Saving, Investment and the Net Foreign Asset Position*

Mathias Hoffmann
Department of Economics
University of Cologne†

26th of June 2003

Abstract

This paper acknowledges that significant net foreign asset positions of countries are due to long-run trend differences in saving and investment behaviour rather than business cycle effects. It explores the importance of short- and long-run changes in the level of domestic wealth and capital stock on net foreign asset positions across industrialised and developing countries. Using cointegration techniques, a link between output per capita, the stock of public debt and age distribution on saving, investment and hence, the net external wealth across countries is established.

JEL Classification: C23, F41, G15

Keywords: Savings, Investment and Net Foreign Assets, Cointegrated Panel Data

*I would like to thank Philip Lane for helpful comments and suggestions as well as participants of the Trinity International Group Seminar, Trinity College Dublin (2002) and the MEA Workshop on Population Ageing and international Capital Flows, University of Mannheim (2002). This work is part of a research network on 'The Analysis of International Capital Markets: Understanding Europe's Role in the Global Economy', funded by the European Commission under the Research Training Network Programme (Contract No. HPRN-CT-1999-00067).

†Address of Correspondence: Mathias Hoffmann, Department of Economics, University of Cologne -Chair of International Economics, Professor Dr Axel Weber- Albertus-Magnus-Platz, 50931 Cologne, Germany. email: m.hoffmann@wiso.uni-koeln.de

1 Introduction

Financial integration de-links national saving and domestic investment in an open economy and, hence, a country is able to run current account deficits if consumption and investment cannot be funded domestically. This perception motivated Feldstein and Horioka's (1980) work in which the authors highlight the correlation between national savings and domestic investment.[1] This paper takes another perspective and explores whether significant net foreign asset positions are due to long-run trend differences in saving and investment behaviour. Drawing on time series and cross section data, the paper analyses the importance of a country's output per capita, public debt and population age structure in determining saving and investment flows. Thereby, it assesses how these factors affect the external asset position of a country via long-run changes in domestic wealth and the capital stock.

The switch of the United States from a large net foreign creditor to a net foreign debtor as a result of a large and persistent current account deficit in the 1980s and 1990s is a good example of the importance of savings and investment in an open economy.[2] The change in the net foreign asset position was due to a sharp fall in the national saving rate relative to investment undertaken. The shortfall in saving was covered by foreign capital inflows, a necessary counterpart to the current account deficit. As the United States turned into a net foreign debtor other industrialised countries became net foreign creditors. The Federal Reserve Board (2002) finds that during the past six years, about 40 percent of the total increase in the United States' capital stock has been financed, on net, by savings from abroad. This illustrates the importance of analysing the link between saving, investment and the external asset position.

Lane and Milesi-Ferretti (2002) establish that GDP per capita, public debt and demographic factors act as the principal determinants of net foreign assets in the long-run.[3] In contrast to considering the impact of GDP per capita, public debt and demographic factors on the net foreign asset position on the whole, this paper distinguishes between the effect of the three

[1] An alternative explanation for the strong correlation between domestic saving and investment is given by the intertemporal budget constraint. It imposes stationarity of the current account in the long-run (around a non-zero mean), which keeps savings and investment rates together. A high coefficient in this analysis is indicative of the intertemporal budget constraint being satisfied. However, this finding may also be consistent with high capital mobility.

[2] Countries with growing output might be able to run perpetual current account deficits by reducing their external liabilities relative to GDP. Should foreign investors become less willing to invest in a country, the debt would have to be repaid by running trade surpluses. Maintaining domestic investment will necessitate an increase in national saving.

[3] The authors concentrate on the stocks of net foreign assets. The stock position is the relevant state variable at the macroeconomic level. Earlier literature on foreign assets and liabilities concentrated on flows rather than stock positions of countries. Flows arise to close the gap between the actual and desired stock position.

variables on saving and investment. Once the precise influence of GDP per capita, public debt and demographic factors has been clarified, further insights on their ability to influence net foreign assets via saving and investment are obtained. It will become evident in which ways GDP per capita, public debt and demographic factors impact upon saving and investment and, as a result, the net foreign asset position. The effect on the external position depends on the extent to which the saving rate restricts the domestic supply of capital. If the investment rate is not influenced by output per capita, public debt and the population age structure, changes in savings will be directly reflected in the net foreign asset position. If capital is not perfectly mobile, the outcome is less pronounced; the effects of the three factors on the net foreign asset position vanish if capital is immobile. Nevertheless, if investment is independently affected by changes in the three factors, a more complex case arises. Domestic investment and saving rates may be more or less correlated. The effects on the country's net foreign asset position might be either reinforced or weakened even if capital is internationally mobile. Thus, the main focus of this paper is to investigate the effects of GDP per capita, public debt and demographic factors on the saving or investment rate in the long as well as in the short-run. The results obtained below show different effects of public debt, GDP per capita and demography on saving and investment in industrialised and developing countries in the short and long-run . To illustrate the diverse impact the paper utilises the same set of variables for the long and short-term analysis of the net foreign asset position across countries.

The effects of the three variables on wealth, capital stock and, hence, the net foreign asset position might be contingent on other macroeconomic variables which influence the intertemporal saving decision.[4] To overcome this problem the data will be adjusted for any time-invariant or country specific effects to control for any omitted variable bias.[5]

Other papers close to this work are Higgins (1998) and Taylor (1994). Higgins analyses demographic effects on national savings and investment. The author discusses the implications for the current account balance but does not take into account effects of public debt and domestic wealth. Taylor also incorporates demographic factors to investigate the saving-investment puzzle initiated by Feldstein and Horioka (1980). However, Taylor only concentrates on the correlation between saving and investment.

In the next section the theoretical background underlying this work will be discussed in more detail in order to outline the predictional impact of the saving and investment flows on a country's net foreign asset position. Section 3 depicts the empirical strategy and the data

[4] For example global fluctuations in world output, institutional changes in individual countries, capital account liberalisation, income inequality, relative prices of goods, real exchange rate movements and terms of trade.

[5] However, note that panel estimation does not control for omitted variables that are highly volatile over time.

used for this study. Estimates of the effects of income per capita, debt and the population age structure on saving and investment are also presented in this section. Moreover, the role of GDP per capita, public debt and demographic factors in influencing the net foreign asset position via saving and investment is delineated in more detail. Section 4 concludes.

2 Theoretical Background

In a closed economy saving and investment are identical by definition. However, in an open economy they do not need to equalise. If capital is mobile, changes in the saving rate will be directly mirrored in the current account, CA, and the net foreign asset position, F.[6] Hence, the gap between saving and investment is financed by borrowing or lending, and CA is the indicator of the saving-investment balance of an economy. The net foreign asset position includes all forms of financial assets and is calculated as the sum of all foreign claims minus all foreign liabilities. Thus, countries with negative net foreign assets at time t, $F_t < 0$, are net debtors while $F_t > 0$ identifies the country as a net creditor at time t. In the balance of payments, the change in the net foreign asset position equals the current account and a term $\mathcal{E}_t$, which captures valuation effects and net errors and omissions, as discussed in more detail by Lane and Milesi-Ferretti (2002). $\mathcal{E}_t$ includes changes in unrecorded debt assets held by country residents abroad as well as capital gains and losses on existing claims.[7]

The empirical strategy of the paper and the relationship between saving, investment and GDP per capita, public debt and demographic factors becomes clear by recognising that in a small open economy the net foreign asset position, F, at time t follows the difference between country $i's$ wealth, $W_{t,i}$, and its capital stock, $K_{t,i}$:

$$F_{t,i} = W_{t,i} - K_{t,i}. \tag{1}$$

Lane and Milesi-Ferretti (2002) have shown that the net foreign asset position of country i can be explained by income per capita, YC, public debt, D_G, and the population age structure, Dem. Hence, the long-run or steady state effects of wealth and the capital stock on net foreign assets can also be approximated by the behaviour of GDP per capita, public debt and demographic

[6] In the intertemporal model of the current account an optimising infinitely lived representative household determines the consumption path under perfect foresight. This formulation assumes saving to be endogenous in the economy. Hence, saving, investment and net foreign assets are clearly part of a unified theory with an intertemporal dimension (see Obstfeld and Rogoff, 1996).

[7] In general, the long-run or steady state net foreign asset position in a non-zero growth environment depends on output growth as well as the rates of return, which are not explicitly discussed above but captured by $\mathcal{E}_t$. Rates of return vary across countries, over time and between different categories of assets and liabilities.

factors. A fixed fraction of an economy's wealth, W, will be consumed while the remaining fraction γ is used for saving,

$$W_{t,i} = \omega S_{t,i}, \text{ where } \omega = \frac{1}{\gamma}. \tag{2}$$

The capital stock, K, consists of all productive assets in the economy. A constant fraction, λ, of productive assets, K, in the economy is assumed to be used for the reproduction of new capital and, hence, will be reinvested:

$$K_{t,i} = \kappa I_{t,i}, \text{ where } \kappa = \frac{1}{\lambda}. \tag{3}$$

The linear relation of domestic wealth and saving as well as domestic capital stock and investment in the long-run or steady state allows the approximation of net foreign assets by the difference in saving and investment. This is due to the fact that the relationship between saving and domestic wealth as well as investment and the domestic capital stock needs to be stable to ensure that economy i remains in the neighbourhood of its steady state. With the use of equation (2) and (3) it is possible to express the net foreign asset relationship in equation (1) as

$$F_{t,i} = \omega S_{t,i} - \kappa I_{t,i}. \tag{4}$$

Equation (4) shows that the net foreign asset position can also be approximated by saving and investment. Thus, in the empirical part the capital stock and domestic wealth are captured by country $i's$ investment and saving rate. The question to what extent wealth (saving) and the capital stock (investment) are affected by income per capita, public debt and the population age structure arises.

In general, the behaviour of wealth and the saving rate in relation to income per capita is ambiguous as it involves offsetting impacts from substitution and income effects in the closed economy. More developed countries tend to have higher capital stocks and, if productivity is the same, lower marginal products of capital. This decreases the rate of return on domestic capital and tends to lower savings (substitution effect). As a result in the closed economy $\frac{dW}{dYC}$ and $\frac{dK}{dYC}$ fall towards zero as wealth and capital become large. However, in the open economy the negative saving effect might be offset if home investors have access to international capital markets. This allows them to seek new investment opportunities abroad with higher rates of return than at home. This would transform the home country into a holder of net foreign assets. The saving rate tends to rise as a closed economy grows richer, due to the diminishing gap between current and permanent income (income effect). Consumption tends to fall relative to income and the saving rate rises, $\frac{dW}{dYC} > 0$. In the open economy there could be a permanent change in the net foreign asset position even if the path of the high saving rate is temporary. Developing countries might operate under credit constraints. Such constraints are particularly binding for low-income countries with low growth performance. Thus, domestic saving and investment might be linked more tightly under such conditions. However, an increase in growth and, hence, production allows such countries to participate more strongly in international capital markets as well as in borrowing and lending. Consequently, the link between domestic saving and investment might be relaxed.

The demographic effects on a country's wealth and capital stock depend on the population age structure and can be summarised by the dependency rate theories of savings and theories of population-sensitive capital formation (see Goldberger, 1973 and Leff, 1969). According to Lane and Milesi-Ferretti (2002) as well as Higgins (1998) the demographic structure is of importance in explaining the evolution of net foreign asset positions and current accounts between countries. Saving rates are negatively affected by a high dependency rate or an old population ratio, since dependents and elderly people are consuming more than they produce and depend on the provision of goods by productive members of the economy. The following should hold, $\frac{dW}{dDem}|_{Youth,\ Old} < 0$. The intuition follows from the life cycle theory of consumption, where higher income and saving in mid-life offset dissaving when young and old. This, on the other hand, implies that countries with a high ratio of a working-age population should explore positive saving effects, $\frac{dW}{dDem}|_{Young\ Adults,\ Middle\ Age} > 0$. The two opposite effects on the saving rate are due to offsetting demographic mechanisms at work. The influence of the demographic structure in an economy on the domestic investment rate can be explained by scrutinising subcomponents of investment. Domestic investment will be negatively affected by a reduction in growth of the working-age population if capital and labour are complements in production.[8] The opposite is true for the young and old population. However, a high dependency and old population ratio implies a heavy demand for social infrastructure. Public investment rates, I^{Public}, are assumed to be positively affected, $\frac{dK\ |I^{Public}}{dDem}|_{Youth,\ Old} > 0$. From the discussion it becomes clear that the impact of demographic factors on the saving and investment rate clearly depends on the distribution of population age in the economy. Thus, the empirical investigation helps to shed further light on the actual relationship between saving, investment and demography.

The last variable to be considered in the analysis is the stock of public debt. The effects on the saving rate depend on whether the Ricardian equivalence holds. Higher levels of public debt are associated with higher domestic saving rates by households, S^H, when the Ricardian equivalence theorem holds, $\frac{dW\ |S^H}{dD_G}|_{Ricardian} > 0$ and $\frac{dW\ |S}{dD_G}|_{Ricardian} = 0$. However, as the second term of the

[8] This will especially hold for business investment. An efficient and experienced workforce has a favourable impact on capital accumulation in production.

expression implies, the Ricardian view also predicts that a rise in public debt may have no effect on the overall saving rate of the economy, S, since private saving will rise by an equivalent amount in anticipation of future repayments of debt. A departure from the Ricardian equivalence implies that an increase in public debt is not fully offset by an increase in private saving. This is due to the positive impact on private wealth. The effect on the saving rate becomes more ambiguous. Given that households are myopic, an increase in public debt will raise consumption since households shift the burden from present to future generations. A decline in government saving will lead to a decline in national saving, S. This result would also hold if households form rational expectations about future liabilities but are liquidity constrained. This constraint would prevent households from acting on these expectations by adjusting their consumption-saving behaviour. Nevertheless, in an open economy the increase in public debt may increase the domestic interest rate and lead to an increase in foreign saving. High public debt may also result in households' transferring funds abroad instead of saving domestically due to the expected high future tax burden. This would increase the costs of capital formation at home. However, the effect of public debt on the domestic investment rate is generally ambiguous. A higher public debt may crowd out private capital formation by reducing the availability of credits to the private sector or by raising interest rates. Given this, the overall effect on the domestic investment rate might become negative, $\frac{dK\ |I}{dD_G}|_{crowd-out} < 0$. When public debt is used for investment in infrastructure projects this may complement private investment, $\frac{dK\ |I}{dD_G}|_{complementary\ effect} > 0$. A high public debt burden could discourage foreign investment in the economy since the government may resort to restrictions on external payment obligations on investment income.

3 Empirical Approach

The theoretical assumptions are empirically analysed in this section. It will present the statistical inference of a country's wealth and capital stock, approximated by its saving and investment rate. A country's long-run net foreign asset position can be defined as the difference between the country's saving and investment rates. To recall, GDP per capita, public debt and demography are able to influence the net foreign asset position of a country. In the context of this study it will be investigated in which ways the three variables determine the saving and investment rates of the economy and thereby affect net foreign assets. The paper concentrates on the post 1980s period, which reflects an environment of higher capital mobility due to liberalised capital accounts. The sample consists of 31 developing countries and 22 industrialised countries, Tables 1 and 2. To control for a potentially different relationship between debt, output per capita and demographic factors on saving and investment in industrial and developing countries this paper splits the sample into long-standing members of the OECD and less developed countries. Most of the industrialised countries are holders of net foreign assets while the developing countries in the sample are mainly characterised by net foreign liabilities. Hence, the net foreign asset position affects the evolution of public debt differently in developed and less developed countries. Additionally, liquidity constraints and other sources of violation from Ricardian equivalence in developing countries may induce differences in the relation of saving, investment and public debt in the two groups. As explained above income per capita has different effects on the saving and investment behaviour, depending on whether a country is richer or poorer. There are clearly different demographic structures present in the industrialised and developing countries under consideration.[9] To control for a potentially different relationship and to allow for differences in the data quality this paper splits the sample into industrialised and developing countries.

3.1 Data

To estimate the relationship between the variables the following data are used. The investment rate equals the gross rate of capital formation over GDP and is derived from the World Development Indicators (WDI) (2002). The saving rate follows as the residual from the current account identity, calculated by the current account balance plus the investment rate of country i.[10] Data on the countries' current account balance are also obtained from the WDI. The wealth per person of a country is approximated by its GDP per capita in 1995 US dollars and measured in logs (WDI). The stock of public debt as a ratio of GDP is obtained from Lane and Milesi-Ferretti (2002). To ensure a parsimonious model, the demographic variables are calculated by a method of cubic polynomials, suggested by Fair and Dominguez (1991) and applied by Higgins (1998) as well as Lane and Milesi-Ferretti (2002).[11] This technique allows to incorporate the demographic information into the statistical analysis and has the advantage of capturing the entire age distribution. The polynomial approach represents twelve population age cohorts: 0-14, 15-19, 20-24, ..., 65+. The estimated coefficients have no structural interpretation; nevertheless, the implicit age distribution coefficient α_j can be easily recovered from the estimated polynomials. The source of the demographic variables is Lane and Milesi-Ferretti (2002), who utilise the United Nation's Demographic Year Book (1948-1997) and data by Herbertson and Zoega (1999).

[9] It follows that for example differences in life expectancy and retirement patterns in industrialised and developing countries affect saving and investment in a different manner.

[10] Comprehensive expenditure data do not exist. Hence, it is not possible to directly observe national saving or to calculate it as a difference between income and consumption measures. However, any bias in the current account or investment measurement will be passed on to savings.

[11] For a precise explanation of this approach the reader is referred to the appendix.

3.2 Nonstationarity and Cointegration

As a precursor to the regression analysis the data series are tested for unit roots and cointegration. To test the null hypothesis that the data generating process in question is stationary the paper applies Hadri's (2000) approach.[12] Table 3 and 4 report results for the industrial and developing country sample.[13] The test clearly rejects the null of stationarity in both samples.[14] Given that the time series properties of the data are not stationary, one has to consider the long-run relationships between the different time series to see whether there is a cointegration relation between the variables of interest. The null hypothesis that the residuals are nonstationary, hence, that the data are not cointegrated, is used. Pedroni's (1999) and Kao's (1999) multivariate cointegration tests are applied. The test statistics are presented in Table 5 for the two country sets. A cointegration relation between saving and the explanatory variables and between investment and these variables exists.[15]

3.3 Estimation by Dynamic OLS

Having identified that the data series follow a common trend, Stock and Watson's (1993) procedure is utilised and the long-run relation between the variables is estimated by dynamic OLS (DOLS). DOLS allows the estimation of the long-run relationship of the variables even if the regressors are not strictly exogenous. The regressors of interest might be endogenous since movements in saving or investment, represented by shifts in the error term, affect the evolution of income per capita, debt and perhaps demography. The application of DOLS ensures that the variables in levels for the estimation of the $\boldsymbol{\beta}$ parameters in equation (5) are strictly exogenous. This exogeneity is obtained by including past and future changes of income per capita, debt and demography. The number of leads and lags is chosen to be of order 1 (-1,1).[16] Saving and investment are estimated in two separate equations of the following form:

$$y_{t,i} = \mu + \boldsymbol{\beta}'\mathbf{X}_{t,i} + \boldsymbol{\gamma}_1'\Delta\mathbf{X}_{t,i} + \boldsymbol{\gamma}_2'\Delta\mathbf{X}_{t+1,i} + \boldsymbol{\gamma}_3'\Delta\mathbf{X}_{t-1,i} + v_{t,i}. \tag{5}$$

$y_{t,i}$ is country i's ratio of either saving or investment to GDP in year t. $\mathbf{X}_{t,i}$ is a vector containing the explanatory variables. The $\boldsymbol{\beta}s$ are the parameters in the DOLS equation which estimate the long-run relationship between saving or investment and debt, GDP per capita as well as the

[12] The tests discussed are performed using the NPT 1.2 package by Chiang and Kao (2001).

[13] The test is applied for fixed and time effects. Using only fixed effects returns similar results.

[14] The paper also tested the alternative null hypothesis that the series is nonstationary using Levin and Lin (1992). The test accepts the null of nonstationarity. Results are available on request.

[15] Pedroni's variance ratio test, ADF test and 'Philips-Perron' test also indicate a cointegration relationship. Kao's ADF test with one lag also rejects the null hypothesis that the residuals are nonstationary.

[16] A model estimated by (-2,2) gives similar results to the one reported below.

demographic age factors. All variables are corrected for fixed and time effects to take into account unobserved country specific effects and common global movements. The fixed effects also have the advantage of controlling for unobserved variables that could lead to long-standing differences in saving and investment rates between countries.[17] However, the DOLS method does not always produce residuals free from autocorrelation. Shifts in saving and investment impact at least upon output per capita and debt. The estimation of equation (5) eliminates the correlation of $\mathbf{X}_{t,i}$ with $v_{t,i}$. However, it does not remove the serial correlation in $v_{t,i}$, which is due to the relationship of saving and investment with income per capita, debt and demography.[18] To ensure a correct statistical inference the long-run variance of the error term $v_{t,i}$ has been estimated by a first order autoregressive process.[19] The estimated long-run variance allows to rescale the standard errors from equation (5) to obtain a consistent statistical inference. Note that the estimation also takes account of possible heteroskedasticity by applying White's (1980) consistent estimates. A joint estimation by GLS or seemingly unrelated regression (SUR) might be applicable. However, all explanatory variables are the same for the saving and investment equation. In this case estimation by GLS (SUR) reproduces identical point estimates (see Zellner, 1962). Nevertheless, the estimated standard errors might be smaller. Thus, in Tables 6 and 8 the statistical inference is reported for both the DOLS and 'dynamic' SUR estimations.

3.3.1 Industrial Countries

Table 6 details the industrial countries' estimates of the saving and investment relationship. The estimated cointegrated saving equation is able to explain 32 percent of the variation in the saving rate, given a country's GDP per capita, debt and demographic factors. However, the individual null hypothesis that the $\boldsymbol{\beta}$ parameters associated with the explanatory variables are equal to zero cannot be rejected. Equally, a Wald test of the null hypothesis that the $\boldsymbol{\beta}$ parameters are jointly equal to zero cannot be rejected.

The estimation of the investment equation shows a strong positive relationship between output per capita and the investment rate. An increase in a country's GDP per capita by 20 percent means that the country's investment rate in relation to GDP increases by around 2.5

[17] The fixed effects are calculated by the deviation from county $i's$ individual mean while the time effects follow as the deviation of country i from period $t's$ mean. Adjusting for time effects allows to express the data relative to the world average.

[18] This affects the asymptotic distribution and makes the statistical inference more complicated (Hayashi, 2000, pp. 650).

[19] The autoregressive process of the error term is assumed to be of order one. However, to ensure a correct specification, the long-run variance has also been estimated by a second order autoregressive process. The statistical inference does not change significantly.

percentage points. This result provides evidence for the correlation between income per capita and the investment rate as a driving force in promoting a country's capital stock in the long-run. Overall, a Wald test of the joint null hypothesis that the $\boldsymbol{\beta}$ parameters are equal to zero can be rejected at the 5 percent level. The estimated parameter of public debt is statistically significant under the dynamic SUR estimation. A one percentage point increase in public debt reduces the investment rate of industrialised countries by 0.02 percentage points. This suggests that public debt crowds out capital formation in the long-run. The age distribution coefficients, α_j, illustrate that the maximal impact is found for the age group j =0-14 years. This might reflect a high demand for social infrastructure by the young people in the economy. A one percentage point increase in the share of the youngest in the economy is associated with a 0.23 percentage point increase in the investment rate. By contrast, a one percentage point rise in the age cohort 50-54 implies a fall in the investment rate by 0.2 percentage points. A complete picture of the effects of the age distribution on the saving and investment rate is provided by Figures 1 and 3.

Figures 9 to 10 and 11 to 12 examine how well the panel specification, which assumes equality of the slope coefficients within industrial countries, matches the investment and saving dynamics at the individual country level.[20] The first set of graphs suggests that the regression specification matches the time series behaviour of the investment rate well for Japan but does not do as well for the United States. For the latter country the strong growth performance and, hence, improvement in GDP per capita might explain the diverging pattern of the actual and fitted values in Figure 10. The analysis of the saving rate, Figures 11 to 12, demonstrate that only the fitted values for Japan are able to replicate the actual data.

Since the net foreign asset position is positively affected by a rise in saving and negatively affected by an increase in investment, equation (4), it is possible to make predictions about whether saving or investment initiate changes in a country's external wealth. From Table 6 it becomes clear that an increase in public debt by 20 percentage points leads to a decline in savings by 0.32 percentage points and a reduction in the capital formation by 0.48 percentage points. The example shows that the investment rate declines more strongly than the saving rate. Leaving other factors unchanged, overall the net foreign asset position would not deteriorate strongly. This result is in line with Lane and Milesi-Ferretti (2002) who find that an increase in debt is domestically absorbed to a large extent. By contrast, an increase in income per capita has a three times stronger impact on investment than saving for industrial countries. With respect to income, the investment channel seems to be the driving force in determining the external

[20] Only selected countries are reported. However, graphs for all other countries are available on request. The graphs were constructed by using the $\boldsymbol{\beta}$ coefficients from the DOLS estimation. Using the coefficients from the panel OLS regressions provide similar results.

wealth of rich countries. This result, however, is not consistent with the findings by Lane and Milesi-Ferretti (2002). They find a strong positive correlation between income per capita and the net foreign asset position. Decomposing the effect of GDP per capita on the net foreign asset position via saving and investment illustrates that the long-run net foreign asset position is mostly affected via the investment behaviour of industrialised countries. The contradicting findings to Lane and Milesi-Ferretti (2002) may result from the different channel, through which this study explores the net foreign asset position; namely the impact of GDP per capita, public debt and demography on net foreign asset position via savings and investment.

Australia is an important outlier in the industrial country sample for 1980-1998. In order to analyse whether Australia also has an exceptional position with reference to saving and investment, Table 6 reports the statistical results without Australia. The exclusion has minor effects on the overall explanatory power of the saving and investment regression when considering the DOLS estimation. However, the negative point estimate of public debt increases. Indeed, Lane and Milesi-Ferretti (2002) point out that Australia weakens the conditional correlation between the net foreign asset position and debt to GDP. Under dynamic SUR the estimated parameter of public debt has a negative and statistically significant impact on the saving and investment rates. All estimated parameters of the variables in levels of the saving rate are jointly statistically significant when Australia is excluded and the dynamic SUR estimation is considered.

3.3.2 Developing Countries

Table 7 reports results on the evolution of net foreign assets since the developing country sample in this paper is not the same as in Lane and Milesi-Ferretti's (2002) work. The paper focuses on the DOLS (-1,1) panel estimation with fixed time and country effects. The net foreign asset position of developing countries relative to their GDP is measured by cumulated current account balances (*CumCA*) and as a robustness check by the sum of stocks of external assets and liabilities (*CumFL*). The latter is calculated by adjusted cumulative capital flows.[21] The estimated net foreign asset equation is able to explain 43 (54) percent of the cross-country variation given the *CumCA* (*CumFL*) measurement. As established by Lane and Milesi-Ferretti (2002) public debt is a very important explanatory variable. Overall, a Wald test of the joint null hypothesis that the $\boldsymbol{\beta}$ parameters of GDP per capita, public debt and demographic factors are equal to zero has to be rejected at the 1 percent level. However, no individual statistical significance is established for the parameters of GDP per capita and demography. This even holds when Singapore is excluded

[21] For a more detailed explanation see Lane and Milesi-Ferretti (2001). All data are obtained from Lane and Milesi-Ferretti (2002).

from the sample. Yet, the exclusion of Singapore improves the explanatory power of the *CumFL* regression and it is able to explain 58 percent of the variation in the data. The differences in the results compared with Lane and Milesi-Ferretti (2002) are due to the estimation of a balanced panel for the period 1980-1998, which induces a different sample size and a different number of included countries.

Table 8 reports the panel estimation for the developing country sample of the saving and investment analysis. Looking at the estimated saving equation, 24 percent of the cross-country variation are explained by public debt, output per capita and demography. The joint null hypothesis that the $\boldsymbol{\beta}$ parameters are equal to zero has to be rejected at the 1 percent level. The individual null hypothesis that the $\boldsymbol{\beta}$ parameter of public debt equals zero has to be rejected at the 10 percent level. A 50 percentage point increase in domestic public debt decreases the total saving rate in developing countries by 1.5 percentage points. The result implies a deviation from the Ricardian equivalence. The negative impact on the saving rate might be due to liquidity constraints on household and corporate borrowing, which are clearly present in less developed countries. In contrast to the industrial country sample a statistically strong positive relationship between income per capita and the saving rate of developing countries is established. The point coefficient of 0.13 means that a 20 percent improvement in domestic GDP per capita raises the saving rate by 2.6 percentage points. This suggests that the saving-income relationship is dominated by the income effect in less developed countries in the long-run. Demographic factors are a very important explanatory factor in defining a country's saving rate. Table 8 shows that the joint null hypothesis that the $\boldsymbol{\beta}$ parameters of the three demographic polynomials equal zero has to be rejected at the 1 percent level. Figure 4 provides the distribution of the twelve age cohorts. The maximal impact is found in the age group 40-44. The implicit α_{40-44} coefficient means that a ten percentage point rise in the population share in this group increases the saving rate by nine percentage points. A very strong negative impact is found for the age group of over 65 (α_{65+}). A one percentage point decrease in the share of the over 65 improves the saving rate by three percentage points.[22]

The investment equation is able to explain 18 percent of the variation in the data. A Wald test of the joint null hypothesis that the $\boldsymbol{\beta}$ parameters are equal to zero has to be rejected at the 1 percent level. As for the industrial countries, GDP per capita has a strong explanatory power. A ten percent increase in income per capita raises the investment rate by 1.1 percentage points. The joint null hypothesis that the $\boldsymbol{\beta}$ parameters of the three demographic polynomials are equal to zero cannot be rejected. Nevertheless, Table 8 shows that the strongest positive impact is found for the age cohort 25-29. Similar to the saving equation a strong negative impact

[22] This finding stands in contrast to the industrial country sample (Table 6).

is found for the population share over 65. A ten percentage point increase in the share of the 65+ population decreases the investment rate by 14.7 percentage points. Comparing the results with the industrial country sample, it becomes obvious that older age groups (65+) have a much stronger negative impact on the investment rate than in more developed countries. Another interesting finding is that the investment rate increases within the entire young population in developing countries (Figure 2). There is no statistically significant evidence that public debt is able to crowd out new capital formation in the long-run.

Figures 13 to 14 and 15 to 16 compare the actual and fitted values of the investment and saving rate for individual developing countries over the time horizon 1980 to 1998.[23] The investment dynamics at the individual country level are presented first. Figure 13 shows that the panel coefficients are able to match the time series pattern of South Korea well but do not achieve the same for Malaysia. The regression model in Table 8 only predicts minor effects of public debt on the investment rate. However, the strong decline in debt in Malaysia seems to promote investment in the long-run in this country and, therefore, makes it difficult to match the actual data in this particular case. The actual and fitted values of the saving rate are illustrated in Figures 15 to 16. Remarkably, the overall fit of the saving dynamics for the developing countries is very good. This is true for both small open economies. The good match of the time series pattern is derived from statistical significance of public debt, income per capita and the demographic factors in the savings equation.

To answer the question whether saving or investment drives the external wealth of a country reconsider Table 8. The demographic factors are more pronounced for saving than investment. In this respect, the net foreign asset position is mostly influenced by changes in the saving rate in developing countries. Saving and investment are positively affected by an increase in income per capita, suggesting that income per capita drives the external position of developing countries via both, saving and investment. The net foreign asset position is negatively affected by debt to GDP, which can be seen from the stronger decline in the saving rate relative to investment. This finding is supported by Lane and Milesi-Ferretti (2002). Their empirical evidence shows that a high 'pass-through' from net government liabilities to net external liabilities in developing countries occurs. Table 7 also confirms this finding.

Previous econometric studies point towards Singapore as an important outlier in the developing country sample. An outlier like Singapore is not necessarily negative.[24] Since Singapore has an extraordinary position as a financial centre, results excluding Singapore are reported in

[23] It is assumed that the slope coefficients within developing countries are the same.

[24] Variations in the data generate the basis for identifying relationships. However, if an outlier is non-representative due to factors which differentiate it from the rest of the sample, it should be excluded.

the second part of Table 8. The goodness of fit of the saving and investment equation clearly improves. All estimated parameters of the variables in levels are jointly statistically significant in both regression specifications, while the point estimates remain stable after the exclusion of Singapore. When comparing the point estimates of GDP per capita it becomes apparent that an increase of output per capita by ten percent leads to a rise in savings by 1.26 percentage points and an increase in capital formation by 1.27 percentage points.[25] Leaving other factors unchanged, overall the net foreign asset position would deteriorate slightly. Lane and Milesi-Ferretti (2002) also find a negative impact of GDP per capita on the net foreign asset position for the developing countries. As a country becomes relatively richer it increases its net external liabilities, as illuminated in Tables 7 and 8.

3.4 Estimation of an Error Correction Specification

This section analyses the short-run dynamics of the saving and investment rate by shifting the attention to their adjustment mechanisms. Due to the cointegrated relationships of saving or investment with public debt, income per capita as well as demography, the desired change of saving or investment, $\Delta y_{t,i}$, can be estimated by an error correction model. This is represented by the following equation:[26]

$$\Delta y_{t,i} = \mu + \boldsymbol{\rho}' \Delta \mathbf{X}_{t,i} - \theta \epsilon_{t-1,i} + \phi \Delta y_{t-1,i} + u_{t,i}. \tag{6}$$

$\epsilon_{t-1,i}$ represents the error correction term of an estimated panel OLS regression, which takes into account fixed time and country specific effects. The $\mathbf{X}_{t,i}$ have the same interpretation as above. The feedback coefficient θ provides the key to the long-run relation by capturing the behaviour of the adjustment term $\epsilon_{t-1,i}$. A lower value of θ implies that country i is able to maintain a saving or investment rate in excess or below of its long-run value. Hence, a country is able to smooth the adjustment process of saving or investment. A high value of θ reflects a rise in the speed of adjustment towards its long-run value. The correlation of saving or investment with the three explanatory factors is given by the impact parameters $\boldsymbol{\rho}'$. The $\boldsymbol{\rho}'$ capture the contemporaneous correlation in equation (6) in response to shocks which have hit the economy in the past.[27] The specification of the regression also includes the lagged changes in either saving or investment. Tables 9 to 12 illustrate the results for the industrial country and developing country sample respectively.

[25] The example shows that the impact on the investment and saving rates are more or less equal.

[26] It is assumed that the slope coefficients are the same within the groups of developing and industrial countries.

[27] Higher $\boldsymbol{\rho}'$ coefficients imply a short-run importance of debt, GDP per capita and demography in explaining the dynamics of saving and investment.

At this point it is worthwhile to discuss the question of causality. To address this issue the paper follows Enders (1995) and compares error correction models which either contain saving, GDP per capita, public debt as well as demography or investment and the variables of interest as dependent variables. The speed of adjustment is estimated by using the lagged error term from the panel regression with saving or investment as the dependent variable.[28] All cointegrated variables will respond to a deviation from the long-run equilibrium. However, the smaller the response of one of the adjustment parameters to a shock to the system, the less it is affected by the movements of other variables in that system. It is also possible that some of the adjustment parameters are zero, which can be seen as weakly exogenous, as defined by Engle, Hendry and Richard (1983). In this case the other variables are responsible for all the adjustment. For the industrial countries it is found that either saving or investment together with GDP per capita adjust similarly to shocks to the system while for the other two sets of variables the error correction terms are not statistically significant. Thus, GDP per capita as well as saving and investment do not evolve independently. In the investment specification of the developing country sample investment responds to changes in the system. The other error correction terms are statistically insignificant. The analysis of the adjustment parameters under the saving specification illustrates that the saving rate as well as public debt and GDP per capita adjust alike to shocks to the system while the adjustment of demography remains statistically insignificant. Hence, saving responds to changes in public debt and GDP per capita and vice versa.[29]

3.4.1 Industrial Countries

Table 9 reports the estimated error correction model of industrial countries for the saving and investment rates. 32 percent of the short-run variations in the data are explained by the specification of savings. A Wald test of the joint null hypothesis that the $\boldsymbol{\rho}$ parameters are equal to zero has to be rejected at the 1 percent level. Especially GDP per capita and public debt play an important role in explaining short-run deviations in the industrial countries' saving rate. Table 9 demonstrates that the change in debt to GDP is very important in explaining short-run deviations in saving. The statistically significant negative point estimate implies a departure

[28] Since cointegration between the variables exists, any residuals from an equilibrium relationship could have been used.

[29] Hendry (2001) emphasises the importance of testing for misspecifications in the error correction model. He suggests to investigate the properties of the error term with respect to autocorrelation and normality. To test for autocorrelation in the errors this paper applies a Lagrange Multiplier (LM) test for the null hypothesis of no autocorrelation (Baltagi, 2001). Additionally, the paper analysed whether the residuals are non-normal. There is no evidence for autocorrelation nor non-normality. Results are available on request.

from the Ricardian equivalence in more developed countries in the short-run. This contrasts with the finding on the long-run saving rate. The positive coefficient of GDP per capita implies that a two percent increase in the growth rate of income per capita is associated with a raise in the short-run saving rate in industrial countries by 0.5 percentage points. Demography plays a statistically important role in explaining short-run deviations in the saving rate of industrial countries. Figure 7 provides the distribution of the age cohorts in the short-run. A comparison between Figures 3 and 7 shows an almost inverse relationship between the age coefficients in the short and long-run.[30] The analysis of the error correction coefficient θ illustrates that more developed countries adjust towards their long-run saving rate by a half-life of 1.5 years. There is not a high persistence in the deviations of their saving rate from the long-run trend.

The deviations of the investment rate from its long-run trend expose a half-life of around four years. The relative persistency is also confirmed by the lagged investment variable in the regression specification. Overall, the regression is able to explain 47 percent of the variations in the short-run investment rates. The joint null hypothesis that the $\boldsymbol{\rho}$ parameters of all variables are equal to zero has to be rejected at the 1 percent level. Movements in the demographic distribution of industrial countries play a very important role in explaining short-run deviations of investment from equilibrium. A joint test that the three parameters are equal to zero has to be rejected at the 1 percent level. Figure 5 illustrates the short-run changes in the different age cohorts. As before, the positive impact on the investment rate is the highest for the youngest people in the economy. In contrast to the long-run findings, the proportionate increase of the oldest people in the economy influences new capital formation negatively in the short-run. Another important finding is that a change in public debt impacts on the short-term rate of investment. A short-run rise in public debt by 2.5 percentage points has positive implications for capital formation in industrial countries. It raises the investment rate by one percentage point. This finding stands in contrast to the long-run investment rate depicted in Table 6. Investment is also positively correlated with income per capita. When the growth rate of income per capita changes by five percent the short-run investment rate increases by two percentage points. Thus, fast-growing industrial countries are able to promote their short-run capital formation relative to industrial countries which show a weaker growth performance.

The short-run changes in the net foreign asset position of industrial countries are clearly influenced by saving and investment via public debt, demography and income per capita. However, demographic changes seem to feed through the investment channel of long-standing OECD members. This is in stark contrast to the long-run findings illustrated in Table 6, where de-

[30] Thus, deviations from equilibrium occur if middle age groups dissave while young and old people increase their savings.

mographic factors seem to have no explanatory power. Short-run changes in public debt have negative effects on the net foreign asset position. The findings in Table 9 suggest a negative impact of short-run changes in output per capita on the net external position. The effect feeds through both, saving and investment of industrial countries.

The second part of Table 9 reports the empirical findings without Australia, which is an outlier in the industrial country sample. The exclusion of the small open economy weakens the demographic effects on savings but increases the negative point estimate of public debt in the savings regression. Excluding Australia increases the speed of adjustment of the investment rate towards its long-run value. Moreover, in the investment equation the positive effect of public debt on new capital formation is now reduced. However, the individual null hypothesis that the $\boldsymbol{\rho}$ parameter of public debt equals zero has to be rejected at the 5 percent level. Table 10 excludes the demographic factors from the short-run saving equation. Excluding the demographic factors from the short-run saving equation reduces the explanatory power. The error correction model explains only 30 percent of the variations in the data. However, the speed of adjustment remains relatively stable compared to the estimated model above. This finding is also valid when Australia is excluded from the sample. The point estimates of GDP per capita and debt to GDP remain statistically significant at the 1 percent level.

3.4.2 Developing Countries

Table 11 reports the results of the error correction model for the developing country sample. The regression specification of the saving rate is able to explain 32 percent in the variation of the data in developing countries. Overall, a Wald test of the null hypothesis that the $\boldsymbol{\rho}$ parameters are jointly equal to zero has to be rejected at the 1 percent level. The error correction coefficient θ shows a point estimate of around -0.6 and points towards a very quick adjustment process of the saving rate. After an initial deviation it would return to its long-run value within a half-life of 10 months. The short-run estimates of public debt and income per capita confirm the long-run findings depicted in Table 8. In contrast to the long-run findings, demographic factors seem to have no statistically important impact on the short-run behaviour of the saving rate. Nevertheless, Figure 8 exhibits a distribution of the age coefficients similar to the long-run (Figure 4).

In line with the long-run findings, the demographic variables play a minor role in the short-run investment equation. Figure 6 illustrates the age distribution coefficients in the short-run. A comparison with Figure 2 reveals that the different age cohorts impact on the investment rate in a similar way. Yet, a Wald test of the joint null hypothesis that the $\boldsymbol{\rho}$ parameters are equal to zero has to be rejected at the 1 percent level. The investment equation is able to explain 32 percent in the variation of developing countries' capital formation rate. In contrast to the long-run specification a positive and statistically important impact of public debt on capital formation is established in Table 11. In the short-run, a positive change of debt to GDP by two percentage points improves new capital formation by 0.54 percentage points. This is an important finding and is in line with the findings for the industrial country sample. The results seem to support the view that an increase in public debt does not crowd out new capital formation in the economy.

The findings also have implications for the behaviour of the net foreign asset position in the short-run. As for industrial countries, the external wealth position of developing countries is clearly influenced by short-run changes in the investment and saving rate via public debt and income per capita. With respect to income per capita the main contributor to changes in the short-run net external wealth is the investment rate. This is in contrast with the results of the long-run analysis. Moreover, public debt influences the net foreign asset position through both, saving and investment in developing countries.

Similar to the DOLS estimation, Singapore is excluded from the developing country sample in Table 11. The investment equation clearly improves after the exclusion and is now able to explain 33 percent of the short-run variations in the data. The same is true for the explanatory power of the saving equation. The point estimates are stable in both regressions and a Wald test of the joint null hypothesis that the $\boldsymbol{\rho}$ parameters are equal to zero has to be rejected at the 1 percent level. It can be noted that the positive point estimate of public debt gains statistical significance.

The demographic factors are less important and the individual null hypothesis that the $\boldsymbol{\phi}$ parameter of the lagged dependent variable of the saving equation equals zero cannot be rejected. Therefore, Table 12 estimates the error correction model without those variables. The exclusion of lagged savings and demography weakens the statistical significance of the debt to GDP coefficient in the investment equation. However, the individual null hypothesis that the estimated coefficient equals zero has to be rejected at the 10 percent level. The exclusion of the demographic factors increases the persistency in the investment equation relative to the results obtained from Table 11. This is illustrated by the decline in the point estimate of the error correction term. In the saving equation the exclusion of the variables increases the statistical importance of debt to GDP coefficient while the impact of output per capita is weakened.

4 Conclusion

The aim of this paper is to investigate the short and long-run impact of public debt, income per capita as well as demographic factors on national wealth, domestic capital formation and, hence, the net foreign asset position across countries. Several conclusions emerge. Income per capita has positive effects on saving and investment in the short and long-run in developing countries while it only affects industrial countries' investment rate in the long-run. Developing countries' saving rate in the long-run clearly depends on the demographic distribution in those countries. The level of government debt is also an important determinant of national savings in less developed countries. The long-run elasticity is larger than for industrial countries, which is in line with the view that departures from Ricardian equivalence are likely to be larger for developing countries which are subject to financial constraints. There is some evidence that public debt crowds out new investment in industrialised countries in the long-run.

The short-run findings point towards a significant influence of public debt on the direction of savings and investment in industrial countries. Interestingly, in both samples public debt has a complementary effect on domestic capital formation and negatively affects the saving behaviour of domestic households. In contrast to the long-run findings demographic factors have an important role in determining industrial countries' investment rates. This is also the case for the domestic saving rate. While the rate of capital formation generally decreases in the share of elderly people in developing countries, this effect is less pronounced for the industrial country sample. GDP per capita also has a positive short-run effect on national savings and investment in developing and industrial countries.

The regression analysis clearly demonstrates the importance of public debt, output per capita and demographic variables in determining saving and investment in industrial and developing countries. In the long-run, the three variables influence the net foreign asset position of developed countries via investment while developing countries' net foreign assets are influenced through savings. However, in the short-run both, saving and investment rates, appear to be affected by output per capita, public debt and demographic factors. Hence, the three factors are able to influence the net foreign asset position in industrial and developing countries via both saving and investment rates.

Appendix

The appendix explains in more detail the demographic specification. The population is divided into $J = 12$ age cohorts. The age variables enter the saving and investment equation as $\sum_{j=1}^{12} \alpha_j p_{tj}$. p_{tj} is the population share of cohort j in period t. A key restriction is that $\sum_{j=1}^{12} \alpha_j = 0$. The age coefficient α_j can be obtained from a cubic polynomial

$$\alpha_j = \delta_0 + \delta_1 * j + \delta_2 * j^2 + \delta_3 * j^3.$$

The zero sum restriction of the α-coefficients allows to obtain δ_0 by the following equation:

$$\delta_0 = -\frac{\sum_{j=1}^{12} j}{J} * \delta_1 - \frac{\sum_{j=1}^{12} j^2}{J} * \delta_2 - \frac{\sum_{j=1}^{12} j^3}{J} * \delta_3.$$

The δ_1, δ_2 and δ_3 can be obtained by estimating a model in the following way

$$\delta_1 DEM_{1t} + \delta_2 DEM_{2t} + \delta_3 DEM_{3t},$$

with

$$\begin{aligned}
DEM_{1t} &= \sum_{j=1}^{12} j p_{tj} - \frac{\sum_{j=1}^{12} j * \sum_{j=1}^{12} p_{tj}}{J}, \\
DEM_{2t} &= \sum_{j=1}^{12} j^2 p_{tj} - \frac{\sum_{j=1}^{12} j^2 * \sum_{j=1}^{12} p_{tj}}{J} \text{ and} \\
DEM_{3t} &= \sum_{j=1}^{12} j^3 p_{tj} - \frac{\sum_{j=1}^{12} j^3 * \sum_{j=1}^{12} p_{tj}}{J}.
\end{aligned}$$

From the estimated δ_1, δ_2 and δ_3 the δ_0 can be recovered and all four coefficients can be utilised to calculate the α_j.

References

[1] Baltagi, B.H. (2001), *Econometric Analysis of Panel Data*, Wiley, Chichester.

[2] Chiang, M.H. and Kao, C. (2001), "Nonstationary Panel Time Series Using NPT 1.2-A User Guide", mimeo Syracuse University.

[3] Enders, W. (1995), *Applied Econometric Time Series*, John Wiley and Sons, New York.

[4] Engle, R.F., Hendry, D.F. and Richard, J.F. (1983), "Exogeneity", *Econometrica* 51: 277-304.

[5] Fair, R. and Dominguez (1991), "Effects of the Changing U.S. Age Distribution on Macroeconomic Equations", *American Economic Review* 81**:** 1276-1294.

[6] Federal Reserve Board (2002), "2002 National Summit on Retirement Savings", http://www.federalreserve.gov/boarddocs/speeches/2002/20020228/default.htm, Washington.

[7] Feldstein, M. and Horioka, C. (1980), "Domestic Savisng and International Capital Flows", *Economic Journal* 90: 314-329.

[8] Goldberger, A. (1973), "Dependency Rates and Saving Rates: Further Comment", *American Economic Review* 63: 232-233.

[9] Hadri, K. (2001), "Testing for Stationarity in Heterogeneous Panel Data", *Econometrics Journal* 1: 1-14.

[10] Hayashi, F. (2000), *Econometrics*, Princeton, Princeton University Press.

[11] Hendry, D.F. (2001), *Dynamic Econometrics*, Oxford University Press, Oxford.

[12] Herbertson, T. and Zoega, G. (1999), "Trade Surpluses and Life-Cycle Saving Behaviour", *Economics Letters* 65: 227-237.

[13] Higgins, M. (1998), "Demography, National Savings and International capital Flows", *International Economic Review* 39**:** 343-369.

[14] Kao, C. (1999), "Spurious Regression and Residual-Based Tests for Cointegration in Panel Data", *Journal of Econometrics* 90: 1-44.

[15] Lane, P.R. and Milesi-Ferretti, G.M. (1999), "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries", *IMF Working Paper* 99/115 and Forthcoming in *Journal of International Economics.*

[16] Lane, P.R. and G.M. Milesi-Ferretti (2002), "Long-Term Capital Movements", *NBER Macroeconomics Annual* 16, forthcoming.

[17] Leff, N.H. (1969), "Dependency Rates and Saving Rates", *American Economic Review* 59: 886-896.

[18] Levin, A. and Lin, C.F. (1992), "Unit Root Test in Panel Data: Asymptotic and Finite sample Properties", *University of San Diago Discussion Paper* 92-93.

[19] Obstfeld, M. and Rogoff, K. (1996), *Foundations of International Macroeconomics*, London, MIT Press.

[20] Pedroni, P. (1999), "Critical Values for Cointegartion Tests in Heterogeneous Panels with Multiple Regressors", *Oxford Bulletin of Economics and Statistics* 61: 653-678.

[21] Stock, J. and Watson, M. (1993), "A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems", *Econometrica* 61: 783-820.

[22] Taylor, A.M. (1994), "Domestic Savings and International Capital Flows Reconsidered", *NBER Working Paper* 4892.

[23] United Nations (2000), *Demographic Yearbook: Historical Supplement 1948-1997, CD-Rom*, New York.

[24] White, H. (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity", *Econometrica* 48: 817-838.

[25] World Bank (2002) *World Development Indicators CD-Rom*, Washington.

[26] Zellner, A. (1962), "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregate Bias," *Journal of American Statistical Association* 63:502-511.

Developed Countries		
Australia	Germany	Norway
Austria	Greece	Portugal
Belgium	Iceland	Spain
Canada	Ireland	Sweden
Denmark	Italy	Switzerland
Finland	Japan	United Kingdom
France	Netherlands	United States
	New Zealand	

Table 1: Industrial Countries

Asia	Middle East/ North Africa	Sub Saharan Africa	Latin America
India	Morocco	Botswana	Brazil
Indonesia	Israel	Mauritius	Colombia
Korea	Jordan	South Africa	Costa Rica
Malaysia	Tunisia	Zimbabwe	Ecuador
Pakistan	Turkey		El Salvador
Philippines			Guatemala
Singapore			Jameica
Sri Lanka			Mexico
Thailand			Panama
			Paraguay
			Trinidad and Tobago
			Uruguay
			Venezuela

Table 2: Developing Countries

Variables			
	Hadri	(*DGP heterogeneous*)	
		criticalProb.	
Saving	8.3935	0.0000	(reject)
Investment	6.6912	0.0000	(reject)
Debt	13.1051	0.0000	(reject)
GDP per Capita	13.8197	0.0000	(reject)
Demographic 1	21.3099	0.0000	(reject)
Demographic 2	22.3479	0.0000	(reject)
Demographic 3	23.2359	0.0000	(reject)

Table 3: Panel Unit Root Test: Industrial Countries. *Note: The null hypothesis is that the series is stationary.*

Variables			
	Hadri	(*DGP heterogeneous*)	
		criticalProb.	
Saving	9.68424	0.0000	(reject)
Investment	7.41427	0.0000	(reject)
Debt	12.5751	0.0000	(reject)
GDP per Capita	20.563	0.0000	(reject)
Demographic 1	30.2705	0.0000	(reject)
Demographic 2	29.2088	0.0000	(reject)
Demographic 3	28.4483	0.0000	(reject)

Table 4: Panel Unit Root Test: Developing Countries. *Note: The null hypothesis is that the series is stationary.*

Pedroni (1999): t-rho statistic			
Industrial Countries		*Developing Countries*	
Saving:	-27.846 (0.0000)	Saving:	-43.775 (0.000)
Investment:	-23.808 (0.000)	Investment:	-34.853 (0.000)
Kao (1999): DF-test			
Saving:	-4.173 (0.000)	Saving:	-7.582 (0.000)
Investment:	-5.782 (0.000)	Investment:	-6.18 (0.000)

Table 5: Residual Based Cointegration Tests. *Note: The null hypothesis is that there is no cointegration (unit root in the errors). The critical probabilities are in parentheses. The dependent variable is either saving or investment and the independent variables are debt, GDP per capita and the three demographic factors.*

Explanatory Variables	Dependent Variable		Dependent Variable (without Australia)	
	Saving	*Investment*	*Saving*	*Investment*
Debt to GDP	-0.016	-0.024$_{+}$	-0.021$_{+}$	-0.026$_{+}$
	(0.639)	(1.004)	(0.784)	(1.015)
	(1.421)	*(1.894)*	*(1.757)*	*(1.945)*
GDP per Capita	0.035	0.121$^{***}_{+++}$	0.026	0.118$^{**}_{+++}$
	(0.669)	(2.449)	(0.481)	(2.277)
	(1.488)	*(4.623)*	*(1.078)*	*(4.363)*
Demographic 1	-0.034	0.057	-0.032	0.061
	(0.101)	(0.177)	(0.093)	(0.185)
	(0.226)	*(0.334)*	*(0.208)*	*(0.354)*
Demographic 2	0.021	-0.028	0.021	-0.028
	(0.315)	(0.451)	(0.314)	(0.444)
	(0.701)	*(0.852)*	*(0.705)*	*(0.851)*
Demographic 3	-0.002	0.002	-0.002	0.002
	(0.446)	(0.557)	(0.443)	(0.543)
	(0.991)	*(1.052)*	*(0.993)*	*(1.041)*
$\chi^2_{(3)}$(Demographic)	0.740	0.589	0.613	0.533
	0.606	*1.076*	*0.154*	*0.113*
$\chi^2_{(5)}$(All Variables)	3.549	13.93**	3.426	13.118**
	6.064	*17.936*$_{+++}$	*9.26*$_{+}$	*18.91*$_{+++}$
α max.	0.144	0.225	0.152	0.218
	(45-49)	(0-14)	(45-49)	(0-14)
α min.	-0.276	-0.193	-0.263	-0.190
	(65+)	(50-54)	(65+)	(50-54)
adj. R^2	0.32	0.36	0.32	0.35
Observations	352	352	336	336
Countries	22	22	21	21

Table 6: Regression Results (DOLS): Industrial Countries. *Note: Time Period 1980-98. Statistical Results reported with DOLS and DSUR Standard Errors. t-statistics for DSUR Standard Errors in emphasised Parenthesis. t-Statistics in absolute values. ***,+++ Significance at the 1 percent; **,++ at the 5 percent; *+ at the 10 percent level. + refers to DSUR estimation.*

Explanatory Variables	**Dependent Variable**		**Dependent Variable** (without Singapore)	
	CumCA	*CumFL*	*CumCA*	*CumFL*
Debt to GDP	-0.666***	-0.842***	-0.704***	-0.871***
	(4.148)	(4.803)	(5.127)	(6.636)
GDP per Capita	-0.026	-0.151	-0.158	-0.279
	(0.103)	(0.551)	(0.728)	(1.344)
Demographic 1	-5.483	3.561	-0.545	1.553
	(1.673)	(0.995)	(0.170)	(0.507)
Demographic 2	1.128	0.717	0.124	-0.318
	(1.691)	(0.984)	(0.189)	(0.509)
Demographic 3	-0.060	-0.036	-0.007	-0.018
	(1.553)	(0.862)	(0.190)	(0.501)
$\chi^2_{(3)}$(Demographic)	3.35	4.34	0.046	0.238
$\chi^2_{(5)}$(All Variables)	26.442***	26.75***	31.72***	41.01***
α max.	3.246	1.347	0.399	1.66
	(50-54)	(55-59)	(50-54)	(65+)
α min.	-2.77	-2.45	-0.47	-0.711
	(25-29)	(25-29)	(65+)	(45-49)
α (POP<15)	0.535	-0.117	-0.025	-0.621
α (POP>64)	-2.07	0.388	-0.47	1.66
adj. R^2	0.43	0.54	0.42	0.58
Observations	496	496	480	480
Countries	31	31	30	30

Table 7: Regression Results (DOLS): Developing Countries' Net Foreign Assets. *Note: Time Period 1980-98. t-Statistics in absolute values. *** Significance at the 1 percent, ** at the 5 percent, * at the 10 percent level.*

Explanatory Variables	Dependent Variable		Dependent Variable (without Singapore)	
	Saving	*Investment*	*Saving*	*Investment*
Debt to GDP	-0.030^{*}_{+++}	-0.008	-0.032^{**}_{+++}	-0.0004
	(1.835)	(0.321)	(2.011)	(0.018)
	(2.478)	*(0.697)*	*(2.743)*	*(0.038)*
GDP per Capita	0.133^{***}_{+++}	0.109^{***}_{+++}	0.126^{***}_{+++}	0.127^{***}_{+++}
	(5.270)	(2.915)	(5.036)	(3.519)
	(7.114)	*(6.324)*	*(6.868)*	*(7.243)*
Demographic 1	-0.267	0.522	0.008	-0.152
	(0.81)	(1.318)	(0.023)	(0.286)
	(1.094)	*(6.324)*	*(1.472)*	*(0.031)*
Demographic 2	0.122^{*}_{+++}	-0.071	0.076	0.078
	(1.809)	(0.709)	(1.013)	(0.715)
	(2.443)	*(1.537)*	*(1.383)*	*(1.473)*
Demographic 3	-0.010^{***}_{+++}	0.002	-0.008^{*}_{+++}	-0.007
	(2.621)	(0.283)	(1.914)	(1.068)
	(3.539)	*(0.614)*	*(2.611)*	*(1.199)*
$\chi^2_{(3)}$(Demographic)	17.020^{***}	4.34	21.22^{***}	3.736
	$\mathit{18.415}_{+++}$	*1.46*	$\mathit{22.57}_{+++}$	*4.323*
$\chi^2_{(5)}$(All Variables)	65.188^{***}	15.45^{***}	70.47^{***}	19.89^{***}
	$\mathit{30.69}_{+++}$	$\mathit{24.28}_{+++}$	$\mathit{37.62}_{+++}$	$\mathit{18.68}_{+++}$
α max.	0.911	0.664	0.99	0.602
	(40-44)	(25-29)	(35-39)	(40-44)
α min.	-3.000	-1.472	-3.088	-1.903
	(65+)	(65+)	(65+)	(65+)
adj. R^2	0.24	0.18	0.25	0.21
Observations	496	496	480	480
Countries	31	31	30	30

Table 8: Regression Results (DOLS): Developing Countries. *Note: Time Period 1980-98. Statistical Results reported with DOLS and DSUR Standard Errors. t-statistics for DSUR Standard Errors in emphasised Parenthesis. t-Statistics in absolute values. ***,+++ Significance at the 1 percent; **,++ at the 5 percent; *+ at the 10 percent level. + refers to DSUR estimation.*

Explanatory Variables	Dependent Variable		Dependent Variable (without Australia)	
	Saving	*Investment*	*Saving*	*Investment*
Error Correction Term	-0.346*** (7.960)	-0.125*** (2.945)	-0.357*** (9.496)	-0.271*** (7.977)
Δ_{t-1}Lagged Dep. Variable	-0.041 (1.046)	-0.136*** (3.541)	-0.018 (0.405)	0.179*** (4.265)
ΔDebt to GDP	-0.071*** (3.926)	0.039** (2.469)	-0.078*** (4.258)	0.037** (2.322)
ΔGDP per Capita	0.250*** (6.915)	0.412*** (12.368)	0.227*** (6.099)	0.391*** (11.377)
ΔDemographic 1	-0.394 (1.039)	-0.749** (2.293)	-0.306 (0.809)	-0.772** (2.345)
ΔDemographic 2	0.004 (0.052)	0.073 (1.208)	-0.009 (0.127)	0.074 (1.221)
ΔDemographic 3	0.002 (0.588)	-0.002 (0.655)	0.003 (0.727)	-0.002 (0.635)
$\chi^2_{(3)}$(Demographic)	6.93*	18.52***	6.21	18.56***
$\chi^2_{(5)}(Debt,\ GDP,\ Demo.)$	94.22***	163.52***	86.49***	140.79***
adj. R^2	0.32	0.47	0.31	0.46
Observations	374	374	357	357
Countries	22	22	21	21

Table 9: Regression Results (ECM I): Industrial Countries. *Note: Time Period 1980-98. t-Statistics in absolute values. *** Significance at the 1 percent, ** at the 5 percent, * at the 10 percent level.*

Explanatory Variables	Dependent Variable	Dependent Variable (without Australia)
	Saving	*Saving*
Error Correction Term	-0.364*** (10.48)	-0.353*** (10.044)
Δ_{t-1}Lagged Dep. Variable	-	-
ΔDebt to GDP	-0.066*** (3.702)	-0.075*** (4.135)
ΔGDP per Capita	0.246*** (6.919)	0.217*** (5.972)
$\chi^2_{(2)}(Debt,\ GDP)$	88.76***	80.32***
adj. R^2	0.30	0.29
Observations	374	357
Countries	22	21

Table 10: Regression Results (ECM II): Industrial Countries. *Note: Time Period 1980-98. t-Statistics in absolute values. *** Significance at the 1 percent, ** at the 5 percent, * at the 10 percent level.*

Explanatory Variables	Dependent Variable		Dependent Variable (without Singapore)	
	Saving	*Investment*	*Saving*	*Investment*
Error Correction Term	-0.587***	-0.236***	-0.609***	-0.252***
	(13.703)	(5.750)	(13.957)	(5.969)
Δ_{t-1}Lagged Dep. Variable	-0.055	-0.158***	-0.048	-0.169***
	(1.651)	(4.175)	(1.429)	(4.429)
ΔDebt to GDP	-0.063***	0.027**	-0.065***	0.028**
	(3.988)	(2.057)	(4.091)	(2.141)
ΔGDP per Capita	0.133***	0.303***	0.125***	0.321***
	(3.637)	(9.984)	(3.50)	(10.442)
ΔDemographic 1	0.161	0.11	0.539	-0.623
	(0.222)	(0.184)	(0.695)	(0.971)
ΔDemographic 2	-0.004	0.02	-0.063	0.164
	(0.026)	(0.161)	(0.399)	(1.258)
ΔDemographic 3	-0.003	-0.004	-0.0006	-0.011
	(0.290)	(0.516)	(0.067)	(1.506)
$\chi^2_{(3)}$(Demographic)	3.217	5.77	5.018	5.03
$\chi^2_{(5)}$(*Debt, GDP, Demo.*)	49.53***	107.5***	50.36***	116.24***
adj. R^2	0.32	0.32	0.33	0.33
Observations	527	527	510	510
Countries	31	31	30	30

Table 11: Regression Results (ECM I): Developing Countries. *Note: Time Period 1980-98. t-Statistics in absolute values. *** Significance at the 1 percent, ** at the 5 percent, * at the 10 percent level.*

Explanatory Variables	Dependent Variable		Dependent Variable (without Singapore)	
	Saving	*Investment*	*Saving*	*Investment*
Error Correction Term	-0.578***	-0.209***	-0.586***	-0.237***
	(14.80)	(5.002)	(14.809)	(5.635)
Δ_{t-1}Lagged Dep. Variable	-	-0.162***	-	-0.169***
		(4.089)		(4.364)
ΔDebt to GDP	-0.071***	0.022*	-0.074***	0.024*
	(4.478)	(1.708)	(4.625)	(1.847)
ΔGDP per Capita	0.111***	0.288***	0.101***	0.306***
	(3.089)	(9.630)	(2.751)	(10.078)
$\chi^2_{(2)}$(*Debt, GDP*)	47.61***	98.54***	46.25***	107.87***
adj. R^2	0.30	0.30	0.31	0.32
Observations	527	527	510	510
Countries	31	31	30	30

Table 12: Regression Results (ECM II): Developing Countries. *Note: Time Period 1980-98. t-Statistics in absolute values. *** Significance at the 1 percent, ** at the 5 percent, * at the 10 percent level.*

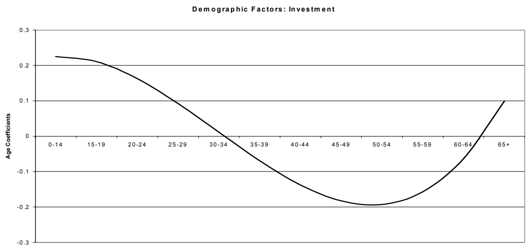

Figure 1: Age Distribution Coefficients of the Industrial Country Sample in the Long-Run.

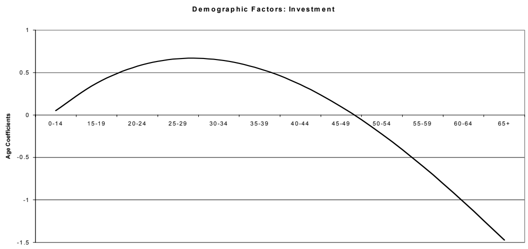

Figure 2: Age Distribution Coefficients of the Developing Country Sample in the Long-Run.

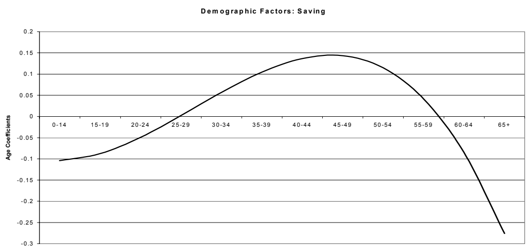

Figure 3: Age Distribution Coefficients of the Industrial Country Sample in the Long-Run.

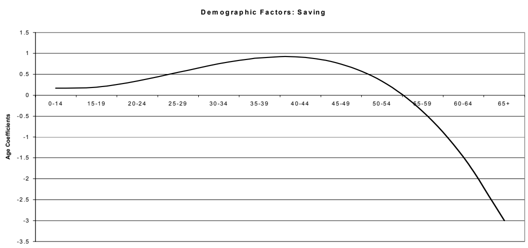

Figure 4: Age Distribution Coefficients of the Developing Country Sample in the Long-Run.

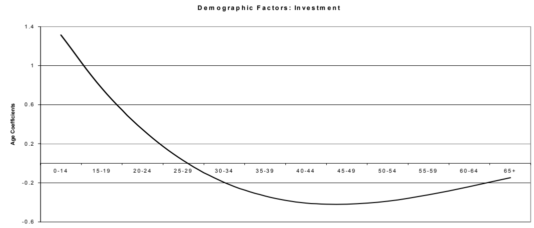

Figure 5: Change in the Age Distribution Coefficients of the Industrial Country Sample in the Short-Run.

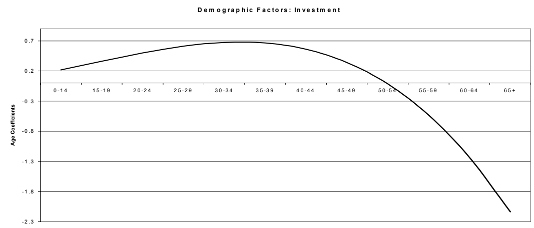

Figure 6: Change in the Age Distribution Coefficients of the Developing Country Sample in the Short-Run.

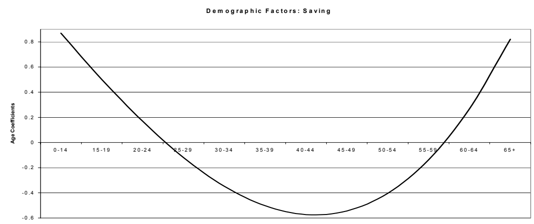

Figure 7: Change in the Age Distribution Coefficients of the Industrial Country Sample in the Short-Run.

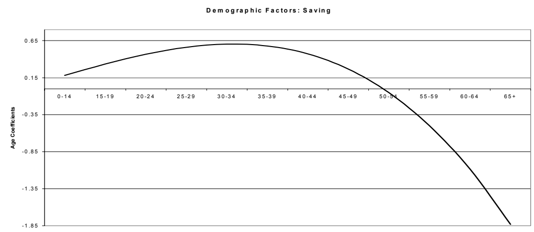

Figure 8: Change in the Age Distribution Coefficients of the Developing Country Sample in the Short-Run.

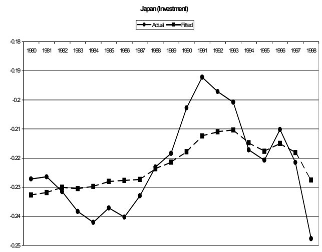

Figure 9: Japan: Actual and Fitted Value, Investment Rate.

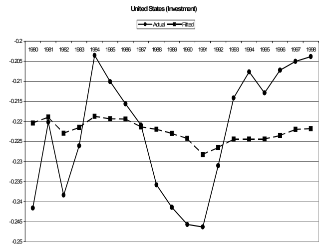

Figure 10: United States: Actual and Fitted Value, Investment Rate.

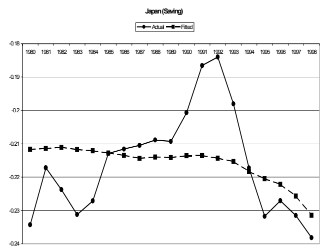

Figure 11: Japan: Actual and Fitted Value, Saving Rate.

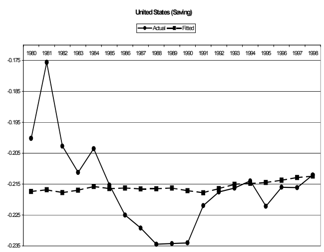

Figure 12: United States: Actual and Fitted Value, Saving Rate.

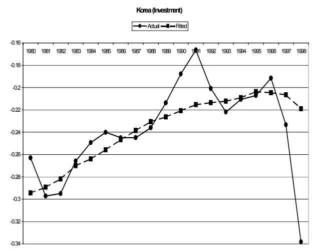

Figure 13: South Korea: Actual and Fitted Value, Investment Rate.

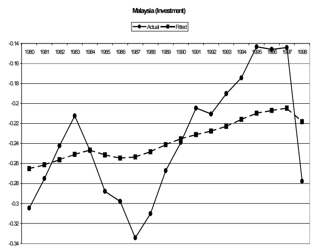

Figure 14: Malaysia: Actual and Fitted Value, Investment Rate.

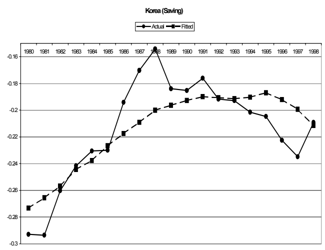

Figure 15: South Korea: Actual and Fitted Value, Saving Rate.

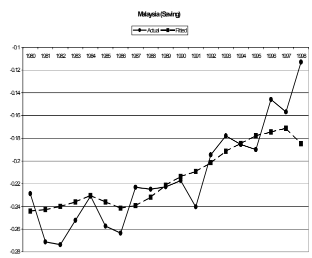

Figure 16: Malaysia: Actual and Fitted Value, Saving Rate.