)
At Most 2	0.110850	1.997324	4.129906(0.185)	1.997324	4.129906(0.185)

**indicates the statistical significance at the 5% level.*

Table 3: Estimates for VECM Regression without Foreign Capital

Independent Variable	ΔI_t	ΔGDS_t
Constant [t-statistic] (p-value)	0.171704 [3.266071] (0.0029)	0.200641 [4.539875] (0.0001)
EC_{t-1} [t-statistic] (p-value)	-1.239160* [-1.697725] (0.1006)	-1.310838* [-2.136330] (0.0415)
ΔI_{t-1} [t-statistic] (p-value)	0.251594 [0.364531] (0.7182)	0.642640 [1.107598] (0.2775)
ΔGDS_{t-1} [t-statistic] (p-value)	-0.354160 [-0.396955] (0.6944)	-0.955394 [-1.273808] (0.2132)

**indicates the statistical significance at the 5% level.*

Table 4: Estimates for VECM Regression with Foreign Capital

Independent Variable	ΔIF_t	ΔGDS_t
Constant [t-statistic] (p-value)	0.179044 [2.834306] (0.0084)	0.176807 [3.770208] (0.0008)
EC_{t-1} [t-statistic] (p-value)	-1.265406* [-1.683602] (0.1034)	-1.122615* [-2.011954] (0.0539)
ΔIF_{t-1} [t-statistic] (p-value)	0.052865 [0.060816] (0.9519)	0.304459 [0.471804] (0.6407)
ΔGDS_{t-1} [t-statistic] (p-value)	-0.163007 [-0.140225] (0.8895)	-0.467468 [-0.541687] (0.5923)

**indicates the statistical significance at the 5% level.*

AN ECONOMETRIC ANALYSIS OF GROWTH RATE: INDIAN ELECTRONICS INDUSTRY FROM 1981 TO 2004

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Abstract: This paper focuses on the growth rate of Indian Electronics industry from1981 to 2004. This study examines the growth rate of Net Value Added (NVA), Gross Value Added (GVA), Value of Output and Productivity of Labor of that particular industry for different states in India. The database of this study has been drawn from the Annual survey of Industries (Central Statistical Organization), India. Wholesale prices, prepared by the Office of the Economic Advisor, Ministry of Industry have been used to construct deflators to convert Nominal value to Real value data. The data has been analyzed using Linear and Non- Linear production function and Pearson Correlation in SPSS software. . The results of this study indicate that even though the Indian electronics market has been growing at double-digit rate there is negative growth rate for Value of output and Productivity of labor for computer, electronic component and similar component manufacture for all-India and for major states in India.

INTRODUCTION

Until 1970s, the Indian Electronics Industry was relatively small compared to the current Industry size. This sector was rigidly controlled and initiated by government. This was followed by developments in consumer electronics mainly with transistor radios, black and white TV, calculators and other audio products. In 1982 – a significant year in the history of television in India – the government allowed thousands of color TV sets to be imported into the country to coincide with the broadcast of Asian Games in New Delhi. 1985 saw the advent of computers and telephone exchanges, which were succeeded by digital exchanges in 1988. The period between 1984 and 1990 was golden period for electronics during which the industry witnessed continuous and rapid growth. The year 1991 is an important landmark in the economic history of post-independent India. The economic structure was changed due to new economic policy in the year 1991. Liberalization started from 1991. With the change in policy regimes after liberalization, the industry experienced restructuring, with respect to product structure and change in the market structure. From 1991 onwards, there was a severe economic crisis triggered by the Gulf war which was followed by political and economic uncertainties within the country.

The growth of electronics output in the 1970s was driven by electronic capital goods which recorded the highest trend growth rate (39.5%) followed by electronic consumer goods (10.7%), and intermediates (10.2%). Not only did electronic capital goods record a higher growth rate, they also accounted for a dominant share in total production. In 1980s, there was a marked improvement in the rate of growth of electronic consumer goods (32.3%) followed by electronic capital goods (26.1%), and electronic intermediates (23%). The growth rate declined in the case of all the subsectors during the 1988-93 period. The highest decline was observed in the case of consumer electronics (0.44%) followed by electronic intermediates (8.67%), and electronic capital goods (14.9%). During 1993-98 there appears to have been a recovery in the growth of consumer electronics and intermediates, but the recorded growth rate in electronic capital goods was lower than in the 1988-93 period [*K.J.Joseph "The electronic industry"]*

Total employment in the electronics industry has increased from 130,000 persons in 1981 to 345,000 persons in 1997. Production in this industry has grown progressively: Rs. 150 billion ($ 3.22 billion) in 1960 ; Rs. 173 billion ($3.72 billion) in 1971 ; to Rs. 221 billion ($4.75) in 1997-98.*[T.A. Bhavani (2002)].*

Kerala was the first state in the country to establish a focal point to spread the growth of electronics at the regional level. At the instance of the Electronics Commission and on the lines of the recommendation of a High level Committee, the government of Kerala established in 1972 the Kerala State Electronics Development Corporation as a fully owned state enterprise with three objectives i.e.to set up all over Kerala electronics industrial units, to create technical framework which would provide the backbone for the development of electronics industry in the state and to provide technical, commercial and marketing assistance to entrepreneurs. Before setting up Keltron, Kerala accounted for less than 0.25% of the national electronics output in the organized sector and ranked the lowest but one position among the 13 electronics producing regions in the country. By 1980-81 Kerala improved its relative position to reach the 6th rank in the country by producing around 6% of the national output. [*K.K.Subrahmanian and K.J. Joseph (1988)*]

With the process of economic liberalization in India there has been a remarkable increase in the total no. of foreign collaborations in the electronics industry. It has contributed in increasing output & employment. This industry plays an important role in contributing to efficient resource – utilization and greater productivity. This has led to rapid growth in the economy as a whole. India remains a major importer of electronic materials, components and finished equipment amounting to around $20 billion (Rs. 84,000 crore now)[1] in 2007. The country imports electronic goods mainly from China. In the last four years, production of computers has grown at a compounded annual growth rate (CAGR) of 31%, the highest among the various electronic products in India. This has been followed by communication and broadcast equipment (25%), strategic electronics (20%) and industrial electronics (17%). The consumer electronics segment, which has grown at a CAGR of 10% in the last five years, includes a wide range of products such as DVD, VCD/MP3 players, television sets and microwave ovens.

The growth in demand for telecom products has been high, with India adding two million mobile phone users every month, which is one of the main reasons for the growth in production of electronic goods. This growth is expected to continue over the next decade, too. The government has identified electronics and IT hardware manufacturing as one of the thrust areas for development. A special incentive package scheme (SIPS) was announced in March 2007 to attract investments for semiconductor fabrication and other micro and nanotechnology manufacturing industries in India. In the case of exports, the largest share was taken by electronic components, with 47% of total electronic exports. Exports of electronic components have grown at a CAGR of 25% in the last five years. India's main destination for electronic goods is the US.

To study the growth pattern of the Indian Electronics Industry the growth rate of Net Value Added (NVA), Gross Value Added (GVA), Value of Output and Productivity of Labor for this industry from 1981-2004 have been calculated. The method used is different from the methods used in the above-mentioned studies.

This study is organized as follows. Section II provides data and methodology. Section III presents the results of estimation. In Annexure we have tables with statistical results for different states in India and Section IV concludes the study.

DATA AND METHODOLOGY

In this paper we estimate the growth rate of Net Value Added (NVA), Gross Value Added (GVA), Value of Output and Labor Productivity of electronics industry in India. The database of this study is drawn from the Annual Survey of Industries (Central Statistical Organization, India)

[1] 1 Crore = 10 million.

for the period 1981-82 to 2003-04 for different states in India. It may be noted that till 1988-89, the classification of industries followed in ASI was based on the National Industrial Classification, NIC-1970, which was replaced by NIC-1987 from 1989-90 onwards. National industrial Classification, NIC-1987 was replaced by NIC-1998 from 1998-99 onwards. Therefore necessary adjustments have been carried out to make the figures comparable. We have treated NIC-1970 as the base and accordingly carried out data adjustment at 3 digit industry level. The figures of the different components of electronics industry are not available for 3 years (95-96; 96-97; 97-98). Then we use "moving average method" to fill the data gaps. Some components of electronics industry had to be merged. The differences among the 3 forms of classification at the three-digit level industries are as follows:

Industrial Classification By Group

DETAILS	National Industrial classification – 1970	National Industrial classification – 1987	National Industrial classification - 1998
GROUP 1	Industry Division 364	Industry Division 365&366	Industry Division 322 & 323
GROUP 2	Industry Division 365	Industry Division 369	
GROUP 3	Industry Division 366	Industry Division 367	Industry Division 300
GROUP 4	Industry Division 367	Industry Division 368	Industry Division 321

The details of the "Industry Division" classification that has been grouped for this analysis are as follows:

GROUP	DETAILS
GROUP 1	radio and television transmitting , radio sets , sound reproducing , telephone , telegraph , tape-recorders , wires and wireless , remote control apparatus , line telephony and line telegraphy.
GROUP 2	radio-graphic x-ray apparatus, x-ray tubes , parts etc.
GROUP 3	electronic computers, control instruments, computer and computer-based systems and office accounting & computing machinery.
GROUP 4	electronic components, electronic valves, tubes and other electronic components.

Suitable deflators have been constructed with the help of the official series on whole sale price indices (index number of wholesale prices in India, prepared by the office of the economic advisor, ministry of industry) to convert nominal value of NVA, GVA, "Value of Output" and "Productivity of Labor" into real terms. NVA was deflated by "Whole Sale Price Index" (base 1981-82=100) to get real Net Value Added. Similarly, GVA, Value of Output and Productivity of Labor have been deflated by "Whole Sale Price Index" (Base 1981-82=100) to get the real value of GVA, Value of Output and Productivity of Labor.

Real NVA = Nominal NVA /Whole Sale Price Index

[Similarly for Real GVA, Real Value of Output and Real Productivity of Labor]

Data for radio-graphic x-ray apparatus, x-ray tubes (i.e. GROUP 2) is not available from 1998-99 to 2003-04. Whole sale prices are not available for those components of electronics industry. So, for the purpose of this study we have eliminated Group 2 from our analysis.

Data of Group 1 is available for "All India" and thirteen major states in India. Thirteen states are Andhra-Pradesh (APR) , Delhi (DEL) , Gujarat (GUJ) , Haryana (HAR) , Karnataka (KAR) , Kerala (KER), Maharashtra (MAH), Madhya-Pradesh (MPR) , Punjab (PUN) , Rajasthan (RAJ) , Tamil-Nadu (TND) , Uttar-Pradesh (UPR) and West-Bengal (WBN) .

Data of Group 3 & Group 4 are not available for MPR and PUN. So, we eliminate these two states from our present study for Group 3 and Group 4. Therefore only eleven states and "All India" data has been used for analyzing

This section briefly describes the method of "Growth Rate Estimation" from 1981-82 to 2003-04. In this context, we assume two specifications—one is linear and other is non-linear or exponential specification. SPSS has been used for calculating the results. Pearson coefficient analysis has been used to calculate the results.

Linear production function can be written as

$Y = A + Bt$............(1)	Here Y is dependent and t (time) is independent variable.
$\hat{Y} = \hat{A} + \hat{B}t$............(2)	Differentiating (1) w.r.t. time we get $\partial y / \partial t = B$

To find out the rate of growth the following calculation is used:-

$ROG = 1/Y \times \partial Y / \partial t$

Replace Y by mean value $(\overline{Y})$ we get rate of growth $ROG = \hat{B} / \overline{Y}$.................(3)

From equation (2) and (3) we get the regression equations and the estimated growth rate of NVA , GVA , Value of Output and Productivity of Labor respectively for linear model.

Let us now consider non-linear or exponential production function

$Y = AB^t$...................(4)

Logarithmic form of the production function can be written as

$LogY = LogA + (LogB)t$................(5)

Here LogY is dependent and t is independent variable. Using SPSS we regress LogY on t and get the following regression equation

$Log\hat{Y} = Log\hat{A} + (Log\hat{B})t$..........................(6)

in non-linear specification the rate of growth is

$ROG = 1 - AntiLog(Log\hat{B})$............................(7)

Equation (6) and (7) give the regression result and the estimated growth rate of NVA,,GVA, Value of Output and Productivity of Labour respectively for non-linear model.

From linear model we compute correlation($r_{Y\hat{Y}}$) between (Y) and estimated Y $(\hat{Y})$. From non-linear model we find out correlation($r_{Y\hat{\hat{Y}}}$) between Y and $\hat{\hat{Y}}$ ($Anti\log(Log\hat{Y})$). $\hat{\hat{Y}}$ in this equation means $Anti\log(Log\hat{Y})$. Y stands for NVA, GVA, Value of Output and Productivity of Labour. Finally, we choose the specification as best fit for which correlation is highest.

RESULTS OF ESTIMATION

Net Value Added:

According to A.S.I. definition NVA is arrived by deducting total input and depreciation from total output. Estimated growth rates in NVA of Group-1 are given in Table T-1 (see Annexure). The coverage of the study relates to the period 1981-82 to 2003-04 for different states in India. It is observed from T-1 that estimated growth rates of NVA for the above states follow linear specification as the best fit because the correlation coefficient (i.e. Pearson correlation) is highest. In T-1 we observe the negative growth rate for six states (Delhi, Karnataka, Kerala, Madhya –Pradesh, Tamil-Nadu and West-Bengal).

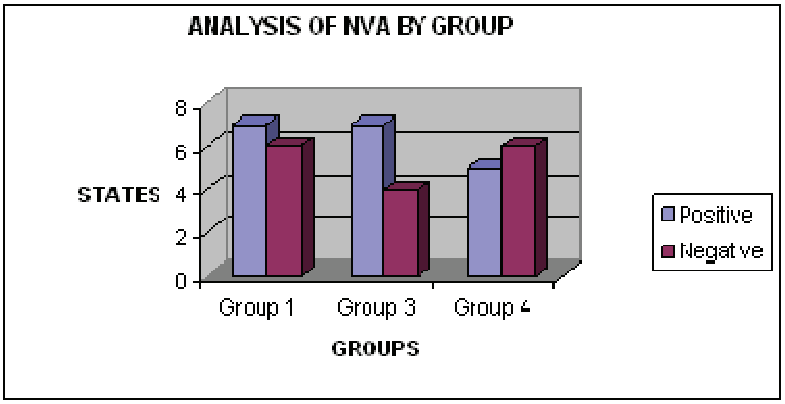
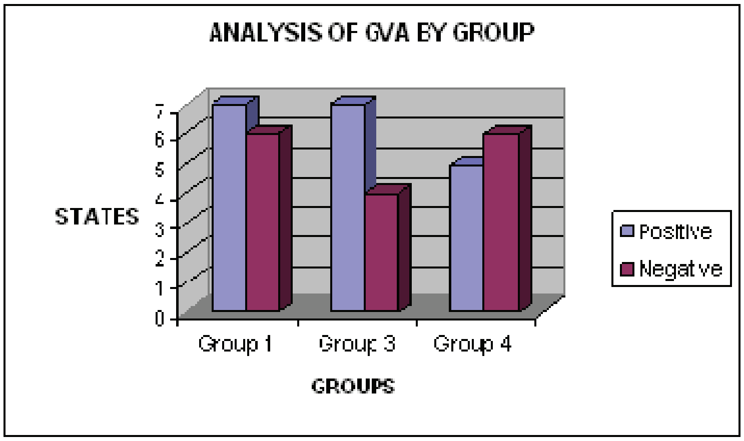


Table T-2 and T-3 (Annexure) present the estimated growth rates in NVA of Group-3 and Group-4 respectively for the states as mentioned in Section II. All states follow linear specification as the best fit because Pearson correlation coefficient is highest. We observe negative growth rate for four states (APR, GUJ and HAR and RAJ) of Group-3..In T-3 all states follow linear model as the best fit because correlation coefficient is highest. We observe negative growth rate of Group-4 in six out of eleven states (APR , HAR , MAH ,RAJ, UPR and WBN).

Gross Value Added

GVA is defined as the sum of net value added and depreciation. Estimated growth rates in GVA of Group-1 are given in Table T-1 (Annexure). It is observed from T-1 that estimated growth rates of GVA for the above states follow linear specification as the best fit because the correlation coefficient (i.e. Pearson correlation) is highest. In T-1 we observe the negative growth rate for six out of thirteen states (Delhi, Karnataka, Kerala , Madhya –Pradesh , Tamil-Nadu and West-Bengal).

Table T-2 and Table T-3 (annexure) present the estimated growth rates in GVA of Group-3 and Group-4 respectively for the states as mentioned in section II. All states follow linear specification as the best fit because Pearson correlation coefficient is highest. We observe negative growth rate for four states (APR , GUJ and HAR and RAJ) for Group-3. In T-3 all states follow linear model as the best fit because correlation coefficient is highest. We observe negative growth rate of Group-4 for six states out of eleven (APR, HAR ,KER, MAH, RAJ and WBN).



Value of output:

According to A.S.I. definition the terms value of output, gross output and total output, have been used in the text interchangeably. Table T-1 (annexure) presents estimated growth rates in Value of output of Group-1 during the entire period 1981-2004. It is observed from T-1 that estimated growth rates of Value of output for the above states follow linear specification as the best fit because the correlation coefficient (i.e. Pearson correlation) is highest. In T-1 we observe the negative growth rate for Seven states (Delhi, Karnataka, Kerala , Madhya –Pradesh , Punjab , Tamil Nadu and West Bengal). It is to be noted that though we have negative NVA and GVA in Six states the Value of Output is negative in seven states.

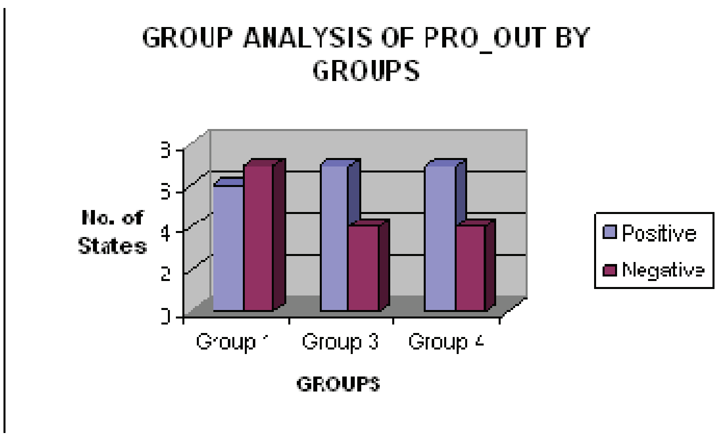


Table T-2 and Table T-3 (annexure) present the estimated growth rates in Value of output of Group-3 and Group-4 respectively for the states as mentioned in Section II of this paper. All states follow linear specification as the best fit because Pearson correlation coefficient is highest. We observe negative growth rate for four states (APR , GUJ and HAR and RAJ) for Group-3.In T-3 all states follow linear model as the best fit because correlation coefficient is highest. We observe negative growth rate of Group-4 for four states (APR , HAR , RAJ and WBN) .

Productivity of labor:

We obtain Productivity of labor as the ratio of Value of output at constant prices to the number of workers. Table T-1 (annexure) presents estimated growth rates in Productivity of labor of Group-1 during the entire period 1981-2004. It is observed from T-1 that estimated growth rates of Productivity of labor for the above states except Punjab follow linear specification as the best fit because the correlation coefficient (i.e. Pearson correlation) is highest. Punjab follows non-linear trend as the best fit. In T-1 we observe the negative growth rate for 62 % of the states (Delhi, Gujarat , Haryana ,Karnataka, Kerala ,Tamil Nadu , Uttar-Pradesh and West Bengal).

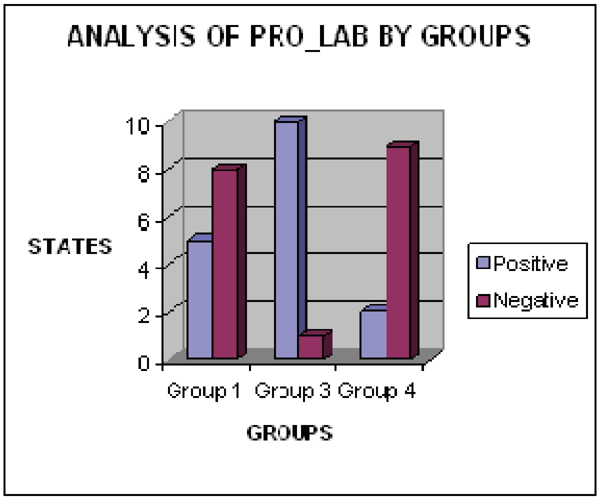


Table T-2 and Table T-3 (annexure) present the estimated growth rates in Productivity of labor of Group-3 and Group-4 .All states follow linear specification as the best fit because Pearson correlation coefficient is highest. We observe that there is a positive growth rate for most of the states. Only Rajasthan has negative growth rate for Group-3. In T-3 all states follow linear model as the best fit because correlation coefficient is highest. We observe negative growth rate of Group-4 for Nine out of eleven states (APR, GUJ, HAR, KER, MAH, RAJ, TND, UPR and WBN).

CONCLUSION

The Indian electronics market has been growing at double-digit rate. Economic growth increasing affluent population, changing lifestyle, and low level penetration of consumer electronic goods have all contributed to this growth. However we observe a negative growth rate for Net value added and Gross value added for Group-3 and Group-4 for all-India and for most major states in India in the calculations stated in this paper upto 2003-04. We observe negative growth rate for Value of output and Productivity of labor for Group-1 and Group-3 for all-India and for major states in India. Estimated growth rates in NVA and GVA of Group-3 are -17.996% and -18.306% for all-India. For Group-4 the estimated growth rates in NVA and GVA are -23.287% and -22.902% for all-India. Estimated growth rates in Value of output and Productivity of labor are -16.7427% and -17.446% for Group-1 for all-India. For Group-3 the estimated growth rates -21.823% and -22.351% for Value of output and Productivity of labor for all-India.

One of the reasons cited by experts for the poor performance of the Indian electronics manufacturing sector is the issue of difference in import taxes between Electronics final products and Electronic components (raw materials). According to Thaindian News (Feb 16th,2008), the inverted duty structure impacts the domestic industry adversely as it has to pay a higher price for the raw material in terms of duty, the finished product on the other hand lands at lower duty and costs less. The Thaindian News further states that India is likely to lower import duties. The Indian industry has also been pressing for a considerable reduction in the import duties for a long time now. Electronics sector has also been affected due to various bilateral trade agreements signed by India. This sentiment on the difference of import duty on raw material and finished good import is shared by the the representatives of the four major industry associations i.e.

CETMA (consumer electronics and television manufacturers association), MAIT(manufacturers association of information technology) , ELCINA (electronic component industries association) and TEMA(telecom equipment manufacturers association). According to these associations as stated in Business Standard, Friday Nov 20, 2009, the entire electronics industry should be taxed in a uniform manner in the age of convergence. The industry has asked for a uniform sales tax of 4% on all electronic products. At present, sales tax varies from 8% for products like PCs to 17% for CTVs. As calculated in this paper the Industry is already seeing negative growth rate and the opening up of the electronics market and having 0% import duty on finished products is not helping the local manufacturing industry. The ELCINA president Mr. Vinod Sharma warns “we in ELCINA strongly feel that ignoring this sector for too long may result in putting the industry in an irretrievable situation, encouraging large scale imports replacing local component and equipment manufacturing.” Most of the hardware and electronic final products attract zero custom duty. Dual use raw materials are still subject to custom duties of 5-10%”.

The issue on difference in import duty between the raw materials and the final product is also aggravated because there is almost no local manufacturing of Electronic Components. As stated in EFY times News, 14th November 2009 “With virtually no domestic production of electronic components, manufacturers like Nokia, Elcoteq, Jabil, Dell and others have to import almost all components and this becomes a major cost factor”.

Infrastructure inadequacy continues to be an issue in India. Inadequate airport facilities, roads, power supply continue to be an issue for the electronics Industry. Electronic sector needs are better policies, reduction of government control and quicker decision-making

Electronics Industry is the way for the future for most major countries. Electronics and IT are driving the growth of "Tiger" economies of South East Asia. To support the geometric growth in the software sector, India needs to accelerate reforms for the electronics-manufacturing sector. The following are suggested:

- Reduction in import duties on electronics components to allow large scale assembly in India
- Zero customs duty for capital goods for the electronics sector that are not manufactured in India
- Grants for creation of electronics clusters across the country like in Pondicherry, Bangalore, Chennai etc.
- 2-hour customs clearance commitment for electronics components
- Rationalization of duties, both customs and excise, on computer hardware. Ideally, import duty on computer hardware to be zero with a rebate of 50% of sale value of computer for excise duty purposes. Policies to increase computer penetration to at least 5 per 100 by 2008
- Special marketing teams to be set up in consultation with industry for facilitating electronics manufacturing in India
- Reduction of excise duty on electronics across the board to 8% to boost this sector.
- Infrastructure also needs special attention. Enhancement of work on the National Highway program and the rural road program are important.
- Indian airports need to be privatized as soon as possible and the government should adopt an open sky policy for India.
- The power sector has grown strong because of reforms and needs to be further encouraged

With the initiation of new economic policy in 1991 and subsequent reforms process, India has witnessed a change in the flow and direction of foreign direct investment (FDI) into the country. This is mainly due to the removal of restrictive and regulated practices. Foreign direct investment in India increased from US $ 129 millions in 1991-92 to US $ 40,885 million in March, 2005, an increase of about 316.9 times. The FD investments have increased in modern industrial sectors like electronics and electrical equipments. We observe positive growth rate for some states in India due to FDI inflows to electronics after liberalization. 100 percent Foreign Direct Investment (FDI) is permitted in the electronics industry under automatic route except Aerospace and defense equipment manufacturing. India boasts of availability of low cost, efficient and technically skilled workforce. The National Electronics Hardware Manufacturing Policy has been advised to be implemented with the aim to dissolve tariff and duties as well as set up manufacturing units, which will encourage more of foreign investments in the unit. Some component manufactures are showing increasing interest in manufacturing electronic components in India. As fallout of the above measures and opportunities some states in India have already witnessed positive growth rate of NVA, GVA, Value of output and Productivity of labor for electronics products. For Group-1 India witnessed positive growth rate of NVA and GVA i.e. 8.592% and 8.9429%. For Group-4 India witnessed positive growth rate of Value of output and Productivity of labor i.e. 24.028% and 10.765%.

India is slowly becoming one of the major global powers. The rise of G20 as the economic global powerhouse with India becoming one of the major power center raise the need for further stimulation of the electronics industry. There are major stimulants for growth of Indian Electronics Industry:

- Availability of low-cost, efficient, and technically skilled workforce.
- Opportunities for the manufacturing of consumer electronic goods and mobile handsets are high given the growing demand in the domestic electronics market.
- Electronics hardware is growing leaps and bounds globally.
- Large-scale manufacturing units of electronics hardware will be set up in the special economic zones with a total exemption of duties and taxes.
- India has high chances to acquire a size USD 11 billion in terms of contract manufacturing out of USD 500 billion by 2010.
- Designing of electronics will touch USD 7 billion by 2010.
- Component exports will touch USD 5 billion by 2010.
- Nokia and Elcoteq Network are planning to set up manufacturing operations in India.

India is expected to have a huge growth in Consumer demand of electronics. As per the ISA-Frost & Sullivan Report 2006 the Consumer Demand for different sectors of the electronics Industry is forecasted to grow as follows:

Electronic Equipment Mkt: Unit forecast and end-user products:
(Units in '000 Nos)

End- User Products	2003	2004	2005	2006	2007	2010	2015
Television	9200	10350	11500	13300	15200	20100	32100
Wireless Handsets	13125	22080	35508	53191	87872	199237	530463
Desktops	2800	3630	4250	5310	6880	14170	38510
Monitors	3800	5000	6500	8150	9620	17500	43500
Laptops	180	220	300	517.5	804	1608	4020

Considering the opportunity that lies ahead and the way the world economy is shaping up for India if India can undertake the necessary reforms the future for the Indian electronics Industry can only be Positive. However the current situation requires immediate implementation of reforms to ensure improvement of Indian Electronics industry.

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'Total Factor Productivity Growth And Output Growth In Indian Electronics Industry In The Liberalization Era : An Empirical Examination' , *Abstract : JEL Code : D24 – ID : 118.*

Annexure

All statistical results for NVA , GVA , Value of output and Productivity of labor are shown in the following tables :

T-1: Estimated growth rates of Group-1 for NVA , GVA , Value of Output and Productivity of Labor from 1981 to 2004 :

State	NVA		GVA		Value of output		Productivity of labour	
	Chosen growth rate(%)	**Chosen growth type**	**Chosen growth rate(%)**	**Chosen growth type**	**Chosen growth rate(%)**	**Chosen growth type**	**Chosen growth rate(%)**	**Chosen growth type**
APR	7.783	Linear	7.3245	Linear	4.93038	Linear	3.4016	Linear
DEL	-.0022	Linear	-0.26804	Linear	-4.04664	Linear	-2.8693	Linear
GUJ	2.1483	Linear	2.05655	Linear	0.16735	Linear	-2.7703	Linear
HAR	4.127	Linear	3.97865	Linear	2.63068	Linear	-0.32565	Linear
KAR	-1.808	Linear	-1.69453	Linear	-.65468	Linear	-0.22269	Linear
KER	-.0086	Linear	-.12033	Linear	-.23967	Linear	-2.36564	Linear
MAH	.5179	Linear	0.40646	Linear	0.90685	Linear	0.24543	Linear
MPR	-3.527	Linear	-2.2453	Linear	-1.27852	Linear	0.13816	Linear
PUN	3.6917	Linear	3.32127	Linear	-0.10711	Linear	10.6612	Non-inear
RAJ	3.5591	Linear	3.52062	Linear	3.6579	Linear	1.27737	Linear
TND	-3.9315	Linear	-3.88227	Linear	-3.131	Linear	-2.69213	Linear
UPR	.54166	Linear	0.45945	Linear	0.48227	Linear	-0.43582	Linear

WBN	-2.7322	Linear	-2.50669	Linear	-1.9293	Linear	-2.66909	Linear
IND	8.59203	Linear	8.94296	Linear	-16.7427	Non-linear	-17.4464	Non-linear

T-2: Estimated growth rates of Group-3 for NVA , GVA , Value of Output and Productivity of Labor from 1981 to 2004 :

States	NVA		GVA		Value of output		Productivity of labour	
	Chosen growth rate	Chosen growth type	Chosen growth rate(%)	Chosen growth type	Chosen growth rate(%)	Chosen growth type	Chosen growth rate(%)	Chosen growth type
APR	-2.5752	Linear	-2.4904	Linear	-2.86605	Linear	0.3877	Linear
DEL	9.8982	Linear	1.77334	Linear	2.67099	Linear	2.5073	Linear
GUJ	-2.68526	Linear	-2.4926	Linear	-2.11246	Linear	1.5257	Linear
HAR	-6.6003	Linear	-6.3334	Linear	-5.71325	Linear	1.28909	Linear
KAR	3.17852	Linear	3.1914	Linear	3.62156	Linear	3.65366	Linear
KER	3.31627	Linear	3.2121	Linear	2.57401	Linear	2.32835	Linear
MAH	1.30516	Linear	1.2221	Linear	2.02091	Linear	1.3529	Linear
RAJ	-10.3868	Linear	-9.9398	Linear	-8.81318	Linear	-2.9541	Linear
TND	1.31273	Linear	1.62401	Linear	2.0142	Linear	1.1737	Linear
UPR	4.5669	Linear	4.6186	Linear	5.03059	Linear	1.4407	Linear
WBN	.83748	Linear	.94161	Linear	.8225	Linear	3.04334	Linear
IND	-17.9967	Non-linear	-18.3068	Non-linear	-21.8231	Non-linear	-22.3516	Non-linear

T-3: Estimated growth rates of Group-4 for NVA , GVA , Value of Output and Productivity of Labor from 1981 to 2004 :

States	NVA		GVA		Value of output		Productivity of labour	
	Chosen growth rate(%)	Chosen growth type	Chosen growth rate(%)	Chosen growth type	Chosen growth rate(%)	Chosen growth type	Chosen growth rate(%)	Chosen growth type
APR	-1.45941	Linear	-1.6373	Linear	-2.07365	Linear	-0.65731	Linear
DEL	3.3515	Linear	3.43744	Linear	3.91915	Linear	1.06915	Linear
GUJ	4.2107	Linear	4.41758	Linear	3.18702	Linear	-0.24146	Linear
HAR	-4.5785	Linear	-4.8488	Linear	-6.0767	Linear	-3.2202	Linear
KAR	3.5027	Linear	3.30226	Linear	3.81137	Linear	0.5937	Linear
KER	.172055	Linear	-1.0676	Linear	0.02166	Linear	-2.7323	Linear
MAH	-.934838	Linear	-0.97448	Linear	.37105	Linear	-0.68721	Linear
RAJ	-1.51005	Linear	-2.11847	Linear	-.398088	Linear	-4.6855	Linear
TND	1.4817	Linear	1.29963	Linear	1.45833	Linear	-0.39209	Linear
UPR	-0.81591	Linear	0.22359	Linear	.536345	Linear	-0.34701	Linear
WBN	-2.32549	Linear	-1.43312	Linear	-1.5678	Linear	-3.1814	Linear
IND	-23.2877	Non-linear	-22.9023	Non-linear	24.02807	Non-linear	10.7659	Linear

The Rise In Equity Exchange Traded Funds (ETFs): The Case of Momentum

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Abstract: Using data obtained from CRSP and Morningstar (2001-2009), this study examines the returns and liquidity behavior of 2,366 Equity Exchange Traded Funds (ETFs). ETF portfolio formation and holding periods (6, 3 and 1 months) for the entire sample and by specialties with deciles categorized by returns and liquidity were analyzed. Momentum does not exist when analyzing the overall portfolio of ETFs. The mean formation estimate for the entire ETFs winners is 31.5%, compared with the value of 0.2% for the 6 months formation and holding periods respectively. On the other hand the mean formation periods returns for the losers are -24.25% compared to 3.3% for the holding period. In the formation and holding periods of 1 and 3 months there were evidence that momentum exist amongst the losers portfolios. The plausible reason for this result is that the 1month and 3 months periods are not enough time to factor in transaction costs.

INTRODUCTION

Exchange traded funds (ETFs) are Trust funds and basket of securities designed to track an index. ETFs add the flexibility, ease, and liquidity of stock trading to the benefits of traditional index fund investing. The world global financial market has witness a substantial increase in equity exchange traded funds (ETFs) since its inception in the early 1990’s to date. These increases are more prevalent in the US. Recently, as early as 1993, the State Street Global Advisor listed the first ETF on the American Stock Exchange. According to Fund International (2004), US domestic equity ETFs grew at an annual compounded rate of 38.3% from 2000 to 2004. Outside the US, similar trends were observed, most especially in UK, Europe, Asia and South Africa.

The reasons for the growth of ETFs could be attributed to its characteristics. ETFs tend to offer greater tax benefits due to the fact that they generate fewer capital gains as a result of lower turnover of the securities that comprises their portfolios. The sale of ETFs securities only reflects the changes in its underlying index. Since ETFs are index based, they are unlikely to experience high management fees. Furthermore, the composition of ETFs as a basket of securities provides diversification inherently across an entire index. ETFs can be traded at any time while the exchange is open. Like other types of funds, arbitrage forces the price of ETFs to be aligned with the net asset value, thereby limiting its tracking error. ETFs are structured as a trust to minimize tax distribution in most cases.

The increasing trends in ETFs have not abated despite the downturn of economic activities. In her recent paper, Mitchell (2010), noted that some portion of the ETF market have withstood the recent slowdown of economics fluctuations. She observed that from January through the end of

April 2010, investors confidence in an economic recovery has led to strong performance in equity exchange traded funds.

LITERATURE REVIEW

Based on size, trading volume, returns and fund price performance, Madura and Ngo (2008), examined whether ETFs exhibited pricing discrepancies. They formed decile of portfolios over 93 months (January 1997-September 2004) in which the beginning of each month was considered the portfolio formation month. For eight different holding periods within each decile, they obtained the abnormal holding period returns. The same decile portfolio applied to apportioned size was also used for trading volume and fund price performance. They concluded that ETFs do not experience momentum. That, the performance of ETF's is inversely related to size, while ETFs with lower trading volume are more likely to be mispriced or subject to liquidity premium. Most literatures look at the source of price momentum either as driven by the stock specific industry or by individual-stock momentum. Scowcroft and Sefton (2005), confirmed that price return momentum is driven by industry momentum. They however postulated that momentum occur in medium cap industry.

Jong and Rhee (2008), looked at the abnormal returns with momentum and contrarian strategies using exchange traded funds. Their study found that investment in ETFs provides abnormal return which exceeds transaction cost. And that the presence of abnormal return exist after using Fama and French (1993) three factor-factor model to adjust for risk. In that case, portfolios of ETFs that either buy the winners and short the losers or buy the losers and short the winners could earn abnormal returns. However, it is pertinent to note that all US ETFs are passively managed to track an index, not actively managed to time the market or beat the market by loading up on high momentum stocks. Yet in spite of this disadvantage of actively managed mutual funds, ETFs provided economically and statistically significant abnormal returns to contrarian strategies of buying the loser ETFs and shorting the winner ETFs with formation and holding periods of one day and one week, and to momentum strategies of buying the winners ETFs and shorting the losers ETFs with formation and holding period from 4 to 39 weeks, according to the authors.

The concept of buying past winners and selling past losers strategies were further evaluated by Jegadeesh and Titman (1993). They found that this strategy realized significant abnormal returns over the 1965 to 1989 period. They selected stocks based on 6-months holding period and returns. They found a realized compounded excess return of 12.01% per year on average. They argued further that the profitability of the relative strength strategies were not due to their systematic risk. The results of their tests also indicated that the relative strength of profits could not be attributed to lead-lag effects that resulted from delayed stock price reactions to common factors. The evidence is, however, consistent with delayed price reactions to firm-specific information. The returns of the zero-cost winners minus losers portfolio were examined in each of the 36 months following the portfolio formation date. With the exception of the first month, this portfolio realizes positive returns in each of the 12 months after the formation date.

However, the longer-term performances of these past winners and losers reveal that half of their excess returns in the year following the portfolio formation date dissipate within the following 2 years. The returns of the stocks in the winners and losers portfolios around their earnings announcements in the 36 months following the formation period were also examined and a similar pattern was found. Specifically, stocks in the winners portfolio realize significantly higher returns than the stocks in the losers portfolio around the quarterly earnings announcements that are made in the first few months following the formation date. However, the announcement date returns in the 8 to 20 months following the formation date are significantly higher for the stocks in the losers portfolio than for the stocks in the winners portfolio, they concluded.

In his comparative study about the interaction between value and momentum, Asness (1997) posited that both value and momentum strategies are effective in predicting returns across sections of stocks. Thus, according to Asness, pursuing a value strategy entails to some extent buying firms with poor momentum. Similarly, buying firms with good momentum entails to some extent pursuing a poor valued strategy. He contends that in most cases, holding momentum constant leads to a more effective value strategy.

Asness further stated that the relations of value and momentum to future returns are not simply stronger holding the other variable constant, but that, they are conditional upon each other. In general, value works, but largely fails for firms with strong momentum. Momentum works, in general, but is particularly strong for expensive firms. He interpreted these differences why value strategies work is that value represents risk versus that the market is inefficient. Value strategies might work because of investors' inability to price securities correctly (e.g., investors might systematically over extrapolate good or bad past results). He went ahead to ask the following questions: “Is it plausible that investors' abilities are much better among recent winners than among recent losers? Do investors misprice bad news more than good news”? Lakonishok, Josef, Shleifer and Vishny (1994) offered one possible explanation for the efficacy of value strategies. According to them, investors might wish to avoid owning stocks with good value because of the perception that those are bad companies. Perhaps no such stigma applies to recent winners, no matter what their valuation measures indicate. They contend that value strategies largely fail among winners because the premium to owning bad companies is nonexistent. That is, there are no bad companies among recent winners.

In their 2001 study, Jegadeesh and Titman evaluates various explanations for the momentum profits documented previously by their 1993 research. Here they first document momentum profits in the eight years subsequent to their 1993 study. They discovered that momentum profits are not entirely due to data snooping biases. Furthermore, their results suggested that market investors did not altered their investment strategies in a way that would eliminate the source of return predictability. They examined the returns of the momentum portfolios in the post-holding period. By looking at the post-holding period performance they concluded that its returns should be negative in comparison to the momentum portfolio.

RESEARCH QUESTIONS

The goal of this study is to access the returns and liquidity behavior of ETFs. How an individual stock reacts to the stream of returns (monthly) as with the case of this study and momentum could be applied in developing hypotheses for return discrepancies of ETFs. Many studies including Chopra (1992), Jegadeesh and Titman (1993), and Liang and Mullineaux (1994) have found the existence of individual stock overreaction on price differences. In their 1999 study, Moskowitz and Grinblatt also found compelling evidence on the existence of momentum on monthly industry returns where the industry indexes are computed from the CRSP data base. The null hypothesis in this study with respect to returns is that ETFs do not exhibit momentum and if they however do, will depend on the formation and holding period and the momentum effects are minimal.

To ascertain the usefulness of trading volume or as an indicator of ETF returns, we estimate liquidity as the proportion of the trading volume to the number of outstanding shares. Hence the liquidity in the previous month is applied in forming deciles of portfolio holdings of ETFs. The returns are then measured from the formation to the holding period. It is hypothesized that ETFs with less liquidity are likely to derive smaller returns due to liquidity premium and because they are more likely to be monitored closely.

METHODOLOGY AND DATA

This study attempts to replicate an existing research using different data set and research questions. The data for this research were obtained from CRSP and Morningstar. The data are from 2001 to 2009. In their 2008 study Madura and Ngo examined if ETFs are constrained to pricing discrepancies. They tested whether the trading strategies resulted in gains above market levels. Their trading strategies were on; a) size (market capitalization), (b) trading volume, and (3) stock price performance (momentum).

This paper is decomposed into two steps: deciles of portfolios are formed based on returns and liquidity. Then, how the decile portfolios performed in subsequent holding periods are accessed. The start of each month from January 2001 to December 2009 is called the portfolio formation month. Hence, we have 108 portfolio formation months. At the start of each portfolio formation month, we compiled and identified all ETFs in existence (2,366). We obtained shares outstanding, prices, market capitalization, volume of trading, value weighted average returns, equal weighted average returns and distributed adjusted prices. With these information we formed ten deciles of ETFs based on the returns and liquidity.

To determine the performance of liquidity and returns, an assessment of the deciles over their holding periods was undertaken. This methodology is consistent with the overlapping holding periods applied by Jegadeesh and Titman (1993). They suggested that the use of overlapping periods increases the powers of the statistical tests. The portfolios formed are then held for the next 6 months, one after the end of the formation period. Then the difference between the abnormal return of the lowest and highest deciles is determined for each overlapping 6-month holding period and tested for significance. The same method is applied for 1 and 3 months formation and holding periods.

The sample in this study consists of all ETFs in existence from January 2001 to December 2009 both locally (US) and internationally for about a total of 2366. The list was compiled from CRSP, Morningstar and American Stock Exchange. Table 1 provides the summary statistics of the whole sample; it provides the number of ETFs in each year and the categories with the following symbols:

1 Asset Allocation
2 Balanced as Bal
3 Corporate Bond General as CorpB
4 Diversified Emerging Market as Emkt
5 Equity-Income as Eqin
6 Europe Stock as Eupa
7 Foreign Stock as Int'l
8 Government Bond as Govt.
9 Growth as Large Cap
10 Growth and Income as Large Cap
11 Income as Large Cap
12 Multisector Bond as MS
13 Municipal Bond as Govt Stock
14 Pacific Stock as Int'l

15 Small Company as Small Cap
16 Specialty – Communication as Comm
17 Specialty – Financial as Finn
18 Specialty –Health as Hlth

19 Specialty – Natural Resources as NatRes
20 Specialty - Precious Metals as PreMetl
21 Specialty -Real Estate as RelEst
22 Specialty –Technology as Tech
23 Specialty – Unaligned as Unalign
24 Specialty – Utility as Utity
25 World Stock as Int'l
26 Worldwide Bond as Int'l

We group the whole ETFs into all and sectors (specialty) and provide some sample statistics at portfolio formation months. From Table 1, it is obvious that the number of ETFs has grown over the years, therefore, the deciles in more recent months contain more ETFs than the deciles formed near the beginning of the sample period. ETFs are large as indicated by the share of the monthly returns and experience heavy trading volume. Table 1 is decomposed into prices, returns, number of shares outstanding, trading volume, market capitalization and trading volume.

The difference between the ETF decile portfolio return and a corresponding benchmark return that is the equally weighted average returns (EWRETD) form the abnormal return. The holding period returns (HPR) for the ETFs are calculated on a monthly compounded basis. Market benchmark holding period returns EWRETD are derived from CRSP-equally weighted index. The abnormal holding period returns (AHPR) is calculated for each ETF decile by using the following formula: $AHPR = \sum(HPR_{ik}-EWHPR_i)/N$ where i is the number of months after the formation period and k is the number of ETFs in each decile portfolio (k=0 to N). EWHPR is equally weighted holding period returns.

EMPIRICAL RESULTS

The results from Table 2 are separated and analyzed with respect to the methods of ETF portfolio formation and holding periods (6, 3 and 1 month). The results are shown for each formation and holding method for the entire sample categorized by returns. There is a difference between the results of average abnormal holding period returns of the decile containing the highest versus lowest ETFs. Following Jegadeesh and Titman (2001), Momentum does not exist when analyzing the overall portfolio of ETFs. The mean formation estimate for the winners is 31.5% while the holding period recorded a value of 0.2% for the 6 months formation and holding periods. On the other hand the mean formation periods returns for the losers are -24.25% compared to 3.3% for the holding period. For the formation and holding periods of 1-month and 3-month, there is evidence that momentum exists amongst the loser portfolios. The plausible explanation for this result is that 1-month and 3-month periods are not enough time to factor in transaction costs.

CONCLUSION

Most studies conclude that momentum does exist with Equity Exchange Traded Funds (ETFs). However, using data obtained from CRSP and Morningstar (2001-2009), this study examined the returns and liquidity behavior of 2,366 ETFs. In particular, the study analyzed ETF portfolio formation and holding periods for 6 months, 3 months and 1 month and by specialties with deciles categorized by returns and liquidity. The study finds that momentum does not exist when analyzing the overall portfolio of ETFs. The mean formation estimate for the entire ETFs winners is 31.5%, compared with the value of 0.2% for the 6 months formation and holding periods. On the other hand, the mean formation period return for the losers is -24.25% compared to 3.3% for the holding period. In the formation and holding periods of 1 month and 3 months there was evidence that momentum exist amongst the losers portfolios according to Table 3. For the 1 month and 3 months formation and holding periods, losers continue to loss. The mean formation period for the 3 months were 21% and 1%, while 12% and 143% were observed for the I month formation and holding period respectively. This result can be attributed to the fact that 1 month and 3 months periods were not enough time for transaction costs to be incorporated into the analysis.

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Table 1
Descriptive Statistics

All ETFs	All	Bal.	CorpB	Emkt	Eupa	Int'l	Govt	LargCap	SmCap	Eqln	Ms	Sectors								
												Comm.	Finn	Hlth	NatRes.	PreMetl	RelEst	Tech	Unalign	Utity
Year (735)																				
2001 86	0	0	0	2	12	10	0	19	8	0	0	4	4	4	4	0	1	9	6	3
2002 110	0	0	0	3	13	13	0	23	8	0	0	5	5	6	7	0	3	14	7	3
2003 123	0	0	1	4	16	13	4	26	15	0	0	5	5	6	7	0	3	15	7	3
2004 131	0	0	1	6	16	13	4	30	8	0	1	5	5	6	7	0	3	15	8	3
2005 166	0	0	1	6	16	15	4	45	14	0	1	6	6	7	9	1	4	15	12	4
2006 217	0	0	1	7	17	20	4	60	20	0	1	8	10	9	12	2	4	19	17	6
2007 346	0	0	1	8	18	42	4	101	26	1	1	8	18	18	29	4	7	24	26	10
2008 534	5	0	4	20	21	75	22	136	38	1	1	8	22	21	50	7	23	30	35	15
2009 653	14	1	4	30	21	100	27	151	42	1	1	11	27	23	72	12	26	34	37	19
Descriptive statistics																				
Variables																				
Price	22	10.5	61.8	41.2	25.8	41.5	59.9	48.1	47.3	44.3	87.0	29.3	55.1	45.8	39.1	36.8	47.6	32.0	39.6	42.3
Returns	0.005	-0.009	0.005	0.001	-0.006	0.004	0.003	0.0006	0.001	0.001	0.004	-0.0005	-0.006	0.003	0.002	0.013	-0.005	0.002	0.002	0.002
Shrout	799	800	25101	29556	8316	35592	14348	24307	12516	727	50215	5393	22104	9675	12015	47354	10971	10694	7241	12865
Market Cap	14.2	6.1	2,223	1,578	315	108	1154	1843	853	35.6	5087	145	434	530	465	2928	491	269.7	248	412
Trading Vol.	12	15	6.3	49	31	23	70	68	43	1.9	7.1	2.0	15.1	7.4	3.4	4.9	3.7	1.7	1.4	9.1

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Table 2

The Mean Formation and Holding Period Performance for the Entire Sample of ETFs, with Deciles Categorized by Returns

Formation & Holding		0(lowest)	1	2	3	4	5	6	7	8	9(Highest)
6	Formation	- 0.24	-0.10	- 0.06	-0.03	-0.00	0.01	0.04	0.07	0.13	0.31
		(-55.73****)	(-29.34****)	(-16.16****)	(-7.51****)	(-1.39)	(4.88****)	(11.79****)	(20.93****)	(38.22****)	(60.75)
	Holding Period	0.03	0.03	0.03	0.03	0,02	0.03	0.02	0.02	0.03	0.00
		(4.75****)	(5.58****)	(6.28****)	(6.84****)	(5.21****)	(5.21****)	(5.96****)	(5.18****)	(6.0****)	(0.29)
3	Formation	-0.17	-0.07	-0.04	- 0.02	- 0.00	0.01	0.03	0.05	0.09	0.20
		(-59.07.****)	(-33.44****)	(18.88****)	(-8.82****)	(-1.50)	(5.88****)	(13.83****)	(24.63****)	(42.81****)	(67.22****)
	Holding period	-0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01
		(-2.72***)	(2.86***)	(3.60***)	(4.31****)	(3.53***)	(5.22****)	(3.30***)	(4.40****)	(5.22****)	(3.55***)
1	Formation	- 0.10	-0.04	-0.02	- 0.01	-0.00	0.00	0.01	0.03	0.05	0.10
		(-61.43****)	(-37.49****)	(-23.17****)	(-12.13****)	(-3.38***)	(5.16****)	(15.17****)	(28.14****)	(49.02****)	(73.76****)
	Holding period	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	- 0.00	-0.00
		(0.62)	(2.46**)	(3.30***)	(3.27***)	(3.16***)	(3.43***)	(2.00**)	(1.43)	(-0.09)	(-0.80)

From the start of each month from January 2001 to December 2009, all the ETFs are ranked by their market returns over the month preceding the portfolio formation month. All ETFs are equally weighted into their respective portfolio. Table 2, presents the Average formation and holding portfolio performance returns for each decile portfolio of ETFs, that are formed based upon the returns of the ETFs. The AFPR is calculated by using the following formula: AHPR = (1+R1)*(1+R2)-1. The cumulative returns were thus calculated.

The *t*- stats. are those presented in brackets.

*= Significance at 10% level, ** = significance at 5% level, ***= significance at 1% level, **** = significance at 0.1% level

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Table 3

The mean Formation and Holding Period Performance for the Entire Sample of ETFs by Specialties with Deciles Categorized by Returns

Formation & Holding	0(lowest)	1	2	3	4	5	6	7	8	9(Highest)
6 Formation	-0.28	-0.13	-0.08	-0.04	-0.01	0.02	0.05	0.09	0.15	0.31
	(-38.45****)	(-21.52****)	(-13.74****)	(-7.67****)	(-2.32**)	(2.69***)	(8.90****)	(14.95****)	(24.01****)	(37.51****)
Holding Period	0.03	0.02	0.22	0.04	0.03	0.02	0.01	0.01	0.02	-0.02
	(2.42**)	(2.62***)	(2.77***)	(4.40***)	(4.07****)	(3.01****)	(1.99**)	(1.58*)	(2.91***)	(-2.46***)
3 Formation	-0.20	-0.09	-0.06	-0.03	-0.01	0.01	0.04	0.06	0.10	0.21
	(-39.13****)	(-24.16****)	(-16.04****)	(-8.43****)	(-209****)	(3.51****)	(10.33****)	(17.60****)	(28.17****)	(42.52****)
Holding period	-0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
	(-2.96***)	(2.04**)	(1.66**)	(1.57**)	(2.17**)	(2.50**)	(1.64**)	(2.82***)	(0.65)	(1.52)
1 Formation	-0.12	-0.10	-0.03	-0.02	-0.01	0.01	0,02	0.04	0.06	0.12
	(-40.47****)	(-27.53****)	(-18.70****)	(-10.86****)	(-3.58****)	(3.69)	(11.77****)	(20.41****)	(32.86****)	(45.99****)
Holding period	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.00	-0.00
	(-0.42)	(2.94***)	(1.68**)	(1.58**)	(1.07)	(1.46)	(0.33)	(0.25)	(-0.72)	(-1.43)

From the start of each month from January 2001 to December 2009, all the ETFs are ranked by their market returns over the month preceding the portfolio formation month. All ETFs are equally weighted into their respective portfolio. Table 2, presents the average holding portfolio returns (AHPR) for each decile portfolio of ETFs, that are formed based upon the returns of the ETFs.

The AHPR is calculated by using the following formula: $AHPR = \sum(HPR_{ik}-EWHPR_i)/N$ where i is the number of months after the formation period and k is the number of ETFs in each decile portfolio (k=0 to N). EWHR is equally weighted holding period returns.

The *t*-stats. are those presented in brackets.

*= Significance at 10% level, ** = significance at 5% level, *** = significance at 1% level, **** = significance at 0.1% level

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