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International Capital Mobility and Saving-Investment Nexus in Nigeria: Revisiting Feldstein-Horioka Hypothesis

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Abstract: This paper tests the validity of Feldstein-Horioka (1980) hypothesis using Nigerian data from 1980 to 2013 by relying on the ARDL Bounds testing approach to co-integration and vector error correction model (VECM). Evidence for the hypothesis over the sub-samples is mixed given absence of co-integrating relationship between savings and investment in both periods. Over the period of market-friendly economic reform (1986 -2013) and entire sample period (1980-2013), we found low saving investment correlation indicating support for the F-H hypothesis (that low saving investment relationship implies high degree of international capital mobility). Presumably, the World Bank and IMF designed economic reform programs in form of liberalization and deregulation – coupled with the neo-liberal economic management framework that Nigeria is currently practicing – may have attenuated the saving investment relation in the reform era, thereby providing support for F-H hypothesis over the reform era. But the finding of similar absence of cointegration between saving and investment in the pre-reform era, against the F-H postulate, reveals the importance of incorporating factors such as money supply and inflow of foreign capital that could affect the saving investment relationship as widely suggested in the literature. Overall, we find support for high degree of international capital mobility across Nigerian borders that may lead to unsustainable current account balance for the economy if left unregulated. The policy import of the paper is the need for a more conscientious implementation of a policy of guided deregulation of Nigeria's capital and trade accounts.

Keywords: Capital Mobility, F-H Hypothesis, ARDL Model, Nigeria, VECM, Bounds Test

1. Introduction

International capital mobility was originally judged by the extent of exchange rate restriction[1]. But, beginning with the work of Feldstein and Horioka (1980), its efficacy became increasingly questioned with the growing evidence that capital flow takes place despite exchange restrictions. Consequently, two broad approaches to the evaluation of the degree of international capital mobility, namely, the price (direct)approach and the quantity (indirect) approachcame to the fore. The price approach is based on testing the law of one price[2] in the context of identical financial assets. Here,the price of assets denominated in different currencies, with similar risks and maturity characteristics tends to equalize quickly through arbitrage. Thus, the price approach examines the equalization of the rates of return between countries through capital flows. Following (Frankel 1991), for instance,the covered interest parity[3] (CIP) is used as the most appropriate indicator of the degree of financial integration and thus capital mobility

[1] In the mid-1970s, a relatively small number of countries – Germany, USA, Canada, and Switzerland – drastically reduced or completely removed capital control. Thus, although many other countries (developed and underdeveloped) retained restriction on international capital flow during much of the current floating exchange rate system, the assumption of perfect capital mobility has been routinely used in the literature on the main exchange rate models, with the exception of variants of the Mundell-Flemming model and the portfolio balance model (Taylor 1995; Taylor and Sarno 1997)

[2] The law of one price is an economic concept which posits that prices (interest rates, rents, goods prices) must equalize in all location. It is the basis of the theory of purchasing power parity. It is based on the no arbitrage assumption; and so, in an efficient market, the convergence of prices is instantaneous.

[3] The CIP states that under perfect capital mobility and floating exchange rate, Interest rate differences between countries must be offset by expected price movements in future markets. It is 'covered' because failure of CIP implies riskless profit opportunity.

across national boundaries. For Less Developed Countries, however, the difficulty in comparing assets and the presence of markets that are relatively illiquid create data limitations that inhibit the formal testing of CIP. An alternative way forward is to consider the quantity approach which has two main variants – the consumption smoothing approach[4] and the savings-investment rates relationship.

This study re-examines the quantity approach to the analysis ofinternational capital mobility through saving-investment rates relationship which was popularized by Martin Feldstein and Charles Horioka (F-P), (Feldstein and Horioka 1980).Obtaining a correlation of saving and investment close to one in their cross-sectional analysis for sixteen industrialized OECD countries for the period 1960-1974, they rejected the perfect capital mobility assumption of mainstream economic theory. Thus, against the general believe that there is high degree of international capital mobility in the world (following the liberalization of their capital account by few industrialized countries in worldin mid 1970s), Feldstein and Horioka(1980) found low capital mobility across OECD countries, reflected by very high national savings-investment correlation[5]. Thus, they argued – in line with mainstream economic theory – that in an economy that is closed to international capital movement; total national savings should be equal to total national investment, in which case the current account would be zero and the correlation of saving with investment will be unity. However, in an economy that is open to international capital movement, the rate of savings and investment may not be equal as the gap could be filled by capital flow, depending on whether the current account is deficit or surplus. When there is excess of domestic savings over domestic investment, the economy would be running current account surpluses (CAS) and exporting capital to the rest of the world. Conversely, when domestic saving is less than domestic investment, the economy would be running current account deficit (CAD) and importing capital from the rest of the world. In their conclusion, therefore, the correlation between saving and investment would be zero (statistically) under perfect capital mobility and statistically unity if there is no capital movement at all.

Although measuring the degree of international capital mobility is important to the wellbeing of both LDCs and MDCs, they are more limited work that addresses the case of LDCs. Measuring international capital mobility for LDCs is important for a number of reasons.First, if economic growth can be promoted by foreign-led capital flows in the way economists of 'Washington Consensus[6]' claim, then higher international capital movements would imply that constraint to country-specific saving and investment must be lifted. Second, under the Mundel-Fleming (MF) model, perfect capital mobility means that fiscal policy is most effective under a floating exchange rate while monetary policy is most effective under fixed exchange rate. The extent of capital mobility may therefore play a role in the design of macroeconomic policy. Third, there are issues of macroeconomic instability associated with capital mobility. If short-term capital inflows are volatile, the receiving LDCs country may be subject to speculative attack. Similarly, capital flight can also have a destabilizing effect on interest rates, exchange rates, foreign exchange reserves and monetary demand (when the currency transfer is linked with capital flight). Moreover, capital inflow to LDCs may bring with it appreciation of real exchange rate that negate the potential impact of nominal devaluation. Regrettably, bulk of the capital inflows to LDCs is short-term and brings with it tacit technology that do not transfer skills and therefore cannot promote development. Thus, given the importance of measuring capital mobility and the dearth of existing research for Nigeria in this area, this study applies the Autoregressive Distributed Lag (ARDL) Bounds Testing Approach to co-integration and the vector error correction model (VECM) in measuring the degree of international capital mobility across Nigeria's borders. The basic research problem is to test the validity of F-H hypothesis in Nigeria's context. The policy import of the paper is its potential to provide useful policy framework on international trade and international capital movement. Although Nigeria hasnot yet completely liberalized its capital accounts, as was the case with some OECD countries in early 1970s, such policy framework is of utmost importance for Nigeria where economic policies should be pro-active rather than reactive to macroeconomic disturbances.

The rest of the paper is organized as follows. Section 2 provides brief review of literature. The empirical strategy is outlined in section 3 wherein the models are also laid out. In section 4, the empirical results and their analyses are presented while section 5 concludes the paper.

2. Theoretical Underpinnings and Literature Review

The Felstein-Horioka puzzle is a widely discussed problem in macroeconomics and international finance that has remained unresolved till date. Feldstein and Horioka (1980) argued that there should be no relationship between savings and investment rates if perfect capital mobility

[4] The consumption smoothening approach examines whether consumption is adequately smoothened through capital flow despite shocks in income.

[5] The F-H hypothesis is their proposition that high Investment-Savings correlation or a significant coefficient from regression of Investment on savings indicates low international capital mobility and vice versa. But the F-H puzzle, as distinguished from their hypothesis, is their finding, against the general expectation, that there is very high degree of international capital mobility in the world, the OECD countries was characterized by very low capital mobility which was reflected by high savings investment correlation.

[6] Washington consensus (WC) is a set of view about effective development strategies that have come to be associated with the Washington-based institutions: the IMF, the World Bank, and the US Treasury. According to Williamson (1990), who provided a brilliant articulation of the consensus, the era of the role of state in initiating industrialization is over. The original conception of WC has three big ideas: a market economy, openness to the world and macroeconomic discipline.

exists. Against general expectation, however, they found high correlation between domestic savings and investment rates in their study of 16 OECD countries over the period 1960-74, suggesting low capital mobility in these countries. Because capitals in these OECD countries were believed to be mobile (in line with mainstreameconomics) prior to their study, this finding gave rise to 'Felstein-Horioka Puzzle' and spawned a number of studies.

Generally, literature on test of F-H hypothesis is bias toward the experience of developed economies. Some of these studies have provided support for F-H view that high correlation of savings and investment rates is a reflection of low degree of international capital mobility (see for example, Penati and Dooley, 1984; Frankel, 1985; Caceres 1985; Dooley, Frankel and Matheison, 1987; Feldstain and Bachetta 1990; Bayoumi, 1990; Bayoumi and Rose, 1993; Taylor, 1996; Caceres, 1997; Khundrakpan and Ranjan, 2010; Nasiru and Usman, 2013).

Frankel, Dooley and Matheison, (1986), for instance, examined a sample of 64 countries (14 developed and 50 developing countries) to study the savings-investment rates relationship and found that except in few less developed countries, savings and investment are highly correlated and shared a long-run equilibrium relationship. Apergis and Tsoulfidis (1997) found that savings and investment rates for 14 EU countries were co-integrated, with saving causing investment, and suggested that capital mobility was not high even with improved efforts towards economic integration. Similarly, in their study of savings-investment relationship for less industrialized and developing countries, Murphy (1984), obstfeld 1986, Dooley et al (1987) and Wong (1990) found evidence of association between savings and investment rates. Contrary to general expectation, their finding also revealed that the correlation were higher during period of economic reform than in the pre-reform era (when capital mobility is expected to be lower and correlation is expected to be higher).

Some other studies have exclusively focused on developing and Asian countries. Sinha (2002) studying 12 Asian countries found that saving and investment rates were co-integrated only in three countries without accounting for structural break, which increased to four when accounted for structural break. The study further indicates that the growth of saving Granger causes the growth of investment in 5 countries while the reverse causality was found in six countries. In addition, Sinha and Sinha (2003) while studying the short-run and long-run relationship between savings and investment rates in 123 countries using an error correction framework found that capital was most mobile in 16 countries with low per capita income. This result is against the conventional wisdom that capital is more mobile in countries with high per capita income. In the case of China, Narayan (2005) found that savings and investment were correlated for two sample periods of 1952-19994 and 1952-1998 but that the correlation coefficient was higher in the first period with fixed exchange rate. Narayan (2005), therefore, concluded that the Chinese economy is in conformity with F-H hypothesis of low capital mobility (and high savings-investment rates correlation) during fixed exchange rate regime.

For the United States, Miller (1988) using data for 1946-1987 found that the savings and investment rates were co-integrated during the period of fixed exchange rate (before 1971) but not during subsequent period due to increased international capital mobility. Pollin and Justice (1994) also found no co-integration between savings and lending rates on US quarterly data and suggested high capital mobility. For Japan, Yamori (1995) and De Vita Abbott (2002) using an ARDL bounds testing procedure found lack of co-integration between savings and investment rates and indicated high capital mobility. For Nigeria, Nasiru and Usman (2013) employed the ARDL Bounds testing approach to co-integration to test for long run relationship between savings and investment in Nigeria for the period 1980 to 2011. They found support for Feldstein Horioka (1990) hypothesis.

However, it has also been argued that the relationship between saving and investment is largely uninformative about capital mobility, as a number of factors could influence the relationship. These factors include: i) business cycle which determines both savings and investment (Obstfeld and Rogoff, 1995) ; (ii) global shocks such as imported inputs and world interest rates that impinge both savings and investment simultaneously (Baxter and Crucini 1993); iii) response of government to current account deficit through fiscal policy that makes public saving component aligned to investment (Summer, 1991); iv) satisfaction of inter-temporal budget constraint leading to high correlation between savings and investment rates even in the presence of high capital mobility (Jansen, 1996). In addition, some authors have identified yet other factors, outside capital mobility, to be responsible for saving-investment relationship. For instance, Tesar (1991) identifies macroeconomic shocks such as population growth, productivity shocks, and limited integration of international goods market as the factors responsible for correlation of saving and investment. Artis and Bayoumi (1989) and Koskela and Viren (1991) explain that government's targeting of current account is responsible for correlation of saving-investment while Roubini (1988) explains it as a result of a public sector that follows policies conducive to smoothen taxation. Levy (1995) presents the view that a positive investment-savings correlation can arise when fiscal policy is endogenous and that this correlation does not depend on capital mobility.

An evaluation of available literature reviewed shows that earlier works testing F-H hypothesis through regression on cross section data, including the work of Feldstein and Horioka (1980), faced the problem of sample selection bias. Nasiru and Usman (2013). Subsequent studies have employe, unit root test, Johansen's cointegration test, ARDL Bound Test for co-integration,and Vector Error correction model (VECM). Standard co-integration analysis such as Johansen's test, however, cannot be applied when savings and investment are integrated of different order or when the presence of time trend and/or drift is not known with certainty. In this case, the appropriate method for estimation is Autoregressive Distributed Lag (ARDL) Bounds Testing Approach to co-integration analysis which was developed by Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran at al., (2001). This approach allows co-integration analysis on variables that are integrated of different orders. It also avoids pre-testing of unit root properties which typically have low explanatory power. Further, it can be applied to small sample size and does not push the short-run dynamics into the residual terms as in the residual based co-integration approach. However, it cannot tell us the number of co-integrating equations and may lead us to inclusive results. In this case, alternative test of co-integration such as the Johansen and Juselius (1990) test could be applied to ascertain the number of co-integrating equations before proceeding to the VECM estimation. More so, we use the VECM to accommodate the view of alternative schools to F-H hypothesis – namely – the view of some researchers that low saving-investment correlation is not the only indicator of high international capital mobility. We do this by incorporating other factors such as money supply and capital inflow that affect both savings an investment. This is important because as Khundrakpan and Ranjan (2010: 55) and Caceres (1997:21) note, the ARDL approach is inappropriate when some of the explanatory variables are endogenous.

Overall, although the debate concerning the 'Feldstein-Horioka Puzzle' has strongly deepened at the theoretical level; they may still shed light on the extent of international capital mobility, especially when complemented by other statistical evidence.Thus, this study – in addition to the use of ARDL bound test for cointegration – employs the VECM to capture the effect of factors, other than capital mobility, that may explain the saving-investment relationship (as widely suggested in the literature) and control for endogeneity of savings and/or investment.

3.Methodology and Data

The empirical strategy adopted in this paper is motivated from Ranjan and Khundrakpam (2010) and Nasiru and Usman (2013) who use the Autoregressive Distributed Lag Model (ARDL) method of regression analysis in testing the Felstein-Horioka hypothesis for India and Nigeria respectively, and Caceres (1997) who uses the Error Correction Model to investigate international capital mobility for two central Americancountries(Salvador and Guatemala). But some earlier empirical works typically (starting from the original F-H (1980) paper) entail cross-section regressions of the form:

$$I/Y_i = \beta_0 + \beta_1 S/Y_i + \varepsilon_t \quad (1)$$

Where:

I/Y and S/Y represent period averages (of investment and savings to GDP ratiosrespectively) and countries are indexed by *i*. The F-Hfinding of β_1=1 (statistically) signifies complete lack of mobility whereas β=0 is the perfect capital mobility case. In this study, we consider three sample periods: (i) 1980-1985 (period with relatively fixed and rigid controls on capital flows); (ii) 1986 -2013 (including post reform period with more flexible and less restrictions on capital flows); and (iii) 1980 – 2013 (which covers the pre- and post-reform era). This allows us to test the F-H hypothesis that the nexus between savings and investment rates would be stronger when capital mobility is lower than when it is high. The unit root properties of the series were scrutinized by the Augmented Dickey Fuller. Given that the trend properties of the variables are not known with certainty (even when saving and investment are integrated of the same order), we employ the ARDL approach to co-integration. We also test for short-run dynamics using the Vector Error Correction Model (VECM) which include a factor such money supply that may affect saving-investment relationship other than international capital mobility.

We begin our specification with some data and model diagnostic checks in order to ensure that we obtainrobust regression estimates. The data is pre-tested for the presence of a Unit root.The equations employed for the data and model diagnostics as well as theestimable models (ARDL and VECM) are specified as follows.

$$\Delta \mathcal{Y}_t = \alpha + \beta t + \gamma \mathcal{Y}_{t-1} + \delta_1 \Delta \mathcal{Y}_{t-1} + \ldots + \delta_{p-1} \Delta \mathcal{Y}_{t-p+1} + \varepsilon_t \quad (2)$$

Where:

α=constant

β=coefficient on a time trend and

p=the lag order of the autoregressive process.

$\mathcal{Y}$=our variable of interest

Δ=the difference operator,

t=the time trend

ε=the white noise residual of zero mean and constant variance.

Equation 2 is used to implement the Augmented Dickey Fuller test for a unit root.

We employ equation 3 to implement the Johansen (1988, 1989) and Johansen and Juselius (1990) test for cointegration.

$$\Delta Y_t = \beta_1 + \beta_2 \Delta X_t + \beta_3 \nu_{t-1} + \varepsilon_{t-1} \quad (3)$$

Equation 4 and 5 are used to implement the Granger causality test. This test helps to determine whether savings precedes investment or vice versa.

$$LINVY_t = \phi_0 + \phi_1 \sum_{j=1}^{\rho} \phi_j \, LSAVY_{t-1} + \phi_2 \sum_{j=1}^{\rho} \phi_j \, LINVY_{t-1} + \varepsilon_t \quad (4)$$

$$LSAVY_t = \psi_0 + \psi_1 \sum_{j=1}^{\rho} \psi_j \, LINVY_{t-1} + \psi_2 \sum_{j=1}^{\rho} \psi_j \, LSAVY_{t-1} + \varepsilon_t \quad (5)$$

Where the variables are as defined in Table 1.

To implement the ARDL Bound test of co-integration, two approaches are discernable. The indirect or OLS approachwhich makes use of significance of F-statistics obtained after OLS estimation of a generic unrestricted error correction model of the type specified in equation 6 and 7. The direct approach entails direct ARDL estimation of equation 6 and 7 type-models using the Microfitquantitative econometrics software that was developed by Pesaran and Pesaran (1997) and Pesaran, Shin, and Smith. (2001) and distributed by Oxford University Press. The two approaches provide similar results and are employed here for purpose of comparison. The difference is that in the direct approached the optimal lag lengths are automatically selected. We first employ the indirect approach to test the existence of a long run relationship between domestic savings and investment by using the reduced-form bi-variate model of Feldstein and Horioka (1980).

$$\Delta LINVY_t = \alpha_0 + \alpha_1 LINVY_{t-1} + \alpha_2 LSAVY_{t-1} + \sum_{i=1}^{q}\alpha_{1i}\,\Delta LINVY_{t-i} + \sum_{i=1}^{\rho}\alpha_{2i}\Delta\, LSAVY_{t-i} + +\varepsilon_t \quad (6)$$

$$\Delta LSAVY_t = \alpha_0 + \alpha_1 LSAVY_{t-1} + \alpha_2 LINVY_{t-1} + \sum_{i=1}^{q}\alpha_{1i}\,\Delta LSAVY_{t-i} + \sum_{i=1}^{\rho}\alpha_{2i}\Delta\, LINVY_{t-i} + +\varepsilon_t \quad (7)$$

As has been noted, the indirect technique for implementing ARDL bounds test for co-integration consists of OLS estimation of equation 6 and testing of a co-integration relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged level of the variables. We focus on equation 6 in fellowship with the traditional F-H model. Thus, the null hypothesis of no co-integration for equation 6 is stated as follows:

$$H_0: \alpha_1 = \alpha_2 = 0$$

Two sets of critical values for a given significance level can be determined (Pesaran et al., 2001). The first set of critical values is obtained on the assumption that all variables included in the ARDL specification are I(0)while the second set of critical values is obtained on the assumption that the variables are I(1).We reject the nullhypothesis of no co-integration when the F-value exceeds the upper critical bounds value (also called P-populated value). We accept H_0(of no co-integration) when the F-value is lower than the lower bounds. The decision about co-integrationis inconclusive if the calculated F-statistics falls between the lower and upper-bound critical values. In the direct approach using the Microfit quantitative software, ARDL estimation report both the F-statistics and the critical bounds value. As has been noted, to ensure that we address the issue of possibleendogeneity of saving andinvestment in the traditionalFelstein-Horioka specification, we implement the VECM. The model also serves to capture the influence of factors other than*capital mobility* that account for saving-investment relationship.

$$\Delta y_t = \alpha + \rho y_{t-1} + \sum_{j=1}^{\rho}\phi_j\,\Delta y_{t-j} + \upsilon_t \quad (8)$$

Equation 8 is the generalized VECM, where *p*isthe coefficient of the level values of the first lag of all explanatory variables (including lag of the dependent variable) in the model, a measure of the speed of adjustment; α is the intercept; ϕ is a vector of coefficients of lagged values of the explanatory variables (y) ; and $\upsilon$is the error term.

Inmore explicit form, the target equation[7] in the VECM is specified as follows.

$$\Delta LINVY_t = \alpha_0 + \alpha_1\Delta LINVY_{t-1} + \alpha_3\Delta LINVY_{t-2} + \alpha_4\Delta LSAVY_{t-1} + + \alpha_5\Delta LSAVY_{t-2} + \alpha_6\Delta LM2Y_{t-1} + \alpha_7\Delta LM2Y_{t-2} + \alpha_9\Delta LNIFCY_{t-1} + \alpha_{10}\Delta LINVY_{t-2} + \alpha_{11}EC_{t-1} + ei \quad (9)$$

Where EC_{t-1} is the error correction term.

The sources of data and the definition of the variables used in the model are presented in Table 1.

Table 1. *Data sources and Variable Definitions.*

Variable	Definition/Description	source
LINVY	Natural log of ratio of gross national investment to realGDP	WEO, 2015
LSAVY	Natural log of ratio of total national savings to real GDP	WEO 2015
LNIFCY	Natural log of ratio of net inflow of FDI to real GDP	WDI, 2014
LM2Y	Natural log of ratio of Broad Money supply (M2) to real GDP	WDI, 2014

Source: Author. Note: The variables were retrieved from WDI and WEO as percentages; the ratios are the Author’s calculations.

All the variables employed in the regression were used in their natural log form in order to normalize[8] them.Figure 1 shows the trend of the variables before and after taking the natural log of the variables. As is obvious from Figure 2 (with regard to Figure 1), logging of the variables help to normalize and make them comparable; it does not change the *pattern* or even *trend* of the variables. Evidently, re-estimating the equations with the variables in percentages rather than ratios returned similar results. *Thus, we argue that the use ofeither the natural log of ratios or natural log of the percentages is inconsequential since they return similar results.*

[7]The ‘target equation’ in our VECM is the co-integrating equation. The number of target equations depends on the number of co-integrating equations. Since, the Johansen and Juselius (1990) test for co-integration indicates that there is only one co-integrating equation, we have just one target equation from our VECM system.

[8]Logging of economic variables becomes a problem when the percentages, percentage changes or growth rates involve negative numbers which give rise to undefined natural logs. For instance, in the calculation of growth rate of GDP, one may encounter negative growth rate. In this case, it is advisable to take the log of the value of GDP before computing the growth rate. The view of many modern econometricians is that decision to log ratios, percentages, percentage changes, and even growth rate (e.g inflation rate, measured as growth rate of CPI) or not is actually at the discretion of the researcher. But the fear is that logging *growth rate (*such as inflation rate which is measure as the growth rate of CPI) may create interpretational difficulties. When a variable is logged, its coefficient is interpreted as elasticity.

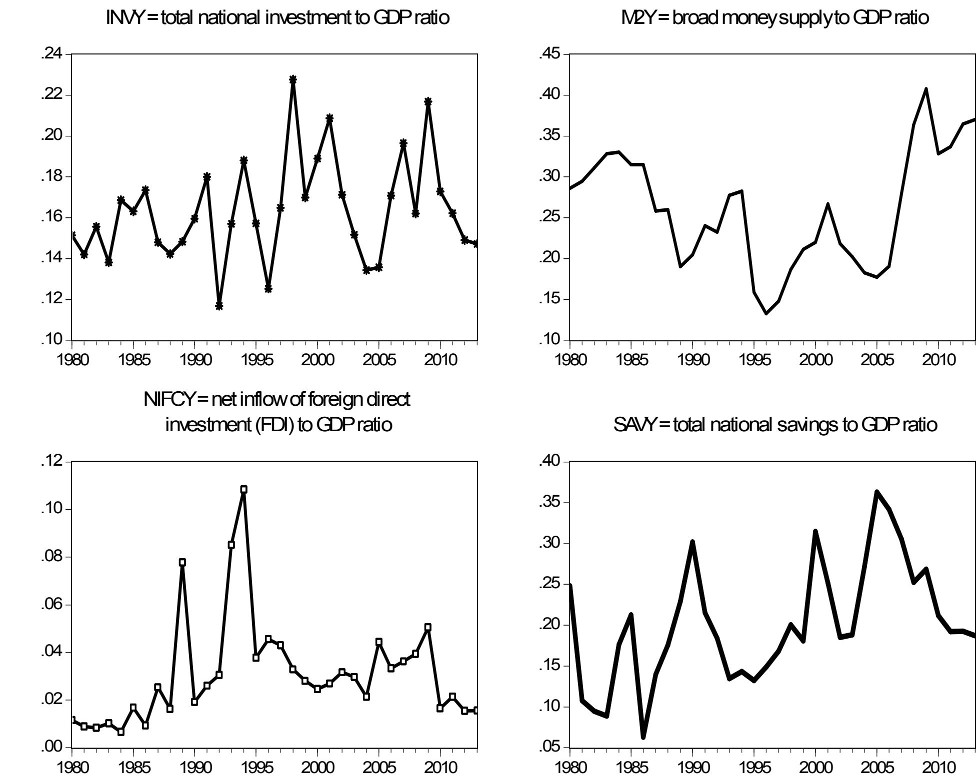

Figure 1. *Time Trend of Raw Data.*

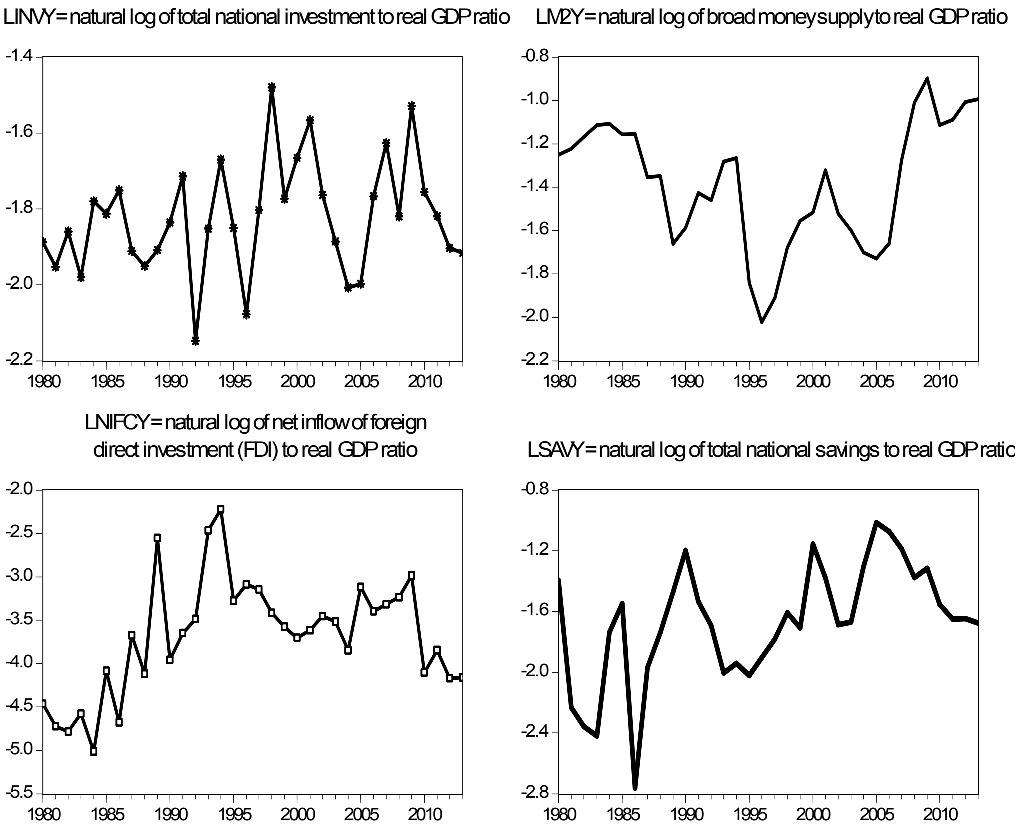

Figure 2. *Time Trend of Natural log of variables.*

Note: In general, the log of the variables indicate present of drift but not necessarily trend; hence, our ARDL estimated assumes (includes) input, i.e., drift, but no trend. Logging of data can also help induce stationary. For instance, SAVY is *I(1)* whereas LSAVY is *I(0)*.

4. The Results

Table 2. *Result of ADF Integration Test.*

Series	Levels		1st Diff.		Order of integration
	ADF	5% critical value	ADF	5% critical value	
LINVY	4.4599*	2.9540	-	-	I(0)
LSAVY	3.0764*	2.9540	-	-	I(0)
LM2Y	2.3390	2.9571	4.3375*	2.9571	I(1)
LNIFCY	2.9450	2.9540	10.0532*	2.9571	I(1)

Note: * indicates significance at 5% level of significance

The result of the unit root indicates that log of saving and investment are I(0). However, for log of money supply and net inflow of foreign capital to GDP ratios, we were unable to reject the null hypothesis of a unit root at levels. Both variables became stationary at first difference and are therefore I(1). Given the uncertainty concerning the trend properties of the variables, we implement the ARDL bound test using both the direct and indirect (OLS) approaches.

Table 3. *Result of Persaran, Shin and Smith's (2001) Bounds Test for Co-integration: Indirect Approach Using OLS Estimation.*

Explanatory variable	Dependent variable LINVY
LINVY-1	-0.9 [0.01]
$LSAVY_{-1}$	0.09 [0.35]
DLINVY-1	0.11 [0.66]
$DLSAVY_{-1}$	-0.07 [0.73]
DLINVY-2	0.0 [0.89]
$DLSAVY_{-2}$	0.04 [0.64]
F-Calculated (from Wald Test ofC2=C3=0)	3.92*
Asymptotic critical value Bounds for F statistics [Lower Bound // Upper Bound]	4.94 // 5.73
D.W Statistics	2.4
Assumption made	constant but no trend

Note: The value in square brackets, [], are the probability values[9]. The coefficients are OLS estimates using EViews 7.0. * indicates no cointegration (since the calculated F-Statistic lies below the lower Bound of the critical F- Bound values.The Asymptotic critical value Bounds for F-statistics are retrieved from Pesaran, Shin and Smith's (2001) P-populated table. Because we assumed no trend and unrestricted intercept in the OLS estimation, use was made of 'Table C1(iii) and Case iii' in P-populated table.The OLS estimate and corresponding Wald testare available on request..

As is obvious from table 3, the F-calculated of 3.92 is less than the asymptotic critical lower bound of 4.94 indicating the possibility of no co-integration relationship between savings and investment. In other words, the result shows absence of a long-run relationship between total national saving and total national investment in Nigeria.***$LSAVY_{-1}$***has an elastic impact of 0.09 with insignificant probability value of 0.35. A simple OLS regression of LINVY on LSAVY also returned an insignificant elastic coefficient of 0.064 (see table 10 in appendix). Since the implementation of our VECM requires that the exact number of co-integrating equation be determined – we employ an alternative test to the Bounds test – namely, the Johansen's test of co-integration to determine the exact number of cointegratingvectors.

Table 4. *Result ofJohansen and Juselius (1990)Cointegration Test.*

Hypothesized No of CE(S)	Trace Statistic	5% Critical Value	Max. Eigen Value	0.05 Critical Value
$\rho = 0$	52.2506*	47.8561	26.0161*	27.5843
$\rho \leq 1$	26.2345	29.7971	17.1489	21.1316
$\rho \leq 2$	9.0855	15.4947	6.6269	14.2646
$\rho \leq 3$	2.4586	3.8415	2.4586	3.8415

From Table 4, the Trace Statistic and Maximum Eigen value indicate that there is only one co-integrating equation.This result is not surprising given weak correlation coefficient among the variables (savings, investment, money supply and net inflow of foreign capital) as their correlation matrix in Table 5 indicates.

Table 5. *Correlation Matrix of the Variables.*

Log of variables

	LINVY	LSAVY	LM2Y	LNIFCY
LINVY	1.000000	0.217977	0.201229	0.173498
LSAVY	0.217977	1.000000	-0.186119	0.331992
LM2Y	0.201229	-0.186119	1.000000	-0.416259
LNIFCY	0.173498	0.331992	-0.416259	1.000000

Variables at Levels

	INVY	SAVY	NIFCY	M2Y
INVY	1.000000	0.231818	0.162338	0.172702
SAVY	0.231818	1.000000	0.073530	-0.186625
NIFCY	0.162338	0.073530	1.000000	-0.239778
M2Y	0.172702	-0.186625	-0.239778	1.000000

As Table 5 show, the correlation between LINVY and LSAVY is merely 21%. The correlation coefficient is highest between LM2Y and LNIFCY at 41%, though negative. In terms of order of precedence of saving and investment, the Granger causality result (Table 6) indicates that neither does

[9]In bounds testing the significance of the individual variables is ignored; the focus is on the joint significance of the explanatory variable by comparing the F statistics from the Wald Test with the lower and upper bound F statistics from the Persaran, Shin and Smith's (2001) p-populated table. * denotes significance at the 5% level of significance, while $\rho$is used to represent the number of hypothesized co-integrating equation.

savings Granger causes investment nor vice versa in Nigeria. This test returned similar result even after iterating with lag length of 1, 2, 3 and 4.

Table 6. *Result of Granger Causality Test.*

H_0	Obs	F. Stats	Prob.	Remark	Type of causality
Lag 1					
LSAVY does not Granger cause LINVY	33	2.15	0.15	DNR H_0	No Causality
LINVY does not Granger cause LSAVY	33	0.20	0.66	DNR H_0	No Causality
Lag 2					
LSAVY does not Granger cause LINVY	32	1.26	0.30	DNR H_0	No Causality
LINVY does not Granger cause LSAVY	32	0.22	0.80	DNR H_0	No Causality
Lag 3					
LSAVY does not Granger cause LINVY	31	0.81	0.50	DNR H_0	No Causality
LINVY does not Granger cause LSAVY	31	0.61	0.61	DNR H_0	No Causality
Lag 4					
LSAVY does not Granger cause LINVY	30	0.37	0.82	DNR H_0	No Causality
LINVY does not Granger cause LSAVY	30	0.38	0.82	DNR H_0	No Causality

Decision Rule: Reject H_0 if Probability Value is< 0.05 or calculated F. Stats. is> critical F.stats.
DNR stands for Do Not Reject Ho which means that we accept Ho.

The implication of the Granger causality result for our VECM is that both saving and investment can be endogenized in the vector error correction model.We turn to the direct estimate of ARDL Bounds test of co-integration using the Microfit quantitative software (Table 7) before reporting the VECM estimates.

Table 7 summarizes the inter-temporal ARDL Bounds test estimates. The period covered include the per-reform era (1980-1986), reform era (1986-2013) and the entire sample period (1980-2013).

Table 7. *Result of ARDL Bound Test: Direct Approach Using Microfit*[10].

Indep. Variable	dependent variables LINVY 1980-1985 (Pre-Reform Era)		LINVY 1986-2013 (Reform Era)		LINVY 1980-2013 (Whole Sample)	
LSAVY	0.19 [0.33]	- -	-	0.18 [0.61]	- -	0.16 (2.0344)
LINVY-1	0.78 [0.23]	- -	- -	0.84 [0.0]	- -	0.85 (11.8500)
F-Calculated	0.26*	-	-	2.2*	-	1.33*
F[Lower Bound// Upper Bound]	8.15// 10.64	-	-	3.37// 4.5	-	3.37 // 4.43
D.W Statistics	3.0	-		1.62	-	2.4
Assumption made	With constantbut no trend	No trend andno constant	With trend but no constant	No trend andno constant	With trend but no constant	No constant and no trend

Source: Author. Where the square brackets '[]' represents the probability values. * indicates no cointegration (since the calculated F-Statistic lies below the lower Bound of the critical F- Bound values. The estimates are obtained by direct ARDL regression using Microfit quantitative software.The critical bounds are computed by stochastic simulations using 20,000 replications. The blank spaces indicate that the model did not run under the assumption.

[10]See Pesaran and Pesaran (1997).

According to Felstein-Horioko hypothesis, saving and investment is expected to be significantly and highly correlated in pre-reform era than reform period since restriction on international capital mobility (that is often associated with pre-reform period) should imply that changes in domestic investment is explained by changes in domestic saving. But as we see in Table 7, the F-calculated values of 0.26, 2.2 and 1.33 lie below the lower asymptotic critical value Bounds for F statistics of 8.15, 3.37, and 3.37 (for the pre-reform, reform and entire sample period respectively) indicating absence of cointegrating relation for both the entire sample and sub samples. Thus, the ARDL estimates provides evidence that is supportive of high degree of international capital mobility across Nigerian borders.

This result is, however, in sharp contrast to the original Felstein-Horioka Puzzle, that is, their finding that there is low degree of international capital mobility across 16 OECD countries against the general believe of the existence of high international capital mobility across major industrialized countries during the time.

Table 8 shows that investment and net inflow of foreign capital are exogenous in the VECM since neither the explanatory variables (except past values of the dependent variable) nor the error correction term are significant. As the error correction term (EC_{-1}) in our VECM provides a confirmatory test of long run relationship between the variable, Table 8 shows that it is investment that has long run impact on saving and not vice versa. Evidently, investment has not significant impact on savings in the short run as can be seen from the probability values.

5. Policy Insight and Conclusions

This paper revisits the Feldstein-Horioka hypothesis that low domestic saving-investment correlation implies high degree of international capital mobility by relying on Auto-Regressive Distributed lag Model (ARDL) and vector error correction model (VECM) using Nigeria data. Evidence for the hypothesis over the sub-samples is mixed given absence of co-integrating relationship between savings and investment in both periods. Over the period of market friendly economic reform(1986 -2013) and entire sample period (1980-2013), we found low saving investment correlation indicating support for the F-H hypothesis (that low saving investment relationship implies high degree of international capital mobility). However, for the sub-sample (1980-86) which represents pre-reform era, we also found weak relationship between saving and investment against F-H hypothesis that saving-investment correlation tends to be higher during period of capital restriction. This result justifies the need for the inclusion of other variables such as money supply and capital inflow that may impact saving and/or investment and provide better explanation of their relationship – as has been widely suggested in the literature. The result of the VECM estimates indicates a long run impact of investment on saving (and not vice versa) but no significant short run effect. Overall, we found high degree of international capital mobility across Nigeria borders that may lead to unsustainable current account balance if it is left unfettered.The policy import of the paper is, therefore, the need for conscientiousimplementation of policy of guided deregulation of Nigeria's capital and trade accounts.

Table 8. *Result of Parsimonious VECM Regression.*

Independent Variable	Dependent Variables			
	$\Delta(LINVY)$	$\Delta(LSAVY)$	$\Delta(LM2Y)$	$\Delta(LNIFCY)$
C	-0.0003 (-0.009)[0.99]	0.03 (0.45)[0.65]	0.006 (0.19)[0.85]	0.034 (0.356)[0.72]
$\Delta LINVY_{-1}$	-0.4 (-2.2)[0.04]		-	-0.74 (-1.4)[0.19]
$\Delta LINVY\_2$	-0.4 (-2.3)[0.03]	-0.33 (-1.1)[0.28]	-	-0.92 (-1.74) [0.09]
$\Delta LNIFCY_{-1}$	-	-0.16 (-1.71)[0.098]	-	-0.59* (-3.7)[0.001]
$\Delta LSAVY_{-2}$	-	-	-0.13 (-1.43)[0.17]	-
$\Delta LM2Y_{-2}$	-	-	-0.26 (-1.5)[0.15]	-
EC_{-1}	-0.003 (-0.045)[0.96]	-0.4* (-3.3)[0.003]	0.19* (2.65)[0.013]	-0.03 (-0.14)[0.89]
R^2	0.23	0.33	0.225	0.39
F	2.75	4.4422	2.62	4.22
Prob(F)	0.06	0.01	0.07	0.009
D.W Statistics	2.1	2.0	1.82	1.8

Source: Author. The values in the brackets '()' are the t-statistics while the values in square brackets '[]' are the probability values.

Appendix

Table 9. *Data used for the regression analysis.*

	Raw Data (in form of Ratio)				Logged Data			
years	INVY	M2Y	NIFCY	SAVY	LINVY	LM2Y	LNIFCY	LSAVY
1980	0.1514	0.2863	0.0115	0.2483	-1.888	-1.251	-4.4647	-1.3932
1981	0.142	0.2946	0.0089	0.1074	-1.952	-1.222	-4.724	-2.2312
1982	0.1557	0.3111	0.0084	0.0949	-1.86	-1.168	-4.7821	-2.355
1983	0.1381	0.3284	0.0103	0.0888	-1.98	-1.114	-4.5776	-2.4209
1984	0.1686	0.3302	0.0066	0.1761	-1.78	-1.108	-5.0151	-1.7368
1985	0.1632	0.3148	0.0168	0.2128	-1.813	-1.156	-4.0853	-1.5475
1986	0.1736	0.3151	0.0093	0.063	-1.751	-1.155	-4.6751	-2.7649
1987	0.148	0.2582	0.0253	0.1396	-1.911	-1.354	-3.6753	-1.9688
1988	0.1422	0.2596	0.0163	0.1757	-1.95	-1.349	-4.1184	-1.7392
1989	0.1483	0.1898	0.0778	0.2293	-1.909	-1.662	-2.5541	-1.4728
1990	0.1596	0.2044	0.0191	0.302	-1.835	-1.588	-3.9573	-1.1974
1991	0.1801	0.2403	0.026	0.2155	-1.714	-1.426	-3.6494	-1.5348
1992	0.1168	0.2324	0.0306	0.1841	-2.147	-1.459	-3.4867	-1.6922
1993	0.157	0.2775	0.0852	0.1346	-1.852	-1.282	-2.4626	-2.0055
1994	0.1882	0.2823	0.1083	0.1434	-1.67	-1.265	-2.2226	-1.942

	Raw Data (in form of Ratio)				Logged Data			
years	**INVY**	**M2Y**	**NIFCY**	**SAVY**	**LINVY**	**LM2Y**	**LNIFCY**	**LSAVY**
1995	0.1572	0.1587	0.0378	0.1323	-1.85	-1.841	-3.2753	-2.0231
1996	0.1252	0.1323	0.0455	0.149	-2.078	-2.023	-3.0891	-1.9041
1997	0.1649	0.1478	0.043	0.1684	-1.803	-1.912	-3.1471	-1.7815
1998	0.2277	0.1866	0.0328	0.2005	-1.48	-1.679	-3.4158	-1.6071
1999	0.1698	0.2113	0.028	0.1812	-1.773	-1.555	-3.575	-1.7083
2000	0.189	0.2196	0.0246	0.315	-1.666	-1.516	-3.7058	-1.1551
2001	0.2088	0.2667	0.027	0.2519	-1.566	-1.322	-3.6128	-1.3786
2002	0.1714	0.2183	0.0317	0.1851	-1.764	-1.522	-3.4514	-1.6867
2003	0.1517	0.202	0.0296	0.1885	-1.886	-1.599	-3.5186	-1.6689
2004	0.1344	0.1826	0.0213	0.2715	-2.007	-1.701	-3.8475	-1.3038
2005	0.1357	0.1773	0.0444	0.363	-1.997	-1.73	-3.1148	-1.0135
2006	0.1708	0.1904	0.0334	0.342	-1.767	-1.659	-3.3998	-1.0729
2007	0.1965	0.2797	0.0363	0.3056	-1.627	-1.274	-3.3171	-1.1855
2008	0.1621	0.3642	0.0394	0.2527	-1.82	-1.01	-3.2341	-1.3757
2009	0.2169	0.4077	0.0505	0.2684	-1.528	-0.897	-2.9862	-1.3151
2010	0.1729	0.328	0.0165	0.2116	-1.755	-1.115	-4.1038	-1.5532
2011	0.1621	0.3368	0.0214	0.1921	-1.819	-1.088	-3.8453	-1.6498
2012	0.1491	0.3651	0.0154	0.1927	-1.903	-1.008	-4.1702	-1.6469
2013	0.1472	0.37	0.0156	0.1869	-1.916	-0.994	-4.1605	-1.6772

Note: L stands for the natural log of the data. The variables are as defined in Table 1. The raw data which were retrieved from WDI (2014) and WEO (2015) were published in percentages. The ratios are the Authors' computations.

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