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The Feldstein-Horioka hypothesis revisited

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Abstract: Feldstein-Horioka hypothesis states that if there is perfect capital mobility, low correlation between domestic investment and savings should be observed. However, empirical analysis failed to confirm the hypothesis. This study attempts to shed a new light on international capital mobility by incorporating the effect of the fiscal balance and the financial balance. Specifically, for a panel of 161 countries over the 1990–2013 period, the extended model is tested in comparison with the existing models of capital mobility. At the aggregate level, strong support is found for the extended model; while, at the region disaggregated level, compared to the existing models the hypothesis of capital mobility holds for a larger number of regions. Our model and estimates are additionally extended to account for the fact that the above mentioned relationships, are conditional on the country's level of financial development.

Keywords: capital mobility; Feldstein-Horioka; fiscal balance; investment; saving; Shibata-Shintani.

JEL codes: F41.

1 Introduction

The theory of capital mobility advanced by Feldstein and Horioka (1980) predicts that with greater capital mobility the relationship between domestic savings and investment should weaken; hence, the level of investment in a country need not be constrained by the level of domestic savings.[1] Contrary to theoretical predictions in the literature, Feldstein and Horioka find a high correlation between domestic savings and investment for a sample of OECD countries, which implies the presence of significant imperfections in international capital markets. This finding

1 See Apergis and Tsoumas (2009) for a review of the literature.

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has led to the establishment of two stylized facts: one, the persistence of a strong positive correlation between savings and investment for the OECD nations (see, Feldstein 1983; Penati and Dooley 1984); and two, a higher savings-investment correlation for developed rather than developing countries (see, Fieleke 1982; Dooley, Frankel, and Mathieson 1987; Wong 1990).

The existence of a high correlation between savings and investment, contrary to theoretical predictions in the literature, led Obstfeld and Rogoff (2000) to label the Feldstein-Horioka puzzle as one of the six major puzzles in international macroeconomics. In an attempt to resolve this puzzle, an alternative theory of capital mobility was proposed by Shibata and Shintani (1998). They observe that the main shortcoming of the Feldstein-Horioka approach is that their empirical model lacks a rigorous theoretical foundation. In this respect, Shibata and Shintani (1998) make a significant contribution to the literature by developing a theoretical model based on the permanent income approach of Campbell and Mankiw (1989, 1990, 1991), which shows that the effect of capital mobility depends on the link between domestic consumption and net output. According to this theory, a country's changes in consumption should be uncorrelated with predictable changes in net output under the condition of perfect capital mobility. They find that this model yields greater support for capital mobility; that is, they find evidence of capital mobility in over half of the countries examined in their study.

In this paper we revisit the Feldstein-Horioka puzzle. Namely, we consider the FH puzzle from the perspective suggested by Shibata and Shintani (1998), but we relax some of the original assumptions of their model. The primary point in our extended model is that we acknowledge that net output in autarky is different from net output with capital mobility. This occurs due to the possibility of fiscal and saving-investment imbalances that can be caused by (i) international financing of government expenditure and investment, and (ii) the adjustment of saving and taxation due to capital mobility. Incorporating the abovementioned adjustment mechanisms into the original model implies that consumption in autarky, or the part of it that is independent of capital mobility, needs to be determined only by the variables that are also independent of capital mobility.

In our context, this requires that we take into account the formulation of a budget constraint that directly affects private consumption. Here, consumption independent of capital mobility is determined by savings (income not consumed) and taxes (income withheld by the government), not investment (undertaken by firms and able to be partially financed from abroad) and government expenditure (undertaken by the government and also able to be partially financed from abroad). However, using a budget constraint of the form $Y_t - I_t - G_t$ (as in Shibata and Shintani 1998) to determine the level of consumption that is independent of trade may lead to biased results. This is because both investment, I_t, and

government expenditure, G_t, incorporate the effect of capital mobility, and by imposing a constraint $C_t^a = Y_t - I_t - G_t$ one would be distorting the estimation of consumption in autarky (consumption independent of capital mobility).

In addition, to incorporate possible structural differences between the cases of autarky and imperfect capital mobility, we allow for savings and taxes to be different from the autarky levels in transition to imperfect capital mobility. Furthermore, in the derivation of the first-order difference of consumption, we do not assume that the change of expectations and the difference between the two time periods are identical. As such, this ascertains that a change in expectations of the level of consumption has not only played an unpredictable part as in Shibata and Shintani (1998), but also a predictable part that depends on the change in foreign asset holdings (national debt).

Another contribution of our study is to consider an alternative view of the Feldstein-Horioka puzzle. The existing approach used to test for capital mobility may be flawed, as the saving and investment relationship neglects important aspects of the financial system. The FH model assumes that the level of financial development of a country does not influence the ability of an economy to adjust their savings and taxes. However, studies point to differences in the financial systems of countries, and that these systems can affect the degree of capital mobility (Coakley, Hasan, and Smith 1999; Kim and Jeon 2013; Chang and Smith 2014; Johnson and Lamdin 2014). These studies show that the degree of capital mobility not only affects the degree of correlation between savings and investment, but also financial frictions that depend on the level of financial development. Thus, we also account for the level of financial development of a country as a factor that drives the relationships between savings-investment, consumption-net output, and government-net taxes, and thereby affects the degree of capital mobility. Building upon the literature on financial development, we take into account that financial development not only encourages capital flows but also reflects the efficiency of financial institutions in dealing with financial frictions. We propose that one aspect of financial development is that it channels domestic savings into domestic investment, while another is that this may offset the effect of financial frictions on international capital flows.

Our extended model is tested empirically and the results are discussed in comparison to the FH and SS models. The number of countries in our sample, 161, is greater than the number of countries used in the FH and SS models; also, our data span the period 1990–2013. Estimation is carried out for the full aggregated sample and for the sample disaggregated by regions, as capital mobility need not be homogenous across regions. In addition to panel fixed estimation, endogeneity is controlled for through the use of system GMM. The results obtained provide strong support for our extended model compared to the FH and SS models, and

indicate a higher degree of capital mobility compared to the previous literature. In addition, the empirical test of the hypothesis on the impact of financial frictions shows that the degree of financial development of a country affects capital mobility through its capacity to affect savings and taxes.

The remainder of this paper is structured as follows. Section 2 discusses the literature. Section 3 presents our extended model. Section 4 presents the data and methodology. Section 5 discusses the results and Section 6 concludes.

2 Background

The literature on the Feldstein-Horioka model is vast. Given this, we provide a brief outline of some theoretical studies and the studies that empirically apply the Shibata-Shintani model in order to show how the present study extends this existing literature.

Feldstein and Horioka (1980) put forward a test of capital mobility based on the correlation between a country's level of domestic savings and investment. They argue that with greater capital mobility the level of investment in a country need not be constrained by the level of domestic savings, as any discrepancy can be financed by foreign savings. Hence, the correlation between domestic savings and investment is zero under conditions of perfect capital mobility, and savings equals investment in the case of perfect capital immobility. Using data from 1960 to 1970, Feldstein and Horioka ran a regression of the investment ratio on the savings ratio (S/Y) for a cross section of 16 OECD countries. In addition, the regression was also run with the sample period divided into three sub-samples. The coefficient on savings was in the range of 0.94 and 0.83 for the four sample periods examined, which implies a rejection of perfect capital mobility. Contrary to theoretical predictions, the data revealed almost a one-to-one increase in the domestic savings ratio in response to an increase in the domestic investment ratio. By extending the sample period to cover the period 1974–1979, Feldstein (1983) supported Feldstein and Horioka's (1980) findings, with the coefficient on the savings ratio ranging from 0.78 to 0.99 for all the sample periods examined.

The inability to find any evidence of capital mobility has resulted in a vast amount of literature on the Feldstein-Horioka puzzle, with their findings subsequently confirmed by many others, including Dooley, Frankel, and Mathieson (1987), Penati and Dooley (1984), Bayoumi (1990), Golub (1990) and Kim (1993). This puzzle has been explained in terms of institutional and legal restrictions (Feldstein and Horioka 1980), population growth, income growth and terms of trade shocks (Obstfeld 1986; Summers 1988), non-traded consumption goods

and immobile factors of production (Frankel 1986; Wong 1990), real interest rate differentials (Mishkin 1984; Cumby and Mishkin 1986), government policy (Summers 1988; Bayoumi 1990), asymmetric information (Gordon and Bovenberg 1996), and econometric methodology (Abbot and De Vita 2003; Caporale, Panopoulou, and Pittis 2005; Giannone and Lenza 2009). While the studies of Dooley, Frankel, and Mathieson (1987) and Frankel and MacArthur (1988) indicate a strong relationship between domestic savings and investment for economies with relatively open capital accounts, they find a weaker correlation for developing economies that rely heavily on foreign aid to finance their current account deficits. On the other hand, Vredin and Warne (1991) and Krol (1996) find some support for a stronger correlation between investment and savings. Similarly, Wong (1990) finds that the systematic relationship between savings and investment is explained when the non-traded sector is taken into account.

In an attempt to resolve this puzzle, Shibata and Shintani (1998) put forward an alternative model of capital mobility based on the correlation between a country's consumption and net output. To do so they employ the permanent income model of Campbell and Mankiw (1989, 1990, 1991). The intuition underlying this model is that under conditions of perfect capital mobility, changes in consumption should be uncorrelated with predictable changes in net output. Estimating the model for a sample of 11 OECD countries, they conclude that capital mobility appears to be greater in countries that had previously maintained capital controls compared to those that had not. Studies that have applied the Shibata-Shintani model include Huang (2010), Cooray (2005) and Manap and Ghani (2012). Using an intertemporal current account model approach that takes into account changes in the terms of trade, Huang (2010) finds a lower degree of capital mobility compared to Shibata and Shintani (1998). Cooray (2005) extends the Shibata and Shintani model to include the interest rate differential and tests the model for four South Asian economies. Overall, the results suggest an absence of capital mobility for South Asia, as the interest rate differential is not found to be related to changes in consumption. Manap and Ghani (2012) apply the Shibata-Shintani model and examine the degree of capital mobility in Malaysia, and they too find that the degree of capital mobility is relatively low for the time period examined. In this current paper, we extend the SS model by incorporating savings and taxes into the original SS model.

Notably, there is an alternative view on the Feldstein-Horioka puzzle that argues that the model used to test for capital mobility that is based on the saving and investment correlation may be flawed as it may neglect some important aspects of the financial system. By employing a calibrated model with frictions, Bai and Zhang (2010) find that when financial frictions affect capital flows endogenously, the Feldstein-Horioka puzzle disappears. Similarly, Blanchard and Giavazzi (2002)

argue that the Feldstein-Horioka puzzle has diminished over time, particularly in the case of the European Union where greater integration has reduced financial frictions. The existing literature along these lines highlights how the differences in financial systems between developed and developing countries may lead to different capital mobility outcomes. For example, Coakley, Hasan, and Smith (1999) argue that capital mobility in developing countries could be affected by long-run solvency constraints faced by these countries. Similarly, Chang and Smith (2014) show that the correlation between saving and investment is influenced by transitory and trend technology shocks that influence world interest rates and the degree of correlation between national and global shocks. They note that advanced economies show larger co-movements with global shocks, and therefore exhibit a higher degree of correlation between saving and investment. On the other hand, developing countries are more strongly affected by trend shocks and therefore have lower correlation between saving and investment.

The above findings are in line with Papaioannou (2009) and Alfaro, Kalemli-Ozcan, and Volosovych (2007) who show that institutional improvements are followed by significant increases in international finance. This supports the hypothesis on why capital does not flow from rich to poor countries, as proposed by Lucas (1990) and named the "Lucas paradox." However, the Feldstein-Horioka puzzle appears to stem from the Lucas paradox because, given more efficient financial institutions, it is implicitly expected that rich economies will exhibit higher levels of capital mobility. Notwithstanding, this proposition is refuted by the empirical test of the Feldstein-Horioka hypothesis. Notably, the effects of financial development on capital mobility have not been studied in the literature. Therefore, we extend our theoretical model further and test it empirically by accounting for the degree of financial development of a country. Namely, we consider a level of capital mobility adjusted for the degree of financial development within that country. Our hypothesis in this case is that higher financial development not only leads to a rise in capital flows but also leads to higher capital retention within the economy. The reason for this is that financial development reflects how well financial institutions are able to decrease transaction costs and solve asymmetric information problems. It is well-known that the bulk of funds from savers to borrowers is channeled through intermediary institutions, that is, banks, as they are more efficient in solving information problems in financial markets (Hackethal and Schmidt 2004). Thus, with greater financial development (larger credit amounts being issued for a unit of income), the intermediary dependency of investment should lead to a higher retention of domestic saving. Under such conditions, one expects that the measure of capital mobility adjusted for the level of financial development should be lower for economies with more advanced and larger financial sectors.

3 The model

3.1 The extended SS model

While we follow the framework of the model presented in Shibata and Shintani (1998), we modify it by relaxing some of their assumptions. In this study, we assume a small economy that faces a fixed world interest rate, r. This economy produces a GDP, Y_t, which is equal to the sum of investment, I_t, consumption, C_t, government expenditure, G_t, and net exports, TB_t. Given that the economy has foreign asset holdings denoted by A_t, the country's GNP will be equal to $Y_t + rA_t$. Under this setting the country's budget constraint is given by:

$$A_{t+1} = (1+r)A_t + Y_t - C_t - I_t - G_t \tag{1}$$

Using the national income accounting identity we can write:

$$CA_t = rA_t + X_t - C_t, \tag{2}$$

where $X_t = Y_t - I_t - G_t$, and CA_t is the current account.

Now, employing a quadratic utility function, $u_t = \sum_{t=0}^{N-1}\left(C_t - \frac{b}{2}C_t^2\right)$, $b>0$ as in Shibata and Shintani (1998), we can express the optimal consumption for the case of perfect capital mobility, C_t^p, just as they established, as:

$$C_t^p = r\left[A_t^p + \left(\frac{1}{1+r}\right)\left(\frac{E_t X_t}{(1+r)^0} + \frac{E_t X_{t+1}}{(1+r)^1} + \frac{E_t X_{t+2}}{(1+r)^2} + \ldots + \frac{E_t X_{t+i}}{(1+r)^i}\right)\right]. \tag{3}$$

The first-difference of (3) can be expressed as:

$$\Delta C_t^p = C_t^p - C_{t-1}^p = r\Delta A_t^p + \left(\frac{r}{1+r}\right)\sum_{i=0}^{\infty}\left(\frac{(E_t - E_{t-1})\Delta X_{t+i}}{(1+r)^i}\right), \tag{4}$$

where $E_t - E_{t-1}$, denotes changes in expectations between periods t–1 and t. An update of the change in expectations and the level of the variable will be unpredictable; thus, using the same rationale as Shibata and Shintani (1998), we can write:

$$\Delta C_t^p = r\Delta A_t^p + \varepsilon_t, \tag{5}$$

where ε_t is the rational forecast error.

Now, we consider the other extreme case of no capital mobility, which implies that

$$C_t^a = X_t^a, \tag{6}$$

where X_t^a is the net output in autarky. Note that in the case of autarky we are still assuming the same level of GDP, Y_t; otherwise one cannot compare the structural differences caused by capital mobility. That is,

$$X_t^a = Y_t - I_t^a - G_t^a, \tag{7}$$

where I_t^a is investment, and G_t^a is government expenditure in autarky. Clearly, in autarky, the following should hold:

$$(T_t^a - G_t^a) + (S_t^a - I_t^a) = 0, \tag{8}$$

where S_t^a is saving and T_t^a is net taxes in autarky. Equation (8) implies that, in autarky, the fiscal and saving-investment accounts should be jointly balanced.

Unlike Shibata and Shintani (1998), we do not assume that the net output in autarky will be the same as in the case of capital mobility. This is because when capital mobility is introduced into the model, the fiscal and saving-investment accounts do not have to be jointly in balance, as the deficit in these accounts can be covered by an inflow of foreign funds. That is, with capital mobility, (8) does not have to hold, and hence $(S_t - I_t) - (T_t - G_t) \neq 0$. This imbalance alters net output, as envisioned by Shibata and Shintani (1998). Now we see how this change in net output caused by capital mobility can be explained by the joint gaps in the fiscal and saving-investment balances. We assume that both S and T are different in the environment with capital mobility than S^a and T^a in autarky. Since these changes are caused by capital mobility (openness), we assume that these variables are related as: $S^a = \sigma S$ and $T^a = \psi T$. Here we assume that the relationship between the variables depend on the degree of capital mobility, λ. That is, when $\lambda = 1$ (autarky), both $\sigma = 1$ and $\psi = 1$, whereas when $0 < \lambda < 1$, we assume that both parameters can be either less or greater than one. In other words, we do not impose any a priori constraint on the direction of the adjustment in savings and taxes; hence, $\sigma > 1$ or $\sigma \leq 1$ and $\psi > 1$ or $\psi \leq 1$.

The latter assumption is based on the rationale that in small economies the interest rates can be lower than in autarky due to access to international markets; thus, saving is expected to decrease. However, growth in productivity stemming from openness can increase returns to capital; hence, savings rise. Similarly, moving from autarky to capital mobility presumably limits the ability of a government to tax capital income, as capital has become a mobile factor of production. On the other hand, openness can generate additional tax revenue by boosting trade and domestic income. Overall, the above discussion implies that both the magnitude and the direction of the adjustment in saving and taxes are required to be determined empirically.

We recall the definition of net output and the condition for autarky given by (8) and write the following:

$$X_t^a = Y_t - S_t^a - T_t^a,$$
$$X_t = Y_t - I_t - G_t.$$

By subtracting the second equation from the first one, and given that $S^a = \sigma S$ and $T^a = \psi T$, the net output levels in autarky and with capital mobility are related as follows:

$$X_t^a = X_t - (\sigma S_t - I_t) - (\psi T_t - G_t), \tag{9}$$

where S_t, I_t, T_t, and G_t are the saving, investment, tax, and government expenditure levels with capital mobility. In equation (9), we depart from the SS model, as we do not assume that net output is the same in autarky as it is with capital mobility. This difference becomes important when we consider the intermediate case of imperfect capital mobility. With imperfect capital mobility, Shibata and Shintani (1998) model consumption as the weighted average of its values in autarky and perfect capital mobility. Intuitively, consumption that is independent of capital mobility needs to be determined only by the variables that are also independent of capital mobility. In our context, this implies that we need to take into account the budget constraint that directly affects private consumption. That is, consumption independent of capital mobility is determined by savings (income not consumed) and taxes (income withheld by the government), not by investment (undertaken by firms and able to be partially financed from abroad) and government expenditure (undertaken by the government and also able to be partially financed from abroad). When there is some capital mobility (although not perfect), using a budget constraint, $Y_t - I_t - G_t$, to determine the level of consumption that is independent of trade may result in biased results as both investment, I_t, and government expenditure, G_t, incorporate the effect of capital mobility.

The difference of our approach from the SS model can easily be established here by considering a special case when both $\sigma = 1$ and $\psi = 1$. That is, in the SS case, we will have $X_t^a = X_t = Y_t - I_t - G_t$, whereas in our case, it can be shown that $X_t \neq X_t^a = Y_t - T_t - S_t$. Therefore, the main difference in our model from the SS model is that the net output independent of capital mobility is given by $X_t^a = Y_t - T_t - S_t$. In addition, if capital mobility alters savings and taxation, hence $\sigma \neq 1$ and $\psi \neq 1$, then our estimations of capital mobility would depart from the SS approach even further.

As in Shibata and Shintani (1998), the intermediate case with imperfect capital mobility results in the following consumption function:

$$C_t = (1-\lambda)C_t^p + \lambda C_t^a, \tag{10}$$

where, λ is the degree of capital mobility, and $\lambda \in [0,1]$. We note that A_t^p in (5) is the amount of assets under perfect capital mobility; thus, it is reasonable to expect that with imperfect capital mobility this amount will decline, other things being fixed. To capture this dependence on capital mobility, we assume that under imperfect capital mobility $A_t = \pi A_t^p$, where $\pi < 1$, if $0 < \lambda < 1$ and $\pi = 0$, if $\lambda = 1$.

Recall that $X_t = Y_t - I_t - G_t$, and taking into account (5), (6), and (9), we can write (10) in difference form:

$$\Delta C_t = \lambda\left(\Delta Y_t - \sigma\Delta S_t - \psi\Delta T_t\right) + (1-\lambda)\pi r\Delta A_t + (1-\lambda)\varepsilon_t. \tag{11}$$

The main difference between our equation given by (11) and equation (10) in Shibata and Shintani (1998) given as $\Delta C_t = \lambda(\Delta Y_t - \Delta I_t - \Delta G_t) + (1-\lambda)\varepsilon_t$ is that our measure of capital mobility depends on the income side variables: changes in saving, taxes, and foreign income flows.

We estimate equation (11) and examine the magnitude of λ to test the null hypothesis of perfect capital mobility ($\lambda = 0$). Hence, if there is

Perfect capital mobility: $\lambda = 0$;
Perfect capital immobility: $\lambda = 1$;
If there is imperfect capital mobility: $0 < \lambda < 1$.

Equation (11) in the present study is analogous to equation (10) in the Shibata-Shintani model, and reflects the main difference in our approach, that is, the effect of the degree of capital mobility on consumption is conditional on the level and change of asset income in the economy.

The term $r\Delta A_t$ is non-zero only with capital mobility. In autarky there is no borrowing; hence, this term becomes zero. Given that $\lambda \in [0,1]$, we expect the size of the coefficients in (11) to be all less than unity. The sign of the first coefficient is expected to be positive as in Shibata and Shintani (1998), whereas the sign of the second coefficient is negative given A_t is borrowing from abroad, while it is positive if it measures lending abroad.

3.2 The empirical model

To make it clearer to the reader about how our empirical model is different from the SS model, let us first present the original Shibata-Shintani empirical model and then proceed to our extended model. Shibata and Shintani (1998) estimate the following regression model:

$$\Delta C_t = \lambda \Delta X_t + (1-\lambda)\varepsilon_t = \lambda(\Delta Y_t - \Delta I_t - \Delta G_t) + (1-\lambda)\varepsilon_t. \quad (12)$$

Their model implies that the part of consumption that is independent of capital mobility depends on net output remaining after subtracting investment and government expenditure: $\Delta Y_t - \Delta I_t - \Delta G_t$. The main problem with this approach is that we use values for investment and government expenditure in the presence of capital mobility (though imperfect) to estimate the contribution of consumption that is independent of capital mobility. In this specification, λ exactly stands for the weight given to the part of consumption that does not depend on capital mobility. However, as discussed above, this specification is due to the implicit assumption that net output in autarky and in the presence of capital mobility is the same; hence, the budget and saving-investment balances are not altered by capital mobility. By moving away from this assumption, we modified the equation that relates consumption to net output in the presence of capital mobility, which is given by equation (11).

Now, the empirical model stemming from equation (11) can be obtained as follows:

$$\Delta C_t = \alpha_0 + \alpha_1 \Delta Y_t + \beta_1 \Delta S_t + \beta_2 \Delta T_t + \alpha_2 r \Delta A_t + u_t. \quad (13)$$

In this empirical model, we differ from Shibata and Shintani (1998) by using a budget constraint that incorporates only income side variables such as savings and taxes. As we argue above, using expenditure variables (government expenditure and investment) as in Shibata and Shintani (1998) would lead to a biased estimation of capital mobility as these variables can be directly affected by capital flows. In addition, we also allow for possible indirect adjustments in savings and tax revenue caused by capital mobility. Specifically, the coefficients β_1 and β_2 would also capture the impact of capital mobility on saving and taxes correspondingly.

As mentioned above, with capital mobility, the saving-investment and fiscal accounts balances do not have to hold, as the saving-investment gap or budget deficit can be covered by foreign borrowings. Similarly, a surplus in these accounts can lead to a capital outflow. With reference to equation (11), this implies that an increase in both the saving-investment and fiscal deficits should impact consumption growth negatively. Therefore, we expect that the estimator of λ, parameter α_1 in (13), will be different from that found by Shibata and Shintani (1998). This is because in our case we are not dealing with net output alone but net output adjusted for the fiscal and saving-investment deficit changes caused by capital mobility. Due to the aforementioned restrictions, in the general case, with imperfect capital mobility we have $0 \leq \alpha_1 = \lambda \leq 1$, and since $\sigma \neq 1$ and $\psi \neq 1$, this implies that $|\beta_1|, |\beta_2| \neq \alpha_1$. The coefficients on the tax and savings adjustment terms can

be positive or negative depending on whether openness increases or decreases tax revenue and savings. Moreover, when $0<\lambda<1$, $\alpha_2<1$. However, in the extreme cases α_1 can be either zero or one depending on the degree capital mobility. In particular, if there is perfect capital immobility, $\lambda=1$; hence, $\alpha_1=\beta_1=\beta_2=\lambda=1$ and $\alpha_2=(1-\lambda)\pi=0$ should hold. With perfect capital mobility $\lambda=0$; hence, based on (11) and (13), $\alpha_1=\beta_1=\beta_2=\lambda=0$ and $\alpha_2=(1-\lambda)\pi=1$ should hold.

3.3 Accounting for the effect of financial development

The above approach suffers from an important omission in terms of modeling. Specifically, it implicitly assumes that the level of financial development and the sophistication of financial markets and institutions do not play any role in the capacity of economies to adjust their saving and taxes, which, we argue, drives the degree of capital mobility. However, in the literature, it has been pointed out that the Feldstein-Horioka puzzle might exist because it fails to account for other aspects of the economy that affect the correlation between saving and investment. For example, Coakley, Hasan, and Smith (1999) suggest that the estimated capital mobility measure for less-developed countries (LDCs) appears to be driven by the long-run solvency constraint faced by countries, as the solvency-maintaining feedback mechanism may be weaker in LDCs. Taking this idea a step further, Chang and Smith (2014) develop a model where they show that the correlation between saving and investment is driven by transitory and trend technology shocks that influence the world interest rates, and by the degree of correlation between national and global shocks. They emphasize that advanced economies have greater co-movement with global shocks, and therefore tend to have a higher correlation between saving and investment.

On the other hand, developing economies are more affected by trend shocks; thus, they tend to have a lower correlation between saving and investment. Kim and Jeon (2013) and Johnson and Lamdin (2014) also confirm the link between shocks and capital mobility. The former study finds that after the Asian financial crisis of 1997, the correlation between saving and investment was lower for the Asian economies. The latter study, however, shows that during the crisis of 2006–2008 the correlation between saving and investment increased, indicating that shocks in the Eurozone economies are highly correlated with global shocks and thus lead to a higher correlation between saving and investment, as Chang and Smith (2014) predict.

We attempt to incorporate the above idea by taking into account the cross-correlation of a country to national and global shocks that influence saving and investment, and by assuming that this relationship is conditional on the financial

development of the economy. Specifically, we now test an alternative view on λ. Here, this measure is adjusted for the effect of financial development. Thus, we can re-write (10) as follows:

$$C_t = (1-\tilde{\lambda})C_t^p + \tilde{\lambda}C_t^a, \tag{14}$$

where, $\tilde{\lambda}$ is the degree of adjusted capital mobility, which is determined as

$$\tilde{\lambda} = \phi\lambda,$$

where $\lambda \in [0,1]$ is the potential degree of capital mobility as in Shibata and Shintani (1998) if one assumes no transaction costs and information problems in the financial system, whereas ϕ captures internal friction stemming from the financial system. From this perspective, $\tilde{\lambda}$ measures the dependence of consumption on the productive capacity of the economy without trade. In our context this also implies dependence of investment on domestic savings. Therefore, given the same potential for capital mobility, two economies with different levels of financial development would demonstrate a different correlation between saving and investment.

In this aspect we depart from Shibata and Shintani (1998), as we allow for effective capital mobility to be also conditional on the financial system. The main rationale here is that due to institutional differences and the size of the economy, the relationship between investment and savings of a country and the degree of capital mobility might reflect how the financial system operates and how it interacts with global markets. The majority of investment made by firms in advanced economies is funded by banks rather than through direct borrowing. This indicates that the degree of financial development depends on how successful these financial institutions are in solving asymmetric information problems. In addition, the data indicate that banks are the most important institutions in terms of channeling savings to investors (Hackethal and Schmidt 2004). Since banks mostly finance local businesses, one would expect a rise in the share of local banks in local investment with higher financial development. Thus, if one accounts for the degree of financial development, the correlation between investment and saving should be higher in countries with higher financial development.

In light of the above considerations, we assume that the parameter ϕ depends on the level of financial development. Given this new element in the model, we test this adjustment using data to see if there is any supporting evidence. In order to test the null hypothesis of perfect capital mobility ($\tilde{\lambda} = 0$), the empirical model is updated by considering $\tilde{\lambda} = \lambda(1+\delta findev)$. Here, *findev* is a measure of the financial development of the country, whereas parameter δ captures the effect of financial development on the saving and investment correlation. Taking the latter ideas into account, the empirical model (13) is re-cast as follows:

$$\begin{aligned}\Delta C_t = {} & \alpha_0 + \alpha_1(1+\delta findev)\cdot\Delta Y_t + \beta_1(1+\delta findev)\Delta S_t \\ & + \beta_2(1+\delta findev)\Delta T_t + \alpha_2(1+\delta findev)\cdot r\Delta A_t + u_t,\end{aligned} \tag{15}$$

In this version of the model, we estimate the degree of capital mobility taking into account its dependence on the level of financial development. This formulation implies that the above model (13) and the empirical model estimated in Shibata and Shintani (1998) involve specific cases when some factors affecting the correlation between saving and investment have not been taken into account. The results of the empirical model given by equation (15) will be compared with the SS approach.

4 Data and methodology

4.1 Data

In the empirical analysis, we use panel data for 161 countries for the period 1990–2013. The data include high, middle and low income economies ranging from Sub-Saharan Africa, East Asia and the Pacific, Eastern Europe and Central Asia, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and the high income OECD countries. All data were obtained from the World Development Indicators (World Bank, 2014a). The ratio of gross domestic investment to gross domestic product (GDP), (I_t/Y_t), and gross domestic savings to GDP, (S_t/Y_t), is used to test the FH model. The change in consumption expenditure (ΔC_t) is the dependent variable in the SS model and in our extended model. Net output, $(X_t = Y_t - I_t - G_t)$ is constructed by deducting gross domestic investment and government expenditure from GDP. All variables are expressed in real terms by deflating using the GDP deflator. In our extended model, A is measured by net foreign assets and r is the real interest rate. Here, the US interest rate is used as the world interest rate and is deflated by the GDP deflator to give the real interest rate. The degree of financial development of a country is measured by domestic credit to the private sector as a ratio of GDP following the literature (e.g. King and Levine 1993). Domestic credit to the private sector as a ratio of GDP is a measure of the provision of credit by the banking sector to the private sector and degree of activity of financial intermediaries. If the estimated coefficients are statistically significant and of the expected magnitude and sign in terms of λ, it will confirm the importance of accounting for the fiscal and saving-investment balances jointly in determining the degree of capital mobility.

4.2 Methodology

Both fixed effects estimation and the General Method of Moments (GMM) were used to estimate the empirical models. The preliminary estimation was carried out using panel fixed effects estimation. Both fixed and random effects models were estimated. However, based on the results of the Hausman test, the fixed effects model was found to be relatively more reliable. Therefore, the paper reports results only for panel fixed effect estimation.

It can be argued that all explanatory variables used in our empirical model are not strictly exogenous. An approach that allows for controlling for joint endogeneity of explanatory variables through the use of internal instruments is the Arellano and Bover (1995) and Blundell and Bond (1998) system GMM estimator. Two diagnostic tests were carried out: the Hansen test for over-identifying restrictions in which the null hypothesis is that the instruments are not correlated with the residuals, and the Arellano-Bond test for second order correlation in the first differenced residuals.

5 Empirical results

The estimation was initially carried out on the full sample using fixed effects estimation. The results are presented in Table 1. In order to test the predictions of our extended model, it is useful to compare our results with the results of the FH and SS models. Therefore, we present results for the FH model in column (1), the SS model in column (2), and our extended model given by equation (13) in column (3). We only use observations and years for countries where we were able to estimate all three models. Regarding the results of our extended model that are reported in column (3), the degree of capital mobility is measured by λ in equation (11), or, the coefficient α_1 in equation (13). Here, ΔC depends not on ΔX as in SS, but on ΔY, ΔS and ΔT. The coefficient on the savings ratio for the FH model in column (1) is 0.11, and is statistically significant at the 5 per cent level. This signifies that 11 per cent of the increase in the domestic investment ratio is financed by domestic savings. The coefficient on ΔC in the SS model is 0.67 and is statistically significant at the 1 per cent level. The coefficient is relatively high compared to the FH model, and implies that 67 per cent of the increase in domestic consumption is financed by net output. Note that in our extended model in column (3), the low and statistically insignificant coefficient on ΔY suggests that the change in consumption is not entirely financed by domestic output. Similarly, the coefficients on ΔS and ΔT are close to zero and not statistically significant, suggesting that

Table 1: Fixed effects estimation.

Variables	(1) FH model I/Y_t	(2) SS model ΔC_t	(3) SS extended model ΔC_t
S/Y_t	0.110 (0.044)**	–	–
ΔX_t	–	0.665 (0.158)***	
ΔY_t			0.027 (0.020)
$r\Delta A_t$	–	–	0.072 (0.017)***
ΔS_t	–	–	0.018 (0.021)
ΔT_t	–	–	–0.028 (0.022)
Observations	1125	1125	1125
R-squared	0.261	0.387	0.376
H0: perfect capital mobility			
F statistic	10.82	19.58	2.90
(p-Value)	(0.00)	(0.00)	(0.12)

Robust standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively. Estimated equations:
Column (1): $\Delta I/Y = \beta_0 + \beta_1 I/Y + \varepsilon_t$
Column (2): $\Delta C = \gamma_0 + \gamma_1 \Delta X + \nu_t$
Column (3): $\Delta C_t = \alpha_0 + \alpha_1 \Delta Y_t + \beta_1 \Delta S_t + \beta_2 \Delta T_t + \alpha_2 r\Delta A_t + u_t$.

saving and taxes do not adjust significantly due to openness, which we argue is a sign of dependence on capital inflows. This implies that capital mobility plays a positive role in a change of consumption. This argument is confirmed by the statistically significant positive coefficient on $r\Delta A_t$ at the 1 percent level. The positive coefficient suggests that the capital income from overseas influences consumption. However, the value of the coefficient is quite low, suggesting that some other mechanisms may be affecting the flow of capital income.

The *F* test statistics of the test for perfect capital mobility for the three models (*p* values reported in the last row) suggest that the null of perfect capital mobility is rejected at the 1 per cent level for both the FH and the SS model, with *F* test statistic of 10.82 and 19.58, respectively. However, for our extended model, the null hypothesis of perfect capital mobility cannot be rejected (*F* test statistic of 2.90, $p = 0.12$). This implies that the adjustments suggested by our model, which include accounting for saving and taxes instead of government expenditure and investment, appear to solve the Feldstein-Horioka puzzle by indicating a higher degree of capital mobility across the countries analysed.

In order to control for endogeneity in the model, we replicate the estimation in Table 1 by using system GMM. The results are presented in Table 2. The coefficient on the savings ratio in column (1) in the FH model is 0.11 and is statistically

Table 2: System GMM estimation.

Variables	(1) I/Y_t	(2) ΔC_t	(3) ΔC_t
S/Y_t	0.110 (0.032)***	–	–
ΔX_t	–	0.578 (0.220)***	–
ΔY_t			0.021 (0.022)
$r\Delta A_t$	–	–	0.072 (0.026)***
ΔS_t	–	–	0.021 (0.015)
ΔT_t	–	–	–0.034 (0.029)
Lag dependent variable	0.745 (0.047)***	0.281 (0.110)**	0.523 (0.061)***
Observations	1103	11.03	1103
Hansen test for over-identifying restriction: p-Value	0.42	0.45	0.45
H0: perfect capital mobility			
$\chi 2$ statistic	48.07	169.0	2.14
(p-Value)	0.00	0.00	0.13

Standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively. The difference equation is instrumented with the lagged levels, two periods of the dependent variable and the levels equation with the difference lagged one period. Estimated equations:
Column (1): $\Delta I/Y = \beta_0 + \beta_1 I/Y + \varepsilon_t$
Column (2): $\Delta C = \gamma_0 + \gamma_1 \Delta X + \nu_t$
Column (3): $\Delta C_t = \alpha_0 + \alpha_1 \Delta Y_t + \beta_1 \Delta S_t + \beta_2 \Delta T_t + \alpha_2 r\Delta A_t + u_t$.

significant at the 1 percent level. The coefficient on ΔX in the SS model is 0.58. Testing for perfect capital mobility results in rejecting the null hypothesis of perfect capital mobility for the FH and SS models, as the chi-squared statistics are 48.07 and 169, respectively. The absence of capital mobility in these two models is perhaps explained by the low coefficient on ΔY in our extended model, which suggests that the change in consumption is not only explained by net output (as in the SS model) but also by net output adjusted for the saving-investment and fiscal deficits. The positive and statistically significant coefficient on $r\Delta A_t$ at the 1 percent level confirms this, and suggests that higher capital income from abroad influences the deficits and consumption. When we test for perfect capital mobility for our extended model, we get a chi-squared statistic of 2.14 and a p-value of 0.13, which means that the null hypothesis of perfect capital mobility cannot be rejected. In all specifications, the Hansen test for over-identifying restrictions and the Arellano-Bond test for second order serial correlation in the first differenced residuals confirm that the moment conditions cannot be rejected.

5.1 Region disaggregated estimation

Figures 1–3 present some region specific characteristics for 2012. Note that gross investment-to-GDP ratio exceeds that of gross savings-to-GDP ratio for 2012 in all regions except in the high income OECD, and in the East Asia and the Pacific regions (Figure 1). Household consumption-to-GDP ratio in all regions seems to be around the same level, with the lowest ratio of household consumption to GDP for the Middle East and North Africa (Figure 2).

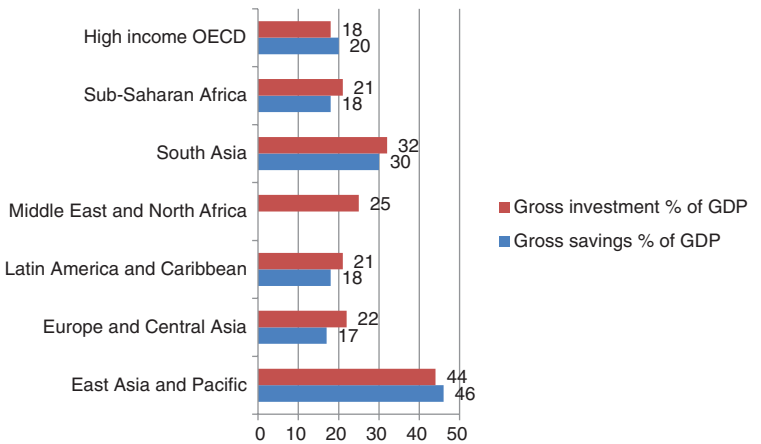

Figure 1: Gross investment and savings % of GDP by region.
Source: World Bank 2014a, world development indicators.

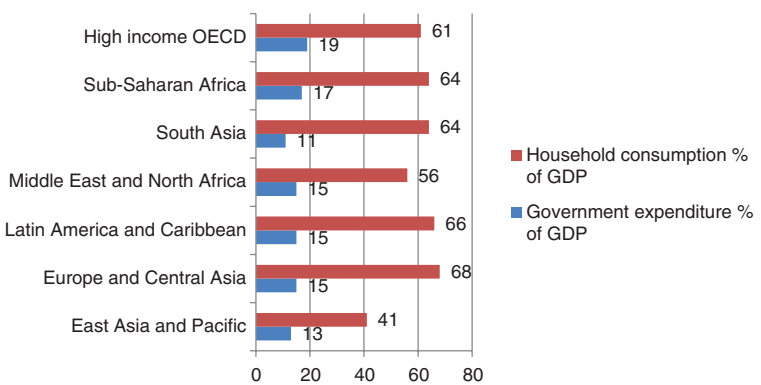

Figure 2: Household and government consumption expenditure as % of GDP by region.
Source: World Bank 2014a, world development indicators.

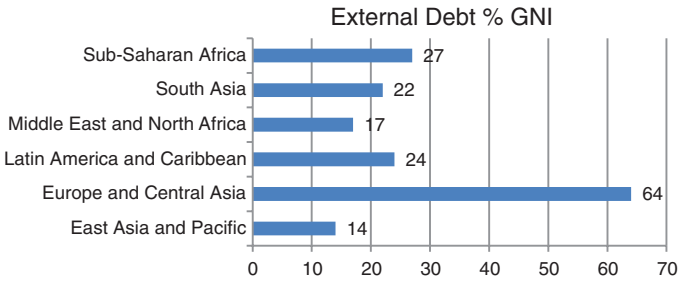

Figure 3: External debt as % of GNI by region.
Source: World Bank (2014b) http://data.worldbank.org/topic/external-debt.

An examination of the external debt stocks at a regional level (Figure 3) shows that it is not homogenous across regions, with Eastern Europe and Central Asia having the highest percentage at 64 percent. Therefore, given these differences across regions, capital mobility need not be homogenous across regions. For this reason, we also estimate the three models at a disaggregated level, that is, by region.

Table 3 reports results for the original FH model estimated at a regional level using system GMM. Note that the highest savings retention coefficient (0.32) is obtained for the high income OECD group, which is consistent with the findings of FH, followed by East Asia and the Pacific (0.11). The lowest savings retention coefficient is obtained for Sub-Saharan Africa (0.01). However, the null hypothesis of perfect capital mobility is rejected for Sub-Sharan Africa. The coefficient on the savings ratio is relatively low for all regions with the exception of the high income OECD group. The relationship between the savings ratio and the investment ratio in the Middle East and North Africa, and South Asia is not statistically significant, and the null hypothesis that the coefficient on the savings ratio is zero cannot be rejected for these two regions.

Next we test the SS model using the disaggregated dataset at a regional level and the system GMM estimator. The results are presented in Table 4. The coefficients on ΔX are higher than on the S/Y ratio in the FH model. The coefficient on ΔX for South America and the Caribbean is approximately one, suggesting capital immobility. The coefficient on the high income OECD group is 0.88 suggesting that 88 percent of the increase in consumption is explained by increases in net output in this region. This finding is in line with the original SS results. The null hypothesis of perfect capital mobility is rejected for all regions with the exception of the Middle East and North Africa. The failure to reject the null hypothesis of capital mobility for this region is consistent with the result obtained under the FH model above.

Table 3: System GMM estimation: feldstien-horioka model at a region disaggregated level.

Variables	(1) Sub Saharan Africa	(2) East Asia and the Pacific	(3) Eastern Europe and Central Asia	(4) Middle East and North Africa	(5) South America and the Caribbean	(6) South Asia	(7) High income OECD
Lag I/Y_t	0.679	0.719	0.756	0.600	0.611	0.924	0.702
	(0.029)***	(0.040)***	(0.033)***	(0.045)***	(0.035)***	(0.046)***	(0.025)***
S/Y_t	0.010	0.109	0.082	0.004	0.091	0.028	0.316
	(0.020)	(0.032)***	(0.022)***	(0.019)	(0.025)***	(0.039)	(0.025)***
Observations	851	260	467	263	570	151	651
Hansen test for over-identifying restriction: p-Value	0.45	0.48	0.32	0.30	0.56	0.43	0.21
Arellano-Bond test for 2nd Order Autocorrelation: p-Value	0.21	0.32	0.27	0.31	0.44	0.21	0.22
H0: perfect capital mobility							
χ^2 statistic	0.22	11.38	13.82	0.05	13.53	0.51	163.9
(p-Value)	(0.63)	(0.11)	(0.00)	(0.82)	(0.00)	(0.47)	(0.00)

Standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively. The difference equation is instrumented with the lagged levels, two periods of the dependent variable and the levels equation with the difference lagged one period.

Estimated equation: $\Delta I/Y = \beta_0 + \beta_1 I/Y + \varepsilon_t$.

Table 4: System GMM estimation: Shibata-Shintani model at a region disaggregated level.

Variables	(1) Sub Saharan Africa	(2) East Asia and the Pacific	(3) Eastern Europe and Central Asia	(4) Middle East and North Africa	(5) South America and the Caribbean	(6) South Asia	(7) High income OECD
Lag ΔC_t	0.206	−0.012	0.646	0.073	0.137	0.651	0.201
	(0.024)***	(0.058)	(0.034)***	(0.087)	(0.023)***	(0.047)***	(0.025)***
ΔX_t	0.535	0.220	0.224	0.042	1.108	0.362	0.877
	(0.022)***	(0.077)***	(0.032)***	(0.045)	(0.036)***	(0.060)***	(0.031)***
Observations	593	171	356	85	419	103	610
Hansen test for over-identifying restrictions: p-Value	0.32	0.28	0.30	0.22	0.29	0.30	0.22
Arellano-Bond test for 2nd Order Autocorrelation: p-Value	0.20	0.30	0.23	0.27	0.38	0.25	0.28
H0: perfect capital mobility							
χ^2 statistic	57.9	8.13	48.3	0.86	38.5	36.2	81.7
(p-Value)	(0.00)	(0.00)	(0.00)	(0.35)	(0.00)	(0.00)	(0.00)

Standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively. The difference equation is instrumented with the lagged levels, two periods of the dependent variable and the levels equation with the difference lagged one period.

Estimated equation: $\Delta C = \gamma_0 + \gamma_1 \Delta X + \nu_t$.

Finally, we test our extended model using the disaggregated data and the system GMM estimator. The results are reported in Table 5. As opposed to the FH and SS models, there is greater support for capital mobility for a larger number of regions. For Sub-Saharan Africa, Eastern Europe and Central Asia, South America and the Caribbean, and South Asia, the coefficients on ΔY are statistically insignificant, suggesting no correlation between output and consumption, which implies a high degree of capital mobility. Similar to the aggregate case, the coefficients on ΔS and ΔT are not significant, which implies that the effect of capital mobility on saving and tax adjustments is not strong. However, capital mobility plays a positive role in influencing consumption through investments abroad. This is confirmed by the positive and statistically significant coefficients on $r\Delta A_t$, suggesting that consumption is affected by capital inflows from abroad. For these regions the null hypothesis of perfect capital mobility cannot be rejected.

Consistent with the findings of FH, SS and also our extended model in Tables 3 and 4, the highest $\Delta C - \Delta Y$ correlation is found for the high income OECD nations. A high correlation between ΔC and ΔY is also found for East Asia and the Pacific, and the Middle East and North Africa in Table 5, suggesting that in these regions investment and government debt is primarily financed through domestic sources. In the case of East Asia and the Pacific, and the OECD, we notice that the adjustments in taxation and saving caused by capital mobility have similar patterns and are statistically significant. This outcome is in line with our rationale on why the estimated degree of capital mobility is low for these economies, as these adjustments absorb some of the effect of capital mobility on consumption. These result indicate that the adjustments in savings and taxes appear to have a significant effect on consumption directly, as well as indirectly through the fiscal and saving-investment balances captured by ΔY. In general, the countries that demonstrated low capital mobility are also the countries with greater capacity to adjust their saving and taxation. This response may mean that the need to entirely detach investment from saving is reduced. The reason for the high correlation between saving and investment may be the so-called "home bias"[2] effect, as these economies are more stable and may provide attractive "safe havens." This hypothesis is tested below when we consider the effect of financial development on the main variables of the model.

The coefficient on ΔY is positive and significant also for the Middle East and North Africa. However, the coefficient on $r\Delta A_t$ for this region is not statistically

2 French and Poterba (1991), for example, find that 94% of US portfolios are invested in US securities, and 98% of Japanese portfolios are invested in Japanese securities.

Table 5: System GMM estimation: Shibata-Shintani extended model.

Variables	(1) Sub Saharan Africa	(2) East Asia and the Pacific	(3) Eastern Europe and Central Asia	(4) Middle East and North Africa	(5) South America and the Caribbean	(6) South Asia	(7) High income OECD
Lag ΔC_t	0.380	0.017	0.722	0.629	0.332	0.869	0.659
	(0.049)***	(0.061)	(0.040)***	(0.110)***	(0.045)***	(0.052)***	(0.027)***
ΔY_t	0.074	0.545	0.045	0.642	0.060	0.059	0.712
	(0.060)	(0.132)***	(0.044)	(0.312)**	(0.071)	(0.054)	(0.321)**
$r\Delta A_t$	0.282	0.029	0.354	−0.025	0.062	0.018	0.031
	(0.050)***	(0.023)	(0.062)***	(0.031)	(0.012)***	(0.005)***	(0.042)
ΔS_t	0.022	0.344	0.061	0.112	0.052	0.029	0.314
	(0.018)	(0.124)***	(0.059)	(0.114)	(0.044)	(0.028)	(0.115)***
ΔT_t	−0.111	−0.215	−0.112	−0.030	−0.103	−0.139	−0.252
	(0.112)	(0.105)**	(0.022)	(0.026)	(0.113)	(0.134)	(0.113)**
Observations	193	107	191	85	190	76	309
Hansen test for over-identifying restrictions: p-Value	0.35	0.23	0.26	0.28	0.49	0.35	0.26
Arellano-Bond test for 2nd Order Autocorrelation: p-Value	0.42	0.57	0.28	0.26	0.32	0.23	0.30
H0: perfect capital mobility							
χ^2 statistic	0.18	10.12	0.36	11.31	0.20	0.16	19.10
(p-Value)	(0.14)	(0.00)	(0.13)	(0.00)	(0.21)	(0.14)	(0.00)

Standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively. The difference equation is instrumented with the lagged levels, two periods of the dependent variable and the levels equation with the difference lagged one period.

Estimated Equation: $\Delta C_t = \alpha_0 + \alpha_1 \Delta Y_t + \beta_1 \Delta S_t + \beta_2 \Delta T_t + \alpha_2 r\Delta A_t + u_t$.

significant. It is possible that in the Middle East and North Africa there have been capital outflows due to low levels of investor confidence and uncertainty with regard to monetary and fiscal policy, in addition to events hindering the Middle East peace process (United Nations 2001).

Overall, an interesting observation has been made by linking the degree of capital mobility to the role played by capital income from abroad. In all cases where we fail to reject the perfect capital mobility hypothesis, we also find a significant and positive effect of capital income inflows, whereas in cases where capital mobility is found to be low, the impact of capital income on the changes in consumption is not statistically significant. These results provide empirical support for the theoretical conjecture of the model discussed in this paper, that is, by accounting for the effect of capital mobility on the joint fiscal and saving-investment balance, we obtain a more complete representation of capital mobility. The estimated capital mobility measure indicates a high degree of capital mobility for most regions, particularly those regions that are more dependent on foreign debt.

To ensure that the region disaggregated results are robust to the use of the estimation procedure, the extended SS model is re-estimated using the fixed effects estimator. The results are reported in Table 6. Here we find that the basic conclusions do not change. For Sub-Saharan Africa, Eastern Europe and Central Asia, South America and the Caribbean, and South Asia, the coefficients on ΔY, ΔS and ΔT continue to be statistically insignificant, suggesting high capital mobility. Importantly, capital mobility is also confirmed by the statistically significant coefficients on $r\Delta A$. Consistent with the findings in Table 5, a strong statistically significant relationship between ΔC and ΔY is found for the OECD countries, East Asia and the Pacific, and the Middle East and North Africa.

Finally we estimate the model by controlling for the level of financial development of a country, as given by equation (15), to see if the level of financial sector development of a region influences the degree of capital mobility through its effect on saving and tax adjustment capacity. The results are reported in Table 7. The coefficient on financial sector development is statistically significant for all regions, suggesting that financial sector development is important for capital flows in all regions. The coefficients on ΔY, ΔS and ΔT are similar to those in Tables 5 and 6. We find that the coefficients on the interaction terms, ΔY*$findev$, ΔS*$findev$, ΔT*$findev$ and $r\Delta A$*$findev$ are statistically significant, suggesting that the level of financial development of a country does indeed affect the saving-investment and fiscal balance, and through that the level of capital flows into a country, as suggested by Coakley, Hasan, and Smith (1999). The coefficients on the ΔS* $findev$ term are larger for the OECD economies, East Asia and the Pacific, and the Middle East and North Africa, suggesting that these regions

Table 6: Fixed effects estimation: Shibata-Shintani extended model.

Variables	(1) Sub Saharan Africa	(2) East Asia and the Pacific	(3) Eastern Europe and Central Asia	(4) Middle East and North Africa	(5) South America and the Caribbean	(6) South Asia	(7) High income OECD
ΔY_t	0.018	0.436	0.055	0.421	0.069	0.066	0.801
	(0.022)	(0.113)***	(0.044)	(0.236)*	(0.065)	(0.058)	(0.240)***
$r\Delta A_t$	0.105	0.036	0.219	−0.019	0.052	0.020	0.027
	(0.014)***	(0.028)	(0.082)***	(0.020)	(0.022)**	(0.008)***	(0.031)
ΔS_t	0.026	0.312	0.055	0.128	0.045	0.026	0.321
	(0.019)	(0.124)***	(0.050)	(0.121)	(0.039)	(0.025)	0.111)***
ΔT_t	−0.108	−0.220	−0.120	−0.042	−0.117	−0.135	−0.224
	(0.111)	(0.104)**	(0.115)	(0.036)	(0.121)	(0.128)	(0.110)**
Observations	193	107	191	85	190	76	309
R-squared	0.28	0.39	0.44	0.29	0.36	0.29	0.33
H0: perfect capital mobility							
F statistic	2.13	13.06	2.78	12.12	3.03	2.12	15.22
(p-Value)	(0.12)	(0.01)	(0.13)	(0.05)	(0.15)	(0.12)	(0.00)

Robust standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively.

Estimated equation: $\Delta C_t = \alpha_0 + \alpha_1 \Delta Y_t + \beta_1 \Delta S_t + \beta_2 \Delta T_t + \alpha_2 r\Delta A_t + u_t$.

Table 7: Fixed effects estimation: Shibata-Shintani extended model controlling for financial sector development.

Variables	(1) Sub Saharan Africa	(2) East Asia and the Pacific	(3) Eastern Europe and Central Asia	(4) Middle East and North Africa	(5) South America and the Caribbean	(6) South Asia	(7) High income OECD
ΔY_t	0.022	0.222	0.039	0.302	0.029	0.048	0.571
	(0.026)	(0.110)***	(0.048)	(0.134)*	(0.030)	(0.051)	(0.165)***
$\Delta Y_t^* findev$	0.044	0.119	0.351	0.248	0.055	0.042	0.233
	(0.101)	(0.050)**	(0.185)*	(0.103)**	(0.110)	(0.104)	(0.047)***
$r\Delta A_t$	0.111	0.030	0.104	−0.013	0.052	0.028	0.015
	(0.022)***	(0.026)	(0.034)***	(0.020)	(0.027)**	(0.010)***	(0.012)
$r\Delta A_t^* findev$	0.311	0.264	0.353	0.232	0.324	0.366	0.127
	(0.112)***	(0.115)**	(0.064)***	(0.071)***	(0.124)***	(0.111)***	(0.065)*
ΔS_t	0.020	0.304	0.033	0.120	0.031	0.016	0.229
	(0.015)	(0.122)***	(0.037)	(0.118)	(0.039)	(0.022)	(0.113)**
$\Delta S_t^* findev$	0.144	0.345	0.215	0.298	0.251	0.118	0.320
	(0.075)*	(0.121)***	(0.106)**	(0.065)***	(0.114)**	(0.064)*	(0.052)***
ΔT_t	−0.102	−0.310	−0.128	−0.046	−0.127	−0.125	−0.222
	(0.111)	(0.101)**	(0.124)	(0.050)	(0.122)	(0.123)	(0.110)**
$\Delta T_t^* findev$	0.204	0.234	0.266	0.222	0.421	0.233	0.125
	(0.110)*	(0.114)**	(0.044)***	(0.032)***	(0.204)**	(0.112)**	(0.057)**
Findev	0.354	0.263	0.204	0.344	0.263	0.182	0.191
	(0.221)***	(0.106)***	(0.101)**	(0.109)***	(0.115)**	(0.063)***	(0.085)***
Observations	193	107	191	85	190	76	309
R-squared	0.58	0.61	0.48	0.52	0.59	0.56	0.60
H0: perfect capital mobility							
F statistic	2.11	12.11	2.30	11.44	1.97	2.22	13.40
(p-Value)	(0.13)	(0.01)	(0.10)	(0.05)	(0.14)	(0.12)	(0.00)

Robust standard errors reported in parentheses. ***, **, * are significant at the 1%, 5% and 10% levels, respectively.

with greater financial sector development have higher saving adjustments due to greater openness. This finding further supports the increasing link between openness caused by adjustments in taxes and saving, and the correlation between saving and investment. This correlation is higher in economies with more developed financial systems. Testing for the restriction that $\tilde{\lambda}=0$ suggests that the null hypothesis of perfect capital mobility is rejected for East Asia and the Pacific, the OECD nations, and the Middle East and North Africa, which is consistent with our previous results. We also estimate the model by using system GMM (results not reported). The conclusions are similar to those obtained under fixed effects estimation.

Overall, we can conclude that in economies with a higher correlation between saving and investment, the relevant countries have a higher capacity to adjust savings and taxes, whereas countries that lack this capacity tend to depend on capital flows for their investment. This conclusion is line with the empirical findings of Coakley, Hasan, and Smith (1999) who suggest that capital mobility measures are higher in LDCs as they have a lower solvency capacity, which in our view is caused by low capacity to adjust taxes and savings. Our findings that demonstrate the link between adjustment capacity in terms of taxes and savings and capital mobility are also supported by Chang and Smith (2014). These authors argue that in economies with a high correlation between national and global shocks, the degree of capital mobility is low, whereas in developing economies where this correlation is low, capital mobility is high. Our results show that this difference in the adjustment capacity is driven to some extent by the degree of financial development.

6 Conclusions

This study revisits the Feldstein-Horioka (FH) puzzle by extending the Shibata-Shintani (SS) model. The primary point in our extension is that we acknowledge that net output in autarky is different from net output with capital mobility. This occurs due to the fiscal and saving-investment imbalances and the adjustment of saving and taxation caused by capital mobility. Incorporating the abovementioned adjustment mechanisms into the original model implies that consumption in autarky, or part of it that is independent of capital mobility, needs to be determined only by savings and taxes. Subsequently, the extended model is tested against the FH and SS models. We find that the extended model provides greater support for capital mobility at the aggregate level as opposed to the FH and SS models. In addition to controlling for taxes and savings, we also control for the level of financial sector development of a country. At the disaggregated regional

level, the evidence that emerges from the estimates is mixed. The results provide evidence of capital mobility for some regions, which is intuitively expected given the heterogeneity in the level of financial sector development across countries. The level of financial development of a country has a significant effect on the saving and taxes, as well as the capital flows into a country.

Nonetheless, it should be kept in mind that a number of factors could bias the results in favor of capital mobility in our extended model. Dooley, Frankel, and Mathieson (1987) and Frankel and MacArthur (1988) find a strong association between domestic savings and investment for economies with relatively open capital accounts, and a weak correlation between savings and investment for developing economies that rely heavily on foreign aid to finance their current accounts. Additionally, Coakley, Hasan, and Smith (1999) show that a rise in the debt ratio in developing countries leads to a widening of the current account ratio, increasing the gap between the savings ratio and investment ratio. Therefore, it is possible that an increase in foreign debt and a widening of the current account deficit caused by a low capacity to adjust taxes and savings is the main reason for the lack of a correlation between the change in consumption and net output. This implies a high degree of capital mobility in South Asia, Sub-Saharan Africa, South America and the Caribbean, and Eastern Europe and Central Asia. On the other hand, the lack of evidence of perfect capital mobility in the high-income OECD economies, and in East Asia and the Pacific is primarily due to the relative lack of reliance on foreign debt thanks to a better developed financial system, the existence of "home bias" and the relative stability of these regions. The evidence on this aspect shows that a high capacity to adjust taxes and savings depends on the level of financial development of an economy.

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