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Domestic Savings-Investment Gap and Growth: A Cross-Country Panel Study

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Domestic Savings-Investment Gap and Growth:

A Cross-Country Panel Study[1]

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Abstract

Standard neoclassical growth models assume that foreign savings are perfect substitutes of domestic savings in financing domestic capital. Therefore, domestic saving rates are supposed to have no impact on investments and growth rates of countries. However, these models fail to explain the divergence of growth rates between East Asian countries with high domestic saving rates and other emerging market economies with low saving rates. This study forwards the view that saving-investment gaps, if not domestic savings themselves, may explain to some extent the divergence of growth rates among countries. We borrow the methodology of Aizenman et al. (2007) in calculating self-financing ratios (cumulative saving-investment gaps) of 46 countries for the period of 1993-2010. Surprisingly, we find that countries on average financed a larger fraction of their capital by domestic savings in the 2000s when international financial integration has intensified and there has been a surge in capital flows across countries. Our empirical findings suggest that increasing the fraction of domestic savings in the financing of domestic capital, i.e. a rise in self-financing ratios, contributes to growth performance of countries. This finding is more pronounced for low-middle income countries and countries with low self-financing ratios. Evidence also shows that countries with low and declining self-financing ratios have been more affected from the recent global financial crisis.

Key words: growth, self-financing ratio, domestic savings, panel data analysis
JEL Classification: C23, E21, O40

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[1] The views expressed in this paper are those of authors and do not necessarily reflect the official views of the Central Bank of Turkey. All errors are our own.
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1. Introduction

Empirical evidence indicates that the sustainability of growth faces a significant risk when saving-investment gap or the share of foreign savings in total financing in developing countries is excessively high. In other words, countries with large external imbalances or high reliance on the foreign capital in financing domestic investments are observed to be more vulnerable to external shocks in terms of their growth performances. Unlike theoretical models that hardly suggest a link between growth rates and saving-investment gaps of countries, empirical studies provide robust and rich evidence about this linkage (Prasad et. al., 2007; Aghion et al., 2009; Aizenman et al., 2007).

In terms of policy implications, institutions such as the World Bank and the IMF tend to address this issue in their policy reports. For instance, World Bank in its report on Turkey claims that "*low domestic saving jeopardizes the sustainability of high growth*". It further explains the potential channel from low domestic savings or high external financing to lower growth as "*…for credit-constrained firms (small and medium enterprises) with little or no means of external financing, the lack of domestic saving lowers investment and thus lowers growth of the economy*…" (World Bank (2012: 11-12).

In this study, our major concern is to investigate empirically the relationship between countries' growth rates and saving-investment gaps, which are represented by self-financing ratio (*SFR*) developed by Aizenman et al. (2007). This study follows a parallel line with the empirical research carried out by Aizenman et al. (2007) and Prasad et al. (2007). What makes our study different from Aizenman et al. (2007) is that we improved the calculation of this key variable named *SFR*, firstly, by allowing capital-output ratios (k) to vary across countries and secondly, by extending the period of analysis to 2000s as well as exploring a wider range of econometric specifications beyond that in Aizenman et. al. (2007).

In this context, *SFR* is at the center of our empirical analysis as a proxy for saving-investment gap. *SFR* measures the fraction of domestic capital that is financed by discounted cumulative domestic savings for a time-horizon of 10 years. This measure can also be interpreted as "wealth gap" of a country, which is expected to have contemporaneous growth impact. This is best expressed by Deaton (1999:38)'s saying *"Growth has to come from somewhere, and it is hard to think of growth rates as a pure time-series process, unaffected by previous levels of*

investment (=saving)". In parallel to this view, *SFR* takes past values of investments and savings into account.[4]

There is ample empirical evidence suggesting the link between domestic savings and growth even though traditional theoretical approaches often fail to identify this linkage.[5] Firstly, empirical evidence suggests a positive association between domestic saving and investment or an imperfect substitution between domestic and foreign savings, i.e. Feldstein-Horoika puzzle (Feldstein and Horoika, 1980). Although recent empirical studies find evidence that domestic saving and investment are decoupled in high income countries, it is documented that the investment-saving association is still present for low-middle income countries (Blanchard and Giavazzi, 2002; World Bank, 2012). Secondly, in contrast to the predictions of theoretical models, empirical observations show that the direction of net capital flows is not actually from high income to low income countries, as suggested by Lucas paradox (Lucas, 1990). Lastly, Prasad et al. (2007) put forward the view that low-middle income countries with relatively low reliance on foreign savings in financing domestic capital, grow faster. Empirical findings of Aizenman et al. (2007) also support this view and suggest that countries financing a larger fraction of their capital by domestic savings, i.e. with high *SFRs*, grew faster than countries with low *SFRs* throughout the 1990s. These two empirical findings carry utmost importance in terms of questions addressed in this study.

Furthermore, the theoretical framework provided by Aghion et al. (2009) highlights the role of domestic savings in attracting foreign capital and contributing to growth. Within this framework, domestic savings are treated as collateral for attracting growth-enhancing foreign capital to countries that are far away from technological frontier, i.e. low-middle income countries with low saving rates. More specifically, countries which are in need of foreign capital and far away from technological frontier may enhance their growth performance by raising domestic savings through which the extent of asymmetric

[4] Findings from empirical and theoretical studies on the growth-saving causality do not suggest a strong judgment on the direction of causality. We avoid going into details of these discussions.

[5] Neo-classical growth models suggest a direct link between domestic saving rates and growth under the closed economy assumption (Solow, 1956; Cass, 1965; Koopmans, 1965; Ramsey, 1925). However, this link disappears under the open economy assumption, where foreign savings perfectly substitutes domestic savings in financing domestic capital. Endogenous growth models give most of the credit to total factor productivity, technological change and innovation rather than savings and capital accumulation in enhancing growth (Romer, 1986; Romer, 1990; Aghion and Howitt, 1992). These theoretical models fail to explain the divergence of growth rates between high-saver East Asian countries and other emerging countries, that is, countries in the former group have exhibited stronger growth performance compared to the latter group.

information is minimized and thus foreign investors feel confident about investing in good projects. This would ease the adoption of new technology by local firms and consequently leads to better growth performance.[6] In short, the transmission mechanism proposed by Aghion et al. (2009) is another channel through which a rise in domestic savings may enhance the growth performance of countries that are far away from technological frontier.

This study examines the empirical relationship between *SFRs* and growth rates for a sample of 46 countries (24 developed and 22 developing) over a time span of 1993-2010 using panel data techniques. Our analysis focuses on the medium-term perspective of growth dynamics. In order to test the sensitivity of our findings, we examine growth model at different frequencies (5-year averaged data and 3-year averaged data) to observe whether they provide a consistent story. Our main empirical findings indicate that medium term growth rates in low-middle income countries as well as in countries with low *SFRs,* increase with *SFR*.

The next section of the paper examines descriptive analysis of self-financing ratios. Section 3 defines the empirical model and evaluates the findings of empirical analysis. The last section concludes the paper.

2. Descriptive Analysis of Self-financing Ratios (*SFRs*)

As mentioned previously, self-financing ratio developed by Aizenman et al. (2007), has been an important part of our empirical analysis. It roughly determines the fraction of domestic capital stock financed by cumulative national savings. In this section, we describe the variable and summarize the main findings of the study by Aizenman et al. (2007).

The formula for the approximated measure of self-financing ratio is:

$$f_{t;n} = \frac{\sum_{i=1}^{n} S_{t-i}(1-d)^{i-1} + kY_{t-n}(1-d)^{n}}{\sum_{i=1}^{n} I_{t-i}(1-d)^{i-1} + kY_{t-n}(1-d)^{n}}$$

Where, *k* denotes capital-GDP ratio in the beginning of the period and is invariant across countries, *d* the depreciation rate, *Y* the real *GDP*, *I* real gross investment, *S* real gross

[6] This theoretical approach resembles "financial accelerator theory" in which firms with large collateral raise external financing at lower cost due to lower external finance premium, which, in turn, reduces the extent of asymmetric information (Bernanke, et al., 1996).

domestic savings. The idea here is basically to "backcast" *S* and *I* for horizon of *n* periods. Therefore, *SFR* at time *t*, indicates a ratio that is calculated using "backcast" of *S* and *I* for horizon of *n* periods. As observed in the formula, larger weights are assigned to recent investment and savings figures.[7] A value of *SFR* below 1 designates a partial reliance on foreign saving, while a value of 1 resembles that the entire stock of domestic capital is self-financed, i.e., financed by domestic savings.

Aizenman et al. (2007) calculated the average *SFRs* for developing countries below one, which exhibited a stable pattern throughout the 1990s, in an era of increased financial integration. They claimed that the wave of financial liberalization in the beginning of 1990s had little impact on *SFRs* in 1990s. In other words, in a period of greater financial integration, changes in average *SFRs* remained almost negligible. Furthermore, their study suggests that "throughout the 1990s, countries with higher *SFRs* grew faster than countries with low *SFRs*".[8] Notwithstanding the increased financial integration, in low-middle income countries, foreign savings played a limited role in the financing of domestic capital stock.

In this section, we report the patterns of self-financing ratios. *SFRs* are calculated for 46 countries (24 developed and 22 developing) for the period 1993-2010, which represent almost 90 percent of global *GDP*.[9] We improved the calculation of *SFRs* given in Aizenman et. al. (2007), firstly by allowing capital output ratios (k) to vary across countries based on Saygılı and Cihan (2013) and secondly extending the period of analysis beyond that in Aizenman et. al. (2007). The extension of period to 2000s enabled us to analyze the impact of growing global imbalances witnessed in 2000s on *SFR,* and relate them to the corresponding growth performances of selected countries.

Together with the stream of policies and reforms to liberalize trade and capital account regimes in the 1980s, there has been a rapid increase in the trade volume and capital flows globally in the 1990s. During the period of 1990-2008, world trade volume increased by 3.5 times in US dollar terms, reaching 64 percent of global GDP before the start of global crisis in 2008, while it was amounting to 40 percent of global GDP in 1990. Capital flows have increased during that period as well. Foreign direct investment (net) as a percentage of world GDP increased by 3.3 points to 4.2 percent during the period of 1990-2007. In other

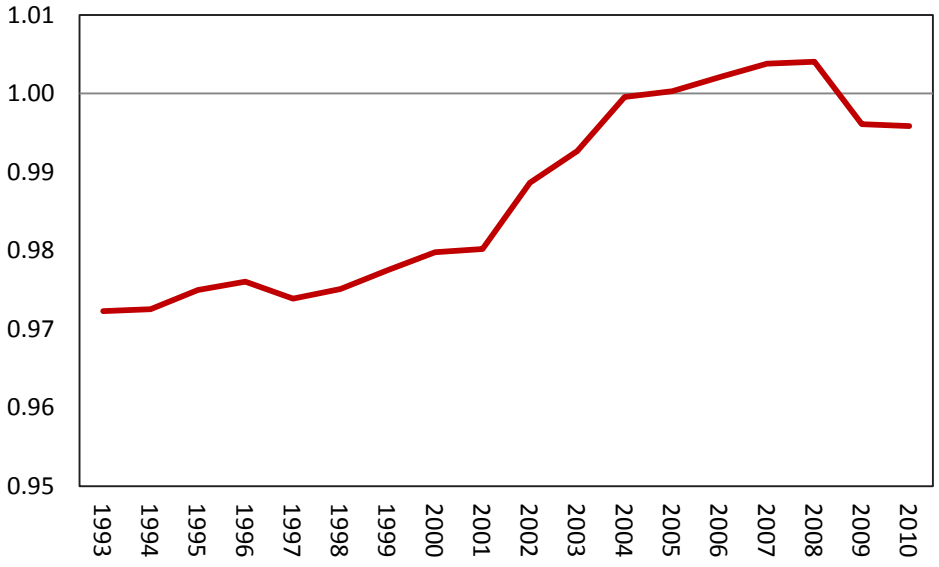
[7] For more details about the formula, please see Aizenman et al. (2007).
[8] Aizenman et al. (2007:684)
[9] For the list of countries, see Appendix 2.

words, net foreign direct investments increased approximately by 8.5 folds annually during this period. A similar tendency is also observed for long-term borrowings and portfolio investments.

Based on our calculations, together with a rapid increase in cross border trade and international capital flows during 2000s, countries have changed the patterns of financing their domestic capital stocks. On the one side, countries with low domestic saving rates began to rely more heavily on foreign savings to finance their growing investments; on the other side, there have been increases in capital outflows of the countries that have high domestic savings. Capital flows across countries have affected countries' *SFRs*.

Average *SFR* of selected countries between 1993 and 2010 can be viewed on Graph 1. It is observed that average *SFR* increased sharply in the first half of the 2000s, while they slightly declined during the global crisis. When average *SFR* is weighted by national incomes of countries, it is clear that throughout the period, average *SFR* is still below "1" and increased only slightly.[10] Furthermore, the fact that most of the selected countries' *SFRs* are below "1" implies that countries generally financed their capital stock by domestic savings.

Graph 1: Average SFR of Selected Countries (1993-2010)



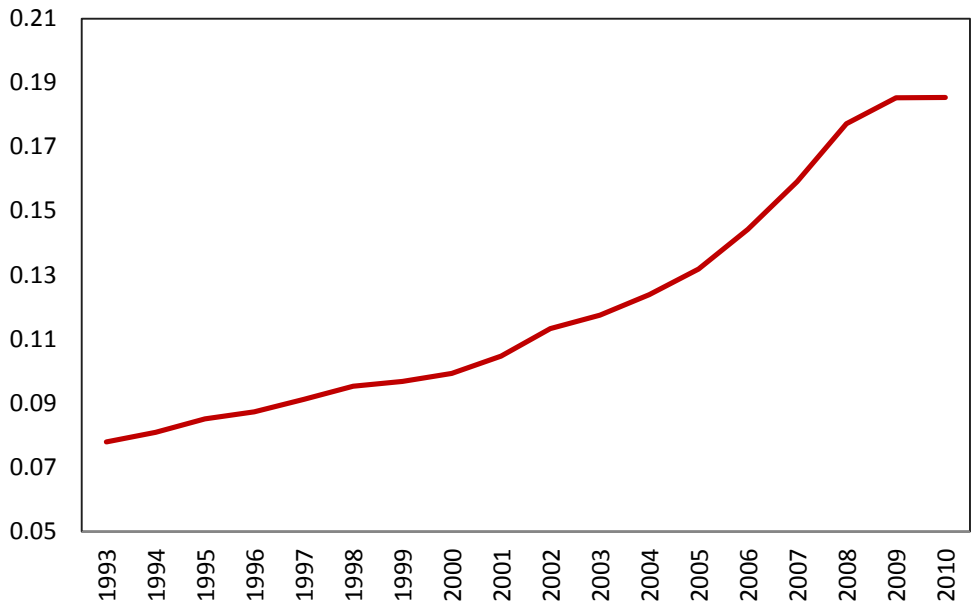
Source: Authors' calculations.

[10] High-income countries with declining *SFRs* in the dataset such as the United States and the United Kingdom have been influential on the rather slow increase in weighted averages as compared to simple averages.

The dispersion or volatility in *SFRs* has also increased sharply in the 2000s, in the face of rapid increases in global capital flows, as a possible reflection of global imbalances (Graph 2). On the one hand, countries with already high domestic saving rates such as China, Malaysia, Norway and Germany raised their *SFRs* through further increases in their domestic savings, on the other hand, *SFRs* in some other countries such as United States, Turkey, Greece, South Africa, Bulgaria, Spain and Romania declined more, contributing to global imbalances. Although these imbalances somewhat corrected during the global crisis period of 2008-2009, it still continues to be an important issue.

SFRs of a number of developed and developing countries have declined significantly in recent years. Countries that have deeply affected by the global crisis, such as Greece, Iceland, Portugal, Romania, Spain, Italy and Ireland had already experienced a decline in their *SFRs* in the pre-crisis period. Furthermore, South Africa, United Kingdom, United States, New Zealand, Hungary, Bulgaria, Poland and Turkey also experienced falls in their *SFRs* to various degrees during the same period.

Graph 2: Volatility of *SFR* of Selected Countries (1993-2010)



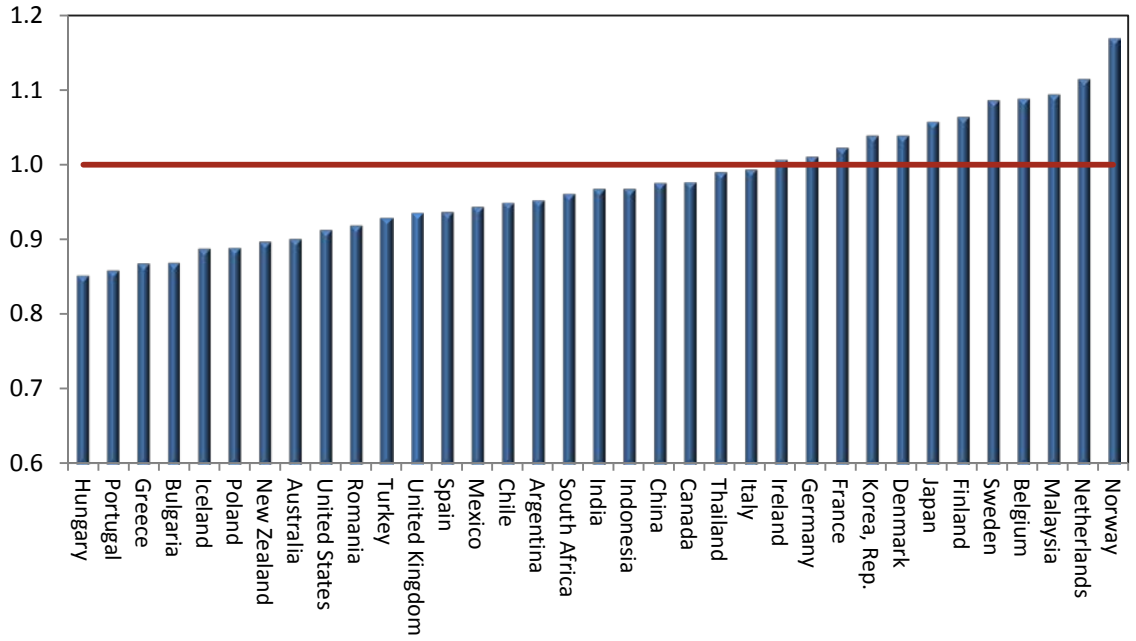
Source: Authors' calculations

Average *SFR* of some selected countries over the period of 2000-2010 can be viewed in Graph 3. Differences in average *SFR* in the period of 2000-2010 as compared to the period of 1993-1999 are observed in Graph 4. For most of the countries in the dataset, *SFRs* have increased. Countries that had already high average *SFR*, have generally increased their *SFRs*

throughout time. As can be viewed from the Graph 3 and 4, high-income countries such as Norway, Finland, Canada, France, Germany, Denmark, Japan, Belgium, Netherlands, Sweden and some low-middle income East Asian countries such as Malaysia, Thailand, South Korea and China are the ones that belong to this group of countries.

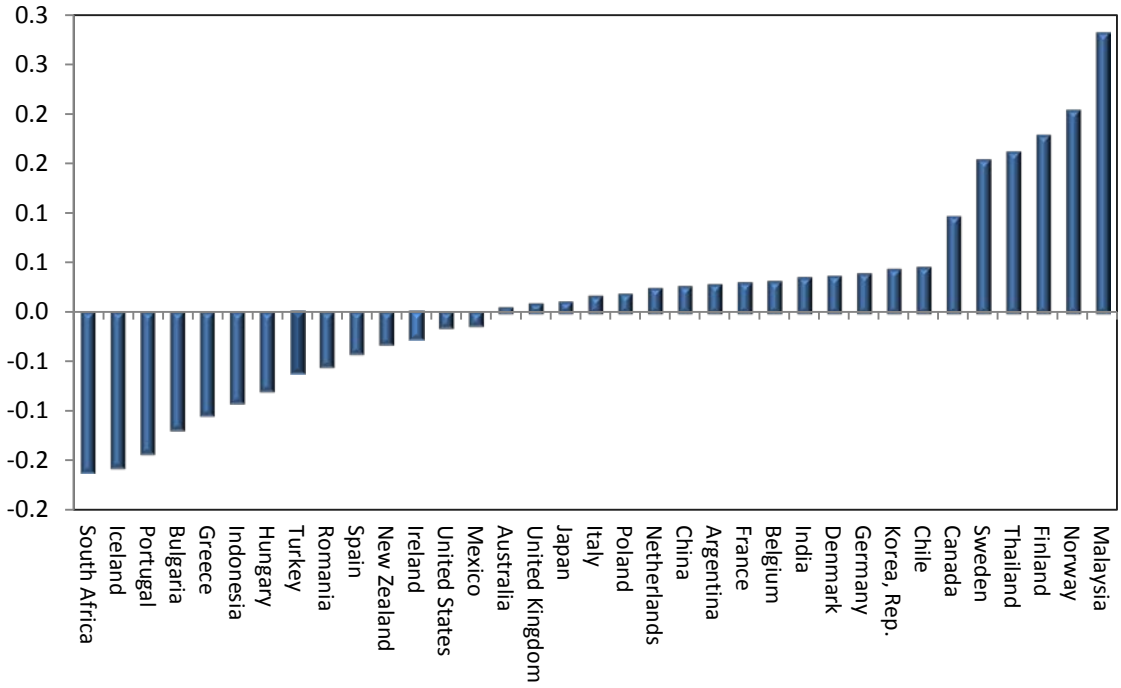
Countries in need of foreign financing generally financed their expenditures by importing capital in the forms of foreign direct investment and/or long-term debt from high-income countries along with borrowing from countries having high accumulated reserves. For instance, the fact that Central Bank of China holds an important portion of their reserves in government bonds of USA, allows lower interest rates and higher consumption in USA. As can be viewed in Graph 4, Portugal, Bulgaria, Greece, Spain, Ireland, Romania, South Africa, Indonesia, Hungry, Turkey, New Zealand and USA are among the countries whose average self-financing ratios declined during the 2000s compared to 1990s.

Graph 3: Average Self Financing Ratios of Selected Countries during the Period of 2000-2010



Source: Authors' calculations

Graph 4: Difference of Average Self Financing Ratios of Selected Countries for the Period of 2000-2010 as Compared to 1993-1999 Period



Source: Authors' calculations

Table 1 provides some descriptive statistics for the variables that are used in the empirical analysis given in the following section.

Table 1. Descriptive Statistics for the Variables

Variables	Obs.	Mean	Std. Dev.	Min	Max
GROWTH	820	2.4	3.5	-14.3	13.6
PCINCOME	828	9.3	1.2	5.7	11.7
SFR	786	1.0	0.1	0.6	1.5
POLSTAB	552	0.3	0.9	-2.4	1.7
TOPEN	828	84.3	64.6	15.0	460.5
WORKAGE	828	66.3	3.0	56.5	73.6
INVGDP	808	23.1	5.7	8.3	48.2
FDIGDP	817	9.5	46.9	-29.2	564.9
PORTFGDP	828	1.7	19.7	-113.4	312.0
INFCPI	809	15.1	112.0	-4.5	2075.9
GBALGDP	777	-1.9	4.5	-31.3	18.8
M2GDP	756	83.9	75.9	14.0	636.5

3. Empirical Analysis

Econometric analysis has been carried out for two different time frequencies to deal with short-run variations in variables in explaining growth rates of the countries. Since our interest is mainly medium-term growth dynamics, initially, we construct a panel data set that contains non-overlapping 5-year averages of the data for each country. Therefore, for instance, 18 annual observations for a particular country over the period of 1993-2010 are compressed into four observations for each country. First observations are the average of three years 1993, 1994, 1995 while the remaining three observations are the average of five years.[11] For the non-overlapping 5-year average figures, we carried out static panel estimations, i.e. fixed effect. Alternatively, we do the same for non-overlapping 3-year averages, where 18 annual observations for a particular country are compressed into six observations over the period, which is sufficient number of observations for performing dynamic panel regressions. This method allows us not only to capture dynamic factors and to deal with endogeneity problem but also to carry out additional regressions that identify the impact of global crisis.

3.a. Findings from Panel Regression

We begin our empirical analysis by estimating the following model:

$$GROWTH_{i,t} = \beta_1 PCINCOME_{i,t-1} + \beta_2 SFR_{i,t} + \beta_3 SQSFR_{i,t} + \sum_{j=1}^{k} \delta_i X_{it,j} + \theta\ INTSFRLOW_{i,t} + \ell\ INTSFRLINC_{i,t} + \varepsilon_{it} \qquad (1)$$

where i = 1,…..,46, j = 1,…..,k and t, respectively refer to country, number of control variables and time series element of the data. ε is the error term. As mentioned above, we initially work with a panel data set that contains non-overlapping 5-year averages of the data for each country. *GROWTH* is average per capita growth rate. The square of *SFR*, *SQSFR*, allows for possible nonlinearities. This variable allows us to test our hypothesis that the growth impact of *SFR* weakens as *SFR* increases.[12] Other regressors used in this model include the log of lagged per capita income ($PCINCOME_{t-1}$) to address convergence across countries, the vector of control variable *X* involves trade openness *(TOPEN),* the share

[11] *SFR* averages for different income groups across periods are given in Appendix 1.

[12] Alternatively; we use savings rates instead of *SFR* even though regression results are not reported here. The coefficient of domestic savings are estimated to be insignificant, implying that it is the saving-investment gap rather than saving rates themselves that matter for growth.

working age population (*WORKAGE*), investment rate (*INVGDP*), the share of foreign direct investment in *GDP* (*FDIGDP*), the portfolio investments as percent of *GDP (PORTFGDP),* inflation rate (*INFGDP*) and government balance as percent of *GDP (GBALGDP)*. Furthermore, two different interaction terms are included in the regressions interchangeably: *INTSFRLOW* and *INTSFRLINC*. *INTSFRLOW* is product of dummy variable representing countries whose average *SFR* is below 0.96 (*DSRFLOW*) and *SFR*.[13] *INTSFRLINC* is the product of dummy variable representing low-middle income countries (*DLINC*) and *SFR*. This analysis allows us to test the hypothesis that foreign savings may not be perfect substitute for domestic savings and thus an improvement in saving-investment gap (rise in domestic savings) may enhance the growth performance of countries that are far from the technological frontier, i.e. low-middle income countries.

Estimation results for the fixed effect model are reported in Table 2. The first column represents the basic model without the interaction terms. In the second column, *SQSFR* is added as a regressor to control non-linearity. In the other columns, we incorporate above-mentioned interaction terms (*INTSFRLOW* and *INTSFRLINC*) interchangeably, while in the fourth and sixth columns *SQSFR* is included in the regression as well.

In regression (1), the estimated coefficient of *SFR* is positive and statistically significant while in regression (2) coefficient of *SQSFR* is negative as expected but not statistically significant, implying no clear evidence for non-linearity in the association between average growth rates and *SFRs*. Alternatively, in regression (3), *INTSFRLOW* is added as a regressor in place of *SQSFR* to control for any non-linearity. The coefficient of *INTSFRLOW* is positive and statistically significant, supporting the view that a rise in *SFR* may contribute to growth rates significantly when *SFR* is low but this contribution disappears as it gets higher. In regression (4), we use both *SQSFR* and *INTSFRLOW* as regressors to control for non-linearity and only the coefficient of the latter is statistically significant.[14] Regression in the first column suggests that a 10 basis point increase in *SFR* will add 2.2 percentage points to the average per capita growth rate. This figure is larger for countries with lower *SFRs*.

[13] Low SFR countries are : Argentina, Australia, Brazil, Bulgaria, Chile, Colombia, Czech Republic, Greece, Hungary, Iceland, Israel, Slovak Republic, Mexico, New Zealand, Philippines, Peru, Poland, Portugal, Romania, Spain, Turkey, United States, United Kingdom

[14] We thank to anonymous referee for suggesting to use these two variables in the same regression.

Furthermore, the coefficient of interaction term *INTSFRLINC* is also positive and statistically significant in the regression (5), implying positive impact of *SFR* on growth in low-middle income countries. This outcome does not change when *SQSFR* is added as a regressor alongside *INTSFRLINC* in regression (6). This finding clearly supports the hypothesis suggested by Aghion et al. (2009) that lower income countries that are in need of technological transfer from abroad may benefit from having a stock of domestic savings, which can be regarded as collateral that raise willingness of foreign investors to invest in good domestic projects.

Table 2: Fixed-Effect Panel Regression
Dependent Variable: GDP growth rate (%)

	(1)	(2)	(3)	(4)	(5)	(6)
$PCINCOME_{i,t-1}$	-2.507	-2.383	-2.154	-2.252	-2.465	-2.452
	(2.52)**	(2.34)**	(2.22)**	(2.29)**	(2.53)**	(2.43)**
SFR_{it}	2.222	8.506	0.701	-6.258	0.077	0.834
	(1.69)*	(0.87)	(0.53)	(0.60)	(0.04)	(0.08)
$SQSFR_{it}$	-	-3.442	-	3.725	-	-0.395
		(0.64)		(0.65)		(0.07)
$INTSFRLOW_{it}$	-	-	6.132	6.773	-	-
			(3.90)***	(3.55)***		
$INTSFRLINC_{it}$	-	-	-	-	4.051	3.982
					(1.84)*	(1.78)*
$TOPEN_{it}$	0.018	0.019	0.026	0.025	0.018	0.018
	(1.11)	(1.16)	(1.83)*	(1.76)*	(1.16)	(1.16)
$WORKAGE_{it}$	0.448	0.438	0.337	0.336	0.304	0.305
	(3.03)***	(2.98)***	(2.36)**	(2.37)**	(1.77)*	(1.74)*
$INVGDP_{it}$	0.210	0.196	0.169	0.180	0.225	0.223
	(3.48)***	(2.84)***	(3.00)***	(3.08)***	(4.03)***	(3.34)***
$FDIGDP_{it}$	-0.005	-0.002	0.002	-0.001	-0.003	-0.002
	(0.38)	(0.11)	(0.15)	(0.11)	(0.19)	(0.15)
$PORTFGDP_{it}$	0.002	-0.002	-0.011	-0.008	0.000	0.000
	(0.10)	(0.06)	(0.49)	(0.36)	(0.02)	(0.00)
$INFGDP_{it}$	-0.031	-0.031	-0.030	-0.030	-0.029	-0.029
	(2.46)**	(2.51)**	(3.28)***	(3.23)***	(2.61)**	(2.60)**
$GBALGDP_{it}$	0.177	0.184	0.211	0.208	0.230	0.230
	(1.72)*	(1.86)*	(2.21)**	(2.18)**	(2.31)**	(2.29)**
INT	-11.227	-13.995	-7.542	-4.162	-2.263	-2.733
	(0.95)	(1.07)	(0.65)	(0.32)	(0.17)	(0.18)
R^2	0.40	0.41	0.47	0.47	0.43	0.43
No. of obs.	170	170	170	170	170	170

Notes: The dependent and independent variables are non-overlapping 5-year averages of the corresponding annual variables. Heteroscedasticity consistent robust t-statistics are eported in parenthesis.
The symbols * ,** and *** indicate statitical significance at 10 percent, 5 percent and 1 percent levels, respectively.

The rest of regressors are widely used variables in this literature and their coefficients are generally estimated to be in line with theoretical predictions (Barro and Salai Martin, 1991; 2004; Barro, 1998). Coefficients of the lag per capita income ($PCINCOME_{i,t-1}$) are estimated to

be negative and statistically significant. This finding suggests that countries with lower per capita income grow faster than countries with higher per capita income level or vice versa. That is, the empirical analysis confirms a strong convergence among countries used in the analysis. In addition, estimated coefficients of the share of working age population in total population ($WORKAGE_{it}$) are positive and statistically significant, consistent with the expected positive impacts of labor supply, while the coefficients of trade openness ($TOPEN_{it}$) are positive but rarely significant. Again as expected, coefficients of investment rate ($INVGDP_{it}$) are positive and statistically significant, while those of inflation rate ($INFGDP_{it}$) in all regressions are negative and statistically significant in line with the literature (Bruno and Easterly, 1998; Barro, 1998). Furthermore, improvements in government balance ($GBALGDP_{it}$) have positive impact on growth in all regressions. However, coefficients of *FDIGDP* and *PORTFGDP* as indicators of capital inflows are estimated to be insignificant. This finding is not in line with expectations as regards foreign direct investments which potentially support growth process while dynamic panel estimations carried out in the next sub-section suggests positive and statistically significant coefficients for *FDIGDP* in line with expectations.

3.b. Robustness of Empirical Findings (System-GMM Regression)

As mentioned above, in order to contain dynamic factors and deal with endogeneity problem between *SFR* and growth rate, we estimate the following benchmark dynamic model by system *GMM*:[15]

$$GROWTH_{it} = \beta_1 GROWTH_{i,t-1} + \beta_2 GROWTH_{i,t-2} + \beta_3 PCINCOME_{i,t-1} + \beta_4 SFR_{it} + \beta_5 SQSFR_i + \sum_{j=1}^{k} \delta_j X_{it,j}$$
$$+\theta\ INTSFRLOW_{it} + \ell\ INTSFRLINC_{it} + \sigma_i + \lambda_t + \varepsilon_{it} \qquad (2)$$

where σ_i is country-specific fixed effect and λ_t represents vector of period dummies. In all regressions, we include a full set of time dummies on the right-hand side to allow for a full set of time effects. The system-GMM model with two lags of independent variables needs at least 5 time series observations in order to carry out regressions. Therefore, as described earlier, we work with a panel data set that contains non-overlapping 3-year averages of the

[15] Estimation technique is based on Arellano and Bond (1991) and Arellano and Bover (1995).

data for each country, yielding 6 time series observations per country. This also allows us to test the impact of *SFR* during the global crisis, i.e. 2008-2010 period.

Along with the set of regressors used in the previous model (1), two lags of dependent variable (*GROWTH*) are also included in this model. Furthermore, we add new control variables such as political stability (*POLSTAB*) and the ratio of broad money to GDP (*M2GDP)* in addition to the vector of control variables in the previous model (*TOPEN*, *WORKAGE*, *INVGDP*, *FDIGDP, PORTFGDP, GBALGDP* and *INFGDP)* as observations for these variables are generally available during 2000s*.* Variable definitions and data sources, along with the list of countries in the sample are reported in Appendix 2.

Estimation results are reported in Table 3 and are generally in line with those given in Table 2. Estimated coefficients of *SFR* are estimated to be positive and statistically significant in the equations (1) and (2). In contrast to the findings in Table 2, in Table 3 the coefficient of *SQSFR* is estimated to be negative and statistically significant as shown in equation (2). The two interaction terms are used interchangeably as independent variables. The coefficient of interaction term, *INTSFRLOW,* in the equation (3) is estimated to be positive and statistically significant. Again, in equation (4) where *SQSFR* is included in the regression, the coefficient of *INTSFRLOW* is consistently positive and statistically significant, while the coefficient of *SQSFR* turns to be insignificant. Overall, findings support the view that countries with low saving-investment gaps or high *SFR*s grow faster as claimed by Prasad et al. (2007) and Aizenman et. al.(2007). In addition, our findings put forward that the relation between *SFR* and growth is not linear, i.e. increases in *SFR* in countries with lower *SFR* have stronger favorable impact on growth rates.

In the last two columns of the Table 3, instead of *INTSFRLOW* used in equations (3) and (4), we included *INTSFRLINC* in the regressions in order to test the hypothesis suggested by Aghion et al. (2009) for low-middle income countries which are not close to technological frontiers. We found the evidence supporting the hypothesis that low-middle income countries require domestic savings not only to reduce external imbalances but also to attract foreign capital to invest in projects with high technology, which would in turn improve growth performance. In other words, coefficients of *INTSFRLINC* are estimated to be positive

and statistically significant; empirically supporting the view that higher *SFRs* have a large impact on growth in low-middle income or developing countries.

Table 3: System-GMM Estimations

Dependent variable: Three-year averages of GDP growth rate (%)

	(1)	(2)	(3)	(4)	(5)	(6)
$GROWTH_{i,t-1}$	-0.158	-0.121	-0.156	-0.167	-0.186	-0.163
	(1.39)	(1.09)	(1.44)	(1.50)	(1.95)*	(1.58)
$GROWTH_{i,t-2}$	-0.227	-0.191	-0.197	-0.209	-0.195	-0.165
	(3.27)***	(2.86)***	(3.04)***	(3.01)***	(2.99)***	(2.41)**
$PCINCOME_{i,t-1}$	-1.584	-1.479	-0.972	-0.780	-1.701	-1.768
	(1.05)	(1.03)	(0.72)	(0.57)	(1.33)	(1.42)
SFR_{it}	4.428	27.463	-2.759	-15.126	-4.283	16.072
	(2.13)**	(2.96)***	(0.80)	(0.90)	(1.05)	(1.47)
$SQSFR_{it}$	-	-11.551	-	5.195	-	-9.404
		(2.41)**		(0.73)		(2.14)**
$INTSFRLOW_{it}$	-	-	14.108	17.618	-	-
			(3.28)***	(2.97)***		
$INTSFRLINC_{it}$	-	-	-	-	14.475	12.421
					(3.32)***	(2.87)***
$POLSTAB_{it}$	0.051	0.057	0.041	0.037	0.065	0.065
	(2.55)**	(2.78)***	(2.17)**	(1.86)*	(3.36)***	(3.36)***
$TOPEN_{it}$	-0.000	-0.000	0.000	0.001	-0.000	-0.001
	(0.11)	(0.15)	(0.08)	(0.31)	(0.13)	(0.44)
$WORKAGE_{it}$	0.491	0.483	0.467	0.428	0.353	0.443
	(2.24)**	(2.32)**	(1.89)*	(1.68)*	(1.52)	(1.79)*
$INVGDP_{it}$	0.201	0.143	0.146	0.150	0.260	0.224
	(2.73)***	(2.07)**	(2.07)**	(2.10)**	(3.51)***	(3.01)***
$FDIGDP_{it}$	0.029	0.029	0.026	0.025	0.026	0.026
	(3.12)***	(3.35)***	(3.10)***	(3.06)***	(3.41)***	(3.43)***
$PORTFGDP_{it}$	0.018	0.017	0.015	0.015	0.017	0.016
	(3.69)***	(2.88)***	(2.53)**	(2.60)**	(4.53)***	(3.58)***
$INFGDP_{it}$	-0.046	-0.058	-0.051	-0.054	-0.035	-0.031
	(1.23)	(1.53)	(1.54)	(1.64)	(0.96)	(0.83)
$GBALGDP_{it}$	0.195	0.223	0.234	0.235	0.223	0.233
	(2.30)**	(2.56)**	(2.86)***	(2.88)***	(2.63)**	(2.84)***
$M2GDP_{it}$	-0.013	-0.007	-0.001	-0.002	-0.010	-0.005
	(1.12)	(0.68)	(0.13)	(0.20)	(1.02)	(0.54)
m_1(p-value)	0.010	0.005	0.004	0.003	0.007	0.005
m_2(p-value)	0.825	0.527	0.726	0.800	0.934	0.836
Hansen-test	1.000	1.000	1.000	1.000	1.000	1.000
No. of obs.	129	129	129	129	129	129

Notes: The dependent and independent variables are non-overlapping 3-year averages of the corresponding annual variables. Heteroscedasticity consistent robust t-statistics are reported in parenthesis.
The symbols * ,** and *** indicate statitical significance at 10 percent, 5 percent and 1 percent levels, respectively.

In all regressions, coefficient of lagged per capita income is estimated to be negative and generally significant, again implying a convergence among countries as suggested by the

literature.[16] Again in all regressions, the coefficients of *GBALGDP* are estimated to be positive and statistically significant; meaning that improvements in public saving contribute to growth positively. Furthermore, in almost all regressions, coefficients of *WORKAGE, INVGDP* and *POLSTAB* are estimated to be positive and statistically significant. Labor supply and investment rate which are used as a proxy for factors of production and political stability have a strong favorable impact on growth performance. The coefficients of *FDIGDP* are generally larger than the coefficients of *PORTFGDP*, suggesting that *FDI* financing is more favorable for the growth performance than portfolio investment that has a short term nature[17]. On the other hand, inverse association between inflation and growth is confirmed one more time in all regressions, even though estimated coefficients are not significant. Finally, openness seems to be an unimportant variable for the growth performance in regressions estimated in Table 3.

We extended the model given in equation (2) as follows:

$$GROWTH_{it} = \beta_1 GROWTH_{i,t-1} + \beta_2 GROWTH_{i,t-2} + \beta_3 PCINCOME_{i,t-1} + \beta_4 SFR_{it} + \sum_{j=1}^{k} \delta_j X_{it,j} \qquad (3)$$
$$+\theta\ INTSFRD2000_{it} + \ell\ INTSFRCRIS_{it} + \mu\ INTSFRLOWCRIS + \eta\ INTSFRLINCCRIS + \sigma_i + \lambda_t + \varepsilon_{it}$$

The main difference from benchmark specification given in (2) is that this one contains new interactions terms aimed to characterize the years of global crisis of 2008-2010. These interaction terms are *INTSFRD2000*, *INTSFRCRIS*, *INTSFRLOWCRIS* and *INTSFRLINCCRIS. INTSFRD2000* represents the interaction term, which is the product of *SFR* and the dummy variable taking the value of "1" for the years of 2002-2010 in order to capture the period when global capital flows surge to low saving countries. *INTSFRCRIS* is the product of *SFR* and the dummy variable (*DCRIS*) that takes value of "1" for the years of 2008-2010. Another interaction term, *INTSFRLOWCRIS*, is the product of the dummy variable of *DCRIS* and the interaction term of *INTSFRLOW.* Finally*, INTSFRLINCCRIS* represents the interaction term which is the product of *INTSFRLINC* and the dummy variable of *DCRIS*.

[16] See Barro et al. (1995)

[17] See Chowdhury and Mavrotas (2006), Alfaro et. al. (2003), Xu (2000), Marino (2000), Lensink and Morrissey (2001) for an analysis of the contribution of FDI to economic growth. See also Soto (2000) for capital flows and growth relationship.

Table 4: System-GMM Estimations

Dependent variable: Three-year averages of GDP growth rate (%)

	(1)	(2)	(3)	(4)	(5)
GROWTH$_{i,t-1}$	-0.128	-0.175	-0.150	-0.146	-0.137
	(1.07)	(1.56)	(1.27)	(1.21)	(1.16)
GROWTH$_{i,t-2}$	-0.187	-0.228	-0.188	-0.195	-0.201
	(2.92)***	(3.52)***	(2.83)***	(2.77)***	(2.66)**
PCINCOME$_{i,t-1}$	-1.572	-1.542	-1.634	-1.533	-1.929
	(1.17)	(1.12)	(1.21)	(1.08)	(1.36)
SFR$_{it}$	28.748	8.560	29.469	27.297	28.617
	(3.24)***	(2.94)***	(3.26)***	(3.04)***	(3.33)***
SQSFR$_{it}$	-10.993	-	-10.687	-11.123	-12.063
	(2.15)**		(2.25)**	(2.39)**	(2.79)***
INTSFRD2000$_{it}$	-1.817	-3.225	-	-	-
	(0.48)	(2.03)**			
INTSFRCRIS$_{it}$	-	-	-2.593	-	-
			(1.59)		
INTSFRLOWCRIS	-	-	-	0.475	-
				(0.90)	
INTSFRLINCCRIS	-	-	-	-	0.661
					(0.80)
POLSTAB$_{it}$	0.056	0.052	0.056	0.055	0.059
	(2.67)**	(2.42)**	(2.46)**	(2.50)**	(2.85)***
TOPEN$_{it}$	-0.001	-0.000	-0.001	-0.001	-0.001
	(0.40)	(0.11)	(0.45)	(0.44)	(0.28)
WORKAGE$_{it}$	0.516	0.403	0.487	0.501	0.476
	(2.32)**	(1.80)*	(2.11)**	(2.10)**	(2.02)**
INVGDP$_{it}$	0.159	0.236	0.195	0.176	0.161
	(2.11)**	(3.38)***	(2.70)***	(2.40)**	(2.29)**
FDIGDP$_{it}$	0.024	0.022	0.023	0.027	0.025
	(1.81)*	(2.69)***	(2.61)**	(3.09)***	(2.94)***
PORTFGDP$_{it}$	0.017	0.014	0.013	0.016	0.015
	(2.98)***	(3.16)***	(2.44)**	(2.74)***	(2.70)***
INFGDP$_{it}$	-0.042	-0.056	-0.051	-0.041	-0.045
	(1.11)	(1.45)	(1.30)	(1.07)	(1.18)
GBALGDP$_{it}$	0.211	0.169	0.189	0.200	0.206
	(2.42)**	(2.11)**	(2.31)**	(2.43)**	(2.26)**
M2GDP$_{it}$	-0.006	-0.014	-0.008	-0.008	-0.003
	(0.59)	(1.35)	(0.77)	(0.71)	(0.28)
m_1(p-value)	0.006	0.012	0.008	0.006	0.004
m_2(p-value)	0.836	0.893	0.707	0.859	0.815
Hansen-test	1.000	1.000	1.000	1.000	1.000
N	129	129	129	129	129

Notes: The dependent and independent variables are non-overlapping 3-year averages of the corresponding annual variables. Heteroscedasticity consistent robust t-statistics are reported in parenthesis.
The symbols * ,** and *** indicate statitical significance at 10 percent, 5 percent and 1 percent levels, respectively.

Regression results for the model in equation (3) are given in Table 4. The coefficient of *INTSFRD2000* is estimated to be negative and statistically significant only when *SQSFR* is not used as repressor, implying that the impact of *SFR* on growth seems to weaken during 2000s. This supports the findings that growth rates across country groups classified on the basis of *SFR*, converged in 2000s. Likewise, the coefficient of *INTSFRCRIS* variable which reflect the impact of global crisis is estimated to be negative. This finding may imply that rising *SFRs* through fiscal austerity or tight policies during the global crisis would not be supportive for growth. In fact, many countries have introduced loose fiscal and monetary policy measures to stimulate their domestic demand. The coefficients of *INTSFRLOWCRIS* and *INTSFRLINCCRIS* are estimated to be positive but not significant statistically, implying that raising *SFRs* in either countries with low *SFRs* or developing countries during the recent global crisis had no significant impact on growth.

4. Conclusion

Our findings indicate that domestic capital has been predominantly financed by domestic savings in selected countries even though there has been a significant change in the composition of growth financing during 2000s. This change manifested itself as a dramatic increase in capital flows from countries with high domestic saving rates to countries with low domestic saving rates. It eased the financial constraints in countries with low saving rates due to increased availability and reduced cost of finance and thus led to further drop in domestic savings (or rise in consumption) and *SFR*. In addition, these developments brought together an increased volatility and dispersion among *SFRs* across countries as well as an "imbalance" issue at the global perspective. As a result, average *SFRs* of countries with already high saving rates increased further, leading to higher average *SFRs* during 2000s than previous decade while those of countries with low saving rate decreased.

Empirical findings indicate that higher *SFRs* generally support the growth rate in the medium term. This is pronounced for countries with low *SFRs* and low-middle income countries, which are often financially constrained and far from technological frontier. These findings support the argument of Aghion et.al. (2009) that, a decline in saving-investment gap (or rise in domestic savings rate) may attract foreign capital into growth-enhancing good projects. In other words, higher domestic savings help to reduce the extent of financial constraints and

attract foreign capital with innovative capacity. Consistent with this argument, growth enhancing impact of *SFRs* has been muted in 2000s when *FDI* flows to countries with low *SFRs* increased substantially.

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APPENDIX 1:

Average *SFRs* for Different Income Group of Countries

High Income Countries			
	1993-2001	2002-2010	1993-2010
Germany	0.97	1.09	1.03
United States	0.87	0.82	0.85
Australia	0.83	0.83	0.83
Austria	0.95	1.03	0.99
Belgium	1.16	1.18	1.17
Czech Rep.	-	0.86	0.86
Denmark	1.04	1.11	1.08
Finland	0.98	1.27	1.13
France	1.03	1.06	1.04
Netherland	1.18	1.24	1.21
United Kingdom	0.9	0.89	0.89
Ireland	1.06	0.97	1.01
Spain	0.93	0.84	0.88
Israel	0.89	0.99	0.94
Sweden	1.03	1.31	1.17
Italy	1.00	0.98	0.99
Iceland	0.93	0.64	0.78
Japan	1.08	1.12	1.10
Canada	0.88	1.05	0.97
Korea	1.02	1.08	1.05
Luxemburg	1.49	1.46	1.48
Norway	1.12	1.55	1.33
Portugal	0.89	0.66	0.78
Singapore	1.34	1.68	1.51
Slovak Rep.	-	0.77	0.77
New Zealand	0.84	0.79	0.81
Greece	0.88	0.68	0.78

Low-Middle Income Countries			
	1993-2001	2002-2010	1993-2010
Argentina	0.86	1.00	0.93
Brazil	0.89	0.92	0.91
Bulgaria	0.89	0.68	0.78
China	1.03	1.09	1.06
Indonesia	0.81	1.08	0.94
Philippines	0.73	0.98	0.86
South Africa	1.04	0.89	0.97
India	0.94	0.99	0.96
Colombia	0.81	0.87	0.84
Hungary	0.82	0.73	0.77
Malaysia	0.93	1.40	1.16
Mexico	0.89	0.93	0.91
Peru	0.77	0.90	0.85
Poland	0.89	0.82	0.85
Romania	0.85	0.73	0.79
Russia	-	1.40	1.40
Chile	0.89	0.98	0.94
Thailand	0.90	1.10	1.00
Turkey	0.96	0.89	0.92

APPENDIX 2: Sources of Variables

Variable Name	*Variable Description*	**Source**
PCINCOME	Log of per capita income (in US dollar)	World Development Indicators (WDI) online database. World Bank
GDPPCGR	Per capita income growth rate (percent)	World Development Indicators (WDI) online database. World Bank
GROWTH	GDP growth rate (percent)	World Development Indicators (WDI) online database. World Bank
SFR	Self-financing ratio	IMF World Economic Outlook Database
SQSFR	Square of self-financing ratio	
POLSTAB	Political Stability	World Bank Worldwide Governance Indicators
TOPEN	Sum of exports and imports (percent of GDP)	World Development Indicators (WDI) online database. World Bank
WORKAGE	The share of working age population in total population (percent)	World Development Indicators (WDI) online database. World Bank
INVGDP	Investment as a percentage of GDP	World Development Indicators (WDI) online database. World Bank
FDIGDP	Foreign direct investment(percent of GDP)	World Development Indicators (WDI) online database. World Bank
PORTFGDP	Portfolio investments (percent of GDP)	World Development Indicators (WDI) online database. World Bank
INFGDP	GDP Deflator Inflation Rate)	World Development Indicators (WDI) online database. World Bank
GBALGDP	Government Balance (percent of GDP)	Bloomberg
M2GDP	Money supply. M2 (percent of GDP)	World Development Indicators (WDI) online database. World Bank

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