Foreign Direct Investment and Financial Development in Estimating International Capital Mobility

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This paper investigates saving-investment relationships and the degree of international capital mobility, taking into account foreign direct investment, economic openness and the role of domestic financial development. Data on 23 OECD and 30 African countries were analyzed using recent panel technique estimators of fixed effects and random effects models for each country group. Our results show low saving-retention coefficients for both developed and developing countries, but relatively more so for the latter. The findings confirm the view that capital mobility has increased worldwide, especially in developing countries. Of special interest, is that these results are more pronounced when foreign direct investment is excluded from domestic investment.

Keywords: Feldstein-Horioka puzzle, capital mobility, saving-retention coefficient, panel estimations, OECD, Sub-Saharan Africa

INTRODUCTION

The degree of integration of financial markets around the world has increased significantly, providing opportunities for efficient allocation of capital resources, better corporate governance, international portfolio diversification, and consumption smoothening (Levine, 1997; Kose et al., 2006; Obstfeld, 1994; Van Wincoop, 1999; Eichengreen and Mussa,1998). It also, however, embodies the potential for adverse effects as higher degree of financial integration can generate a severe cross-border financial contagion among the integrated economies (Beine *et al.,* 2010). It may also actually hurt capital-scarce countries with poor institutional quality and lousy policies (Boyd and Smith, 1992), and may be crucial in determining whether countries can pursue independent monetary policies.

Major trends and developments in the last few decades have led to the sizable globalization of the word economy including, the emergence of globalized financial markets, the emergence of the Euro as a global currency, trade liberalization, economic integration, and the widespread privatization efforts by developing countries.[1] Economic theory predicts that, under perfect capital mobility and in the absence of government regulations in financial and goods markets, there will be a tendency for capital to flow around the word in search of higher investment returns as investors, acting rationally, will reallocate their capital from low to high-yield countries. Under a well-functioning single capital market linking most of the economies of the world, a shift of investment or saving schedule in one country would simply result in capital flows in or out of the country and would not result in any change in local interest rates (Harberger, 1980). In that environment, domestic investment will not only find its sources in domestic savings, but will be met by foreign excess savings entering the country in the form of foreign direct investment, and not all domestic

savings will be used to finance domestic investment. This implies that, in a highly globalized and integrated world economy, domestic savings and investment should remain uncorrelated. A divorce can be sustained between the level of national saving and investment within a country, with tangible gains for the capital importer and exporter operating in a highly integrated world economy.

Contrary to this highly plausible economic theory of low correlation between domestic investment and savings, a number of empirical studies found a strong connection between the two variables in different countries and periods. This controversy, which has its origin in the seminal work by Feldstein and Horioka (1980) and known as the Feldstein and Horioka (FH) puzzle, continues to ignite heated debate in open-economy macroeconomics. Using cross-section regressions of investment and savings ratios across 16 OECD (Organization for Economic Co-operation and Development) countries for the 1960–74 period, Feldstein and Horioka (1980) empirically investigated the claim that, under perfect international capital mobility, domestic savings and investment should not be co-integrated. Their results dauntlessly show a very high correlation between the two variables, with the saving-retention coefficient in the range of 0.85-0.95. The authors interpret their results as a lack of international capital mobility, in contrast to the economic wisdom, and putting virtually all international economists "*mal à l'aise*". This is evidently puzzling, given the perceived high degree of international capital mobility that prevails in the highly integrated world economy, especially in the OECD countries. The literature provides possible but still controversial explanations to the puzzle (Apergis and Tsoumas, 2009; Telatar et al., 2007; Kalyoncu, 2007). Given the strategic implications of the association between domestic saving and investment and the inconclusive empirical results, additional research are warranted.

The objective of this study is to provide new evidence on the saving-investment nexus and the degree of capital mobility in both developed and developing countries, by accounting for the crucial role of foreign direct investment, domestic financial development, and economic openness. The rest of the paper is structured as follows. A review of the literature is presented in section 2, while section 3 provides information on the empirical methodology and data. Section 4 details the empirical results of the estimations and section 5 summarizes and wraps up the findings.

LITERATURE REVIEW

The Feldstein and Horioka (FH) controversy, the mother of all puzzles (Obstfeld and Rogoff, 2000), is empirically verified and supported by some researchers, while others viewed it as not really puzzling. According to the latter, the inconsistency between the theoretical prediction and the empirical results can be disentangled by considering and including relevant variables into the FH original model. Some studies question the validity of using a simple two variables regression (as in Feldstein and Horioka, 1980) to measure capital mobility, and the interpretation of the co-movements of saving and investment (specifically, the saving-retention coefficient) as evidence of capital mobility or lack of. In fact, the literature provide evidence that high correlation between national saving and investment within a country is compatible with perfect capital mobility (Murphy, 1984; Baxter and Crucini, 1993; Tesar, 1991; Barro et al., 1995). Whatever the reason, the FH puzzle triggered many empirical investigations into the field, but the mother of all puzzles would still not go away (Sinha and Sinha, 2004).

A respectable number of empirical studies corroborate the FH initial finding, qualifying the puzzle as real and robust overtime, while some report a declining (especially in developing countries) but still high saving-investment coefficient, (Baxter and Crucini, 1993; Turner, 1986; Bayoumi, 1990; Sinn, 1992; Coakley et al., 1998; Pelagidis and Mastroyiannis, 2003; Payne, 2005; Blanchard and Giavazzi, 2002). Others find evidence against the FH argument of high correlation between saving and investment and the associated low capital mobility (Ho, 2002; Papadogonas and Stournaras, 2006; Christopoulos, 2007; and Brahmasrene and Jiranyakul, 2009).

Among the attempts that have been made and the explanations provided to reconcile the economic theory of the saving-investment nexus and the FH paradox, are the studies that address the estimation methods and models used in investigating the issue. They explore different econometric techniques including, pooled OLS, fixed and random effect, dynamic ordinary least squares (DOLS), fully modified

ordinary least squares (FMOLS), and autoregressive distributed lags (ARDL). Building on the advantages of ARDL bounds test techniques, in contrast to other conventional cointegration techniques, Kollias *et al.* (2008) use the ARDL bounds testing procedure and panel regressions to analyze the saving-investment nexus for 15 European Union countries. They found cointegration between saving and investment and a saving-retention coefficient in the range of 0.148-0.157, an indication of higher capital mobility, lower transaction costs in the international capital markets, and the declining status of long-run current account targeting as a primary government objective. In the same vein, Onafowara et al. (2011) using the ARDL approach, examines the relationship between saving and investment in eight advanced economies of the European Union and established evidence of a cointegration relationship between the two variables in six of the eight countries. Other studies that deployed bound testing approach in investigating the saving-investment cointegration include Esso and Keho (2010), Brahmasrene and Jiranyakul (2009), Kaya (2010), and Apergis and Tsoulfidis (1997).

Other critics that address the contradiction between the empirical evidence in Feldstein and Horioka (1980) and the conventional wisdom, resorted to time varying and regime switching models to investigating the puzzle. Ho (2000) investigated the sensitivity of saving and investment to regime shift using quarterly data for the 1979-95 interval and concluded that the saving-retention coefficient responds to differences in regimes. In re-examining the domestic savings-investment correlation and the degree of capital mobility using data for some European countries, Telatar et al. (2007) applied a Markov-switching model with heteroscedastic disturbances and discovered that the correlation coefficients are unstable due to the policy regime changes. Christopoulos (2007) examined the relationship between investment and saving rates in a sample of 13 OECD countries over the period 1885–1992 using panel Dynamic Ordinary Least Squares (DOLS) model. The estimated saving-retention coefficient is around 0.50 for the whole sample period (1885–1992) but increases to 0.79 and 0.90 for sub-periods 1921-1992 and 1950-1992, respectively, an indication of low degree of capital motility for those sub-periods. Papapetrou (2006) used a recursive OLS, rolling OLS, Kalman filter estimator and Markov switching regime modeling to capture the dynamic of the saving-retention coefficient in Greece during the 1980-2003 period. The results confirm a decreasing coefficient overtime and increased capital mobility due to financial liberalization.

Another group of studies narrows its focus on the important role played by relative country size in explaining the degree of correlation between domestic saving and investment. Baxter and Crucini (1993), in a two-country, one-good version of the standard neoclassical model, proved that high correlations between domestic saving and investment are consistent with a world in which capital is highly mobile. Hassan et al. (2014), based on data on saving and investment ratios from 21 OECD and 17 non-OECD countries, and using the dynamic heterogeneous panel estimators of Pooled Mean Group (PMG), Mean Group (MG) and Dynamic Fixed Effects (DFE), obtained saving-retention coefficient of 0.89, 0.93, and 0.16 for the high-income group, OECD category, and non-OECD category, respectively. Their results support lower capital mobility argument in high-income as a whole and OECD countries, and higher capital mobility in the non-OECD countries. Other studies however provide evidence of high capital mobility in large economies, especially in groups of countries with homogeneous institutions and regulations like in the European Union, North American Free Trade Agreement (NAFTA), and G7. Kollias et al. (2008) reported a saving-retention coefficient of 0.148 for the group of 15 European Union countries. Blanchard and Giavazzi (2002) unveils a relatively high saving-retention coefficient of 0.57 in the OECD over the period 1991-2001, and only 0.36 and 0.14 for the European Union and Euro area, respectively. The low saving-retention coefficient and high capital mobility argument for groups of homogeneous and developed countries, is corroborated by Feldstein and Bachetta (1991), Artis and Byoumi (1991), Giannone and Lenza (2004), Coakley et al. (2001), and Ketenci (2012).

Some studies, on the other hand, tested the FH puzzle using samples of developing countries. The majority of these empirical studies reports relatively low saving-retention coefficients and, therefore, a high degree of capital mobility in the developing world (Adeniyi and Egwaikhide, 2013; De Wet and Van Eyden, 2005; Dooley et al., 1987; and Wong, 1990). Using a sample of 20 sub-Saharan Africa countries, Adeniyi and Egwaikhide (2013) investigated the role of financial market sophistication in explaining the saving-investment relationship. According to the authors, greater financial development should help forge closer

ties between saving and investment. Their saving-retention coefficient of 0.32, on average, confirms the magnitude of the saving-retention coefficients reported by past studies for developing countries. More specifically, they uncover a prominent role for financial deepening in the saving-investment association. Applying panel cointegration techniques to data for six African countries, Adedeji and Thornton (2007) reported an increasingly mobile capital in the African countries during 1970–2000 with estimated saving-retention ratios of 0.73 (FMOLS), 0.51 (DOLS with heterogeneity), 0.45 (DOLS), and 0.39 (DOLS with cross-sectional dependence effects).

Among the studies that investigate the co-movement between domestic saving and investment of the FH type, are the research that point at the binding long-run solvency constraint countries face in their current account balance. Given the intertemporal budget constraint, a country can sustain a current account imbalance in the short run, but overtime, the two variables move together and must ultimately equalize to eliminate any current account imbalance in the long run. The literature provides evidence that the necessary condition for the existence of international capital mobility for an economy is that its current account balance be nonstationary (Coakley et al., 1996; Jansen, 1996; Gundlach and Sinn, 1992; and Mastroyiannis, 2007), and that high correlation between domestic saving and investment is plausible even in a perfect capital mobility world (Krol, 1996; Coiteux and Olivier, 2000; Banerjee and Zanghieri, 2003; Coakley and Kulasi, 1997; Coakley et al., 1996; Jansen, 1998; Sinha and Sinha, 2004, and Corbin, 2004).

Many critics and alternative approaches to the FH paradox pertain to variable measurements and missing variables. Critics pinpoint missing relevant variables from the original FH model as the culprit for the puzzle. These include, relative country size and productivity shocks (Baxter and Crucini, 1993), the level of financial development (Kasuga, 2004; Adeniyi and Egwaikhid, 2013; Raheem, 2017), and home biased in investor preferences (Gordon and Bovenberg, 1996; Hericourt and Maurel, 2005). Transaction cost between internal and external investment and tax policies in an open economy (Obstfeld and Rogoff, 2000; Niehans, 1992; Devereux, 1996), foreign aid (Dooley et al., 1987; Isaksson, 2001), and the size of the nontraded sector (Wong, 1990), are also cited in the literature as important factors that can explain the FH puzzle.

EMPIRICAL METHODOLOGY AND DATA

In their original investigation of the investment-saving retention ratio, Feldstein and Horioka (1980) estimated the following, two-variable equation:

$$\left(\frac{I}{Y}\right)_i = \alpha + \beta \left(\frac{S}{Y}\right)_i + \mu_i \tag{1}$$

where I, S, and Y denote domestic investment (proxied by gross fixed capital formation), national savings, and gross domestic product (GDP), respectively for each country i, and μi denotes a random disturbance. The coefficient β is the "savings-retention coefficient". As highlighted in the discussions above, many empirical studies have pointed out the limitations inherent in the FH's empirical treatment for estimating the saving-investment relationship. To overcome some of these drawbacks in the present paper, the saving-investment correlation is reexamined by incorporating a number of improvements suggested in the relevant literature including, variable measurement, missing important variables, and econometric techniques to derive estimation results.

Data-Related Issues

The first and main challenge is the definition of the investment variable. In the FH model and many other research, the investment variable is proxied by the country's gross fixed capital formation (denoted *GrossInv* in this study). The problem with this proxy is that it measures the country's *total*, as opposed to its *purely domestic* investment. Many critics and alternative approaches to the FH paradox pertain to variable measurements and missing variables. Rossini and Zanghieri (2003) introduces some novelty for the investment variable that excludes foreign direct investment (FDI). Contrary to past studies that defined

investment as including both investment undertaken by residents and FDI, Rossini and Zanghieri (2003) opines that FDI is not financed by savings of the recipient country and should be excluded from the domestic investment variable used in the FH equation. The savings-retention coefficient derived by excluding FDI from domestic investment would more precisely reflect the extent to which domestic savings is used to finance domestic investment.

In an attempt to obtain the purely domestic part of the economy's investment, and following Rossini and Zanghieri (2002, 2003), Younas (2011), and Makedonas and Tsopoglou (2013), an alternative proxy for the investment variable is used in this study. It consists of subtracting the value of foreign direct investment (FDI) entering the country from its gross fixed capital formation (*GrossInv*). This is denoted as net investment (*NetInv*).

$$NetInv = GrossInv - FDI \tag{2}$$

The second improvement in this study is by accounting for the important role of financial development in investigating the relationship between domestic saving and investment. In examining this relationship, it is crucial to recognize and account for the important role played by financial intermediaries and their level of development and sophistication. The literature on financial development including, McKinnon (1973), Shaw (1973), Levine (1997), Miller (2003), and Merton and Bodie (2004), asserts that the key function of a financial intermediary is to channel capital from the surplus unit of the economy to the deficit unit of the economy, allowing efficient allocation of resources. Different proxies of financial development have been used in the literature including, the quantity-based measures of financial development indicators (level or size of the financial sector) and qualitative measures (financial deepening). Financial deepening – improvements in the quality and quantity as well as the efficiency of financial services (Adeniyi and Egwaikhide, 2013; Cihak et al., 2012) – out to alleviate market frictions and provide an efficient environment for connecting savers to borrowers. The overall financial development can be broken down along the two subsectors of the financial system (financial institutions and financial markets), each of which can be assessed in terms of its depth, access, and efficiency in channeling saving. In terms of the financial institutions subsector, its depth is generally proxied by the private sector credit to GDP, its access by the number of bank branches, and its efficiency by net interest margin or lending-deposits spread. The depth of the financial markets, on the other hand, is generally proxied by stock market capitalization to GDP, while its access and efficiency are proxied by the percent of market capitalization outside of top 10 largest firms and stock market turnover ratio, respectively (Svirydzenka, 2016).[2] In terms of this research, and for simplicity, domestic credit to private sector as a percentage of GDP will be used as a measure of domestic financial development.

Given the discussion above, the basic FH model is augmented to include the financial development variable (*FinDev*) and the trade openness variable (*Open*) for the developed and developing country models, and the aid variable (Aid) in the case of developing countries.

Model Specifications and Methodology

The empirical models for developed (OECD) and developing (Sub-Saharan African) countries take the following forms:

OECD Countries

$$NetInv_{it} = \alpha_0 + \alpha_1 Saving_{it} + \alpha_2 FinDev_{it} + \alpha_3 Open_{it} + \alpha_4 (Saving_{it} * Z_{it}) + \mu_t + \eta_i + \varepsilon_{it} \tag{3}$$

Sub-Saharan African Countries

$$NetInv_{it} = \delta_0 + \delta_1 Saving_{it} + \delta_2 FinDev_{it} + \delta_3 Open_{it} + \delta_4 Aid_{it} + \delta_5 (Saving_{it} * Z_{it}) + \varphi_t + \gamma_i + \upsilon_{it} \tag{4}$$

where Z_{it} = $FinDev_{it}$, $Open_{it}$, $Open_{it}$, or *Aid*; μ_t and ϕ_t are time specific effects; η_i and γ_i are unobserved country-specific fixed effects; and ε_{it} and υ_{it} are the error terms. The subscripts *i* and *t* indicate country and time period, respectively. *NetInv* denotes net investment defined as the difference between gross fixed capital formation and inward FDI as a share of GDP. The *Saving* variable is the gross domestic saving as a percentage of GDP of the country. *FinDev* represents financial development and efficiency and is proxied by the domestic credit to private sector as a percentage of GDP. *Open* denotes the sum of export and imports as a percentage of GDP, and is used as a measure for the degree of openness of the economy. The aid variable (*Aid*) measures foreign aid received by the country and is proxied by net official development assistance and official aid received as a percentage of GDP. Foreign aid to developing countries is an important source of domestic investment in those countries and should be taken into account when investigating the saving-investment nexus. As pointed out in other studies, omitting such an important variable in the model, would weaken the correlation between saving and investment, thereby exaggerating the degree of capital mobility (Hanson, 1992; Montiel, 1994; Isakson, 2001; Younas and Debasish, 2011).

The interaction term ($Saving_{it}$*Z) is added to the model under the hypothesis that the impact of domestic saving on investment may depend on the level of the country's financial development, openness to trade, or foreign aid received (in the case of SSA countries). In other words, the interaction term will help test whether the level of domestic financial deepening, trade openness, or foreign aid affects the impact of domestic saving on investment. The coefficients of the interaction term (α_4, or δ_5) measure the amount by which the change in response with one predictor is affected by the other predictor.

A positive coefficient on (*Savingit*FinDevit*) indicates that the saving impact on investment is stronger in countries with deeper financial systems, while a positive coefficient on ($Savingit*Aid_{it}$) is an indication that the saving impact on investment is higher for countries that receive more foreign aid. A negative coefficient on ($Saving_{it}$*$Open_{it}$), on the other hand, shows a weak correlation between domestic saving and investment in countries that are more open in terms of trade and finance. The coefficients α4 (for OECD) and δ_5 (for SSA) are therefore expected to be positive for ($Saving_{it}*FinDev_{it}$) and ($Saving_{it}*Aid_{it}$), but negative for ($Saving_{it}*Open_{it}$). A statistically insignificant coefficient of the interaction terms is a demonstration that the impact of Saving on the dependent variable (*NetInv*) does not depend on *Open*, *FinDev*, or *Aid* in the respective countries.

This study uses panel data for two groups of countries (OECD and SSA countries). The OECD group comprises 23 countries while 30 countries are included in the SSA sample. All the data series are annual data and were obtained from the World Development Indicator (WDI) for the period 1990-2014. The dataset is an unbalanced panel data due to missing variables in some cases. As a prelude to estimating the investment-saving relationships, the variables included in equations (3) and (4) are subject to different tests to ensure cointegration, an extremely useful econometric property (Engel and Granger, 1987). Statistical inference from time series generally assumes that the variables included in the regression are stationary (constant mean and variance) and that shocks to the variables are temporary in the sense that, overtime, the effect of the shocks will vanish and the variables will converge to their long-run mean levels. Cointegration implies that there exists some adjustment process that prevents the variables from drifting apart in the long-run, therefore ensuring a long-run relationship among those variables. That is, they move together for a long period of time. Testing and establishing cointegration becomes a precondition to ensure empirically meaningful relationships. Failure to establish cointegration among nonstationary variables will lead to non-standard distributions and perhaps spurious regression results.

The econometric method used to estimate the steady state, long-run relationship in this study is based on the stationarity test results. If the variables are found to be stationary, a test for cointegration among the variables included in the model is then conducted. The following three-step procedure is therefore followed. In the first step, the integrational properties of the data series are ascertained. To that end and to investigate the stationarity property of each of the variables, five alternative panel-unit root tests are considered. In the second step, a test for panel cointegration relationships is performed. To determine whether a stable, long run relationships exist amongst the variables included in each country-group model, the Pedroni panel cointegration tests (proposed by Pedroni, 1999) were undertaken. The Pedroni tests are residual-based panel

cointegration tests with four within-dimension-based (panel) and three between-dimension-based (group) statistics to test the hypothesis of no cointegration in dynamic panel series with multiple regressors.

In the third step, the long-run relationships amongst the variables are estimated. This is achieved by using the fixed effects and random effects models (FEM and REM, respectively) which are the most commonly estimated models in panel data analyses, and help capture the heterogeneity effect. If it is believed that there are omitted variables in the model and that these variables are correlated with the variables included in the model, the fixed effect model is the preferred model as it controls for the omitted variable bias. The fixed effect model is fully efficient as the sample size increases even if the true model is random effect. However, the random effects model is appropriate and produces unbiased estimates of the coefficients with the smallest standard errors, if there are no omitted variables in the model or if the omitted variables are uncorrelated with the explanatory variables included in the model. A common decision rule is to use random effect model unless the Hausman test reject it. According to Clark et al. (2010), when the selection mechanism is fairly well understood and the researcher has access to rich data, the random effects model should be preferred. Moreover, according to the authors, random effects estimators of regression coefficients are more statistically efficient than those for fixed effects. Nwakuya and Ijomah (2017), on the hand, in comparing the fixed effect and random effects modeling in a panel data analysis, concluded that their results revealed that random effect were inconsistent in all their tests, showing that the fixed effect was more appropriate for the data. Obviously, it is not straightforward to determine when an effect must be considered as fixed or random effect. To examine which of the two models (fixed or random effects model) is appropriate for the data in this study, the Hausman test (a nested sub-model of the fixed effects model) will be applied.

EMPIRICAL RESULTS AND DISCUSSION

This section reports the results of the panel unit root tests, cointegration tests, and the estimation of the saving-investment equations. To ensure stationarity, five alternative panel-unit root tests are applied to each series to test for the existence of a unit root to determine the order of integration. These are Levin, Lin and Chu (LLC); Im, Pesaran, and Shin W-stat (IPS); Augmented Dickey–Fuller–Fisher chi-square (ADF); Phillips–Perron–Fisher chi-squared (PP); and Breitung test (BR). All five methods have a null hypothesis of unit roots or non-stationary series. The LLC and the Breitung tests have a null hypothesis of the presence of a common unit root process while the IPS, the ADF, and the PP test for the presence of individual unit root processes in series. The results of the various panel unit root tests for the two groups of countries (OECD and SSA) are reported in Table 1. For the saving variable (in the case of OECD countries), four of the five tests indicates the variable is integrated of order zero. For the same group of countries, three of the five tests show that the financial development variable is integrated of order zero. All the other variables for the two groups of countries are integrated of order zero as shown by all five panel unit root tests. Overall, these results exhibit strong evidence that, for all the variables in the models, the null hypothesis of unit root can be rejected at levels. The variables are therefore stationary at levels or integrated of the same order zero, I(0), confirming that there is a possibility of long run co-trending among the series.

The next set of results concern the tests for cointegration to establish long-run relationships (or a lack thereafter) amongst the variables included in the models (Equations 3 and 4). Cointegration techniques require that all the system's variables are integrated of the same order. Based on our panel unit root tests discussed above, that pre-requisite is resoundingly satisfied and give the basis for cointegration analysis. The Pedroni panel cointegration tests were applied in this study to the various sets of variables for each country group.

TABLE 1
PANEL UNIT ROOT TESTS

Variables	Level					First Difference					Decision
	LLC[a]	IPS[b]	ADF[b]	PP[b]	BR[a]	LLC[a]	IPS[b]	ADF[b]	PP[b]	BR[a]	
OECD Countries											
GrossInv	-4.7*	-5.0*	120.7*	84.2*	-1.4***	-10.6*	-11.1*	204.3*	221.3*	-6.9*	I(0)
NetInv	-3.8*	-4.6*	102.3*	111.9*	-0.91	-24.9*	-24.0*	455.1*	732.8*	-13.3*	I(0)
Saving	-2.2**	-1.8**	58.0	65.1**	-3.2*	-17.4*	-16.1*	299.9*	326.7*	-7.1*	I(0)
Open	-3.9*	-3.7*	82.3*	90.8*	-2.3**	-15.5*	-14.3*	244.7	457.8*	-10.8*	I(0)
FinDev	-4.3*	-1.5***	66.3**	37.5	2.1	-5.4*	-3.0*	83.1*	134.3*	-2.7*	I(0)
SSA Countries											
NetInv	-1.7**	3.0*	99.9*	112.1*	-3.9*	-26.0*	-25.6*	555.7*	720.5*	-10.8*	I(0)
Saving	-4.3*	-4.9*	136.3*	130.2*	-0.7	-25.7*	-25.0*	543.3*	847.2*	-13.8*	I(0)
Open	-3.1*	-3.1*	107.4*	105.1*	-1.5***	-21.7*	-22.2*	481.0*	679.6*	-10.0*	I(0)
FinDev	-13.1*	-4.1*	389.6*	116.0*	5.1	-14.0*	-11.8*	249.1*	537.3*	-6.3*	I(0)
Aid	-6.5*	-5.3*	131.4*	125.0*	-2.0**	-23.2*	-23.8*	520.6*	1005.8*	-10.2*	I(0)

Notes: LLC: Levin, Lin, and Chu test (Levin et al., 2002).
IPS: Im, Pesaran and Shin test (Im et al. 2003).
ADF: Augmented Dickey–Fuller–Fisher chi-square test (Maddala and Wu, 1999; and Choi, 2001).
PP: Phillips–Perron–Fisher chi-squared test (Maddala and Wu, 1999; and Choi, 2001).
BR: Breitung test (Breitung, 2000).
a. Tests the hypothesis of the presence of the common unit root process.
b. Tests the hypothesis of the presence of the individual unit root process.
The null hypothesis is the panel data series has a unit root (non-stationary).
*,**,***: Denote rejection of null hypothesis at 1%, 5% and 10% respectively.

The results of the panel cointegration tests are reported in Table 2. In the case of the OECD countries, there are two sets of variables (1 and 2): These are net investment, saving, openness, and financial development; and gross investment, saving, openness, and financial development, respectively. For Set 1, out of the 11 tests (8 within-dimension-based and 3 between-dimension-based), 8 reject the null hypothesis of no co-integration at the 1% level, supporting the hypothesis that the variables are co-integrated. Only the panel v-Stat (both Statistics and weighted Statistics) and the group Rho-Stat support the null hypothesis of non-cointegration. For the second set, 7 out of the 11 tests reject the null of no cointegration (3 at the 1% level, 3 at the 5% level, and 1 at the 10% level, respectively), and it can therefore be inferred that the variables are cointegrated. For the Sub-Saharan African countries, the majority of the tests also show that the variables as cointegrated. Of the 11 tests, 6 are significant at the 1% level, strongly rejecting the null hypothesis. Summing up, it can be concluded that there is evidence of long-run relationships among the series in the models for both country groups.

Armed with these corroborative results (panel unit root and panel cointegration tests), the ground is well prepared for the third step of the analysis, i.e., the estimation and identification of the saving-retention coefficients of the saving-investment relationships in the two country groups. As discussed above, this study uses fixed effect and random effect models (FEM, REM, respectively) as better estimators due to the inability of pooled OLS model to control for unobserved country-specific heterogeneity issues in cross country regression panel data. The choice of FEM and REM over a pooled OLS model, and which of the two models (FEM and REM) is more appropriate based on the current dataset, were documented using standard diagnostic tests.

TABLE 2
PEDRONI PANEL COINTEGRATION TEST RESULTS

OECD Countries **Variables (Set 1): NetInv, Saving, Open, FinDev**							
	Within Dimension (Panel)				Between Dimension (Group)		
	v-Stat	rho-Stat	PP-Stat	ADF-Stat	Rho-Stat	PP-Stat	ADF-Stat
Statistics	-0.002	-4.422*	-8.791*	-5.884*	-0.821	-8.683*	-7.431*
	(0.501)	(0.000)	(0.000)	(0.000)	(0.206)	(0.000)	(0.000)
Weighted Stat	0.787	-2.429*	-7.080*	-6.012*			
	(0.216)	(0.008)	(0.000)	(0.000)			
OECD Countries **Variables (Set 2): GrossInv, Saving, Open, FinDev**							
	Within Dimension (Panel)				Between Dimension (Group)		
	v-Stat	rho-Stat	PP-Stat	ADF-Stat	Rho-Stat	PP-Stat	ADF-Stat
Statistics	2.177**	0.511	-0.721	-3.800*	1.530	-1.424***	-5.437*
	(0.015)	(0.695)	(0.236)	(0.000)	(0.937)	(0.077)	(0.000)
Weighted Stat	1.887**	-0.040	-1.737**	-3.917*			
	(0.030)	(0.484)	(0.041)	(0.000)			
SSA Countries **Variables: NetInv, Saving, Open, FinDev, Aid**							
	Within Dimension (Panel)				Between Dimension (Group)		
	v-Stat	rho-Stat	PP-Stat	ADF-Stat	Rho-Stat	PP-Stat	ADF-Stat
Statistics	1.239	-0.567	-4.941*	-5.002*	1.148	-6.188*	-5.909*
	(0.108)	(0.286)	(0.000)	(0.000)	(0.875)	(0.000)	(0.000)
Weighted Stat	0.634	-0.677	-5.712*	-5.559*			
	(0.263)	(0.249)	(0.000)	(0.000)			

Notes: Trend Assumption: No deterministic trend
Automatic lag length selection based on AIC

Null Hypothesis: No cointegration
*,**,*** denote rejection of null hypothesis at 1%, 5% and 10% respectively.

The estimations are conducted in two stages. In the first stage, the models are estimated without the interaction terms (restricted models). The interaction terms are accounted for in the second step using the full models. The results of the estimations of the saving-investment relationships (without the interaction terms) in the two country groups, are reported in Table 3. The redundant fixed effect test (F-test) results show that the effects are statistically significant, therefore strongly rejecting the null hypothesis of pooled OLS. The results and conclusion that the FEM and REM outperform the pooled OLS model are consistent across the different models in each of the country groups.

To determine the appropriateness of the FEM vs. REM model, the Hausman test is employed. The results are split across the different models and country groups. According to the test results, preference is expressed in favor of the FEM for Models 1 and 2 of the OECD countries. On the other hand, the results show that the REM is more reliable in Model 3 of OECD countries and Models 1 and 2 of the SSA countries. Due to the advantages and disadvantages of each of the FEM and REM models and for comparison purposes, both the FEM and REM models are reported in Table 3, although the Hausman test rejects one model in favor of the other in the different settings.

TABLE 3
SAVING-INVESTMENT REGRESSION ESTIMATES (RESTRICTED MODELS)

OECD Countries						
Independent Variables	**Dependent Variable:** Net Investment (NetInv)		**Dependent Variable:** Gross Investment (GrossInv)			
	Model 1		**Model 2**		**Model 3**	
	FEM	**REM**	**FEM**	**REM**	**FEM**	**REM**
Constant†	26.124*	22.343*	10.831*	11.431*	13.127*	13.301*
	(9.97)	(9.98)	(12.50)	(11.69)	(14.59)	(13.47)
Saving	0.206**	0.306*	0.471*	0.447*	0.529*	0.517*
	(2.14)	(3.77)	(13.64)	(13.78)	(15.90)	(16.38)
Open	-0.209*	-0.173*			-0.068*	-0.064*
	(9.04)	(10.40)			(8.97)	(9.33)
FinDev	0.021**	0.010			0.010*	0.009*
	(2.19)	(1.20)			(3.01)	(2.72)
Adj. R^2	0.501	0.169	0.685	0.246	0.736	0.359
F-test (POLS vs. FEM)	F(22,505)=9.09; p=0.000 Decision: Reject Pooled OLS		F(22,551)=37.22; p=0.000 Decision: Reject Pooled OLS		F(22,515)=32.94; p=0.000 Decision: Reject Pooled OLS	
Hausman test (FEM vs. REM)	$\chi^2(3)$=9.44; p=0.024 Decision: Accept FEM		$\chi^2(1)$=4.15; p =0.042 Decision: Accept FEM		$\chi^2(3)$=3.16; p=0.368 Decision: Accept REM	
Observations	531	531	575	575	541	541
SSA Countries						
Independent Variables	**Dependent Variable:** Net Investment (NetInv)					
	Model 1		**Model 2**			
	FEM	**REM**	**FEM**	**REM**		
Constant†	-6.163*	-5.165*	-0.513	0.865		
	(3.99)	(2.73)	(0.35)	(0.49)		

Saving	0.152*	0.138*	0.072*	0.056*
	(5.32)	(5.16)	(2.56)	(2.15)
Open	0.218*	0.212*	0.200*	0.195*
	(17.62)	(18.77)	(15.66)	(16.88)
FinDev	0.142*	0.107*	0.158*	0.100*
	(3.17)	(3.01)	(3.37)	(2.73)
Aid	0.346*	0.347*		
	(8.42)	(8.58)		
Adj. R^2	0.699	0.374	0.669	0.313
F-test (POLS vs. FEM)	F(29,697)=9.09; p=0.000 Decision: Reject Pooled OLS		F(29,698)=18.70; p=0.000 Decision: Reject Pooled OLS	
Hausman test (FEM vs. REM)	$\chi^2(4)$=3.42; p=0.490 Decision: Accept REM		$\chi^2(3)$=5.73; p=0.126 Decision: Accept REM	
Observations	731	731	731	731

Notes:

† The value of the constant term for the FEM models is the average of the fixed effects.
The numbers in parentheses below the estimated coefficients are t-statistics.
*,**,*** denote rejection of null hypothesis at 1%, 5% and 10% respectively.

The saving-investment regression models for the OECD countries are estimated using net investment (*NetInv*) and gross investment (*GrossInv*) as independent variables – Model 1; and Models 2 and 3, respectively.[3] For the OECD countries, the saving-retention coefficient estimate is positive and statistically significant across all the different specifications. The magnitude of the coefficients ranges from 0.206 to 0.529, which is in contrast with the basic FH model and therefore supporting the view of a higher degree of capital mobility for developed countries. It is crucial, however, to note the striking difference in the size of the coefficients in the models with gross investment as dependent variable (Models 2 and 3) versus the one with net investment as dependent variable (Model 1). In the former, the magnitude of the coefficient ranges from 0.447 to 0.529, compared to 0.206 to 0.306 in the latter. These results suggest that excluding FDI from the domestic investment variable used in the FH equation, at least partially, resolves the FH puzzle. This conclusion is consistent with those reported by Rossini and Zanghieri (2003). Their results unveil lower saving-retention coefficient and, therefore, high degree of capital mobility. The results are also in line with Younas (2011) who found that capital mobility is remarkably high in developed as well as developing countries when foreign direct investment is excluded from domestic investment. In the same vein, and using a new proxy for the investment variable denoted 'modified gross fixed capital formation' and derived by subtracting the imports of fixed assets included in an economy's gross fixed capital formation from the gross fixed capital formation itself, Makedonas and Tsopoglou (2013) claims that the new approach significantly reduces or even eliminates the high autocorrelation inherent in the initial Feldstein and Horioka model specification.

Another important variable in this study is the domestic financial development (*FinDev*) included in the models to account for the key role of the financial system in the saving-investment nexus. The results indicate that the financial development variable is significantly correlated with investment rates in the OECD countries. The estimated coefficient is positive in all four specifications and statistically significant in three (1% level in two and 5% level in 1). This suggests that financial intermediaries and their level of development and sophistication help bridge the gap between domestic saving and investment. Of all the estimates obtained for the OECD countries, the openness variable (*Open*) presents some challenges as the sign of its coefficient is not only negative but statistically significant across all models. This finding at first appears disturbing, as it is at odd with the literature. Theory suggests that an open economy would allow for free flows of capital in search of the greatest returns, and should be highly positively correlated with domestic investment. One could also, however, argue that this *a-priori* expectation may be more valid for developing as opposed to developed countries. Although Younas and Chakraborty (2011) show that an

increase in overall globalization has a positive and significant impact on investment rates for developed as well as developing countries, they pointed out that the effect appears to be smaller for developed countries. Additionally, Kim et al. (2013) posit that trade should positively affects investment in high-human-capital, more-financially-developed, or less-corrupted countries. Based on this, it can be argued that developed countries should experience higher investment as a result of their trade openness compared to developing countries which can see negative impact on their investment as a result of their openness to the world. However, empirical studies mostly report strong positive impact of trade liberalization on investment in the developing world. The arguments above suggests that there are other factors at play when it comes to the impact of trade openness on domestic investment. A possible factor and argument in support of a possible adverse effect of trade openness on domestic investment come from Razin et al. (2002). According to the authors, in the presence of lumpy investment cost of adjustment, trade openness may not have its conventional effects on the level of investment as it may lead to boom-bust cycles of investment which may destabilize the economy. Although there can be substantial gains from globalization in the investment-boom equilibrium, gains could be small, or negative, in the investment-bust equilibrium. It appears therefore that the sign of the openness variable obtained in this study is not, after all, inconsistent with expectations for developed countries.

Let's now turn the focus to the estimates for the Sub-Saharan African (SSA) countries. It is important to note that the dependent variable in these SSA models (Model 1 and Model 2) is domestic investment rates net of FDI (*NetInv*) whose choice was carefully explained above. In all four specifications, all the estimated coefficients are correctly signed and statistically significant. The results show that the savings rate coefficients are positive and statistically significant at 1 percent level in all four specifications. More importantly, is the magnitude of those coefficients when compared with the case of OECD countries. The size of the coefficients is clearly lower for SSA countries, strongly confirming the view of a higher degree of capital mobility in the developing countries than in the developed world. For consistency reason, and comparing Model 2 (SSA) and Model 1 (OECD) that resort to net investment as dependent variable and include the same explanatory variables, the difference in the size of the saving-retention ratio is quite patent. The coefficients are 0.206 (FEM) and 0.306 (REM) for OECD countries and only 0.072 (FEM) and 0.056 (REM) for the SSA country group. Controlling for foreign aid received by developing countries by adding it in Model 1 (SSA) increases the size of the saving-investment coefficient to 0.152 (FEM) and 0.138 (REM), but the magnitude still remains significantly lower compared to the OECD country group. Note that these results for SSA fare even better in terms of capital mobility when compared to the case of OECD when gross investment (*GrossInv*) is used as dependent variable (Models 2 and 3 – OECD), where the saving coefficients vary from 0.447 to 0.529. These results are robust across the different specifications and are in line with Younas and Chakraborty (2011) who reported a smaller saving coefficient for developing countries compared to developed countries (0.195 and 0.499, respectively). After controlling for globalization, they reached the same conclusion of higher capital mobility in developing countries based on savings-retention coefficients of 0.47 and 0.34 for OECD countries and 0.19 and 0.12 for developing countries. Raheem (2017), using annual dataset for 31 SSA countries, reported saving-retention coefficient estimates in the range of 0.052 and 0.061. A high capital mobility in Sub-Saharan Africa (SSA) is also confirmed by De Wet and Van Eyden (2005), based on stationary panel data techniques for 36 SSA countries that produced a low saving-retention coefficients in the range of 0.286 and 0.349.

In contrast with the case of OECD countries, the estimated coefficients of the openness variable (*Open*) for SSA countries are positive and statistically significant at the 1% level. The inclusion of the foreign aid variable (*Aid*) in the saving-investment regression (Model 1) does not noticeably change the coefficient estimates of the openness variable which remain robust across the models and specifications. These results clearly revealed that in the developing world, economies that are more open to trade and capital flows, stand to gain in terms of investment and are likely to grow faster. The results are also consistent with findings of De Wet and Eyden (2005), Payne and Kumazawa (2005), and Younas (2007) who reported that openness has had a significantly positive effect on investment rates in Sub-Saharan Africa countries. As explained above, the financial development variable (*FinDev*) is included in this study to account for the important role of domestic financial markets in the saving-investment nexus. Consistent with the case of OECD

countries, the estimated coefficients for SSA countries confirm the view that financial deepening help bridge the gap between domestic saving and investment. The coefficients are correctly positively signed and significant at the 1% level across all specifications and after accounting for foreign aid in Model 1. The findings are in line with Adeniyi and Egwaikhide (2013) who reported results similar in magnitude for SSA. They stressed the telling intervening role of financial deepening in the saving-investment space and why this role should form an integral part of discussions in both academic and policy circles. The results of this study are also an addition to other past studies that report similar findings including, Ndikumana (2005) and Raheem (2017).

In Model 1 (SSA countries), the saving-investment regression is extended to account for foreign aid received by developing countries. The coefficient estimate of that variable is positive and statistically significant at the 1% level, with a magnitude of 0.346 (FEM) and 0.347 (REM) that patently shows the importance of that variable in explaining investment in SSA countries. This finding mirrors Younas (2007) who reported that a 10 percent increase in foreign aid as a ratio to GDP would result in increased investment of around 3.19 percentage points, which compared favorably with the 3.35 percent found in this study. Similar results in support of the high impact of foreign aid on domestic investment in SSA come from Payne and Kumazawa (2005), Younas and Chakraborty (2011), and Raheem (2017). It is also important to note the remarkable change in the magnitude of the saving coefficient when the financial aid variable is included in the regression (Model 1 vs. Model 2). The coefficient increased from 0.072 to 0.152 (FEM) and 0.056 to 0.138 (REM), suggesting that foreign aid is an important source of saving in SSA countries. In line with his study on the degree of capital mobility in developing countries, Isaksson (2001) noted that including foreign aid in the saving–investment regression has an important positive effect on the saving coefficient.

TABLE 4
SAVING-INVESTMENT REGRESSION ESTIMATES (FULL MODELS) ‡

Independent Variables	**OECD**		**SSA**		
	1	2	1	2	3
Constant†	17.591*	33.415*	11.389*	-1.812***	1.216
	(16.26)	(20.65)	(12.71)	(1.68)	(1.01)
Saving	0.252*	0.168***	0.137*	0.191*	0.128*
	(2.61)	(1.69)	(3.68)	(5.51)	(4.56)
Open	-0.165*	-0.209*	0.220*	0.215*	0.199*
	(6.35)	(9.05)	(16.84)	(17.26)	(15.93)
FinDev	0.018***	0.022**	0.141*	0.147*	0.171*
	(1.83)	(2.22)	(3.15)	(3.29)	(3.89)
Aid			0.342*	0.363*	0.486*
			(8.23)	(8.66)	(10.41)
Saving*Open	-0.007*		9.6E-05		
	(3.50)		(0.63)		
Saving*FinDev		0.002		0.005**	
		(1.55)		(1.98)	
Saving*Aid					0.011*
					(5.87)
Adj. R^2	0.512	0.502	0.699	0.700	0.726
Observations	531	531	731	731	731

Notes:

‡The dependent variable is net investment ( ) and all models (1, 2, and 3) are fixed effect models (FEM)

† The value of the constant term is the average of the fixed effects.

The numbers in parentheses are t-statistics.
*,**,*** denote rejection of null hypothesis at 1%, 5% and 10% respectively.

Next, the full models (with the interaction terms) are estimated. To increase the interpretability of the effects, the predictor variables (*Saving*, *Open*, *FinDev*, and *Aid*) are first centered before fitting the regression models. Centering reduces multicollinearity among predictor variables and can, as in this study, be done by subtracting the mean value from each case, and then compute the interaction terms. The coefficients from a centered model are often more accurate, meaningful, and easier to interpret (Aiken and West, 1991; Judd and McClelland, 1989, and Jaccard et al.1990). The results of the estimations are reported in Table 4 for both OECD and SSA countries. They are largely consistent with expectations and in line with those reported above under the restricted models (no interaction terms), and can be used as a robustness check for the overall estimation results in this study. The main conclusion about capital mobility in the two country groups still holds, as the results in Table 4 confirm higher capital mobility in developing countries compared to developed countries.

In the case of OECD countries, the results indicate that the level of trade openness affects the impact of domestic saving on investment. The interacted coefficient of the variable (*Saving*Open*) is negative and statistically significant at the 1 percent level. This finding suggests that OECD countries are likely to experience a low saving-investment correlation, the more open to the world they are. Although the literature show that capital is relatively less mobile in developed compared to developing countries, the result of the interacted coefficient of the (*Saving*Open*) variable in this study suggests that the capital immobility claim is less severe in more open economies. The coefficient of the interacted term in SSA countries, however, is statistically insignificant. For those countries, the data indicate that trade openness mostly affects investment directly instead of through its impact on saving. As in the case of the models without interaction terms, the coefficients of the openness variable (*Open*), representing the direct effects, are positive and significant.

For SSA countries, in addition to their direct impacts, both the financial development and foreign aid variables work their way through domestic savings to affect those countries' investment rates. The signs of the interacted coefficients of (*Saving*FinDev*) and (*Saving*Aid*) are positive and significant for SSA countries. These findings confirm not only the essential role of foreign aid as an alternative source of saving and investment in recipient countries, but, more importantly, investment and economic growth prospects are deeper in countries that benefit more from foreign aid. As for the degree of financial development, the positive sign on the interaction term (*Saving*FinDev*) provides evident of domestic saving as an important source of domestic investment in countries with deeper financial systems. The study therefore unveils the crucial role of more developed, well-functioning financial systems in creating and matching domestic saving with productive investment opportunities in SSA countries, thereby enhancing prospects for economic growth in those countries. The coefficient of the financial development interaction term for OECD countries, although positive, is statistically insignificant. Its effect on investment mostly materializes through its direct impact in those countries as shown by the positive and statistical significant coefficients of the financial development variable.

CONCLUDING REMARKS

The degree of integration of capital and financial markets around the world has increased, providing opportunities for efficient allocation of capital resources and international portfolio diversification. Despite the current globalized and integrated world economy, a controversy still exists as to the degree of international capital mobility and the correlation between domestic saving and investment. Given the strategic implications of the association between domestic saving and investment and the inconclusive empirical results, additional research are warranted. This paper provides new evidence on the saving-investment nexus and the degree of international capital mobility in both developed and developing countries, taking into account foreign direct investment, economic openness, and the role of domestic financial development. Annual data on 23 OECD and 30 SSA countries for the period of 1990-2014 were

analyzed using recent panel technique estimators of fixed effects and random effects models for each country group. The results show low saving-retention coefficients for both developed and developing countries, but relatively more so for the latter. The findings confirm the view that capital mobility has increased worldwide, especially in developing countries. Of special interest, is that these results are more pronounced when foreign direct investment is excluded from domestic investment.

The results also show that in OECD countries, trade openness has direct and indirect effects on investment, and that those countries are likely to experience higher capital mobility, the more open they are to the rest of the world. The degree of financial development in those countries, on the other hand, mostly affects investment directly instead of through its impact on saving. For SSA countries, the results indicate that, although trade openness only has direct impacts on investment, financial development has both direct and indirect effects, and SSA countries with deeper financial systems are more likely to experience low capital mobility. Interestingly, and as echoed in other studies, the results also confirm the crucial role of foreign aid received as an alternative source of saving and investment in those countries.

ENDNOTES

1. Refer to Eun and Resnick (2015) for additional information.
2. Svirydzenka (2016) provides a detailed analysis of financial development with examples.
3. The use of gross investment variable ($GrossInv$) as dependent variable in some of the OECD country models is simply motivated by comparison reasons. The models with net investment ($NetInv$) as dependent variable is the main focus of this study. This explains why, in the case of developing countries, only models with ($NetInv$) as dependent variable are considered.

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