MAGKS

Joint Discussion Paper Series in Economics

by the Universities of

Aachen · Gießen · Göttingen
Kassel · Marburg · Siegen

ISSN 1867-3678

No. 42-2014

Matthias Hoffmann, Michael Krause and Peter Tillmann

International Capital Flows, External Assets and Output Volatility

Coordination: Bernd Hayo • Philipps-University Marburg
Faculty of Business Administration and Economics • Universitätsstraße 24, D-35032 Marburg
Tel: +49-6421-2823091, Fax: +49-6421-2823088, e-mail: hayo@wiwi.uni-marburg.de

International Capital Flows, External Assets and Output Volatility*

Mathias Hoffmann
Deutsche Bundesbank

Michael Krause
Deutsche Bundesbank

Peter Tillmann
University of Giessen

August 7, 2014

Abstract

This paper proposes a new perspective on international capital flows and countries' long-run external asset position. Cross-sectional evidence for 84 developing countries shows that over the last three decades countries that have had on average higher volatility of output growth (1) accumulated higher external assets in the long-run and (2) experienced more procyclical capital outflows over the business cycle than those countries with a same growth rate but a more stable output path. To explain this finding we provide a theoretical mechanism within a stochastic real business cycle growth model in which higher uncertainty of the income stream increases the precautionary savings motive of households. They have a desire to save more when the variance of their expected income stream is higher. We show that in the model the combination of income risk and a precautionary savings motive will lead to procyclical capital outflows at business cycle frequency and a higher long-run external asset position.

JEL codes: F32, F36, F43, F44

Keywords: Capital flows, net foreign assets, productivity growth, uncertainty, precautionary savings

*Mathias Hoffmann: Deutsche Bundesbank, Economic Research, 60431 Frankfurt, Germany. E-mail: mathias.hoffmann@bundesbank.de. Michael Krause: Deutsche Bundesbank, Economic Research, 60431 Frankfurt, Germany. E-mail: michael.krause@bundesbank.de. Peter Tillmann: Justus-Liebig-University Giessen, Licher Str. 66, 35394 Giessen, Germany. E-mail: peter.tillmann@wirtschaft.uni-giessen.de. The views expressed in this paper are those of the authors but not necessarily those of the Bundesbank. We thank Richard Clarida, Zeno Enders, Fabio Ghironi, Philipp Harms, Eric Leeper, Giovanni Lomabardo, Gernot Müller, Cédric Tille and participants of the Joint Lunch Time Seminar workshop of the Bundesbank, CFS and ECB 2013, the Joint Research Seminar of the Bundesbank, ÖNB and SNB 2013, Theories and Methods in Macroeconomics, University of Lausanne 2014, Joint Macro Workshop Banque de France – Bundesbank 2014, the CEPR and SNB Conference on Exchange Rates and External Adjustment 2014, Society of Computational Economics, Oslo, 2014, International Trade and Macroeconomics Workshop 2014.

1 Introduction

This paper proposes a new perspective on international capital flows over the business cycle and sheds some new light on the determination of countries' long-run external asset position. We use data for 84 developing and emerging market countries to show that over the business cycle countries with a high uncertainty about their income stream experience a positive relationship between capital outflows and output growth. Countries with an higher output growth volatility would generate more capital outflows than those with the same growth rate but a lower output growth volatility.

The effect of an increasing uncertainty about the income stream does not only affect the relationship between output growth and capital outflows but also impacts the long-run accumulation of the external asset position of countries. When the income volatility increases so does the long-run net foreign asset position compared to a country with the same growth rate but less output growth variation. Thus, an increasing uncertainty about the income stream translates into both a higher long-run net foreign asset position across the 84 countries in question as well as a higher outflow of capital at business cycle frequency.

These facts are difficult to square with standard theories of the open economy. The basic open-economy stochastic growth, or real business cycle, model predicts countercyclical capital flows.[1] Over the long-run, the same model predicts that fast growing countries should attract foreign capital to finance higher consumption and investment, thus building up foreign debt. The key theoretical driver of these predictions is households' desire to intertemporally smooth consumption, which is based on the present value of households' expected income stream. The higher the expected income stream the more households are willing to borrow against brighter future income prospects.

To explain this perspective on the cyclicality of international capital flows and the determinants of long-run foreign asset positions we focus on another theoretical prediction, namely that higher expected income volatility ought to increase precautionary savings as households aim at self-insuring against negative income shocks. This aspect has until recently been left unexplored in studies of international capital flows. As data on emerging and developing countries show that even though those countries with more volatile output growth tend to grow faster, they also tend to export rather than import capital. Capital flows and output volatility are positively correlated. This points toward a precautionary savings motive at work, in fact manifesting itself in higher net foreign asset positions of those countries.

We present a real stochastic growth model of a small open economy to interpret these findings. Central to the analysis is the solution method that takes the second-order effects of uncertain

[1] See for example Aguiar and Gopinath (2007) and Uribe (2012).

income growth on agents' choices into account.[2] On the one hand, a high covariance between consumption and income growth makes consumption smoothing harder, creating the incentive to invest in an asset that yields a more stable income stream. On the other hand, a higher volatility of consumption growth raises the precautionary motive for savings. Both effects lead towards a particular net foreign asset position in equilibrium, and we show that they can be sufficiently large to dominate the desire to borrow against higher future income.[3] A first-order solutions instead would leave undetermined the optimal savings choice of a countries residents.

This precautionary savings motive will affect the consumption and, hence, savings decisions of households both in the short as well as in the long-run.[4] Households within a country of higher output growth volatility, following a positive income shock, want to accumulate a buffer stock of foreign assets to insure against the presence of higher uncertainty about the future expected income stream. They desire a stable consumption path and also higher future consumption. To finance the higher consumption in the long-run, households endogenously choose their portfolio so that a higher long-run i.e. steady state position of external assets occurs. To obtain a higher long-run external wealth households will save in the short-run more net foreign assets, which will lead to capital outflows, with the consequence of a procyclical relationship between capital outflows and output growth at business cycle frequency. Thus, for a given output growth the combination of income risk and a precautionary savings motive will lead to a higher (long-run) net foreign asset position and larger capital outflows in countries with faster output growth but with higher output growth volatility - a new aspect offered to the standard neoclassical growth model.

Empirically, our results shed further light on the debate why capital flows from fast growing (emerging markets) to less growing industrialized economies. Using capital inflow measures expressed as foreign asset accumulation over several decades, Gourinchas and Jeanne (2012) forcefully show that capital does not flow to countries that grow more. They refer to the "allocation puzzle" of capital flows. Our empirical results reveal that the higher the degree of uncertainty, the more the "allocation puzzle" of Gourinchas and Jeanne (2012) applies also at business cycle frequency.[5] Our results also shed light on the famous Lucas (1990) paradox of North-South capital

[2] Carroll (1994) shows empirically for a panel of individual households that consumers facing higher income uncertainty consume less and are willing to accumulate buffer-stock savings. See also Deaton (1991) for a theoretical assessment of the effect of uncertainty on consumption.

[3] Precautionary savings are not the only interpretation of recent developments in international capital flows. Caballero, Farhi, and Gourinchas (2008) argue that flows are driven by countries' supply of assets.

[4] For example Carroll and Weil (1994), Loayza, Schmidt-Hebbel and Serven (2000) or Hausmann, Pritchett and Rodrik (2005) show that national saving rates of faster-growing emerging economies have been rising over time.

[5] Note that this puzzle is different from the famous Lucas paradox of North-South capital flows, see Lucas (1990). See Alfaro et al. (2013) for distinguishing private and public capital flows and their different patterns of correlation with productivity growth.

flows. Lucas points to the fact that the direction of capital flows among rich and poor countries is inconsistent with a standard neoclassical growth model. Capital does not flow to countries with a relatively larger marginal product of capital. As recently noted by Gros (2013), the investment rate in developing countries has increased markedly since the 1980s. The true puzzle, according to his view, is why savings rates increased even more in the most recent period thus making the Lucas paradox even more pervasive. Our paper suggests that the increased volatility of income gives rise to precautionary savings which explains exactly this development.

Theoretically, the related literature has so far focused on precautionary savings in the context of sudden stops in capital flows. Durdu, Mendoza and Terrones (2009) assess the optimal level of precautionary assets of a small open economy in response to business cycle volatility and the risk of a sudden stop. They conclude that these risks are plausible explanations of the observed surge in foreign exchange reserves in emerging market countries.[6] However, Jeanne and Ranciere (2011) argue that it is difficult to explain the build-up in emerging markets' reserves as insurance against the risk of a sudden stop.

The studies by Carroll and Jeanne (2009) and Fogli and Perri (2006, 2014) are most closely related to ours. Carroll and Jeanne (2009) utilize a model of individual precautionary saving developed by Carroll (2007) to assess its role for reducing global imbalances. They show that reducing the desired stock of saving in the rest of the world (via reducing their individual income risk households face in the rest of the world) causes mainly a decline in the world's capital stock outside the U.S. but not necessarily a decline in wealth in the U.S. The authors focus on idiosyncratic individual unemployment risk and the role of social insurance on the net foreign asset evolution. In contrast, in this paper the precautionary savings motive is borne by macroeconomic risk within the small open economy. Fogli and Perri (2006, 2014) link income uncertainty to evolution of the net foreign asset position within a 10-year horizon.[7] If the domestic reduction of uncertainty is more pronounced than abroad as e.g. in the U.S. during the 'Great Moderation', smaller precautionary saving can lead to the build-up of external imbalances. We also detect a positive association between output growth volatility and the net foreign asset position across countries over a long-run horizon of three decades. We are able to link this observation to Gourinchas and Jeanne's (2012) allocation puzzle of international capital flows. Since Fogli and Perri (2006, 2014), in contrast to our work, do not incorporate growth into their study they cannot draw a link between capital flows and growth. Furthermore, our work does not only establish a positive link between capital

[6] Mendoza, Quadrini and Rios-Rull (2009) analyze the role of risk on the savings behavior of countries. They show that international financial integration can cause an accumulation of a large level of external liabilities by more financially advanced countries.

[7] Interestingly, Broer (2012) points to the role of endogenous financial deepening which can change the sign of the positive association between external assets and macroeconomic uncertainty.

outflows and higher output growth volatility but also highlights that such a relationship is the result of a positive long-run relationship between the level of a country's external wealth and the output growth volatility it faces. This result is obtained by allowing for an endogenous portfolio choice by households to determine the long-run net foreign asset position. This aspect has not been incorporated by the above contributions. Thereby we extend the work by Coeurdacier, Rey and Winant (2011) as well as Juillard and Kamenik (2005) and explore the properties of the risky steady state within an environment of economic growth and capital flows.

The remainder of the paper is structured as follows: Section 2 provides an explanation of the econometric methodology and establishes the stylized facts. Section 3 presents a model that replicates the empirical findings. Section 4 summarizes the main results.

2 A new stylized fact

In this section we establish a new stylized fact: the procyclicality of capital outflows increases in the volatility of income. For that purpose we collect annual data on a set of 84 small -mostly developing and emerging- economies over the period 1980 to 2007. The countries are listed in Table (1). Our key series are, first, yearly real GDP growth and, second, the stock of net foreign assets. As our first measure of income uncertainty, we calculate the sample standard deviation of real GDP growth. To net out global shocks we also use a second measure of output growth volatility that reflects the country-specific component of uncertainty only. This idiosyncratic component of income growth, which is similar to Fogli and Perri's (2014) measure, is derived by regressing each country's GDP growth rate on a constant and the average growth rate of all countries in the sample. We relate both of these measures to the yearly change in net foreign assets as a measure of capital outflows.[8] Details on data definitions, the composition of the sample and the data sources are provided in a separate appendix below.

2.1 A first look at the data

We establish a new perspective on one of the most important insights of the neoclassical growth model, which states that countries with higher output growth should attract more foreign capital to finance consumption and investment. Thus, we should observe a negative correlation between output growth and changes in net foreign assets. A precautionary saving motive is shown to change that pattern and to cause not only a positive relationship between output growth and capital outflows but also a higher external asset position.

[8] We adjust the data on net foreign assets for valuation effects and in order to be consistent with the PPP-adjusted data used below we construct a deflator using the Penn World Tables, as described in the data appendix.

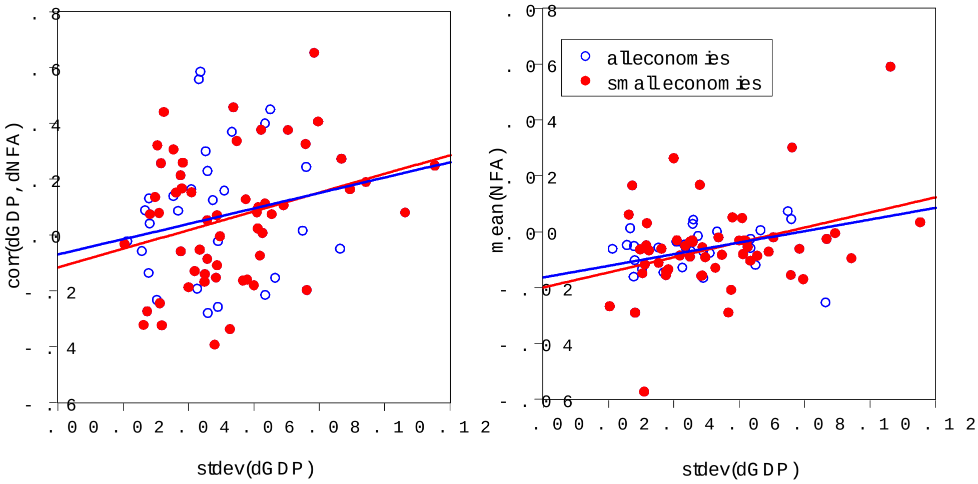

Figure 1: Income volatility and the correlation between capital outflows and output growth (left panel). Income volatility and the long-run net foreign asset position (right panel). Shown for 84 countries over 1980-2007

The left panel of Figure 1 shows the correlation of capital outflows and output growth on the vertical axis and its interaction with the volatility of output growth on the horizontal axis for 84 emerging economies over the period 1980 to 2007. To construct this illustrative figure we use our first measure of income uncertainty, i.e. the standard deviation of aggregate GDP. It follows from the left panel of Figure 1 that an on average negative correlation between output growth and capital outflows, in 84 emerging economies over the time horizon 1980 to 2007 exists, when there is zero volatility of output growth. In this case countries with a higher output growth would generate more capital inflows. Our contribution, however, is to condition the growth-capital outflow nexus on income uncertainty, which is measured on the horizontal axis in Figure 1.

With an increasing uncertainty about the future expected income stream, i.e. a higher volatility of output growth, a procyclical relationship arises. Countries with higher output growth generate more net capital outflows. Thus, the positive correlation between capital outflows and productivity growth highlighted by Gourinchas and Jeanne (2012) also holds at a business cycle frequency and becomes stronger as income volatility increases.

The right panel of Figure 1 shows the relationship between the long-run net foreign asset position (on the vertical axis) and the volatility of output growth (on the horizontal axis). On average, across the 84 emerging economies a negative external debt position exists at zero output growth volatility. Again, a positive connection obtains when the income volatility increases. Countries with a more uncertain income stream accumulate a higher net foreign asset position. Thus, an increasing uncertainty about the income stream, i.e. higher volatility of output growth, causes both a higher long-run net foreign asset position across the 84 countries in question as well as a higher outflow of capital at business cycle frequency. Both relationships are stronger for small open economies than for medium-to-large open economies.

This connection between the net foreign asset position and income uncertainty is also subject of Fogli and Perri (2014). While they use 10-year rolling windows to establish a correlation, we use the full sample. Our paper goes beyond Fogli and Perri (2014) by shedding light on the impact of income uncertainty on the correlation between net foreign assets and output growth. We thus extend the analysis to also encompass the business cycle interaction among foreign asset accumulation and uncertainty.

2.2 Regression results

We proceed in two steps. First, we evaluate whether the savings rate and the investment rate across all countries in our sample responds to income uncertainty. A positive coefficient in such a sample cross-sectional regression would point to some kind of precautionary behavior. This finding, however, cannot inform us whether countries' accumulate external assets to hedge against uncertainty are save domestically. In a second step, we therefore explain the correlation between changes in net foreign assets and output growth in terms of the standard deviation of real GDP growth and our macroeconomic controls. We also regress the mean net foreign asset position on the same set of variables.

The results for the first step are shown in table (2). We regress the savings and the investment rate, respectively, on the standard deviation of income, real GDP per capita, the size of the country measured by total GDP, the average growth rate of GDP, the price of investment goods (PI), openness as measured by the sum of exports and imports over GDP and the Chinn-Ito index of capital account openness. All variables are averaged over the sample period. For reasons of data availability, these regressions are restricted to 59 countries.[9] The result of primary interest suggests that saving is indeed sensitive to income uncertainty. A higher standard deviation of GDP is associated with a higher savings rate. Investment as a fraction of GDP, however, does not reflect income uncertainty. Households in our sample accumulate assets, whether domestic or foreign, to insure against uncertainty.

Given that aggregate saving responds to macroeconomic uncertainty we now turn to the open-economy dimension. The bivariate relationship between the correlation of output changes and capital flows on the one hand and income uncertainty on the other, which were discussed in the previous section, might simply be the result of a third variable not taken into account when

[9] Note that the empirical results presented below also hold within the sample of the 59 countries for which data on savings and investment are available.

considering simple scatter plots. We therefore employ a set of regressions where we augment the simple bivariate relationship with control variables that are standard in the literature on open-economy macroeconomics. In particular, we condition the relationship on real GDP per capita, the size of the country measured by total GDP, the average growth rate of GDP, the price of investment goods (PI), openness measured as the sum of exports and imports over GDP and the Chinn-Ito index of capital account openness. All variables are averaged over the sample period.

Table (3) reports the results from cross-sectional regressions of the correlation between changes in net foreign assets and output growth on the standard deviation of GDP and our macroeconomic controls for all of our 84 sample countries. The baseline result can be seen to survive even when the control variables enter the regression equation. A higher standard deviation of output strengthens the positive correlation between capital outflows and output growth. The inclusion of the control variables does not change the statistically significant positive effect output growth volatility has on the correlation between changes in net foreign assets and output growth. GDP per capita as an explanatory control variable is statistically significant. If we compare two arbitrary countries with the same growth rate, the same level of income and otherwise identical structural characteristics as represented by our control variables, the country with the higher standard deviation of GDP experiences a higher correlation of growth and capital outflows and higher mean external assets.

When using the trade balance, measured by its deviations from mean to capture the business cycle effects, instead of changes in net foreign assets as a measure of capital outflows, the standard deviation of income still enters positively and statistically significant. Interestingly, when focusing on column (4) of Table (3) we see that at zero volatility of output growth a negative relationship between output growth and the trade balance exists. Uribe (2012) shows that this is a stylized international business cycle fact in emerging market economies. Thus at zero output growth volatility, countries with higher output growth should experience a deterioration of its trade balance. However, once we account for output growth volatility this result is reversed.

In columns (3) and (6) of Table (3) we elicit the effect of income volatility for net debtor and creditor countries, respectively. This specification is motivated by the study of Benhima (2013), who showed that the long-run relationship between capital outflows and productivity growth depends on the sign of the external position. We find that the effect of uncertainty does not hinge on the country having on average foreign assets or liabilities.[10]

In columns (7) and (8) of Table (3) we relate the mean net foreign asset position to income uncertainty and additional macroeconomic control variables.[11] From the control variables, only

[10] While we use conventional least-squares to estimate the relationships, the results remain identical once we take account of the bounded nature of the dependent variables and switch to censored regression techniques.

[11] Note that the results do not hinge on expressing net foreign assets and the trade balance, respectively, as a fraction of current GDP. When using initial GDP instead, which is in spirit of Gourinchas and Jeanne (2012), the

per capita income and the price of investment goods enter positively and are statistically significant. Most importantly, however, income uncertainty remains a statistically significant explanatory variable with a positive effect on mean external assets.[12]

Table (4) provides the estimates of these baseline regression for different sub-samples of countries. We define appropriate dummy variables to separate small and large economies and rich and poor economies, respectively.[13] It turns out that the connection between income uncertainty and the growth-outflow nexus is particularly strong for either small and poor economies. The impact of income uncertainty on the mean net foreign asset position is stronger in rich economies compared to the full sample.[14]

The saving behavior of households in small open economies is not only influenced by macroeconomic determinants, but also driven by their average human capital endowment, the institutional quality of the economic environment and the stability of the political system. To account for these forces, we estimate a separate regression that contains our main explanatory variable, i.e. the uncertainty of income, the level of per-capita income and an indicator of the quality of institutions. Alternatively, we include the years of schooling as a control variable capturing the accumulation of human capital. The results of that exercise are presented in Table (5). As expected, schooling enters the explanation of the mean net foreign asset position with a negative sign. Accumulating a larger stock of human capital can thus be interpreted as a substitute for saving in terms of foreign assets. The institutional quality has the expected negative sign, indicating that improved institutions lead to a smaller extent of precautionary saving, but this coefficient mostly lacks statistical significance. Most importantly, however, the case of the standard deviation of income as a determinant of the correlation between growth and capital outflows and the mean net foreign asset position, respectively, is strengthened once these institutional variables are considered.

International financial markets can be used to insure income risk through borrowing and lending only to the extent this risk is idiosyncratic in nature. We thus use our second measure of income uncertainty to corroborate our finding. The idiosyncratic component of income growth is derived by regressing each country's GDP growth rate on a constant and the average growth rate of all

results become slightly stronger.

[12] In the theoretical section it is shown that a higher long-run external asset position and higher capital outflows at business cycle frequency in the presence of higher income growth volatility occur simultaneously. To empirically account for this we estimated both regression equations simultaneously using SUR. The results are confirmed within this estimation procedure.

[13] Here we interpret both the medium-sized and the large economies from Table (1) as being large.

[14] We also used a set of dummy variables to evaluate regional differences in the interaction between income uncertainty, growth and external saving. The results, however, do not suggest sizable differences. The only regional dummy that is significant pertains to the correlation between growth and asset accumulation which is significantly higher in Asian economies than in other regions.

countries in the sample. The standard deviation of the residual is interpreted as idiosyncratic income uncertainty. Table (6) reveals that all baseline results remain qualitatively unchanged. As expected when excluding aggregate, i.e. global uncertainty, the impact of $stdev(\Delta GDP^{idio})$ becomes even slightly larger compared to our baseline results presented before.

The next section presents a model that is able to replicate this pattern of precautionary savings and foreign asset accumulation, respectively.

3 The model

This section presents a stochastic real business cycle growth model of a small open economy, which allows the explicit analysis of the effect of higher income uncertainty, measured by output growth volatility, on capital outflows and the long-run external asset position.[15] We extend the standard stochastic real business cycle model by growth and a stochastic steady state. Within this steady state the realization of any shock is zero so that households decide to remain in the steady state but they know that in the future shocks could hit the economy.[16] It is this uncertainty about the future macroeconomic environment which will give households a precautionary savings incentive leading to an endogenously determined steady state external asset position. The main determinant of future income is aggregate productivity, with two stochastic nonstationary components which can either cause level shifts in technology or a sequence of changes in technology so that it raises the country's growth rate temporarily above its long-run growth trend. We first present a simplified version where output is only driven by the two stochastic productivity components to highlight the mechanisms at work. We then show that the results are also valid in an economy with an endogenous capital stock and a larger set of stochastic disturbances.

3.1 The endowment economy

Consider an economy populated by a large number of infinitely lived households with preferences, a budget constraint and production described below. Households' preferences are summarized by the following utility function

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma} - 1}{1-\sigma}, \tag{1}$$

with C_t reflecting consumption, β the time preference and σ the relative risk aversion. E_t is the expectations operator at time t. Each period, households receive an exogenous and stochastic

[15] The small open economy model we are using is in the spirit of Mendoza (1991), extended here to allow for economic growth as in Aguiar and Gopinath (2007) or Cicco, Pancrazi and Uribe (2010).

[16] See also Coeurdacier, Rey and Winant (2011) as well as Juillard and Kamenik (2005). The work by Aguiar and Gopinath (2007) or Cicco, Pancrazi and Uribe (2010) does not consider a stochastic steady state environment.

endowment of output Y and can borrow or lend in a real bond B that pays a constant world real interest rate r.[17] The evolution of the external asset position of the representative household is given by

$$B_t - B_{t-1} = Y_t + rB_{t-1} - C_t, \tag{2}$$

whereby the no-Ponzi game restriction and Transversality condition are assumed to hold. Output is determined by technology Z_t only:

$$Y_t = Z_t. \tag{3}$$

The growth rate of technology and, hence, output evolves according to

$$\ln Z_{t+1} - \ln Z_t = g_{t+1} + w_{t+1}, \text{ with} \tag{4}$$

$$g_{t+1} = (1-\rho)\,\overline{G} + \rho g_t + v_{t+1}. \tag{5}$$

Both, w_{t+1} and v_{t+1} are i.i.d. shocks with mean zero and a shock variance of σ_w^2 and σ_v^2, respectively. $\overline{G}$ reflects the economy's long-run or steady state growth trend. The innovations w_t cause one time shifts in the level of technology but with no lasting effects on the growth rate of technology. By contrast, an innovation to the growth trend by v_t leads to a sequence of changes in the level of technology Z since it leads to persistent deviations of the growth rate g_t from its steady state growth rate $\overline{G}$.

The household chooses consumption and external assets in each period in time, so as to maximize (1) subject to (2). The optimality condition associated with this problem gives the following Euler condition:

$$\frac{1}{\beta} = E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}(1+r)\right]. \tag{6}$$

Since the model economy is growing at a stochastic growth rate, to find a solution for the equilibrium dynamics, the system must be made stationary for standard solution methods to apply. Thus, to make them stationary, all variables are now expressed relative to productivity, Z_t. Note that within our economy $\widetilde{X}$ is equivalent to a ratio relative to output, with $\widetilde{X} = X/Z = X/Y$. Then the model can once again be stated in relative output terms, with $dZ_t = Z_t/Z_{t-1}$ and $dY_t = Y_t/Y_{t-1}$ denoting the gross growth rates of technology and output, respectively. Equation (7) corresponds to our definition of the capital flow equation in the empirical section, named $\widetilde{\Delta NFA}$

$$\widetilde{\Delta NFA}_t \equiv 1 + \frac{r}{dY_t}\widetilde{B}_{t-1} - \widetilde{C}_t. \tag{7}$$

The other variable of interest is the trade balance, $TB = Y - C$, defined as the difference between production and absorption. The trade balance relative to output equals then

$$\widetilde{TB}_t = 1 - \widetilde{C}_t, \tag{8}$$

[17] In the next section we will also allow for a stochastic world real interest rate.

and depends on the consumption to output ratio $\widetilde{C}$. The latter evolves according to

$$\frac{1}{\beta} = E_t \left[\left(\frac{\widetilde{C}_{t+1}}{\widetilde{C}_t} \right)^{-\sigma} (1+r)\, dY_{t+1}^{-\sigma} \right]. \tag{9}$$

To see how risk affects consumption and hence, capital flows and the trade balance, consider the Euler equation in approximated form

$$\widetilde{C}_t = \frac{E_t\left(dY_{t+1}\right) E_t(\widetilde{C}_{t+1})}{\left(\beta\left(1+r\right)\left(1+\sigma\left(\sigma+1\right)\left(\frac{var(\widetilde{C})}{E_t(C_{t+1}^2)}+\frac{var(dY)}{E_t(dY_{t+1}^2)}\right)+\sigma^2\frac{cov(\widetilde{C},dY)}{(1+r)E_t(\widetilde{C}_{t+1})E_t d(Y_{t+1})}\right)\right)^{\frac{1}{\sigma}}}, \tag{10}$$

where $var\,(.)$ and $cov\,(.,.)$ reflect the variance of the variable X and its covariance relationship with an other variable of the system.[18] Equation (10) shows nicely how uncertainty about the future income, i.e. output growth variability, affects the consumption choice of households. The more uncertain the income stream of the economy becomes, i.e. the larger the output growth volatility $var\,(dY)$, the more households are willing to reduce consumption relative to output today and to increase their savings. The precautionary desire to save becomes stronger the more volatile consumption $var(\widetilde{C})$ is expected to be. A positive correlation between consumption and output growth, i.e. $cov(\widetilde{C}, dY)/[E_t(\widetilde{C}_{t+1})E_t(dY_{t+1})] > 0$, would accelerate the desire to save more. However, reducing consumption when output growth is high so that $cov(\widetilde{C}, dY)/[E_t(\widetilde{C}_{t+1})E_t d\,(Y_{t+1})] < 0$ can act as an insurance device and allows for some consumption smoothing in the presence of risk. The implications of higher output growth volatility are also seen when defining the household's stochastic time preference rate in the presence of risk when making its intertemporal choice as

$$\widehat{\beta}_t = \beta\left(1+\sigma\left(\sigma+1\right)\left(\frac{var(\widetilde{C})}{E_t(C_{t+1}^2)}+\frac{var\,(dY)}{E_t(dY_{t+1}^2)}\right)+\frac{(1+r)^{-1}\,\sigma^2 cov(\widetilde{C},dY)}{E_t(\widetilde{C}_{t+1})E_t d\,(Y_{t+1})}\right). \tag{11}$$

Then from (10) consumption grows at $E_t(\widetilde{C}_{t+1})/\widetilde{C}_t = ((1+r)\,\widehat{\beta}_t)^{\frac{1}{\sigma}}/E_t\,(dY_{t+1})$. Variations in the stochastic time preference rate will change the incentive of households to borrow or lend at a given world interest rate r. To see this consider once again the Euler equation $E_t(\widetilde{C}_{t+1})/\widetilde{C}_t = ((1+r)\,\widehat{\beta}_t)^{\frac{1}{\sigma}}/E_t\,(dY_{t+1})$, which shows that households are willing to sacrifice consumption today when the stochastic time preference rate is high, which is the case the more volatile the economy becomes, as shown by (11). Then a lower consumption today translates into an improved trade balance (8). The income received from more exports will be saved so that an outflow of capital occurs, (7). This results in a higher future external asset position which can be used to finance future consumption.

[18] To obtain this equation we use the second-order expansion of $\Phi(x,y)$: $\Phi(x,y) = F\left(E_t\left(x,y\right)\right) + E_t\left(F''var, cov\left(x,y\right)\right)$.

3.1.1 The stochastic steady state and the solution to the model

In the stochastic steady state the consumption Euler equation equals

$$\widehat{\beta} = \beta\left(1 + \sigma\left(\sigma+1\right)\left(\frac{var(\widetilde{C})}{\overline{\widetilde{C}}^2} + \frac{var\left(dY\right)}{\overline{dY}^2}\right) + \frac{\sigma^2 cov(\widetilde{C}, dY)}{\left(1+r\right)\overline{\widetilde{C}}\,\overline{dY}}\right) = \frac{\overline{dY}^{\sigma}}{(1+r)}, \tag{12}$$

with $\overline{dY} \equiv 1 + \overline{G}$, the steady state growth trend of the economy. In the absence of risk, the return on holding an external portfolio would simply be equal to $1 + r = \overline{dY}^{\sigma}/\beta$, the long-run growth rate of the economy in relation to the time preference β and consumption would not be determined in the steady state via the Euler equation. However, in the stochastic steady state for a given world interest rate consumption is pinned down by the variance and covariance relationships of consumption and output growth. Once we have solved for steady state consumption $\overline{\widetilde{C}}$ we can find a unique solution to the steady state external asset position

$$\overline{\widetilde{B}} = -\frac{1 - \overline{\widetilde{C}}}{r - \overline{G}}\overline{dY}. \tag{13}$$

From (8) we define the steady state trade balance as $\overline{\widetilde{TB}} = 1 - \overline{\widetilde{C}}$. Consequently, the steady state external asset position depends on the steady state trade balance. The term $\overline{\widetilde{TB}}/(r - \overline{G})$ reflects the discounted world market value of the country's long-run trade balance. We impose the condition that the world real interest rate r is positive and, more importantly, larger than the economy's growth trend, $r > \overline{G}$, so that the present value of the resources of the economy is bounded. Then equation (13) implies that for a given output growth $\overline{dY}$ a long-run trade deficit, i.e. $\overline{\widetilde{TB}} < 0$, must be backed by a positive long-run external asset position, i.e. $\overline{\widetilde{B}} > 0$, to ensure solvency.[19] The decision to run a trade deficit will depend on consumption in relation to the risk households face within the economy.

To solve this problem, we postulate a linear decision rule around the stochastic steady state. Because the stochastic steady state depends on the decision rule, we get a fixed point problem. This is solved by identifying jointly the stochastic steady state and the coefficients of the decision rule. Therefore, first of all we log-linearize the equilibrium conditions (7) and (9) around the stochastic steady state, (31) and (13), whereby for consumption, $\widetilde{c}_t$, and output growth, dy_t, it holds that $\widetilde{x} = \ln(\widetilde{X}/\overline{\widetilde{X}})$ while for external assets, $\widetilde{b}_t$, the trade balance, $\widetilde{tb}_t$, and capital flows, $\widetilde{\Delta nfa}_t$, we define $\widetilde{x} = \widetilde{X} - \overline{\widetilde{X}}$. Then we apply the linear decision rule to obtain the solution for the linear rational expectations model using undetermined coefficients. With this solution at hand we can solve our model accurately with respect to the stochastic steady state by using an iterative

[19] Durdu, Mendoza and Terrones (2013) provide empirical evidence on this using an error-correction model.

procedure. The linearized model is given by

$$\begin{aligned}
\widetilde{c}_t &= E_t \widetilde{c}_{t+1} \Gamma_{c,c} + E_t dy_{t+1} \Gamma_{c,dy}, & (14)\\
\overline{\widetilde{C}} \widetilde{c}_t + \widetilde{b}_t &= \widetilde{b}_{t-1} \frac{(1+r)}{\overline{dY}} - dy_t \overline{\widetilde{B}} \frac{(1+r)}{\overline{dY}}, & (15)\\
dy_t &= g_t + w_t, & (16)
\end{aligned}$$

where for simplicity we assume that $\sigma = 1$. The parameters $\Gamma_{c,c}$ and $\Gamma_{c,dy}$ together with the coefficients of the linear decision rule

$$\widetilde{c}_t = a_{cb} \widetilde{b}_{t-1} + a_{cg} g_t + a_{cw} w_t, \text{ for which } \widetilde{b}_t = a_{bb} \widetilde{b}_{t-1} + a_{bg} g_t + a_{bw} w_t \qquad (17)$$

are summarized by the following table:

$\widetilde{c}$	$\widetilde{b}$
$a_{cb} = \frac{\Gamma_{c,c} \frac{(1+r)}{\overline{dY}} - 1}{\Gamma_{c,c} \overline{\widetilde{C}}}$	$a_{bb} = \frac{1}{\Gamma_{c,c}}$
$a_{cg} = \frac{\Gamma_{c,dy} \rho - \Gamma_{c,c} a_{cb} \overline{\widetilde{B}} \frac{(1+r)}{\overline{dY}}}{\left((1 - \Gamma_{c,c} \rho) + \Gamma_{c,c} a_{cb} \overline{\widetilde{C}}\right)}$	$a_{bg} = \frac{\left(a_{cg}(1 - \Gamma_{c,c} \rho) - \Gamma_{c,dy} \rho\right)}{\Gamma_{c,c} a_{cb}}$
$a_{cw} = \frac{\Gamma_{c,c} a_{cb} \overline{\widetilde{B}} \frac{(1+r)}{\overline{dY}}}{\Gamma_{c,c} a_{cb} \overline{\widetilde{C}} - 1}$	$a_{bw} = \frac{a_{cw}}{\Gamma_{c,c} a_{cb}}$
$\Gamma_{c,c} = \left[1 + \frac{\beta}{\overline{dY}} \left(\frac{cov(\widetilde{C}, dY)}{\overline{dY}\,\overline{\widetilde{C}}} + (1+r)\, 4 \frac{var(\widetilde{C})}{\overline{\widetilde{C}}^2} \right)\right]$	
$\Gamma_{c,dy} = \frac{\beta}{\overline{dY}} \left[(1+r) \left(1 + 2 \frac{var(\widetilde{C})}{\overline{\widetilde{C}}^2} + 6 \frac{var(dY)}{\overline{dY}^2} \right) + 2 \frac{cov(\widetilde{C}, dY)}{\overline{\widetilde{C}}\,\overline{dY}} \right]$	

Having established the evolution of $\widetilde{c}_t$ and $\widetilde{b}_t$ we can write the remaining variables of interest in linearized form as

$$\widetilde{tb}_t = -\overline{\widetilde{C}} \widetilde{c}_t \text{ and } \widetilde{\Delta nfa}_t = \frac{r}{\overline{dY}} \widetilde{b}_{t-1} - \frac{r \overline{\widetilde{B}}}{\overline{dY}} \widetilde{dy}_t - \overline{\widetilde{C}} \widetilde{c}_t. \qquad (18)$$

To fully solve the model we have to define the conditional moments. We assume that the shocks are uncorrelated among each other. Then it follows from (16) and (17) that

$$var(\widetilde{C}) = a_{cg}^2 \sigma_v^2 + a_{cw}^2 \sigma_w^2 \text{ and } var(dY) = \sigma_v^2 + \sigma_w^2. \qquad (19)$$

The covariance between output growth and consumption is given by

$$cov(\widetilde{C}, dY) = a_{cg} \sigma_v^2 + a_{cw} \sigma_w^2. \qquad (20)$$

We are now able to solve for the stochastic steady state. We have four unknown variables, $\overline{\widetilde{C}}$, $\overline{\widetilde{B}}$, $var(\widetilde{C})$ and $cov(\widetilde{C}, dY)$, for which we have four equations given by (31), (13), (19) and (20). This enables us to solve the fixed point problem using an iterative non-linear procedure.

With the solution at hand we can assess the implications of higher output growth volatility on consumption, the trade balance and the net foreign asset position. To do so we have to define the exogenous parameters of the model. We follow the literature on emerging market real business cycles. The long-run growth trend of the economy $\overline{G}$ is set so that the economy grows at a yearly rate of 5 percent, which is the average of the 84 countries in our empirical exercise. The time preference β equals 0.96, a value common in the literature for yearly frequency (see also Obstfeld and Rogoff, 1996). The real interest rate r is set to 8 percent, a common value in the real business cycle literature for emerging market economies (see Cicco, Pancrazi and Uribe, 2010 or Obstfeld and Rogoff, 1996). Following Cicco, Pancrazi and Uribe (2010) we set the persistence of the growth rate shock ρ equal to 0.82.

3.1.2 Output growth volatility, capital flows and external assets

The long-run external asset position Let us start with an assessment of the long-run net foreign asset position and how a higher output growth volatility affects the external asset position. Assume for a moment that risk is absent. Then from our above calibration it follows that $\beta < \overline{dY}/(1+r)$. Consequently, the desired consumption path would be tilted downward. Households would be less patient and consumption growth would be lower. Putting it differently, if β is the household's desired price of consumption and $\overline{dY}/(1+r)$ reflecting the world price of consumption, then households put more weight on the desired price of consumption then on its world price and are willing to sacrifice a higher long-run consumption level. The result would be a negative long-run external asset position.

In the presence of risk it follows from (31) that $\widehat{\beta} = \overline{dY}/(1+r)$. Thus, the desired price of consumption in a risky environment, $\widehat{\beta}$, must be equal to the world price of consumption. This ensures a constant steady state consumption path. Since it follows from (31) that $\widehat{\beta}$ equals the sum of the "pure" time preference β and the risk households take into account within the steady state, it must hold that $\widehat{\beta} > \beta$. The difference between the stochastic and pure discount rate is increasing the higher output growth volatility becomes. The implication is that a more volatile small open economy will have a higher stochastic discount rate and the desired consumption path is tilted upward. As a consequence, steady state consumption $\overline{\widetilde{C}}$ will be higher. To finance this higher steady state consumption level, it follows from (13) that households have saved an higher amount of external assets $\overline{\widetilde{B}}$. Thus, the more volatile the economy becomes, the higher will be the long-run external asset position of the small open economy and the higher will be $\overline{\widetilde{C}}$.

Consider the following calibration for illustration: As a guideline, the sample average of the volatility of output growth, $stdev(dY)$, across our 84 countries is about 4 percent.[20] We set the

[20] The standard deviation of output in our model is given by $stdev(dY) = \sqrt{var(dY)} = \sqrt{\sigma_v^2 + \sigma_w^2}$.

standard deviation of the growth rate shock σ_v and level shock σ_w equal to 0.03, respectively (see Cicco, Pancrazi and Uribe, 2010). Those values are also close to our sample average of the volatility of output. The sample average of the volatility of output has a standard deviation of around 2 percent. We therefore illustrate the effects of an increasing output volatility on the long-run consumption and external asset position within this range. The following table illustrates that a small open economy with an increasing output growth volatility will experience a higher long-run external asset position compared to a country with the same steady state growth rate but a lower output growth volatility. This is in line with one of the stylized facts established in the empirical section.

Output growth volatility $stdev(dY)$	low risk 0.02	sample mean 0.04	high risk 0.06
Consumption ($\overline{\overline{C}}$)	0.94	1.19	1.51
External Assets ($\overline{\overline{B}}$)	-2.02	6.94	18.49

Notes: The low risk environment is obtained by setting σ_v and σ_w equal to 0.015, the sample mean environment by setting σ_v and σ_w equal to 0.03 and the high risk environment by setting σ_v and σ_w equal to 0.045.

The correlation between output growth and capital outflows Having established the relationship between the long-run external asset position and output volatility, we now assess the business cycle effects. Figure 2 demonstrates how higher risk, captured by output growth volatility, affects consumption, the trade balance and capital flows over the business cycle. We display impulse response functions for a 0.1 percent innovation in the growth rate of technology in deviations from the steady state, the black dotted line.

Following the above exercise, the model economies only differ in their output growth volatility while the underlining growth trend and its innovation are the same across all scenarios. The green dashed line reflects the low risk environment with a low output growth volatility, the red dashed line with dots shows the average risk environment while the blue solid line displays the reaction of the economy for a high risk environment.

For all scenarios the higher output growth, shown in panel a. of Figure 2 leads initially to an increase in consumption relative to output in panel b. Households perceive themselves as richer and are willing to borrow against the brighter income prospects. As a consequence, domestic absorption increases and the trade balance in panel c. deteriorates. More international capital flows into the country, shown by the negative response to capital outflows in panel d.

Figure 2 nicely shows that the magnitude and course of the responses are depending on the output growth volatility the economy is facing. Agents are aware of the risky economic environment

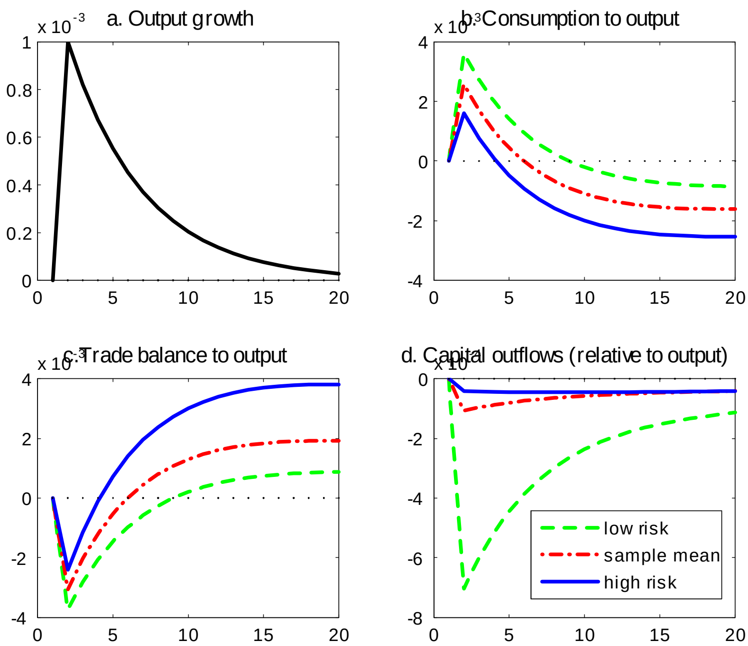

Figure 2: Responses to a positive growth rate shock to productivity for different risk scenarios. *Notes:* The low risk environment is obtained by setting the standard devation of output growth equal to 0.02, the sample mean environment by setting it equal to 0.04 and the high risk environment by setting it equal to 0.06, respectively.

and will mitigate their consumption response to a positive output growth innovation the higher is uncertainty. This is due to the higher stochastic discount rate which causes the desired consumption path to be tilted upward. Households are more patient and consumption growth rises for a riskier economy. As a consequence, the deficit of the trade balance is smaller and also improves faster. Finally, capital outflows need more time to converge to the steady state the higher is the output growth volatility.

The picture looks similar with respect to risk when assessing the effects of a level shock to technology. Figure 3 shows the response of the economy to a 0.1 percent innovation to the level of technology. Households want to smooth consumption and do not consume all their additional endowment, so that consumption to output in panel b. declines. The trade balance in panel c. improves and initially, capital outflows occur to a minor extend. As there is only a one time shift to the level of technology, the overall effect on consumption is very small due to the consumption smoothing motive and so is the impact on capital flows. Most importantly, the effects of a higher output growth volatility on consumption, their trade balance and capital flows are not affected by the origin of the shock.

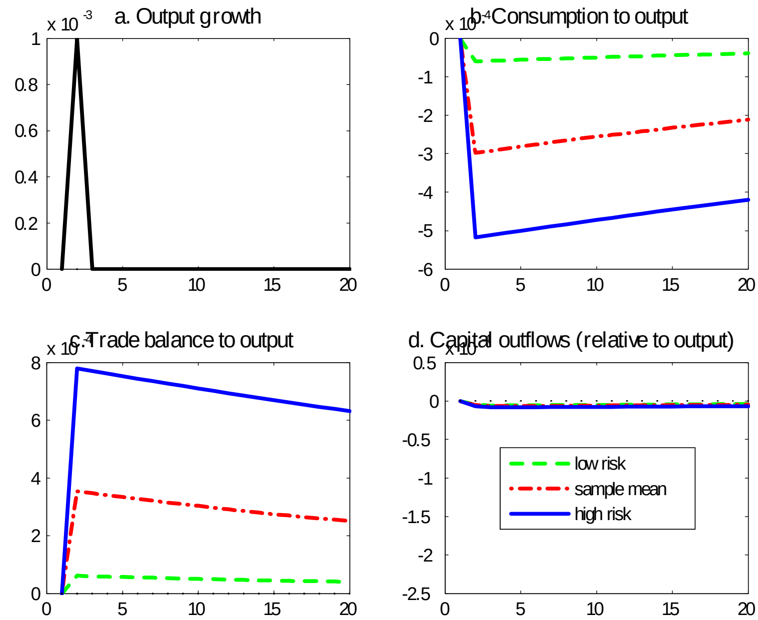

Figure 3: Responses to a positive level shock to productivity for different risk scenarios. *Notes:* The low risk environment is obtained by setting the standard devation of output growth equal to 0.02, the sample mean environment by setting it equal to 0.04 and the high risk environment by setting it equal to 0.06, respectively.

Having established how income risk, measured by output growth volatility, influences the dynamic adjustment of the small open economy, we now assess the model's business cycle statistics. The exercise we are considering is as follows: The second moments are obtained by considering small open economies which are hit by the same economic disturbances but differ in their risk profile with respect to inherent output growth volatility. Based on this, the following table displays the unconditional moments of our model. The second moments are shown for the different risk scenarios outlined above.

The table shows that moving from a low risk towards a high risk environment causes an increase in the correlation between the trade balance and output growth as well as capital outflows and output changes. The more volatile output growth becomes the more households want to save. Relating this to the findings above regarding the long-run external asset position it can be seen that the results do not hinge on whether the country is a creditor or debtor country.

Output growth volatility	low risk	sample mean	high risk
$stdev(dY)$	0.02	0.04	0.06
$corr(\widetilde{tb}_t, dy_t)$	-0.93	-0.52	-0.43
$corr(\widetilde{\Delta nfa}_t, dy_t)$	-0.88	-0.87	-0.46

Figure 1 shows that within the cross-section of countries even a higher output growth volatility is not unlikely to occur. Considering a upper bound of output growth volatility ($stdev(dY)$) in the data of for example around 0.09 would even imply positive relationship between capital outflows and output (growth) at business cycle frequency, i.e. $corr(\widetilde{\Delta nfa_t, dy_t})$ of around 0.4. Thus, moving from a low risk towards a higher risk environment does not even lead to an increase in the correlation between capital flows and output growth but causes a positive sign in the cross correlation.

In summary, this section has shown that the model is able to replicate the empirical results by relating the findings to a precautionary savings motive of households, which aim to increase their savings to accumulate a buffer stock of foreign assets in the long-run to insure against the presence of higher uncertainty about the future expected income stream to keep consumption stable. A higher long-run net foreign asset position requires to accrue in the short-run more net foreign assets so that in the short-run capital outflows occur even when output growth is high. As a result, a more positive relationship between capital outflows and output (growth) at business cycle frequency occurs as uncertainty increases.

3.2 The economy with an endogenous capital stock

We now turn to a model where output is not only driven by movements in technology but also by labour and capital as inputs to production. Firms produce a single good which is used for consumption and investment in the small open economy as well as in the rest of the world.

As before, households obtain utility (1) from consumption and hold an international real bond B on which they now receive a stochastic return from the world real interest rate r. In addition, they provide capital K to firms on which they receive a return r^k and offer labour inelastically to firms at a wage rate $\mathcal{W}$. Then the budget constraint equals

$$\mathcal{W}_t L + r_t B_{t-1} + r_t^k K_{t-1} = C_t + I_t + S_t + B_t - B_{t-1}, \tag{21}$$

whereby the no-Ponzi game restriction and Transversality condition are assumed to hold. The world real interest rate evolves by

$$r_t = (1 - \rho^r)\, r + \rho^r\, (r_{t-1}) + \epsilon_t,$$

with r reflecting its steady state value. Output follows out of labour, capital and technology, so that

$$Y_t = (L Z_t)^{\alpha}\, K_{t-1}^{1-\alpha}, \tag{22}$$

whereby technology evolves according to (4) and (5). The capital accumulation equation equals

$$K_t = (1 - \delta)\, K_{t-1} + I_t, \tag{23}$$

with a return on capital and wages equal to

$$1 + r_t^k = (1-\alpha)\left(LZ_t\right)^{\alpha} K_{t-1}^{-\alpha} \text{ and } \mathcal{W}_t = \alpha L^{-(1-\alpha)} Z_t^{\alpha} K_{t-1}^{1-\alpha}\text{, respectively.} \tag{24}$$

A domestic (exogenous) spending shock S is introduced, which is defined as

$$\left(\frac{S_t}{Z_t} - \frac{S}{Z}\right) = \rho^s \left(\frac{S_{t-1}}{Z_{t-1}} - \frac{S}{Z}\right) + \varepsilon_t.$$

The Euler equation is given by

$$\frac{1}{\beta} = E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(1 + r_{t+1}\right)\right]. \tag{25}$$

Capital adjusts to meet

$$\frac{1}{\beta} = E_t\left[\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(1 + r_{t+1}^k + \delta\right)\right]. \tag{26}$$

As before, the economy is growing at a stochastic growth rate. To find a solution the system must be made stationary. All variables are therefore expressed relative to productivity, Z_t, to make them stationary. The full solution to the model is presented in the appendix. Once we have the solution we can rescale the variables relative to output, with $\widetilde{X} = X/Y$. Then from the budget constraint it follows that

$$\widetilde{\Delta NFA}_t \equiv 1 + \frac{r_t}{dY_t}\widetilde{B}_{t-1} - \widetilde{C}_t - \widetilde{I}_t - \widetilde{S}_t. \tag{27}$$

The other variable of interest is the trade balance, $TB = Y - C - I$, defined as the difference between production and absorption. The trade balance relative to output equals then

$$\widetilde{TB}_t = 1 - \widetilde{C}_t - \widetilde{I}_t - \widetilde{S}_t. \tag{28}$$

The Euler equations with respect to consumption and capital are

$$\frac{1}{\beta} = E_t\left[\left(\frac{\widetilde{C}_{t+1}}{\widetilde{C}_t}\right)^{-\sigma}\frac{\left(1 + r_{t+1}\right)}{dY_{t+1}^{\sigma}}\right] \text{ and } \frac{1}{\beta} = E_t\left[\left(\frac{\widetilde{C}_{t+1}}{\widetilde{C}_t}\right)^{-\sigma}\frac{\left(1 + r_{t+1}^k\right)}{dY_{t+1}^{\sigma}}\right]\text{, respectively.} \tag{29}$$

We have discussed the implication of the consumption Euler equation in section 3.1. What are the consequences of output volatility for the rental rate of capital? To see this consider its approximated form

$$E_t\left(1 + r_{t+1}^k + \delta\right) = E_t\left(1 + r_{t+1}\right) + \sigma\frac{cov\left(\widetilde{C}_{t+1}, \left(1 + r_{t+1}^k + \delta\right)\right) - cov\left(\widetilde{C}_{t+1}, 1 + r_{t+1}\right)}{E_t\widetilde{C}_{t+1}\left(1 + \sigma\left(\sigma+1\right)\frac{var\left(\widetilde{C}_{t+1}\right)}{E_t C_{t+1}^2} + \sigma\left(\sigma+1\right)\frac{var\left(dY_{t+1}\right)}{E_t dY_{t+1}^2}\right)} \tag{30}$$

Equation (30) shows nicely the relationship between the return to capital and the world real interest rate. Without any risk, the domestic rental rate to capital r^k is equal to the world real interest rate r. However, once uncertainty enters the economy a wedge is driven between the domestic return to capital and the world real interest rate. In general, a higher r^k will make it less attractive for firms to instal an additional unit of capital and investment should fall.[21] Whether the return to capital is higher in a stochastic environment depends on the volatility of output growth as well as the covariance relationship between the return to capital and the world real interest rate. All else equal, a higher output growth volatility will lead to a decline in r^k. The economy wants to build up its future capital stock to insure against the higher uncertainty, such that households want to invest more today and consume less. A similar effect obtains with respect to higher consumption variability. A positive correlation between consumption and the world real interest rate would mean that the financial asset cannot provide the desired consumption smoothing. Instead, households would desire a higher future capital stock to do so. Consequently, the return to capital declines to make investment more attractive. The opposite holds with respect to the correlation between consumption and the rental rate to capital.

The implications of risk for the steady state are similar to the ones discussed above. Again, the long-run net foreign asset position of the small open economy can be endogenously defined within the stochastic steady state. To fully obtain the general equilibrium effects we proceed as above. We postulate a linear decision rule around the stochastic steady state and solve jointly the stochastic steady state and the coefficients of the decision rule. The full solution is provided in the appendix. To illustrate the working of the model we keep the calibration of section 3.1.1 with respect to the steady state world real interest rate r, time preference β the steady state growth rate $\overline{G}$ and the persistence of the growth rate shock ρ. Given that within this section we have introduced further stochastic disturbances we set the standard deviation of the growth rate shock σ_v equal to 0.007 and level shock σ_w equal to 0.03, while the standard deviation of the world real interest rate disturbance σ_ϵ is set to 0.05 and of the spending shock σ_ε is equal to 0.015, following Cicco, Pancrazi and Uribe (2010). We also use their estimates with respect to ρ^s, which is equal to 0.29 while ρ^r is set at the higher end of their estimates, equal to 0.95. Finally, the depreciation rate δ is set at 0.04. Those values are close to our sample average of the volatility of output, equal to around 4 percent.

3.2.1 Output growth volatility, capital flows and external assets

Before we assess in more detail the implications of higher output growth volatility for the long-run external asset position and the correlation between output growth and capital outflows, we provide

[21] To see this, consider the marginal product of capital (24), which can be written as $E_t\left(1+r_{t+1}^k\right) = E_t\left(\left(1-\alpha\right)\left(Y_{t+1}\right)/K_t\right)$. Assuming for a moment for simplicity that the depreciation rate is $\delta = 1$, it follows from the inverse function role that $\partial I_t/\partial E_t\left(r_{t+1}^k\right) \equiv -1/E_t\left(\alpha\left(1-\alpha\right)\left(Y_{t+1}\right)/K_t^2\right) < 0$.

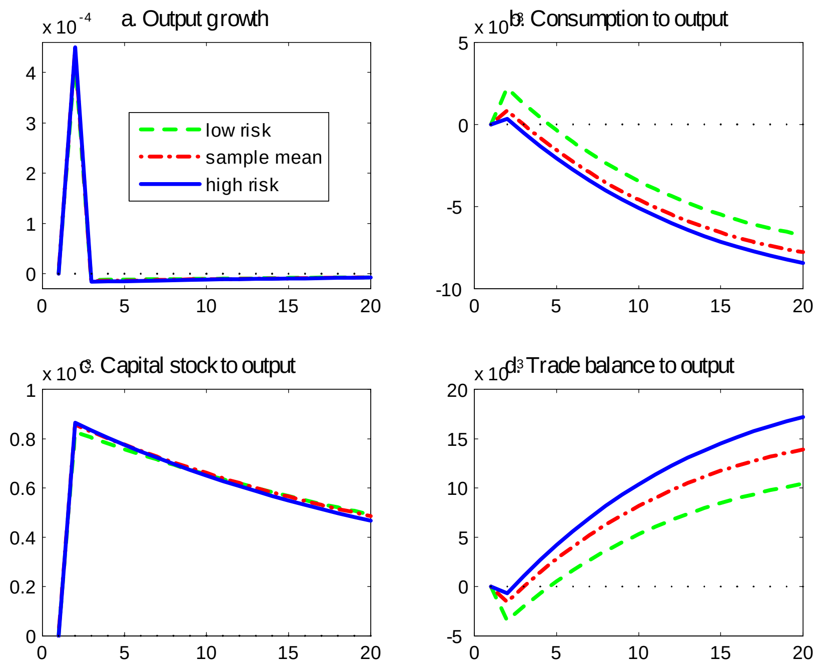

Figure 4: Responses to a negative shock to the world real interest rate for different risk scenarios. *Notes:* The low risk environment is obtained by setting the standard devation of output growth equal to 0.02, the sample mean environment by setting it equal to 0.04 and the high risk environment by setting it equal to 0.06, respectively.

impulse response functions to the two additional shocks introduced in this section.[22] In Figure 4 we show the reaction of the economy under the above proposed different risk scenarios to a 0.1 percent point decline in the world real interest rate while Figure 5 shows the effects of a decline in part of exogenous domestic spending by 0.1 percent.

The effects of a world real interest rate disturbance As the stochastic world real interest rate declines households can finance today's consumption more cheaply, so that consumption relative to output increases in panel b. of Figure 4. Given the link between the return to capital and the world real interest rate as described by (30), households have an incentive to instal more capital at a cheaper rental rate. Hence, they invest more and accumulate a higher capital stock. Panel c. shows that the capital stock increases. Consequently, also output increases and so does output growth in panel a. The higher domestic absorption causes a deterioration of the trade balance, as shown by panel d.

[22] An innovation to the growth rate of technology or the level of technology has qualitatively the same implications as discussed in section 3.1.2.

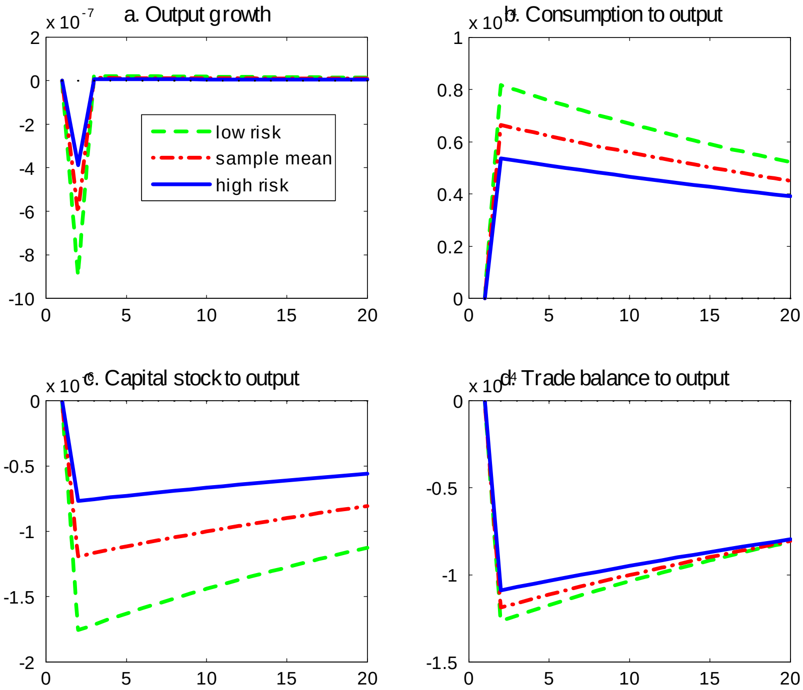

Figure 5: Responses to a negative shock to the exogenous part of domestic spending for different risk scenarios. *Notes:* The low risk environment is obtained by setting the standard devation of output growth equal to 0.02, the sample mean environment by setting it equal to 0.04 and the high risk environment by setting it equal to 0.06, respectively.

Figure 4 also once more nicely shows the effects higher output growth volatility has on the real side of the economy. The higher the uncertainty about the economic environment, i.e. the higher the variability of output growth, the more precautionary households are. To insure against the higher uncertainty they are willing to build up a higher capital stock and to accumulate relatively more savings by consuming less. Consequently, the trade balance improves in relative terms the more riskier the economic environment becomes. The relatively higher trade balance will then also translate into a relatively higher net foreign asset position.

The effects of a domestic spending disturbance In Figure 5 we illustrate the effects of a decline in part of exogenous domestic spending by 0.1 percent. This will have an recessionary effect as shown by panel a. and the capital stock declines. However, the decline in spending frees some resources for private consumption at a given world real interest rate. So that consumption to output in panel b. increases slightly. The decline in output and a higher consumption causes an overall deterioration of the trade balance in panel d.

The effects of higher output growth volatility are similar to above. The riskier the economic environment is, the less willing households are to accept variation in their consumption profile. Consequently, the consumption response in panel b. is mitigated. It follows that households want to keep a relatively higher capital stock. Due to the mitigated consumption response the deterioration of the trade balance in panel d. is smaller than in a lower risk environment.

Long-run external assets and the correlation between output growth and capital outflows In this section we compare the prediction of the model regarding the effects of output growth volatility on the long-run net foreign asset position, $mean(\widetilde{NFA})$, and the correlation between capital outflows and output growth, $corr(\Delta gdp, \widetilde{\Delta nfa})$, as well as $corr(\Delta gdp, \widetilde{tb})$ at business cycle frequency. To do so we compute model implied data by simulating 1000 data series for each country, letting the model match the actual average output growth volatility of the country in question. Therefore, the stochastic disturbances which hit the economies are adjusted respectively, but keeping their relative importance as outlined above. When simulating the data series we also account for the country specific underlying growth trend. The results are summarized in table (7).

Table (7) displays regression results, given the countries' different growth trends and risk profiles. The table confirms the relationship between output growth volatility, capital flows position and the external asset which we have established in section 2. The point estimates by the model implied data on output growth volatility, $stdev(\Delta GDP)$, given either $corr(\Delta gdp, \widetilde{\Delta nfa})$, $corr(\Delta gdp, \widetilde{tb})$ or $mean(\widetilde{NFA})$ are quite close to those of table (3). Table (7) also confirms that output growth volatility affects $corr(\Delta gdp, \widetilde{\Delta nfa})$, $corr(\Delta gdp, \widetilde{tb})$ or $mean(\widetilde{NFA})$ positively and statistically significant. All in all the model is able to replicate the empirical facts established in section 2.

4 Conclusions

This paper proposes a new perspective on international capital flows and countries' long-run external asset positions by investigating the effects of higher economic uncertainty on international capital flows and the long-run external asset position. In particular, we shed light on the role of output growth volatility for the relationship between capital flows and output growth at business cycle frequency as well as the long-run net foreign asset position. Extensive evidence based on a cross-section of 84 developing and emerging countries shows that over the last three decades countries that have had on average higher volatility of output growth, firstly, accumulated higher external assets in the long-run and, secondly, experienced more procyclical capital outflows over the business cycle than those countries with a same growth rate but a more stable output path.

To explain this finding we provide a theoretical mechanism within a stochastic real business cycle growth model in which higher uncertainty of the income stream increases the precautionary savings motive of households. They have a desire to save more when the variance of their expected income stream is higher. Within the model it is shown that the combination of income risk and a precautionary savings motive causes more procyclical capital outflows at business cycle frequency and a higher long-run external asset position.

5 Appendix: Data

Following Gourinchas and Jeanne (2012), all variables are PPP adjusted. Data expressed in current USD such as data taken from Lane and Milesi-Ferretti's External Wealth of Nations data set are converted into constant international USD, the denomination used by the Penn World Tables (PWT), by dividing them by the deflator Q

$$Q = PI\frac{CGDP}{RGDP},$$

where PI_t is the price of investment goods and $CGDP_t$ and $RGDP_t$ are GDP levels in current and constant international USD, respectively. The data series used are the following:

1. The savings rate (S/GDP) in constant local currency units is taken from the World Development Indicators.

2. The investment rate (I/GDP) in constant local currency units is taken as gross capital formation from the World Development Indicators.

3. The net foreign asset position (NFA) in current USD is taken from the External Wealth of Nations data set, divided by Q_t to obtain constant international USD and expressed in percent of GDP in constant international USD taken from the Penn World Tables.

4. The trade balance (TB), measured as exports minus imports in current USD, is taken from the PWT and also expressed in percent of (nominal) GDP from the PWT. The trade balance is detrended ($\widehat{TB_t}$) by its mean.

5. Per capita real GDP ($GDPpc$) is taken from the PWT.

6. The level of real GDP (GDP), which is obtained from multiplying $GDPpc$ by the size of the population taken from the PWT. We also employ the average growth rate of real GDP ($dGDP$).

7. The price of investment goods (PI) is taken from the PWT.

8. A measure of openness to trade (*openn*) is constructed as the sum of exports and imports over GDP, both taken from the PWT.

9. The Chinn-Ito index ($chinn - ito$) is used to measure the degree of capital account openness (Chinn and Ito 2008).

10. The average years of schooling (*schooling*) of the population aged 15 and above, averaged over 1980-2005, taken from the Barro-Lee database.

11. Variables describing the institutional environment taken from the World Development Indicators (WDI) database. The indicators measure the prevalence of the rule of law, the degree of political stability, the degree of corruption control and the quality of regulation. All variables are averaged over the period starting in 1996 (the earliest available observation) and ending in 2007. The resulting four values are averaged for each country to obtain a single indicator measuring the quality of institutions (*qual instit*).

The data is annual and covers the period 1980 to 2007. The countries included are listed in Table (1). The countries are also classified as rich countries and poor countries according to their per-capita GDP and as large, medium-sized and small countries according to their population. Details are also given in Table (1).

6 Appendix: Model

This appendix provides the solution to the model with an endogenous capital stock. we start with providing the solution to the stochastic steady state from which then the dynamics of the model are derived.

6.1 The stochastic steady state

In the stochastic steady state the consumption Euler equation equals

$$\begin{aligned} \frac{1}{\beta} &= \overline{dZ}^{-\sigma}\Bigg((1+r)\left[1+\sigma(\sigma+1)\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^{2}}+\sigma(\sigma+1)\frac{var\left(dZ\right)}{\overline{dZ}^{2}}\right] \\ &\quad -\sigma\frac{cov\left(\widetilde{C},1+r\right)}{\overline{\widetilde{C}}}+\sigma^{2}\frac{cov\left(\widetilde{C},dZ\right)}{\overline{\widetilde{C}}\overline{dZ}}\Bigg), \end{aligned} \tag{31}$$

which provides us with a solution to $\widetilde{C}$, where here $\widetilde{X}=X/Z$ and similarly for the other variables in question. Note that that the steady state growth trend is $\overline{G}=exp(\overline{dZ})$, with $\overline{dZ}>1$. It follows from (26) that

$$\begin{aligned} \frac{1}{\beta} &= \overline{dZ}^{-\sigma}\Bigg(\left(1+\overline{r^{k}}+\delta\right)\left[1+\sigma(\sigma+1)\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^{2}}+\sigma(\sigma+1)\frac{var\left(dZ\right)}{\overline{dZ}^{2}}\right] \\ &\quad -\sigma\frac{cov\left(\widetilde{C},\left(1+r^{k}+\delta\right)\right)}{\overline{\widetilde{C}}}+\sigma^{2}\frac{cov\left(\widetilde{C},dZ\right)}{\overline{\widetilde{C}}\overline{dZ}}\Bigg), \end{aligned} \tag{32}$$

which can be solved for $\overline{r^k}$. Given (31) and (32) we can solve for the remaining variables. From (26), the capital stock is given by

$$\overline{\widetilde{K}}=\left(\frac{(1-\alpha)}{\overline{r^{k}}}\right)^{\frac{1}{\alpha}}\overline{dZ}.$$

The evolution of the capital stock (23) gives the solution to investment, which equals

$$\overline{\widetilde{I}}=-\left(\frac{(1-\delta)-\overline{dZ}}{\overline{dZ}}\right)\overline{\widetilde{K}}.$$

From (22) output equals

$$\overline{\widetilde{Y}}=\frac{\overline{\widetilde{K}}^{1-\alpha}}{\overline{dZ}^{1-\alpha}},$$

given that the exogenous labour supply is set equal to unity. We assume that $\overline{\widetilde{S}}=0$ for simplicity within the steady state, so that from the budget constraint (21) we get

$$\overline{\widetilde{B}}=\frac{\overline{dZ}}{\overline{dZ}-(1+r)}\left[\overline{\widetilde{Y}}-\overline{\widetilde{I}}-\overline{\widetilde{C}}\right], \tag{33}$$

from which we can solve all remaining variables of the system such as $\overline{\widetilde{TB}}$, and capital flows, $\overline{\widetilde{\Delta nfa}}$.

6.2 Linearized system

In the following we assume that $\sigma = 1$. Note that $\widetilde{x} = \ln(\widetilde{X}/\overline{\overline{\widetilde{X}}})$ while for external assets, $\widetilde{b}_t$, the trade balance, $\widetilde{tb}_t$, and capital flows, $\widetilde{\Delta nfa}_t$, we define $\widetilde{x} = \widetilde{X} - \overline{\overline{\widetilde{X}}}$. We linearize around the stochastic steady state. Using (10) for $\widetilde{X}_t = X_t/Z_t$ we have

$$\begin{aligned}
\frac{1}{\beta}\left(E_t\widetilde{c}_{t+1} - \widetilde{c}_t\right) &= -2\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{\widetilde{C}}}\,\overline{\overline{dZ}}^2}E_t dz_{t+1} + \frac{(1+r)}{E_t dz_{t+1}^{-1}}\left[-\frac{1}{\overline{\overline{dZ}}} - 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{dZ}}\,\overline{\overline{\widetilde{C}}}^2} - 6\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] \\
&\quad + \frac{cov\left(\widetilde{C}, 1+r\right)}{\overline{\overline{\widetilde{C}}}\,\overline{\overline{dZ}}}E_t dz_{t+1} + \frac{E_t(\widehat{1+r_{t+1}})}{\overline{\overline{dZ}}}\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + 2\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] \\
&\quad + \frac{E_t\widetilde{c}_{t+1}}{\overline{\overline{dZ}}}\left(-\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{\widetilde{C}}}\,\overline{\overline{dZ}}} - (1+r)\,4\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + \frac{cov\left(\widetilde{C}, 1+r\right)}{\overline{\overline{\widetilde{C}}}}\right),
\end{aligned}$$

which can be written as

$$\begin{aligned}
&\widetilde{c}_t + E_t(\widehat{1+r_{t+1}})\frac{\beta}{\overline{\overline{dZ}}}\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + 2\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] \qquad (34) \\
= \;& E_t\widetilde{c}_{t+1}\left[1 + \frac{\beta}{\overline{\overline{dZ}}}\left(\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{dZ}}\,\overline{\overline{\widetilde{C}}}} + (1+r)\,4\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} - \frac{cov\left(\widetilde{C}, 1+r\right)}{\overline{\overline{\widetilde{C}}}}\right)\right] \\
&+ E_t dz_{t+1}\frac{\beta}{\overline{\overline{dZ}}}\left[(1+r)\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + 6\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] + 2\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{\widetilde{C}}}\,\overline{\overline{dZ}}} - \frac{cov\left(\widetilde{C}, 1+r\right)}{\overline{\overline{\widetilde{C}}}}\right].
\end{aligned}$$

At the deterministic steady state, where $1/\beta = (1+r)/\overline{\overline{dZ}}$, we have $\widetilde{c}_t + \widehat{1+r_t}/(1+r) = E_t\left[\widetilde{c}_{t+1} + dz_{t+1}\right]$. From the capital and consumption Euler equations (30) it follows that

$$\begin{aligned}
&\widetilde{c}_t + E_t(\widehat{1+r^k_{t+1}})\frac{\beta}{\overline{\overline{dZ}}}\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + 2\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] \qquad (35) \\
= \;& E_t\widetilde{c}_{t+1}\left[1 + \frac{\beta}{\overline{\overline{dZ}}}\left(\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{dZ}}\,\overline{\overline{\widetilde{C}}}} + \left(1 + r^k + \delta\right)4\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} - \frac{cov\left(\widetilde{C}, 1+r^k\right)}{\overline{\overline{\widetilde{C}}}}\right)\right] \\
&+ E_t dz_{t+1}\frac{\beta}{\overline{\overline{dZ}}}\left[\left(1 + \overline{r^k} + \delta\right)\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\overline{\widetilde{C}}}^2} + 6\frac{var\left(dZ\right)}{\overline{\overline{dZ}}^2}\right] + 2\frac{cov\left(\widetilde{C}, dZ\right)}{\overline{\overline{\widetilde{C}}}\,\overline{\overline{dZ}}} - \frac{cov\left(\widetilde{C}, 1+r^k\right)}{\overline{\overline{\widetilde{C}}}}\right]
\end{aligned}$$

Again, at the deterministic steady state this would be equal to $E_t(\widehat{1+r^k_{t+1}}) = E_t(\widehat{1+r_{t+1}})$. Furthermore, from (24) we have

$$E_t(\widehat{1+r^k_{t+1}}) = (1-\alpha)\,\alpha\overline{\overline{dZ}}^{\alpha}\overline{\overline{\widetilde{K}}}^{-\alpha}\left(E_t dz_{t+1} - \widetilde{k}_t\right) \text{ and } \widehat{1+r^k_t} = (1-\alpha)\,\alpha\overline{\overline{dZ}}^{\alpha}\overline{\overline{\widetilde{K}}}^{-\alpha}\left(dz_t - \widetilde{k}_{t-1}\right).$$

Output, (22), can be written as

$$\widetilde{y}_t = (1-\alpha)\left(\widetilde{k}_{t-1} - dz_t\right).$$

From the budget constraint (7) it follows that

$$\overline{\widetilde{C}}\widetilde{c}_t + \widetilde{b}_t + \overline{\widetilde{K}}\widetilde{k}_t + \widetilde{s}_t = \overline{\widetilde{Y}}\widetilde{y}_t + \widetilde{b}_{t-1}\left(\frac{(1+r)}{\overline{dZ}}\right) - dz_t\frac{\overline{\widetilde{B}}\,(1+r)}{\overline{dZ}} + \widehat{1+r}_t\frac{\overline{\widetilde{B}}}{\overline{dZ}} + \left(\widetilde{k}_{t-1} - dz_t\right)\frac{\overline{\widetilde{K}}\,(1-\delta)}{\overline{dZ}},$$

which becomes

$$\overline{\widetilde{C}}\widetilde{c}_t + \widetilde{b}_t + \overline{\widetilde{K}}\widetilde{k}_t + \widetilde{s}_t = \widetilde{b}_{t-1}\Gamma_{\widetilde{b}} + \widehat{1+r}_t\frac{\overline{\widetilde{B}}}{\overline{dZ}} + \widetilde{k}_{t-1}\Gamma_{\widetilde{k}} - dz_t\Gamma_{dz} \tag{36}$$

where

$$\begin{aligned}
\Gamma_{\widetilde{b}} &= \frac{(1+r)}{\overline{dZ}} \\
\Gamma_{\widetilde{k}} &= \frac{(1-\delta)\,\overline{\widetilde{K}} + (1-\alpha)\,\overline{dZ}\,\overline{\widetilde{Y}}}{\overline{dZ}} \\
\Gamma_{dz} &= \frac{(1+r)\,\overline{\widetilde{B}} + (1-\delta)\,\overline{\widetilde{K}} + (1-\alpha)\,\overline{dZ}\,\overline{\widetilde{Y}}}{\overline{dZ}}
\end{aligned}$$

Given equations (34)-(36), the relevant linearized system can be summarized by

$$\widetilde{c}_t + E_t(\widehat{1+r_{t+1}})\Gamma_{c,r} = E_t\widetilde{c}_{t+1}\Gamma_{c,c} + E_t dz_{t+1}\Gamma_{c,dz}, \tag{37}$$

$$\begin{aligned}
\left(\overline{\widetilde{C}} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\widetilde{c}_t + \widetilde{b}_t + \widetilde{s}_t - E_t(\widehat{1+r_{t+1}})\frac{\overline{\widetilde{K}}}{\Gamma_{r^k}} &= \widetilde{b}_{t-1}\Gamma_{\widetilde{b}} + \widehat{1+r}_t\left(\frac{\overline{\widetilde{B}}}{\overline{dZ}} - \frac{\Gamma_{\widetilde{k}}}{\Gamma_{r^k}}\right) \\
&\quad - dz_t\left(\Gamma_{dz} - \Gamma_{\widetilde{k}}\left(1 - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\right) \\
&\quad + E_t\widetilde{c}_{t+1}\overline{\widetilde{K}}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}} - \overline{\widetilde{K}}\left(1 - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)E_t dz_{t+1},
\end{aligned} \tag{38}$$

given

$$\Gamma_{c,r} = \frac{\beta}{\overline{dZ}}\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} + 2\frac{var\,(dZ)}{\overline{dZ}^2}\right],$$

$$\Gamma_{r^k,c} = \frac{\left(\left[\left(1 + \overline{r^k} + \delta\right) - (1+r)\right]4\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} - \frac{cov\left(\widetilde{C},1+r^k\right) - cov\left(\widetilde{C},1+r\right)}{\overline{\widetilde{C}}}\right)}{\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} + 2\frac{var(dZ)}{\overline{dZ}^2}\right]},$$

$$\Gamma_{c,c} = \left[1 + \frac{\beta}{\overline{dZ}}\left(\frac{cov\left(\widetilde{C},dZ\right)}{\overline{dZ}\,\overline{\widetilde{C}}} + (1+r)\,4\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} - \frac{cov\left(\widetilde{C},1+r\right)}{\overline{\widetilde{C}}}\right)\right],$$

$$\Gamma_{c,c,k} = \left[1 + \frac{\beta}{\overline{dZ}}\left(\frac{cov\left(\widetilde{C},dZ\right)}{\overline{dZ}\,\overline{\widetilde{C}}} + \left(1 + \overline{r^k} + \delta\right)4\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} - \frac{cov\left(\widetilde{C},1+r^k\right)}{\overline{\widetilde{C}}}\right)\right],$$

$$\Gamma_{c,dz} = \frac{\beta}{\overline{dZ}}\left[(1+r)\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} + 6\frac{var\,(dZ)}{\overline{dZ}^2}\right] + 2\frac{cov\left(\widetilde{C},dZ\right)}{\overline{\widetilde{C}}\,\overline{dZ}} - \frac{cov\left(\widetilde{C},1+r\right)}{\overline{\widetilde{C}}}\right],$$

and

$$\Gamma_{c,dz,k} = \frac{\beta}{\overline{dZ}}\left[\left(1 + \overline{r^k} + \delta\right)\left[1 + 2\frac{var\left(\widetilde{C}\right)}{\overline{\widetilde{C}}^2} + 6\frac{var\,(dZ)}{\overline{dZ}^2}\right] + 2\frac{cov\left(\widetilde{C},dZ\right)}{\overline{\widetilde{C}}\,\overline{dZ}} - \frac{cov\left(\widetilde{C},1+r^k\right)}{\overline{\widetilde{C}}}\right].$$

6.3 Solution to the system

6.3.1 Decision rules

We postulate a linear decision rule around the stochastic steady state which is given by

$$\widetilde{c}_t = a_{cb}\widetilde{b}_{t-1} + a_{cg}g_t + a_{cw}w_t + a_{cr}\widehat{1+r}_t + a_{cs}\widetilde{s}_t, \tag{39}$$

$$\widetilde{b}_t = a_{bb}\widetilde{b}_{t-1} + a_{bg}g_t + a_{bw}w_t + a_{br}\widehat{1+r}_t + a_{bs}\widetilde{s}_t, \tag{40}$$

and

$$\widetilde{k}_t = a_{kb}\widetilde{b}_{t-1} + a_{kg}g_t + a_{kw}w_t + a_{kr}\widehat{1+r_t} + a_{ks}\widetilde{s}_t. \tag{41}$$

Then given (37) and (38) we get a solution to the coefficients on consumption

$$a_{cb} = \frac{\Gamma_{c,c}\Gamma_{\widetilde{b}} - 1}{\Gamma_{c,c}\left(\left(\widetilde{C} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) - \widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}\Gamma_{c,c}}\right)},$$

$$a_{cr} = \frac{\rho^r\Gamma_{c,r}\left(1 - a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) - \Gamma_{c,c}a_{cb}\left(\frac{\widetilde{B}}{dZ} - \frac{\Gamma_{\widetilde{k}}}{\Gamma_{r^k}} + \frac{\rho^r\widetilde{K}}{\Gamma_{r^k}}\right)}{\left(\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\rho^r - \left(\widetilde{C} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\right)\Gamma_{c,c}a_{cb} - (1 - \Gamma_{c,c}\rho^r)\left(1 - a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)},$$

$$a_{cg} = \frac{\Gamma_{c,dz}\rho\left(1 - a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) + \Gamma_{c,c}a_{cb}\left(\Gamma_{\widetilde{k}}\left(1 - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) - \widetilde{K}\left(1 - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\rho - \Gamma_{dz}\right)}{(1 - \Gamma_{c,c}\rho)\left(1 - a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) + \left(\left(\widetilde{C} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) - \rho\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\Gamma_{c,c}a_{cb}},$$

$$a_{cw} = \frac{\left(\Gamma_{\widetilde{k}}\left(1 - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) - \Gamma_{dz}\right)\Gamma_{c,c}a_{cb}}{\left(1 - a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\right) + \Gamma_{c,c}\left(\widetilde{C} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)a_{cb}},$$

and

$$a_{cs} = \frac{\Gamma_{c,c}a_{cb}}{(1 - \Gamma_{c,c}\rho^s)\left(a_{cb}\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}} - 1\right) + \Gamma_{c,c}a_{cb}\left(\rho^s\widetilde{K}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}} - \left(\widetilde{C} + \frac{\Gamma_{\widetilde{k}}\Gamma_{r^k,c}}{\Gamma_{r^k}}\right)\right)}.$$

For the net foreign assets we have

$$a_{bb} = \frac{1}{\Gamma_{c,c}},$$

$$a_{br} = \frac{(a_{cr}(1 - \Gamma_{c,c}\rho^r) + \rho^r\Gamma_{c,r})}{\Gamma_{c,c}a_{cb}},$$

$$a_{bg} = \frac{(a_{cg}(1 - \Gamma_{c,c}\rho) - \Gamma_{c,dz}\rho)}{\Gamma_{c,c}a_{cb}},$$

$$a_{bw} = \frac{a_{cw}}{\Gamma_{c,c}a_{cb}},$$

and

$$a_{bs} = \frac{a_{cs}(1 - \Gamma_{c,c}\rho^s)}{\Gamma_{c,c}a_{cb}}.$$

For the capital stock it follows

$$a_{kb} = -a_{cb}a_{bb}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}},$$

$$a_{kg} = \left(\rho - \frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}\left(\rho\left(1+a_{cg}\right)+a_{cb}a_{bg}\right)\right),$$

$$a_{kw} = -a_{cb}a_{bw}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}},$$

$$a_{kr} = -\frac{\rho^r\left(1+a_{cr}\Gamma_{r^k,c}\right)+\Gamma_{r^k,c}a_{cb}a_{br}}{\Gamma_{r^k}},$$

and

$$a_{ks} = -\rho^s a_{cs}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}} - a_{cb}a_{bs}\frac{\Gamma_{r^k,c}}{\Gamma_{r^k}}.$$

With the policy rules in hand we can derive the remaining endogenous variables of interest. To define the conditional moments we need the evolution of the rental rate to capital, which is given by

$$\widehat{1+r_t^k} = -\alpha\overline{r^k}\left(a_{kb}\widetilde{b}_{t-1} - \left(1-a_{kg}\right)g_t - \left(1-a_{kw}\right)w_t + a_{kr}\widehat{1+r_t} + a_{ks}\widetilde{s}_t\right).$$

6.3.2 The second moments

From the stochastic steady state it follows that we have determine the covariance relationship between consumption and the growth rate of the economy, $cov\left(\widetilde{C}, dZ\right)$, the world real interest rate, $cov\left(\widetilde{C}, 1+r\right)$,as well as the rental rate of capital, $cov\left(\widetilde{C}, 1+r^k\right)$. Furthermore, the variance of consumption, $var\left(\widetilde{C}\right)$, and the growth rate, $var\left(dZ\right)$, have to be derived.

We therefore define the conditional moments. We assume that the shocks are uncorrelated between each other. The conditional moments are calculated given the impact matrix

$$\mathbf{S} = \begin{bmatrix} a_{bg} & a_{bw} & a_{br} & a_{bs} \\ a_{kg} & a_{kw} & a_{kr} & a_{ks} \\ a_{cg} & a_{cw} & a_{cr} & a_{cs} \\ \alpha\overline{r^k}\left(1-a_{kg}\right) & \alpha\overline{r^k}\left(1-a_{kw}\right) & -\alpha\overline{r^k}a_{kr} & -\alpha\overline{r^k}a_{ks} \end{bmatrix}$$

and the diagonal variance-covariance matrix

$$\mathbf{\Sigma} = \begin{bmatrix} \sigma_v^2 & 0 & 0 & 0 \\ 0 & \sigma_w^2 & 0 & 0 \\ 0 & 0 & \sigma_\epsilon^2 & 0 \\ 0 & 0 & 0 & \sigma_\varepsilon^2 \end{bmatrix}.$$

Then the conditional moments **CM** are given by

$$\mathbf{CM} = \mathbf{S\Sigma S}'$$

We need solutions to the variance $var(C)$, while $var(dZ) = \sigma_v^2 + \sigma_w^2$. Then

$$var(\widetilde{C}) = a_{cg}^2\sigma_v^2 + a_{cw}^2\sigma_w^2 + a_{cr}^2\sigma_\epsilon^2 + a_{cs}\sigma_\varepsilon^2 \quad (42)$$

$$var(dZ) = \sigma_v^2 + \sigma_w^2 \quad (43)$$

Furthermore we need solutions to the covariances $cov\left(\widetilde{C},\left(1+r^k\right)\right)$, $cov\left(\widetilde{C},(1+r)\right)$ and $cov\left(\widetilde{C},dZ\right)$, which are given by

$$cov\left(\widetilde{C},\left(1+r^k\right)\right) = \alpha\overline{r^k}\left(1-a_{kg}\right)\sigma_v^2+\alpha\overline{r^k}\left(1-a_{kw}\right)\sigma_w^2-\alpha\overline{r^k}a_{kr}\sigma_\epsilon^2-\alpha\overline{r^k}a_{ks}\sigma_\varepsilon^2, \quad (44)$$

$$cov\left(\widetilde{C},(1+r)\right) = a_{cr}\sigma_\epsilon^2, \quad (45)$$

$$cov\left(\widetilde{C},dZ\right) = a_{cg}\sigma_v^2+a_{cw}\sigma_w^2. \quad (46)$$

We have 8 unknowns, given by $\overline{\widetilde{B}},\overline{\widetilde{C}},\overline{r^k},var(\widetilde{C}),var(dZ),cov\left(\widetilde{C},\left(1+r^k\right)\right),cov\left(\widetilde{C},(1+r)\right)$ and $cov\left(\widetilde{C},dZ\right)$, for which we have 8 equations given by (31), (32), (33) and (42)-(46). This allows us to solve the system. We are using an iterative non-linear procedure, which enables us to solve this fixed point problem.

References

[1] Aguiar, M. and G. Gopinath (2007): "Emerging Market Business Cycles: The Cycle is the Trend", *Journal of Political Economy* 115, 69-102.

[2] Alfaro. L., S. Kalemli-Ozcan and V. Volosovych (2013): "Sovereigns, upstream capital flows, and global imbalances", *unpublished*, University of Maryland.

[3] Benhima, K. (2013): "A Reappraisal of the Allocation Puzzle Through the Portfolio Approach", *Journal of International Economics* 89, 331-346.

[4] Broer, T. (2012): "Domestic or Global Imbalances? Rising income risk and the fall in the US current account", *unpublished*, Stockholm University.

[5] Caballero, R., E. Farhi and P.-O. Gourinchas (2008): "An Equilibrium Model of “Global Imbalances” and Low Interest Rates" *American Economic Review* 98, 358-93.

[6] Carroll, C. (1994): "How Does Future Income Affect Current Consumption?", *The Quarterly Journal of Economics* 109,111-148

[7] Carroll, C. (2007): "Lecture Notes: A Tractable Model of Buffer Stock Saving", Discussion Paper, Johns Hopkins University.

[8] Carroll, C. and O. Jeanne (2009): "A Tractable Model of Precautionary Reserves, Net Foreign Assets, or Sovereign Wealth Funds", NBER Working Paper 15228.

[9] Carroll, C., and D. Weil (1994): "Saving and Growth: A Reinterpretation", *Carnegie-Rochester Conference Series on Public Policy* 40, 133-192.

[10] Chinn, M. D. and H. Ito (2008): "A New Measure of Financial Openness", *Journal of Comparative Policy Analysis* 10, 309-322.

[11] Cicco, J. G., R. Pancrazi and M. Uribe (2010): "Real Business Cycles in Emerging Countries?", *American Economic Review* 100, 2510-2531.

[12] Coeurdacier, N., H. Rey and P. Winant (2011): "The Risky Steady State", *American Economic Review Papers and Proceedings* 101, 398-401.

[13] Deaton, A. (1991): "Savings and Liquidity Constraints", *Econometrica* 59, 1221-1248.

[14] Durdu, C. B., E. G. Mendoza, and M. E. Terrones (2007): "Precautionary Demand for Foreign Assets in Sudden Stop Economies: An Assessment of the New Mercantilism", *Journal of Development Economics* 89, 94-209.

[15] Durdu, C. B., E. G. Mendoza, and M. E. Terrones (2013): "On the Solvency of Nations: Cross-Country evidence on the dynamics of external Adjustment", *Journal of International Money and Finance* 32, 762-780.

[16] Fogli, A. and F. Perri (2006): "The Great Moderation and the U.S. External Imbalance", *Monetary and Economic Studies*, Bank of Japan, December 2006, 209-2033.

[17] Fogli, A. and F. Perri (2014): "Macroeconomic Volatility and External Imbalances", *unpublished*, Federal Reserve Bank of Minneapolis.

[18] Gourinchas, P.-O. and O. Jeanne (2012): "Capital Flows to Developing Countries: The Allocation Puzzle", forthcoming, *Review of Economic Studies.*

[19] Gros, D. (2013): "Why Does Capital Flow From Poor to Rich Countries?", posted on www.voxeu.org, 26 August 2013.

[20] Hausmann, R., L. Pritchett and D. Rodrik (2005): "Growth Accelerations", *Journal of Economic Growth*, 10, 303-329.

[21] Jeanne, O. and R. Rancière (2011): "The Optimal Level of Reserves for Emerging Market Countries: a New Formula and Some Applications", *Economic Journal* 121, 905-930.

[22] Juillard, M. and O. Kamenik (2005): "Solving SDGE Models: Approximation about the Stochastic Steady State", Working Paper.

[23] Lane, P. R. and G. M. Milesi-Ferretti (2007): "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004", *Journal of International Economics* 73, 223-250.

[24] Loayza, N., K. Schmidt-Hebbel and L. Serven (2000): "What Drives Saving Across the World?", *Review of Economics and Statistics*, 82, 165-181.

[25] Lucas, R. E. (1990): "Why Doesn't Capital Flow From Rich to Poor Countries", *American Economic Review* 80, 92-96.

[26] Mendoza, E. (1991): "Real Business Cycles in a Small Open Economy," *American Economic Review* 81, 797-818.

[27] Mendoza, E. G., V. Quadrini and V. Rios-Rull (2009): "Financial Integration, Financial Development, and Global Imbalances", *Journal of Political Economy* 117, 372-416.

[28] Uribe, M. (2013): *Open Economy Macroeconomics*, textbook manuscript available under http://www.columbia.edu/~mu2166/lecture_notes.html.

Table 1: Countries in the sample.

Albania	R	S	Czech Republic	R	S	Kenya	P	M	Poland	R	M
Algeria	R	M	Dominica	R	S	Korea	R	M	Portugal	R	S
Angola	P	S	Ecuador	R	S	Latvia	R	S	Senegal	P	S
Antigua & Barb.	R	S	Egypt	R	L	Lesotho	P	S	Singapore	R	S
Argentina	R	M	El Salvador	R	S	Libya	R	S	Slovak Republic	R	S
Bahrain	R	S	Ethiopia	P	L	Madagascar	P	M	Slovenia	R	S
Bangladesh	P	L	Fiji	R	S	Malawi	P	S	South Africa	R	M
Belarus	R	S	Gabon	R	S	Malaysia	R	M	Sri Lanka	P	M
Belize	R	S	Gambia	R	S	Mali	P	S	Swaziland	R	S
Benin	P	S	Ghana	P	M	Malta	R	S	Syria	R	M
Botswana	R	S	Grenada	R	S	Mauritius	R	S	Taiwan	R	S
Brazil	R	L	Guatemala	R	S	Mexico	R	L	Tanzania	P	M
Bulgaria	R	S	Haiti	P	S	Mongolia	P	S	Thailand	R	M
Cambodia	P	S	Honduras	R	S	Morocco	P	M	Tonga	R	S
Cameroon	P	S	Hong Kong	R	S	Mozambique	P	M	Trinidad & Tob.	R	S
Chile	R	S	Hungary	R	S	Nigeria	P	L	Tunisia	R	S
China	R	L	India	P	L	Oman	R	S	Turkey	R	M
Colombia	R	M	Iran	R	M	Panama	R	S	Uganda	P	M
Costa Rica	R	S	Israel	R	S	Papua N. G.	R	S	Uruguay	R	S
Croatia	R	S	Jamaica	R	S	Paraguay	R	S	Venezuela	R	M
Cyprus	R	S	Jordan	R	S	Peru	R	M	Zambia	P	S

Notes: The countries are classified by size and level of development. The set of poor (denoted by P) and richer (denoted by R) countries are defined as all countries with average PPP converted to GDP per capita over the period 1980-2007 within the ranges 0-3000 and 3000-25000, respectively. The set of small (S), medium (M) and large (L) countries include countries with 2007 populations of, respectively, less than 20 million, between 20 and 80 million and more than 80 million.

Table 2: Saving, Investment and Uncertainty

	dependent variable			
	S/GDP		I/GDP	
	(1)	(2)	(3)	(4)
constant	0.064 (0.047)	−1.038 (0.322***)	0.214 (0.026)	0.312 (0.220)
$stdev(\Delta GDP)$	2.227 (0.909**)	2.250 (0.704***)	0.537 (0.478)	0.475 (0.532)
log(GDPpc)		0.062 (0.013***)		0.018 (0.008**)
log(GDP)		0.026 (0.008***)		−0.007 (0.006)
dGDP		0.635 (0.893)		0.828 (0.629)
log(PI)		−0.020 (0.040)		−0.026 (0.028)
open		0.000 (0.000)		0.000 (0.000)
Chinn-Ito		0.004 (0.000)		−0.007 (0.015)
R^2	0.088	0.515	0.021	0.138
adj. R^2	0.072	0.448	0.004	0.018
obs.	59	59	58	58

Notes: Robust (White) standard errors are given in parenthesis. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.

Table 3: Baseline results

	dependent variable							
	$corr(\Delta gdp, \widetilde{\Delta nfa})$			$corr(\Delta gdp, \widetilde{tb})$			$mean(\widetilde{NFA})$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
constant	−0.070 (0.059)	−0.175 (0.541)	−0.760 (0.603)	−0.295 (0.091***)	−0.360 (0.677)	0.556 (0.671)	−0.016 (0.004***)	−0.113 (0.026***)
$stdev(\Delta GDP)$	2.756 (1.043***)	2.797 (1.051***)	4.082 (1.555**)	3.779 (1.768**)	3.906 (1.802**)	5.071 (1.973**)	0.207 (0.072***)	0.249 (0.066***)
D^{NFL}			0.210 (0.151)			−0.081 (0.182)		
$D^{\mathrm{NFL}} \times stdev(\Delta GDP)$			−0.572 (0.227)			−4.281 (3.072)		
log(GDPpc)		−0.053 (0.025**)	−0.036 (0.026)		0.042 (0.028)	0.013 (0.029)		0.004 (0.001***)
log(GDP)		0.025 (0.014*)	0.032 (0.015**)		−0.022 (0.019)	−0.037 (0.020*)		0.001 (0.001)
dGDP		−3.016 (1.633*)	−1.902 (1.698)		−1.332 (2.184)	−3.093 (1.925)		0.175 (0.080*)
log(PI)		0.015 (0.082)	0.022 (0.081)		0.062 (0.100)	0.053 (0.091)		0.009 (0.004**)
open		0.000 (0.000)	−0.000 (0.000)		0.000 (0.000)	0.000 (0.000)		0.000 (0.000)
Chinn-Ito		0.039 (0.031)	0.040 (0.028)		−0.041 (0.032)	−0.038 (0.027)		−0.000 (0.001)
R^2	0.053	0.141	0.209	0.066	0.137	0.299	0.091	0.319
adj. R^2	0.042	0.060	0.111	0.055	0.056	0.212	0.080	0.255
obs.	84	83	83	84	83	83	84	83

Notes: Robust (White) standard errors are given in parenthesis. The dummy D^{NFL} indicates countries with an on average negative NFA position. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.

Table 4: Baseline results for small/large and rich/poor countries

	dependent variable					
	$corr(\Delta gdp, \widetilde{\Delta nfa})$		$corr(\Delta gdp, \widetilde{tb})$		$mean(\widetilde{NFA})$	
	(1)	(2)	(3)	(4)	(5)	(6)
D^{small}	−0.201 (0.584)		−0.308 (0.806)		−0.114 (0.039***)	
D^{large}	−0.085 (0.624)		−0.186 (0.877)		−0.101 (0.037***)	
D^{rich}		0.328 (0.589)		−0.640 (0.744)		−0.138 (0.035***)
D^{poor}		0.004 (0.552)		−0.558 (0.687)		−0.114 (0.029***)
$stdev(\Delta GDP) \times D^{\text{small}}$	3.383 (1.264***)		4.442 (2.178**)		0.317 (0.138**)	
$stdev(\Delta GDP) \times D^{\text{large}}$	1.111 (2.213)		2.544 (3.225)		0.058 (0.099)	
$stdev(\Delta GDP) \times D^{\text{rich}}$		1.412 (1.371)		3.722 (2.361)		0.396 (0.151**)
$stdev(\Delta GDP) \times D^{\text{poor}}$		5.507 (1.680***)		3.747 (2.601)		0.004 (0.062)
log(GDPpc)	−0.052 (0.026**)	−0.091 (0.041**)	0.047 (0.033)	0.071 (0.057)	0.004 (0.001**)	0.005 (0.002**)
log(GDP)	0.025 (0.017)	0.027 (0.014*)	−0.026 (0.027)	−0.022 (0.019)	0.000 (0.000)	0.000 (0.000)
dGDP	−3.182 (1.669*)	−2.901 (1.691)	−1.537 (2.318)	−1.514 (2.286)	0.154 (0.069**)	0.179 (0.065***)
log(PI)	0.017 (0.086)	−0.014 (0.085)	0.058 (0.105)	0.071 (0.101)	0.009 (0.005**)	0.011 (0.004***)
open	0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Chinn-Ito	0.041 (0.032)	0.043 (0.030)	−0.038 (0.033)	−0.043 (0.032)	−0.000 (0.002)	−0.000 (0.002)
R^2	0.147	0.185	0.141	0.143	0.345	0.400
adj. R^2	0.042	0.085	0.035	0.038	0.264	0.326
obs.	84	83	84	83	84	83

Notes: Robust (White) standard errors are given in parenthesis. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.

Table 5: Baseline results with institutional variables

	dependent variable					
	$corr(\Delta gdp, \widetilde{\Delta nfa})$		$corr(\Delta gdp, \widetilde{tb})$		$mean(\widetilde{NFA})$	
	(1)	(2)	(3)	(4)	(5)	(6)
constant	0.223 (0.237)	0.164 (0.237)	−0.839 (0.277***)	−0.364 (0.263)	−0.052 (0.019***)	−0.064 (0.017***)
$stdev(\Delta GDP)$	2.635 (1.082**)	3.202 (1.264**)	3.028 (1.691*)	2.884 (1.942)	0.223 (0.101**)	0.256 (0.122**)
log(GDPpc)	−0.033 (0.029)	−0.024 (0.041)	0.065 (0.031**)	0.019 (0.039)	0.004 (0.002**)	0.007 (0.002***)
qual instit	0.002 (0.051)		−0.129 (0.050**)		−0.000 (0.003)	
log(schooling)		−0.020 (0.087)		−0.029 (0.111)		−0.009 (0.004**)
R^2	0.076	0.082	0.120	0.036	0.197	0.253
adj. R^2	0.042	0.043	0.087	-0.004	0.167	0.222
obs.	84	75	84	75	84	74

Notes: Robust (White) standard errors are given in parenthesis. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.

Table 6: Baseline results with idiosyncratic uncertainty

	dependent variable							
	$corr(\Delta gdp, \widetilde{\Delta nfa})$			$corr(\Delta gdp, \widetilde{tb})$			$mean(\widetilde{NFA})$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
constant	−0.062 (0.072)	−0.204 (0.521)	−0.810 (0.564)	−0.319 (0.091***)	0.441 (0.691)	0.434 (0.649)	−0.017 (0.006***)	−0.117 (0.033***)
$stdev(\Delta GDP^{idio})$	2.773 (1.162**)	3.047 (1.434**)	4.573 (2.492**)	4.536 (1.857**)	4.659 (1.901**)	6.230 (2.254***)	0.239 (0.125*)	0.287 (0.120**)
D^{NFL}			0.218 (0.175)			−0.049 (0.191)		
$D^{\text{NFL}} \times stdev(\Delta GDP^{idio})$			−0.728 (3.056)			−4.736 (3.069)		
log(GDPpc)		−0.054 (0.028*)	−0.037 (0.028)		0.041 (0.028)	0.012 (0.032)		0.004 (0.001**)
log(GDP)		0.027 (0.015*)	0.034 (0.015**)		−0.019 (0.019)	−0.034 (0.017**)		0.001 (0.001)
dGDP		−3.162 (1.571**)	−2.090 (1.588)		−1.574 (2.185)	−3.351 (1.925**)		0.161 (0.066**)
log(PI)		0.016 (0.080)	0.024 (0.078)		0.064 (0.010)	0.056 (0.091)		0.009 (0.004**)
open		−0.000 (0.000)	−0.000 (0.000)		0.000 (0.000)	0.000 (0.000**)		0.000 (0.000)
Chinn-Ito		0.041 (0.028)	0.042 (0.027)		−0.039 (0.031)	−0.035 (0.027)		−0.000 (0.002)
R^2	0.045	0.139	0.207	0.079	0.147	0.309	0.100	0.328
adj. R^2	0.033	0.058	0.110	0.068	0.068	0.224	0.090	0.266
obs.	84	83	83	84	83	83	84	83

Notes: Robust (White) standard errors are given in parenthesis. The dummy D^{NFL} indicates countries with an on average negative NFA position. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.

Table 7: Model implied stylized facts

	dependent variable					
	$corr(\Delta gdp, \widetilde{\Delta nfa})$		$corr(\Delta gdp, \widetilde{tb})$		$mean(\widetilde{NFA})$	
	(1)	(2)	(3)	(4)	(5)	(6)
constant	−1.636 (0.0700***)	−1.224 (0.324***)	−0.680 (0.075***)	−0.783 (0.402**)	−0.003 (0.002*)	0.005 (0.0141)
$stdev(\Delta GDP)$	2.846 (0.298***)	2.428 (0.956***)	9.598 (1.204***)	9.189 (1.188***)	0.225 (0.038***)	0.223 (0.038***)
log(GDPpc)		0.002 (0.016)		−0.010 (0.025)		−0.001 (0.0007)
log(GDP)		−0.019 (0.007***)		−0.001 (0.014)		−0.0000 (0.0004)
dGDP		−9.055 (0.982***)		2.938 (1.684*)		−0.177 (0.043***)
log(PI)		0.108 (0.052**)		0.031 (0.062)		0.002 (0.002)
open		−0.0001 (0.0006)		0.0002 (0.00009**)		0.0000 (0.0004)
Chinn-Ito		−0.027 (0.016*)		0.0195 (0.021)		0.0002 (0.0007)
R^2	0.064	0.639	0.467	0.513	0.305	0.464
adj. R^2	0.052	0.606	0.461	0.467	0.297	0.414
obs.	84	83	84	83	84	83

Notes: Data on $corr(\Delta gdp, \widetilde{\Delta nfa})$, $corr(\Delta gdp, \widetilde{tb})$ and $mean(\widetilde{NFA})$ are generated by the model given the countries' risk profile and growth trends. Robust (White) standard errors are given in parenthesis. A significance level of 1%, 5% and 10% is indicated by ***, ** and *, respectively.