Capital Mobility in OECD Countries: A Multi-Level Factor Approach to Saving–Investment Correlations

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Abstract

While a high saving–investment correlation is one of the most robust empirical regularities in international economics, there has been debate about whether it can be interpreted as evidence of barriers to international capital flows. When global and country-specific shocks shift saving and investment in the same direction, the high saving–investment association may be observed even in perfectly integrated international financial markets. In order to get an unbiased measure of capital mobility, controlling for the multi-level common factors is crucial. We estimate the global and country-specific factors from a large panel of macroeconomic series in the OECD countries using a multi-level factor analysis, and then explicitly control for them in the saving–investment regression. We show that the global and country-specific factors together account for almost 50% of the saving–investment correlation in the panel of 19 OECD countries for 1961–2005, and capital mobility appears to increase over time particularly in Europe.

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1 Introduction

If capital is perfectly mobile across countries, a country's saving and investment should not be correlated because domestic saving would be invested in its most productive use around the globe and domestic investment can be financed from the international capital market. By contrast, zero capital mobility implies a one-to-one relationship between saving and investment because saving has to be invested domestically. Feldstein and Horioka (1980) found a high correlation between saving and investment in their time-aggregated cross-sectional regression for OECD countries and interpreted it as indicating a low degree of capital mobility. While a number of researchers have confirmed the same empirical finding using different techniques and different data, there has been debate about whether it can be interpreted as evidence of barriers to international capital flows.[1] A high observed correlation between saving and investment is not necessarily inconsistent with a high degree of capital mobility if common shocks drive saving and investment in the same direction.

In order to know the degree of capital mobility, one would need to measure how much of exogenously increased saving is retained within the home country and invested domestically. However, the Feldstein–Horioka regression of investment on observed saving does not distinguish exogenous increases in saving from endogenous increases driven by common factors that also affect investment. For consistent estimation of the saving-retention coefficient, it would be crucial to control for common sources that simultaneously drive saving and investment. There have been attempts to control for common sources by controlling for specific shocks such as technology shocks, government policy, and demographic variables.[2]

We adopt an agnostic view about the nature of the common sources rather than focusing on specific shocks. Instead, we make a fairly realistic assumption about the common sources. Namely, these common shocks can either affect all countries or be specific to each country. In

[1] See Murphy (1984), Dooley et al. (1987), Feldstein and Bachetta (1986), Tesar (1991), and Obstfeld (1995) for cross-section estimation, Obstfeld (1986), Bayoumi (1990), Tesar (1993), and Coakley et al. (1996) for time-series estimation, and Kim (2001), Corbin (2001), and Holmes and Otero (2014) for panel estimation.

[2] See, for example, Obstfeld (1986), Tesar (1991), Baxter and Crucini (1993), Taylor (1994), Kim (2001), Ventura (2003), and Giannone and Lenza (2010).

other words, the common sources can be decomposed into components that are (i) common across all countries' saving and investment (global factors) and (ii) common across saving and investment within each country (country-specific factors). Then, controlling for these multi-level common factors would be crucial in getting a unbiased measure of capital mobility. The effects of these factors would not be eliminated by controlling for country or time fixed effects in a panel structure. The long-run effect of these omitted factors cannot be averaged out by time aggregation either.

We use the multi-level factor model of Choi et al. (2016) to estimate multi-level common factors from a large panel of macroeconomic series in the OECD countries. We then get an unbiased estimate of the saving-retention coefficient by explicitly controlling for the estimated global and country-specific factors. The results indicate that the multi-level common factors indeed help explain the high saving–investment correlation. The global and country-specific factors together account for almost 50% of the saving–investment correlation in the panel of 19 OECD countries for 1961–2005. The levels of the saving-retention coefficient after controlling for the multi-level factors are lower in the sample of the European countries than in the non-European countries. The coefficient declines substantially after 1990 in the European countries, while the decline is much smaller in the sample of the non-European OECD countries. This implies that capital mobility is greater across the European countries and the speed of financial integration after 1990 was faster in the European countries compared to non-Europe OECD countries.

There have been previous attempts to control for global shocks and country-specific shocks separately. For example, Glick and Rogoff (1995) control for both global and country-specific shocks on an investment–current account correlation, while Kim (2001) does so on an saving–investment correlation. They use the averages of country-level output or total factor productivity as a proxy for global shocks. However, a large idiosyncratic shock that affects only one country can be falsely measured as a global shock if one uses a cross-country average as a measure of the global shock. Our estimates of global and country-specific factors are independent from each other. In addition, Glick and Rogoff (1995) and Kim (2001) do not allow for asymmetric impacts of global and country shocks across countries. However, the effects of global factors can vary across countries and there is no reason why a country would respond to its own country-specific shocks in the same way as other countries do. While Giannone and Lenza (2010) allow for heterogenous effects of general equilibrium factors on saving and investment, they control only for principal component estimates of global factors and thus are still subject to omitted variable bias.

The paper is organized as follows. In Section 2, we discuss econometric issues related to estimating the saving-retention coefficient and explain our empirical model and data. We present the empirical results in section 3 and conclude in section 4.

2 Econometric Framework and Data

2.1 Econometric Framework

If capital is perfectly mobile across countries, a country's saving would be invested anywhere in the world. In a closed economy, by contrast, domestic saving has to be invested domestically. Therefore, measuring how much of incremental saving remains within the home country to be invested domestically would reveal the degree of capital mobility. In order to get an informative measure of capital mobility, the increment in saving has to be exogenous in the sense that it should not be affected by common causes that also affect investment. That is, the estimation equation should be in the form:

$$I_{it} = \alpha + \beta S_{it}^{exo} + \varepsilon_{it}, \tag{1}$$

where I_{it} is investment of country i at time t, and S_{it}^{exo} refers to exogenous changes in national saving, which are uncorrelated with ε_{it}. The estimate of β in the regression equation (1) intends to measure how much exogenously increased saving is retained within the country of origin and is referred to as the saving-retention coefficient.

However, when there are common causes that drive both saving and investment, we could observe a positive correlation between saving and investment even though exogenously increased saving does not raise investment. These common sources can either affect all countries or be specific to each country. That is, common sources can be decomposed into components that are (i) common across all countries' saving and investment (global factors) and (ii) common across saving and investment within each country (country-specific factors). Formally, suppose that the true data-generating processes (DGPs) for saving and investment are

$$\begin{aligned} S_{it} &= \gamma_i^{S\prime} G_t + \lambda_i^{S\prime} F_{it} + S_{it}^{exo} \\ I_{it} &= \gamma_i^{I\prime} G_t + \lambda_i^{I\prime} F_{it} + I_{it}^{exo}, \end{aligned} \tag{2}$$

where G_t is a vector of global factors that affect saving and investment across all countries, and F_{it} is a vector of country factors for country i that affect saving and investment in country i only. γ_i^S and γ_i^I are global factor loadings, and λ_i^S and λ_i^I are country factor loadings for country i. S_{it}^{exo} and I_{it}^{exo} refer to the idiosyncratic components in saving and investment that are independent from the global or country-specific factor components.

Then, equation (1) is rewritten as

$$I_{it} = \alpha + \beta S_{it} + \delta_i{}' G_t + \psi_i{}' F_{it} + \varepsilon_{it}, \tag{3}$$

where $\delta_i = -\beta\gamma_i^S$ and $\psi_i = -\beta\lambda_i^S$. Suppose that one employs observed saving S_{it} in the estimation of equation (1) instead of using S_{it}^{exo}, as has often been done in many previous studies. Then, the terms involving global factors and country-specific factors $(\delta_i{}' G_t + \psi_i{}' F_{it})$ would be included in the error term. These terms are correlated with saving, which results in the endogeneity problem of the independent variable. Then, the estimate of β would be biased and could not be interpreted as a measure of the effect on investment of exogenous changes in saving. The omitted terms vary both across countries and across time and thus will not be eliminated even after controlling for country and/or time fixed effects. Even if one intends to focus on the long-run relationship by running a cross-section regression with time-averaged data as in Feldstein and Horioka (1980), β cannot be estimated consistently without controlling for multi-level factors. Time aggregation cannot effectively average out the long-run average of country-specific factors as well as the heterogenous coefficients on the factors, both of which would lead to bias in the estimation.

Hence, controlling for the common factors is crucial in getting an unbiased measure of capital mobility. However, the difficulty usually is that these factors are not observed. By aid of a recently developed multi-level factor model of Choi et al. (2016), we estimate the multi-level factors and explicitly control for them. The multi-level factor model can be written as

$$x_{ijt} = \gamma_{ij}' G_t + \lambda_{ij}' F_{it} + e_{ijt}, \quad (i = 1, \ldots, I;\ j = 1, \ldots, J_i;\ t = 1, \ldots, T), \tag{4}$$

where x_{ijt} is the j^{th} macroeconomic variable of country i at time t. G_t is an $s \times 1$ vector of unobserved global factors that affect the macroeconomic series in all countries, F_{it} is an $r_i \times 1$ vector of unobserved country factors that affect the variables within country i, γ_{ij} and λ_{ij} are vectors of unobserved factor loadings for series j in country i, and e_{ijt} is an idiosyncratic component for each series. If the j^{th} variable is saving, then e_{ijt} corresponds to S_{it}^{exo} in equation (2). The model is estimated using the following sequential procedure. In the initial step, the global factors are estimated using the data from two countries by canonical correlation analysis. Using the initial estimator of the global factors, the principal component estimators (PCEs) of the country factors are constructed. In the third and fourth steps, the estimates of the global and then those of country factors are updated by the principal component method. The PCEs estimate the spaces of the global and country factors consistently and are normally distributed in the limit. Choi et al. (2016) show that this method works well in finite samples as well. The estimates of global factors, country-specific factors, and idiosyncratic components are orthogonal with each other in this multi-level factor model. The number of global factors

(s) and the numbers of country factors in each country (r_i, for $i = 1, \ldots, I$) are identified by information criteria. We use the Bayesian information criterion (BIC) of Akaike (1978) and Schwarz (1978), and the Hannan and Quinn (1979) criterion (HQ), as suggested in Choi et al. (2016):

$$BIC = T \sum_{i=1}^{I} tr \left(\ln \left(\sum_{t=1}^{T} \hat{e}_{it} \hat{e}_{it}' / T \right) \right) + \ln(JT) \left[\sum_{i=1}^{I} r_i (J_i + T) + s(J+T) + J \right] \qquad (5)$$

and

$$HQ = T \sum_{i=1}^{I} tr \left(\ln \left(\sum_{t=1}^{T} \hat{e}_{it} \hat{e}_{it}' / T \right) \right) + 4 \ln(\ln(JT)) \left[\sum_{i=1}^{I} r_i (J_i + T) + s(J+T) + J \right], \qquad (6)$$

where $J = \sum_{i=1}^{I} J_i$, $e_{it} = (e_{i1t}, \ldots, e_{iJ_i t})'$, and $\hat{e}_{it}$ is the estimated e_{it}. Choi et al. (2016) show that the BIC and HQ perform well in finite samples. We refer the reader to Choi et al. (2016) for a more detailed description of the multi-level factor model.

After estimating the multi-level factors, we run the following main panel regression:

$$I_{it} = \alpha_i + \beta S_{it} + {\delta_i}' \hat{G}_t + {\psi_i}' \hat{F}_{it} + \epsilon_{it}, \qquad (7)$$

where $\hat{G}_t$ and $\hat{F}_{it}$ are the estimated factors from equation (4). Note that the effects of the common factors are allowed to be asymmetric across countries, reflecting the DGPs for saving and investment in equation (2). Intuitively, the effects of the global factors can vary across countries and there is no reason why a country would respond to its own country-specific shocks in the same way as other countries do. The intercept α_i is country-specific to permit country heterogeneity, the importance of which has been emphasized in the literature. In order to measure the overall correlation between saving and investment in our panel, after controlling for common factors, we maintain the assumption that the saving-retention coefficient β does not vary across countries.

Since our main regression equation (7) involves estimated factors $\hat{G}_t$ and $\hat{F}_{it}$, the standard errors for the coefficients in equation (7) are inconsistent unless they are adjusted for the estimation error incurred in the first step of the factor estimation.[3] In order to address this "generated regressor problem," we use a bootstrap method. The bootstrap estimates of the standard errors are constructed in the following manner. A random sample with replacement is drawn from x_{ijt}. We denote the bootstrapped data by x^*_{ijt}. Using x^*_{ijt}, the estimates of the factors $\hat{G}^*_t$ and $\hat{F}^*_{it}$ are constructed. Then, using S^*_{it} and I^*_{it}, together with the estimated $\hat{G}^*_t$ and $\hat{F}^*_{it}$, the second-stage estimates for β, denoted by $\hat{\beta}^*$, is constructed. This procedure is repeated 5,000 times. The standard deviation of 5,000 observations of coefficient estimates $\hat{\beta}^*$ is thus the bootstrap standard error for $\hat{\beta}$. The standard error estimates for the other coefficients are constructed in the same way.[4]

2.2 Data

We use annual data for 19 OECD countries for the period 1960–2005. Our sample excludes Greece and Portugal, whose anomalous current account behavior is highlighted in Blanchard and Giavazzi (2002). Luxemburg is excluded because it has been identified as an outlier in saving–investment analyses. We also exclude Iceland, Switzerland, Turkey, and the recently joined members of OECD, such as Chile, Czech Republic, Estonia, Hungary, Israel, Mexico, Poland, Slovak Republic, and Slovenia, owing to data limitations. The source of the data for saving and investment is IMF's International Financial Statistics. Investment is gross capital formation, and saving is GDP minus consumption and government spending.

The time-series data of saving and investment are known to be both non-stationary, which can lead to a spurious regression. Previous studies use saving and investment as ratios of GDP or in first differences.[5] We perform unit root tests to determine whether saving and

[3]See Pagan (1984) for the generated regressor problem in two-stage OLS regressions, and Ludvigson and Ng (2010) and Bai and Ng (2006) for that in factor-augmented regressions.

[4]The standard errors clustered by country are also computed. They are similar to the bootstrap standard errors and thus not reported.

[5]Feldstein and Horioka (1980) and many subsequent studies use saving and investment as ratios of GDP, while Glick and Rogoff (1995), Kim (2001), Decressin and Disyatat (2008), and Bussière et al. (2010) use first-differenced data.

investment are stationary. Table 1 displays the test statistics of the augmented Dickey–Fuller tests.[6] For ΔI and ΔS, the null hypothesis of a unit root is rejected at the 5% level in all sample countries other than Ireland. The null of a unit root is rejected for Ireland too, but with a larger significance level, at 10%. On the other hand, the null hypothesis of a unit root cannot be rejected for most countries for I/Y and S/Y. Thus, we use saving and investment in first differences to ensure stationarity.

Table 1: Unit Root Tests

	Saving			Investment		
	Level	First Difference	Ratio of GDP	Level	First Difference	Ratio of GDP
Australia	−1.510	−5.191***	−2.381	−1.494	−5.607***	−2.874
Austria	−2.221	−4.950***	−1.535	−2.613	−5.404***	−2.443
Belgium	−1.169	−7.239***	−1.985	−1.298	−5.843***	−2.928
Canada	−0.905	−4.679***	−2.282	−0.850	−4.776***	−3.144
Denmark	−1.742	−5.160***	−1.818	−2.012	−5.282***	−2.576
Finland	−2.506	−4.603***	−2.340	−2.205	−4.087**	−2.245
France	−1.548	−5.260***	−1.290	−1.604	−4.995***	−2.173
Germany	−2.821	−6.308***	−2.764	−2.652	−5.578***	−2.821
Ireland	2.639	−4.664***	−1.629	2.196	−3.335*	−1.744
Italy	−2.019	−5.358***	−2.461	−2.089	−5.326***	−2.812
Japan	−1.487	−5.117***	−1.966	−1.457	−4.750***	−2.714
Korea	−2.078	−5.298***	−1.212	−2.611	−5.647***	−2.252
Netherlands	−1.148	−6.451***	−1.869	−2.432	−5.901***	−2.158
New Zealand	−1.169	−4.869***	−4.047**	−1.549	−4.960***	−2.862
Norway	0.476	−3.529**	−2.584	−1.457	−4.153**	−3.254*
Spain	−1.499	−4.195**	−2.050	−1.447	−3.791**	−1.966
Sweden	−1.932	−5.021***	−2.273	−2.406	−4.964***	−2.693
U.K.	−2.543	−4.253***	−1.654	−2.155	−4.420***	−2.392
U.S.	−1.888	−6.039***	−2.602	−0.842	−5.845***	−3.094

Note: The augmented Dickey–Fuller test statistics for H_0 of a unit root are shown. A constant and trend are included. ***, **, and * indicate that H_0 is rejected at the 1%, 5%, and 10% significance levels, respectively.

We estimate the multi-level factors from a balanced panel of 311 annual economic series from 19 OECD countries for the period between 1960 and 2005. The data sources are IMF's International Financial Statistics (IFS), the World Bank's World Development Indicators (WDI), St. Louis Fed's Federal Reserve Economic Data (FRED), and Reinhart and Rogoff (2011). The series were selected to represent macroeconomic variables that are shown to be related with saving or investment in the literature. We intend to include macroeconomic variables that are

[6]The results of the Phillips and Perron (1988) test are similar and thus omitted from the text.

affected by the same set of global and country-specific factors that affect saving and investment. These encompass a broad category of macroeconomic time series: measures of output growth, measures of employment growth, changes in total factor productivity, fiscal policy measures, interest rates, monetary aggregates, terms of trade and demographic variables.[7] The number of series in each country ranges from 14 to 22. The data are transformed so as to ensure stationarity. Following the factor analysis literature, all series are standardized prior to factor estimation (i.e., the sample mean is removed and the variance is standardized to one). This standardization ensures that all series receive equal weight in the search for common factors. Otherwise, common factors are likely to be affected by the series with a large variance. The complete list of series and detailed explanations are given in the data appendix.

3 Empirical Results

3.1 Multi-Level Factors

In this section, we estimate global and country-specific factors and study their features. Before estimating factors, we first identify the numbers of global and country-specific factors using the information criteria described in section 2.1. Both BIC and HQ indicate the existence of one global factor ($s = 1$) and one country-specific factor in each country ($r_i = 1$ for $i = 1, \dots, 19$).[8]

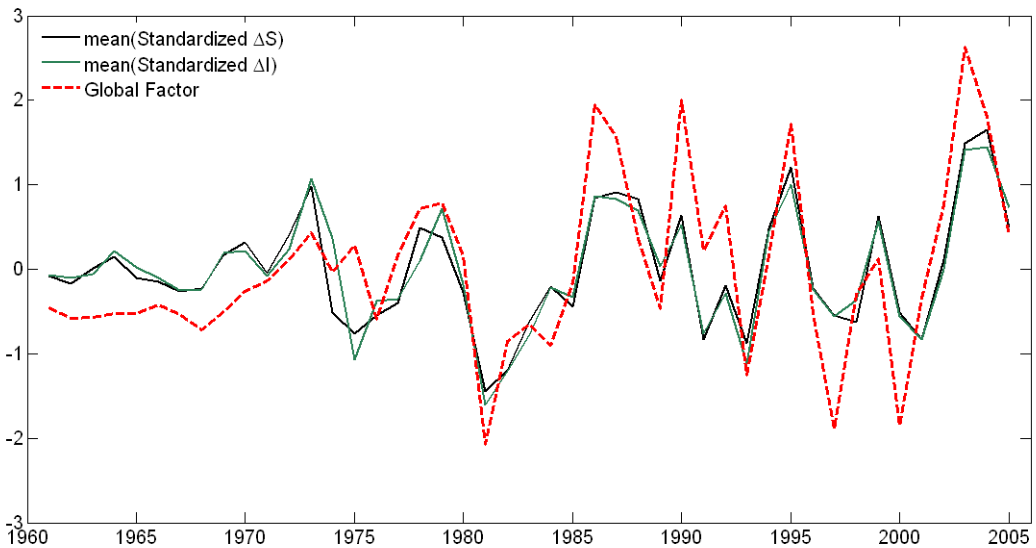
Figure 1 compares the extracted global factor with the cross-country mean of saving and investment. Saving and investment are in first differences and in standardized units with zero means and unit variances. Note that while these standardized units are used in extracting factors, actual saving and investment are used in the main saving–investment regressions. The estimate of the global factor seems to well capture a common factor that drives saving and

[7] Variables that are shown to be related with saving and investment are growth rates in output, productivity, and population (Obstfeld, 1986, Tesar, 1991, Baxter and Crucini, 1993, Taylor, 1994, Ventura, 2003); government policy variables (Obstfeld and Rogoff, 1995, Turnovsky and Sen, 1991, Fieleke, 1982, Summers, 1988, Bayoumi, 1990, Coakley et al., 1996); interest rates and financial development (Frankel, 1986, Frankel, 1992); terms of trade (Svensson and Razin, 1983); and the size of the non-tradable sector (Tesar, 1993).

[8] In factor number selection, we set the maximum factor numbers to three for global factors and to two for country factors in each country.

investment. We can see a close relationship of the global factor with mean saving and investment. It displays concurrent peaks and troughs with saving and investment. While the global factor closely comoves with saving and investment throughout the sample period, it fluctuates more than those starting from the 1980s.

Figure 1: Mean Saving and Investment and Global Factor



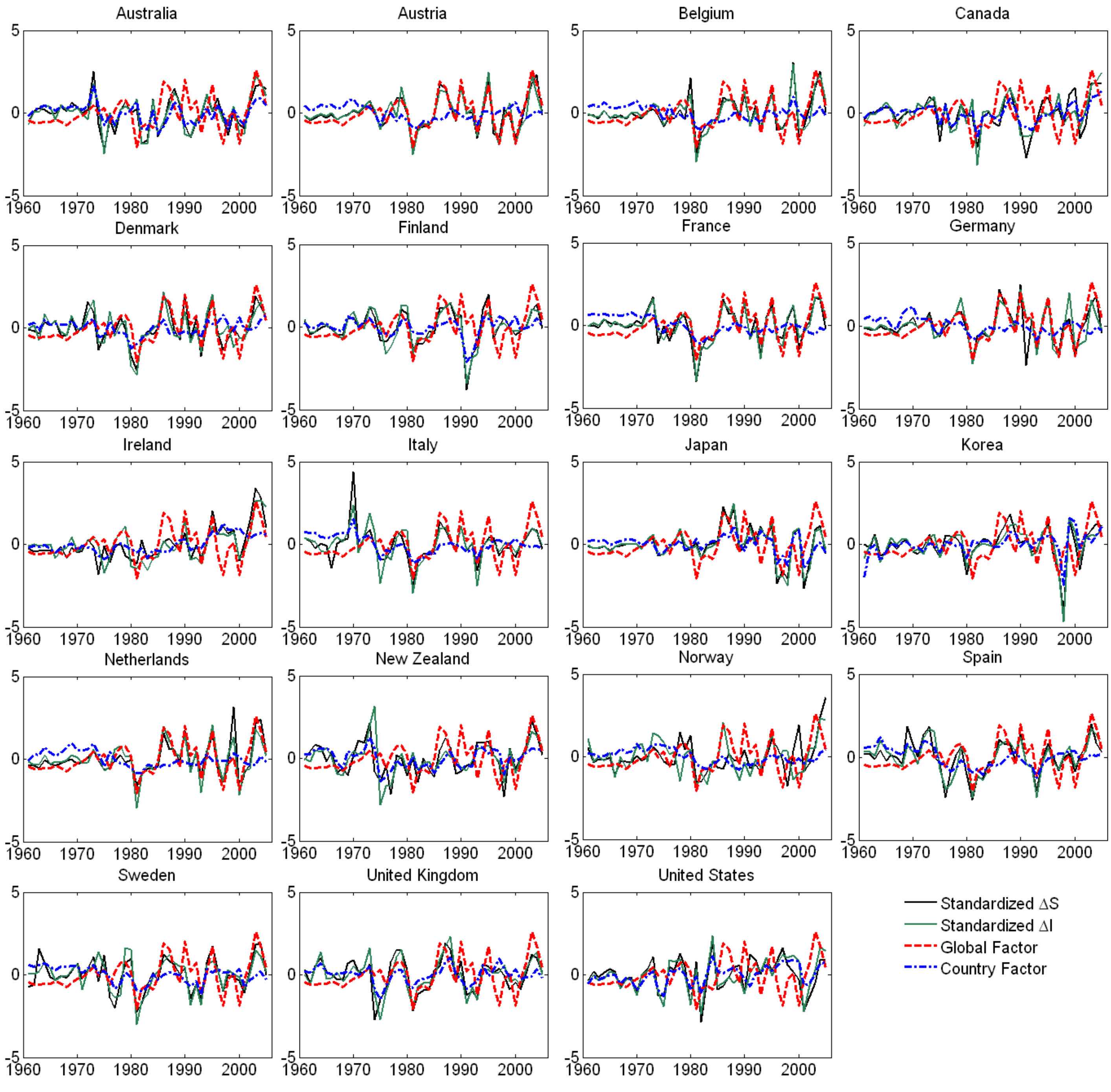
Notes: The figure shows the cross-country average of ΔS and ΔI along with the estimated global factor. ΔS and ΔI are in standardized units with zero means and unit variances.

Figure 2 displays the estimated global and country-specific factors along with each country's saving and investment in standardized units. The global factor and each country's country factor seem to comove well with saving and investment. On average, the estimated global and country factors together explain about 77% of the variance of saving and investment, leaving approximately 23% accounted for by idiosyncratic components in saving and investment.[9]

Then, what economic interpretation can we give to the factors? Since common factors are influenced, to some degree, by all the variables in our large data set, there is no clear interpretation of these factors, which is often criticized as a drawback of factor analyses. Nevertheless, it would be useful to investigate what macroeconomic information the global and country-specific factors contain. To this end, we compute correlations between the factors and all observed

[9] To conserve space, the detailed variance decomposition results are not reported. The results are available upon request.

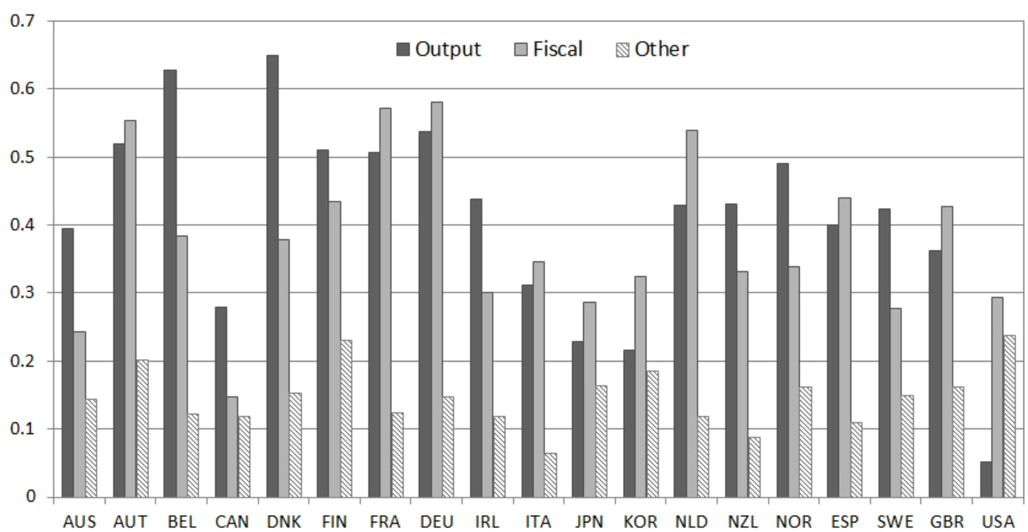
Figure 2: Each Country's Saving, Investment, Global Factor, and Country Factor



Notes: The figure shows each country's ΔS and ΔI along with the estimated global and country factors. ΔS and ΔI are in standardized units with zero means and unit variances.

macroeconomic variables in our panel data set. We classify variables into three sub-categories: output- and employment-related variables, fiscal policy variables, and the other variables. Then, we compute the mean absolute values of the correlation coefficients for each category. Figure 3 shows the mean correlation coefficients between the global factor and variables of each category in each country. The mean correlation coefficients of the global factor with output variables, fiscal policy variables and the other variables in the panel of all sample countries are 0.40, 0.38, and 0.15, respectively. In particular, the global factor shows high correlations with the output and fiscal policy variables in the European countries. The correlation coefficients with the U.S. output variables are surprisingly low, while those with the other U.S. variables are moderate.

Figure 3: Correlation between the Global Factor and Macro Variables



Notes: The figure shows the mean absolute values of the correlation coefficients between the global factor and the variables of each category in each country.

These results accord well with those of previous studies on business cycles of G7 countries based on multi-level factors such as Gregory et al. (1997), Kose et al. (2003), and Choi et al. (2016) in that the global factor shows much greater correlation with variables of European countries than with those of the United States and Canada, and fluctuations in the global and country-specific common factors together account for about 80% of the variances of macroeconomic variables.

3.2 Saving-Retention Coefficient

Before we augment the saving–investment regression with the multi-level factors, we estimate the following panel regression:

$$I_{it} = \alpha_i + \beta S_{it} + u_{it}. \tag{8}$$

Saving and investment are expressed in first differences and converted to the dollar in real terms. α_i captures country fixed effects to control for time-invariant country heterogeneity.[10] The first and second rows of Table 2 show the estimates of β and its standard errors for the whole sample period. Column (1) shows the estimate of β in equation (8), in which saving is the only regressor. The estimated coefficient is 0.955 and highly significant. We cannot reject the hypothesis that β is equal to one which is consistent with the closed economy case. However, the observed high association between saving and investment may reflect the influence of common factors.

Table 2: Saving-Retention Coefficients after Controlling for Multi-level Factors

	No controls	Controlled factors		
	Baseline	Global factors	Country factors	Both factors
	(1)	(2)	(3)	(4)
1961–2005	0.955***	0.945***	0.733***	0.514***
	(0.033)	(0.036)	(0.081)	(0.081)
1961–1990	0.952***	0.933***	0.756***	0.510***
	(0.041)	(0.045)	(0.088)	(0.091)
1991–2005	0.924***	0.911***	0.728***	0.446***
	(0.060)	(0.067)	(0.114)	(0.119)

Note: The table reports the estimates of the saving-retention coefficients from the regression of ΔI on ΔS. Column (1) shows the estimate of β from equation (8). Column (4) shows the estimate of β from equation (7). Compared with column (4), F_{it} and G_t are omitted in columns (2) and (3), respectively. All regressions are estimated using the fixed effects panel OLS regression. Bootstrap standard errors, accounting for the use of estimated factors, are reported in parentheses. ***, **, and * denote a p-value less than 1%, 5%, and 10%, respectively.

In order to examine the effect of exogenously increased saving on investment, we now control

[10] By including country fixed effects, we can also control for country size, the importance of which has been emphasized in the literature (Murphy, 1984).

for the estimated common factors. The estimate of β decreases marginally to 0.945 in column (2) when only the global factor is controlled for. In column (3), controlling for the country factors reduces the estimate of β to 0.733 by more than what the inclusion of the global factor does. Finally, column (4) shows our main estimation result of equation (7) in which the global and country-specific factors are simultaneously controlled for. The estimate of β drops by almost 50% to 0.514. Even though it remains significant, now we can reject the null hypothesis of $\beta = 1$. This indicates that the multi-level common factors indeed have explanatory power for the Feldstein–Horioka puzzle. The explanatory power of the multi-level factors in the saving–investment relation is greater than the conventional macroeconomic shocks considered in Kim (2001), or the principal component estimates of global factors considered in Giannone and Lenza (2010).[11]

The saving-retention coefficients in columns (2)–(4) of Table 2 are estimated without equality restrictions on the coefficients of the common factors. If these coefficients are restricted to be equal across countries, the saving-retention coefficient remains at 0.860, even after controlling for both global and country factors. Thus, if we do not allow for asymmetric effects of the global and country-specific factors across countries, the importance of the common factors would be substantially underestimated.[12] We also perform a statistical test to determine whether the coefficients on the global and country-specific factors vary across countries. The test result indicates that the homogeneity restrictions on the impact of the multi-level common factors are strongly rejected by the data.

The saving-retention coefficient for the entire sample period, 0.514, implies that 51.4% of increased saving remains within the country of origin and is invested domestically. Although significantly smaller than one, it is still significantly larger than zero. The degree of financial

[11] In Kim (2001), country-specific productivity, fiscal or terms-of-trade shocks do not explain the high saving–investment correlation. Global shocks explain less than 20% of the saving–investment relation when global shocks are constructed as a weighted average of country-level shocks. The saving-retention coefficient decreases up to 40% when two lags of shocks are additionally included. In Giannone and Lenza (2010), the saving-retention coefficient decreases by approximately 30% after controlling for two principal components from the saving and investment data in OECD countries.

[12] Giannone and Lenza (2010) emphasize the importance of allowing for heterogenous coefficients on common factors.

integration increased starting from the 1980s and there has been a substantial acceleration of financial integration since the 1990s. In order to examine whether there have been changes in the degree of financial integration over time, we divide the sample into two sub-periods: 1961 to 1990 and after 1990, and see whether the results are different between the sub-periods.[13] The results are shown in the third to sixth rows of Table 2. The estimates of β with no control variables in column (1) do not seem to decline over time, consistent with the results often found in the literature. Some previous works interpret this as evidence of barriers to capital mobility. However, this may not contradict with increased capital mobility, because the coefficients in column (1) may reflect the effect of common factors. The result in column (4), on the other hand, is somewhat puzzling. Even after the global and country-specific factors have been controlled for, the estimate of β in column (4) does not significantly decrease over time. The saving-retention coefficient in column (4) in the later period (0.446) is lower than that in the earlier period (0.510), but the difference is only marginal. Thus we cannot find strong evidence of increased capital mobility based on the regression results for the sample of 19 OECD countries.

One might ask whether there are differences in different sub-groups. In particular, financial flows among countries in the European Union (EU) should be greater than those among the OECD countries in general. Moreover, the speed of financial integration is known to be more rapid within the EU countries. This is also confirmed from the direct comparison of the degrees of financial openness between the European and non-European countries in our sample. Our sample includes twelve EU member countries. Norway is not a member state of the EU but is closely associated with the union through its membership in the European Economic Area (EEA) and the European Free Trade Association (EFTA). Thus, we classify the thirteen European countries including Norway as the Europe group and the remaining six non-European

[13]There are other ways to split the earlier and later parts of the sample. We chose to divide the sample into two sub-periods before and after 1990 for two reasons. First, dividing the sample into shorter periods is not feasible because we need enough sample size in sub-samples given the large number of parameters to be estimated in our model. Second, we chose 1990 as the threshold to highlight the difference between the earlier and later periods because the 1990s is known as a marked improvement in capital mobility among advanced countries. The main results are robust to alternative sample period divisions.

countries as the non-Europe group. Table 3 compares the two of the most widely used measures of financial openness across the two groups. The first one is the Chinn and Ito (2008) Index measuring a country's degree of capital account openness. This index is a *de jure* measure based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. The second one is a *de facto* measure of financial openness based on Lane and Milesi-Ferretti (2007), calculated as a country's aggregate foreign assets plus liabilities relative to its gross domestic product. The table shows the group averages of the openness measures for the sub-periods and calculates the percentage increase between the two sub-periods. The table reveals notable differences in the degrees of financial openness across the two groups. While there have been advances in financial openness in both groups, the speed of financial integration appears to be much faster in the European countries. Both measures show greater increases over time in the European countries than in the non-European countries. Therefore, in the later period, the European countries show much greater financial openness than the non-European countries, according to both *de jure* and *de facto* measures.

Table 3: Comparison of Financial Openness Indicators

	Chinn–Ito			Lane and Milesi–Ferreti		
	1961–1990	1991–2005	Increase	1961–1990	1991–2005	Increase
Europe	0.57	2.19	287.36%	1.14	3.51	207.59%
Non-Europe	1.09	1.83	67.93%	0.62	1.43	132.39%

Note: The table reports the group averages of measures of financial openness for each period. The column labeled "Increase" shows the percentage increase of the measures between the two sub-periods.

Even though these indicators shown in Table 3 do not show capital flows among the European countries, they at least suggest that financial openness in the European OECD countries increased much faster than in the other OECD countries. Therefore, the behavior of the saving–investment relation could also be different between the European countries and the non-European countries. To explore this possibility, we split the sample into European countries and non-European OECD countries and run separate regressions for each group. Table 4 compares the behavior of the saving–investment association in the Europe and the non-Europe groups. The difference between the two groups of countries is not large in column (1) in which common factors are not controlled for. Even though the coefficient is slightly larger in the non-Europe group (1.005) than that in the Europe group (0.872), the estimated coefficients are highly significant and not statistically different from one in both groups. The coefficients appear to decline only marginally after the 1990s in both groups in column (1). However, as emphasized previously, the results in columns (1) to (3) do not tell us about capital mobility and may reflect the effects of common factors. When those common factors are controlled for in column (4), the difference between the two groups becomes substantial. While the saving-retention coefficient for the non-Europe OECD countries is 0.639, that for the European countries is much smaller at 0.277 even though it remains statistically significant. Thus, countries in Europe retain a much smaller fraction of their national saving within the saving country and invest a much larger portion in the other countries in the region than the non-Europe OECD countries do.

Not only are the levels of the saving-retention coefficients different but also the decline of the coefficient over time is much more rapid in the Europe group. The saving-retention coefficient for the Europe group declines from 0.289 before 1990 to 0.078 after the 1990s. It becomes statistically insignificant in the later period, suggesting substantial capital mobility among the European countries in the sample. The decline also implies that financial integration speeded up during the 1990s, especially for the European countries, reflecting accelerated financial integration around the ratification of the Maastricht Treaty. For the non-Europe group, on the other hand, the decline in the coefficient between the two subperiods is much smaller. Furthermore, the absolute level of the saving-retention coefficient is much larger than that of the Europe group, remaining at 0.544 even in the later period.

These results suggest that capital mobility is greater and the speed of financial integration after 1990 was faster in the European countries than in the non-Europe OECD countries. The evidence of increased capital mobility can be found only after the endogeneity of national saving and investment is explicitly adressed by controlling for global and country-specific factors.

Table 4: Saving-Retention Coefficients for Sub-Groups

	No controls	Controlled factors		
	Baseline	Global factors	Country factors	Both factors
	(1)	(2)	(3)	(4)
		Europe		
1961–2005	0.872***	0.781***	0.746***	0.277***
	(0.045)	(0.051)	(0.087)	(0.099)
1961–1990	0.877***	0.798***	0.709***	0.289***
	(0.055)	(0.063)	(0.094)	(0.107)
1991–2005	0.868***	0.699***	0.818***	0.078
	(0.080)	(0.090)	(0.119)	(0.135)
		Non-Europe		
1961–2005	1.005***	1.005***	0.719***	0.639***
	(0.035)	(0.039)	(0.098)	(0.101)
1961–1990	1.017***	1.006***	0.829***	0.697***
	(0.044)	(0.049)	(0.112)	(0.123)
1991–2005	0.946***	0.944***	0.641***	0.544***
	(0.065)	(0.074)	(0.148)	(0.175)

Note: The table reports the estimates of the saving-retention coefficients from the regression of ΔI on ΔS. Column (1) shows the estimate of β from equation (8). Column (4) shows the estimate of β from equation (7). Compared with column (4), F_{it} and G_t are omitted in columns (2) and (3), respectively. All regressions are estimated using the fixed effects panel OLS regression. Bootstrap standard errors, accounting for the use of estimated factors, are reported in parentheses. ***, **, and * denote a p-value less than 1%, 5%, and 10%, respectively.

4 Conclusion

When both saving and investment are driven by common global factors and country-specific factors, the failure to control for these factors leads to bias in the saving-retention coefficient estimates. We empirically evaluate the importance of global and country-specific factors in saving–investment correlations. In particular, we estimate unobserved multi-level common factors using a multi-level factor analysis then explicitly control for the estimated global and country-specific factors.

The results indicate that the multi-level common factors help explain high saving–investment correlations. The global and country-specific factors together account for almost 50% of the saving–investment correlation in the panel regression. The degree of capital mobility and the speed of financial integration after 1990 appear to be greater in the European countries than in the non-Europe OECD countries. The evidence of increased capital mobility can be found only after the endogeneity of national saving and investment is explicitly addressed by controlling for both global and country-specific factors.

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Data Appendix

Description	Included countries	Transformation	Source
Output- and employment-related variables			
GDP per capita	19	Deflated, First difference, Converted to USD	IFS
Household consumption expenditure	19	Deflated, First difference, Converted to USD	IFS
Consumption of fixed capital	11	Deflated, First difference, Converted to USD	IFS
Gross national income	17	Deflated, First difference, Converted to USD	IFS
Industrial production	17	First difference	IFS
Total factor productivity at constant national prices	19	First difference	FRED
Labor force	2	First difference	IFS
Unemployment level	12	First difference	FRED
Wages	12	First difference	IFS
Fiscal policy variables			
Government consumption expenditure	19	Deflated, First difference, Converted to USD	IFS
Government deficit or surplus	11	Deflated, First difference, Converted to USD	IFS
Total gross central government debt/GDP	15	First difference	Reinhart and Rogoff (2011)
Total gross general government debt/GDP	3	First difference	Reinhart and Rogoff (2011)
Other variables			
Ratio of import to GDP	18	No transformation	IFS
Ratio of export prices to import prices	7	No transformation	IFS
M1	9	Deflated, First difference, Converted to USD	IFS
Money market real interest rate	3	Deflated	IFS
Long-term government bond rate	14	Deflated	IFS
Domestic credit provided by financial sector	8	First difference	WDI
Age Dependency Ratio	19	First difference	WDI
Fertility	19	First difference	WDI
Investment	19	Deflated, First difference, Converted to USD	IFS
National saving	19	Deflated, First difference, Converted to USD	IFS