Portfolio Flows in a two-country DSGE model with financial intermediaries

Haakon Kavli and Nicola Viegi

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Abstract

The paper presents a two-country real business cycle model with portfolio flows and risk-constrained financial intermediaries. The novelty of the model is the use of the risk-constraint as a tool to ensure *less-than-perfect* elasticity of demand for financial assets. The modeling of demand elasticity is crucial to understand the causes and consequences of capital flows. Firstly, the elasticity of asset demand is essential in ensuring an interior steady state solution for the portfolio allocation between domestic and foreign assets. Secondly, the elasticity determines the size of portfolio flows in response to external shocks. The risk-constraint may be viewed as macroprudential regulation or a self-imposed rule by the financial intermediary. The model produces results consistent with empirical observations, but provide important new insights for policy makers. Increased risk on any asset, in advanced or emerging economies, lead to portfolio flows from the emerging economy. This causes a temporary drop in consumption in the emerging economy. The effect on consumption is in this case exaggerated by capital flows that are again exaggerated by the risk constraint. An increase in emerging market productivity leads to capital outflows as the emerging market households get wealthier and therefore save and consume more. In this case the capital flow enables the household to smooth consumption by purchasing financial assets back from the foreigner.

1 Introduction

The paper aims to broaden our understanding of the interactions between risk, portfolio flows and macroeconomic variables. A structural model that explains gross portfolio flows must first explain both foreign and domestic demand for financial assets. Secondly, an interior solution in which asset ownership is distributed between residents and non-residents can only arise if the asset demand functions are $less-than-perfectly$ elastic. In this paper we introduce a new tool for modelling the elasticity of asset demand in a rather parsimonious two-country general equilibrium framework. This "tool" adds a binding portfolio risk constraint directly to the financial intermediary's maximisation problem. The risk constraint may be thought of as a simplified *Value at Risk* rule, or alternatively as an externally imposed macroprudential policy. We will argue here that introducing this risk-constraint to a simple real business cycle (RBC) model produces valuable new insights without sacrificing the benefit of tractability and intuition.

As illustrated in *Figure 1*, the past decade has seen large fluctuations in portfolio flows to most emerging economies (IMF, 2014a). China had USD 13.3 billion of equity liabilities to foreigners and USD 7.1 billion of debt liabilities to foreigners in 2001. During the following 12 years, these numbers increased to USD 427.8 billion and USD 192.4 billion respectively. Brazil saw portfolio flows pushing its foreign equity and debt liabilities from USD 33.9 billions and USD 47.5 billion in 2001 to USD 231.4 billion and USD 261.5 billion in 2013. Interestingly, for most emerging economies the bulk of the equity flows happened prior to the global financial crisis of 2008, while the majority of bond flows happened after 2009. *Figure 2* compares the portfolio flows to the GDP of the respective economies, and we see for example that South Africa has experienced capital inflows in bonds and equities from 5.9% and 11% of GDP in 2001 to 12.9% and 27.3% in 2013.

These large and volatile portfolio flows are thought to have significant effects on the recipient economies and have therefore sparked a large body of academic studies into their causes and consequences. For example, the International Monetary Fund (IMF) published in November 2012 their revised institutional view on capital flows (IMF, 2012). In September 2012, the Brookings Institution held a gathering of its Committee on International Economic Policy and Reform with the title *Banks and cross-border capital flows: Policy challenges and regulatory responses* (Brookings Institution, 2012). And the Centre for Economic Policy Research (CEPR) recently published a comprehensive report on the issue of cross border banking in Europe (Allen, Beck, Carletti, Lane, Schoenmaker, and Wagner, 2011).

The model developed in this paper aims to explain what causes these capital flows and how the capital flows may affect the recipient economy. The following paragraphs will briefly review the empirical literature surrounding these two questions. We begin with the former question of explaining capital flows and then move on to a brief discussion of the latter question regarding the macroeconomic effects of these flows. Each subsection is concluded with a short statement of how our model addresses and incorporates the findings of the literature.

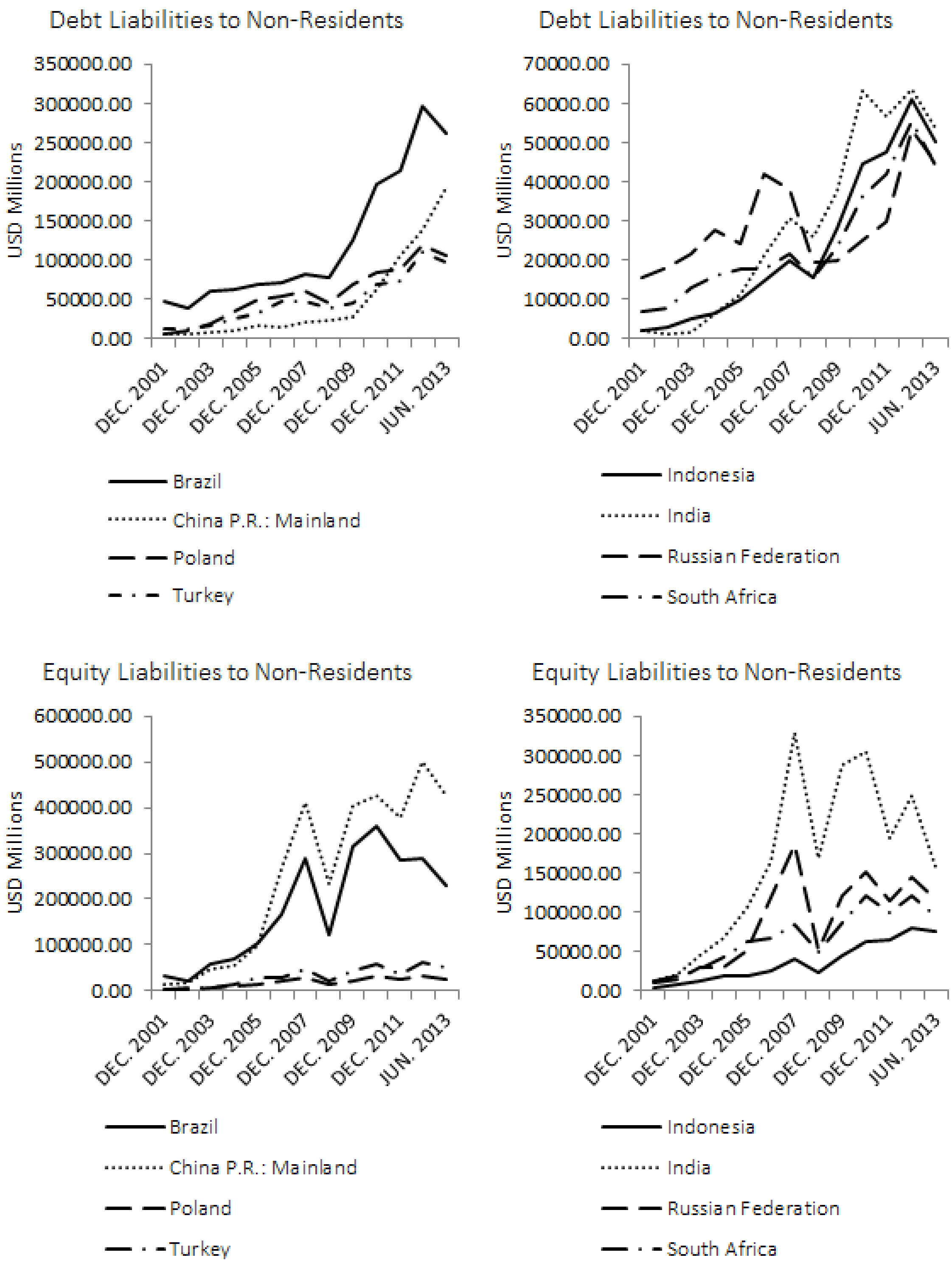

Figure 1: Foreign ownership of debt and equity in selected emerging market economies. Source: IMF (2014a,b)

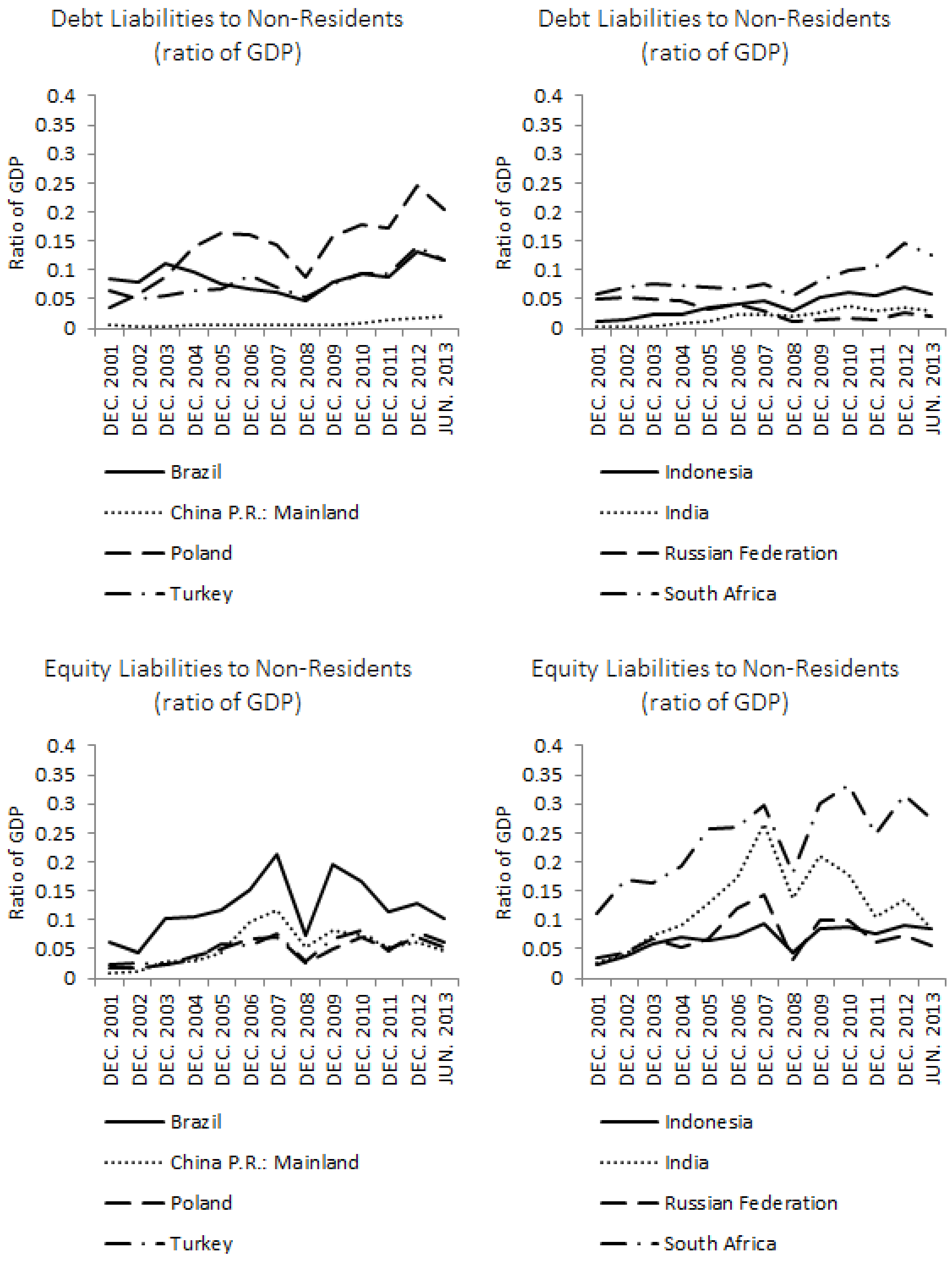

Figure 2: Foreign ownership of debt and equity as share of GDP in selected emerging market economies. Source: IMF (2014a,b)

1.1 Explaining Capital Flows

Taylor and Sarno (1997) find empirical evidence that bond flows to Latin America and Asia between 1988 and 1992 were predominantly caused by global factors, whilst both global and local factors were equally important in determining long-term equity flows. Similar findings were made by Calvo, Leiderman, and Reinhart (1996) who showed that external factors (which they gave the term "push factors" as opposed to domestic "pull factors") were important determinants of capital flows to Latin America in the 1990s. Both papers find US interest rates to be one of the most dominant determinants. [1] Chuhan, Claessens, and Mamingi (1998) conduct a panel study of both bond and equity flows to Latin America and Asia for the same period as Taylor and Sarno (1997), 1988-1992. Their findings indicate that local factors are "at least as important" determinants of capital inflows. In addition they find equity flows to be more sensitive to global factors than bond flows, a finding that goes directly against the evidence found by both Taylor and Sarno (1997) and Calvo et al. (1996). Furthermore Chai-Anant and Ho (2008) make the interesting finding that equity inflows in Asia tend to be driven by common regional (Asian) factors, whilst equity outflows tend to be driven by idiosyncratic local factors. Their results also support the argument of Hau and Rey (2006) that positive asset returns cause a capital outflow from the respective economy as foreign investors rebalance their portfolio.

There are several recent papers that have shown the importance of monetary policy (interest rates) as a driver of capital flows also in more recent times. For example, Taylor (2013) argue that monetary policy in the US tends to force other economies to follow suit with similar policy to avoid the large capital flows caused by the initial change in the US. The link between monetary policy and risk can be very tight, and it is not always straight forward to distinguish the effects of one from the other. For example, Rey (2013) demonstrates forcefully that monetary policy drives capital flows by affecting leverage of global banks and risk / risk aversion. These findings are in strong support of models developed by Adrian and Shin (2009); Bruno and Shin (2013) in which cross-border capital flows are explained by market-based banks targeting a certain level of risk in their portfolio. A drop in expected risk of assets leads the banks to increase leverage until the aggregate risk (measured by the so-called *Value at Risk* metric) is back to its target. This increase in leverage is partly achieved by purchasing foreign assets for borrowed money. McCauley (2012) finds additional evidence that variations in global asset price volatility are driving factors of portfolio flows into emerging market bonds and shares.

The model developed in this paper is largely inspired by these findings of the empirical literature. Global interest rates and the expected risk of asset returns are found to be the main drivers of portfolio flows, and they should therefore be prominent in any general equilibrium model attempting to explain these flows. We therefore explicitly add an exogenous volatility process to the model, and shock this process in order to trace the responses of portfolio flows and macro variables.

1.2 Gross vs. Net Flows and their Macroeconomic Impact

The text book argument in favor of free capital flows suggests that international financial markets are used to hedge risk to future consumption. Without trade, a country can only consume what it produces and is highly vulnerable to swings in production caused by unpredictable states of nature (Obstfeld and Rogoff, 2005). Through *intertemporal* trade a country trades current consumption for future consumption (see for example Obstfeld (2011)). And through *intratemporal* trade a country trades risky assets with another country to smooth their consumption under different stochastic states of nature at a future date. Thus, in simplified terms one may say that intertemporal trade is used to smooth consumption across time by *trading goods for assets*, and intratemporal trade is used to smooth consumption across states of nature by *trading assets for other assets* with different risk profiles. This should raise welfare of risk averse agents and indeed be a Pareto improvement if markets are complete (Obstfeld, 2011). Trading goods for assets would result in an entry on the country's current account, whereas a trade in assets for assets will not. This distinction has recently been drawn into the spotlight, most notably by Borio and Disyatat (2011) who argue heavily against the narrow focus on current account imbalances.

Borio and Disyatat suggests that the global financial crisis of 2008 is too often explained as the consequence of current account imbalances and the net capital flows this entails. Examples of such reasoning include Eichengreen (2009) and Bernanke (2009), who argue that consistent savings above investments in emerging markets caused a flow of capital from these economies into advanced economies with current account deficits. This flow of excess savings pushed down interest rates and incentivized increased credit and risk taking. However, Borio and Disyatat (2011) argue that this focus on excess savings "diverts attention away from the global financing patterns that are at the core of financial fragility" (Borio and Disyatat, 2011). In other words, they suggest that focus should be shifted towards gross flows, that is *intratemporal* trades of assets for assets.

[1] See Calvo (2013) for a more recent discussion of this and other related papers.

Global gross capital flows have increased from approximately 10% of world GDP in 1998 to over 30% in 2007 (Borio and Disyatat, 2011). The volume and composition of these gross flows have not been closely related to the current account deficit (the net flow) of the respective countries. Lane and McQuade (2013) find that "the current account balance is a misleading indicator in understanding the inter-relation between international capital flows and domestic credit growth"'. Forbes (2012) emphasizes the volatility of gross flows and find that both inflows and outflows have been "extremely volatile" in most countries around the world, and that this volatility has sharply increased since the mid-2000s. Again, this volatility is often not visible in net flows, as "gross capital inflows and outflows tend to move simultaneously in opposite directions and be roughly the same magnitude" (Forbes, 2012). Forbes and Warnock (2012) find evidence that while net flows show no significant reaction to global risk, there is a highly significant response in gross capital flows.

In the words of Obstfeld (2011) :"While the general scale and persistence of current account imbalances certainly has increased over the past two decades, even more strikingly - and potentially more threatening to financial and economic stability - is the rapid expansion of *gross* international asset and liability positions [...] [I]t is the gross positions that better reflect the impact on national balance sheets of various economic shocks, including counterparty failure" (emphasis in original).

The model developed in this paper will address some of the issues raised above. We are able to explicitly model gross international asset and liability positions as well as the gross portfolio flows arising from a reallocation of these portfolios. This enables us to study how the portfolio positions and flows respond to external shocks and how they affect macroeconomic variables. The net flows can easily be derived from the gross flows, but net flows will not be the focus of our analysis.

1.3 The Modelling Framework

The purpose of the paper is to develop our understanding of what drives portfolio flows in the real world. Our model economy is naturally a crude simplification and ignores a plethora of opposing forces. The goal is to remove the noise and add a simple structure that allows us to study how different shocks affect the asset demand that further results in portfolio flows and macroeconomic responses.

To highlight the importance of a structural model, consider the following example: A hypothetical increase in non-resident purchases of domestic shares could be caused by any of the following changes in asset demand: reduced demand from residents; increased demand from non-residents; increased demand from both non-residents and residents but a relatively greater increase by non-residents; or even by reduced demand from both residents and non-residents but a relatively greater decline by residents' demand. Each reason have wildly different effects on prices despite an identical direction of capital flows. Similarly they may have different effects on macroeconomic variables in the recipient economy. Clearly, the capital flow is not the cause of macroeconomic changes, but rather a symptom of the underlying cause. This is where the structure of our model is essential: it helps us dissect the observed capital flows and thereby better understand and predict the response of other economic variables.[2]

For these purposes, we will argue that a two-country dynamic stochastic general equilibrium (DSGE) model is appropriate. Most recent DSGE models in international finance and macroeconomics include money and frictions that give rise to a Keynesian multiplier and effective monetary policy. However, the drawback is the very rapid growth in complexity of these models as new elements are added. In order to analyse the response of both share and bond flows to different risk shocks in a two-country DSGE model, this complexity adds a significant cost. Therefore, in order to keep the model and the resulting analysis as tractable as possible, we work in a highly parsimonious RBC framework. While RBC models have lost favor in the academic field, there are several instances of recent research demonstrating that the more parsimonious RBC models can provide valuable insights. McGrattan and Prescott (2014) and Kydland and Zarazaga (2002) show that these models can replicate many empirical observations otherwise thought to be out of the range of RBC models. Devereux and Sutherland (2009) is another good example of a highly informative RBC model related to portfolio flows.

However, by utilising an RBC framework, we give up the ability to analyse the complete relationship between monetary policy, risk, capital flows and the business cycle. We rather focus on the links between market risk and portfolio flows and their more crude relations to saving, consumption and bank leverage.

[2]For further emphasis, consider the following: An empirical study of the effect of portfolio flows on macro economic variables may for example use data on non-resident purchases of domestic shares. A prior hypothesis can be: an increase in non-resident share purchases should, *ceteris paribus*, lead to an increase in the share price. This seems natural, given the increase in demand for shares. However, this seemingly obvious statement is significantly flawed. An increase in non-resident share purchases is just another name for an increase in resident sales of shares. An increase in selling pressure should, *ceteris paribus*, reduce the share price. Which statement is correct? A structural model allows us to disentangle these forces and help us understand what drives the different order flows.

1.3.1 On the elasticity of demand for financial assets

We have argued that capital flows are consequences of changes in relative demand for financial assets. This can be modeled in a general equilibrium framework with two economies where agents in both economies demand domestic and foreign financial assets according to a utility maximisation problem. A capital flow arises when the relative demand shifts from one agent to the other. The characteristics of the asset demand functions will therefore be crucial to understand the drivers of capital flows.

In standard general equilibrium models, the household's demand for financial assets is simply the expected discounted cash flow, familiar to students of both economics and finance. We can for example assume the household faces a simple utility maximization problem represented as: [3]

$$\begin{aligned}&\max_\gamma u(c_t) + E_t[\beta u(c_{t+1})]\\&\text{s.t}\\&c_t + p_t\gamma_t = e_t + x_t\gamma_{t-1}\end{aligned}$$

The first order conditions of this problem gives a demand function:

$$p = E_t\left[\beta \frac{u'(c_{t+1})}{u'(c_t)}\right]$$

The demand is dependent on the discount factor (β) on future expected utility of consumption and on the expected consumption path (c_t). In steady state, the consumption is constant and the demand becomes perfectly elastic equal to β; it does not depend on the quantity of assets held. Once an external shock pushes the consumption away from steady state there will be an adjustment, during which the demand is elastic and downward sloping. During the adjustment, the more financial assets the agent holds, the higher will future consumption be compared to current consumption, implying a temporarily greater discount on future cash flows and thus lower price. In other words: the price the agent is willing to pay is a downward sloping function of the quantity held during the adjustment, but in steady state it is independent of the quantity held. [4]

Now, if there is a second agent in the market, whose steady state discount rate is different, β^*, his demand function will be:

$$p = E_t\left[\beta^* \frac{u'(c^*_{t+1})}{u'(c^*_t)}\right]$$

In steady state, the two demand functions cannot hold at the same time: $p = \beta \neq \beta^*$. By plotting the demand functions together (*Figure 3, Panel a*) we see that there is a boundary steady state solution where the household with the lower discount rate (higher β) holds all assets. An interior solution is only possible if an external shock pushes consumption off the planned consumption path. During the adjustment, there is potential for an interior solution as at least one agent has a downward sloping demand function (for reasons explained above). An example is plotted in *Figure 3* where the Panel *a* illustrates the boundary solution of two perfectly elastic demand functions (the foreign demand is plotted from right to left). Panel *b* illustrates a hypothetical interior solution that arises when the two demand functions have $less-than-perfect$ elasticity.

However, there is no empirical support for a steady state boundary solution as is associated with the perfect elasticity of demand seen in the discounted cash flow representation above. The boundary solution implies that all domestic assets are held either by residents or by non-residents. But in practice we see that domestic financial assets are usually held partly by residents and partly by non-residents. Thus, there needs to be some other characteristic of the maximization problem that ensures an interior solution. This can only occur if asset demand is slightly inelastic in steady state (as in *Figure 3, Panel b*). The source of this inelasticity will determine the model's steady state distribution of financial asset ownership between residents and non-residents.

Furthermore, the elasticity of demand for financial assets will determine the size (and in some cases the sign) of portfolio flows in response to external shocks. Other parts of the model determine how asset demand is affected by the shock, and how macroeconomic variables are affected by the resulting capital flows. But, to reiterate, the size of the capital flow is a direct consequence of the demand elasticity. This is illustrated in *Figure 4* where we shock the home agent's demand for the financial asset. In *Panel a* the foreign demand is relatively inelastic, leading to a small capital flow of size Fa. In *Panel b*, the foreign demand is relatively elastic, leading to a larger capital flow (Fb) in response to the same shock. However, in most cases, both demand functions will

[3] γ_t = holdings of the financial asset, p_t = price of the financial asset, x_t = payoff from financial asset, c_t = consumption, e_t = endowment.

[4] We have assumed that marginal utility with respect to consumption is decreasing as consumption increases.

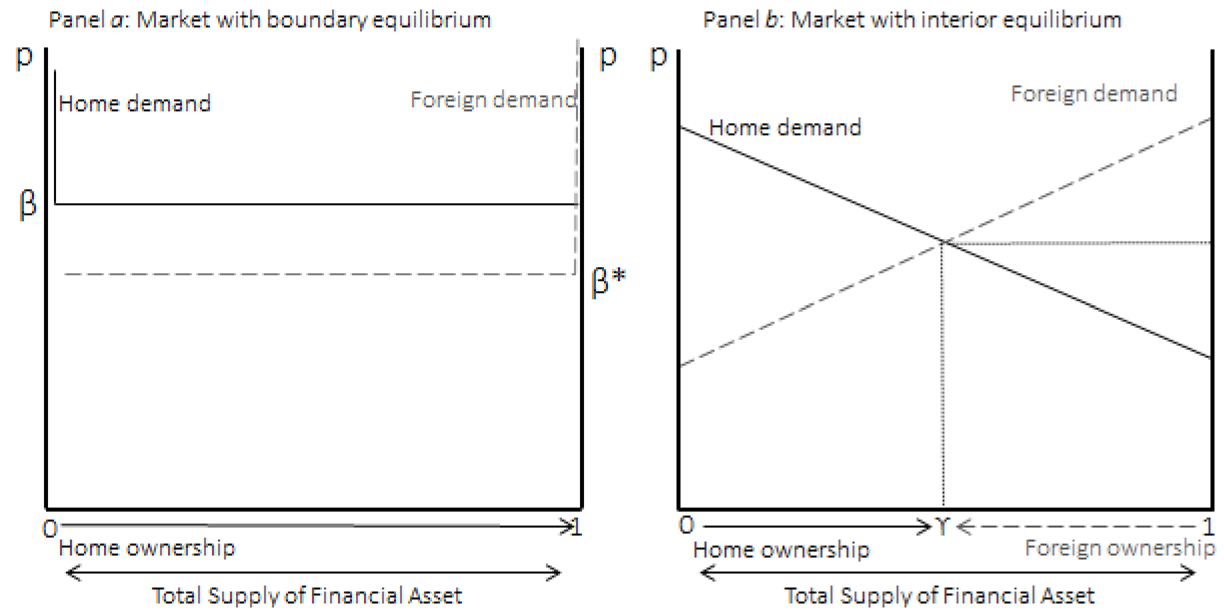

Figure 3: ***Home demand is plotted from left to right and foreign demand plotted from right to left***. There is a fixed supply of financial assets equal to 1 (the full width of the x-axis). Markets clear if total demand for assets from home and foreign add up to the full supply. *Panel a:* Demand from home and foreign are both perfectly elastic. There is a boundary solution where *home* holds all assets ($\gamma = 1$) and foreign holds zero ($\gamma^* = 0$). *Panel b:* Home and foreign demand are both slightly inelastic (downward sloping). There is an interior solution where home holds γ and foreign holds $\gamma^* = 1 - \gamma$.

shift in response to the same shock, either in the same direction or opposite directions, making the elasticity even more significant in determining the size of the resulting capital flow.

Hence, for the purposes of understanding capital flows and their impact on macroeconomic variables, it is essential to study different sources of asset demand elasticity. This is the novelty of the model presented here: we introduce a new source of elasticity. We do not argue that this model is more appropriate than current models, but rather a complement to the current models. The current literature contains a modest pool of models in which portfolio flows are explained by demand, but there is great scope to explore alternative structures affecting demand elasticity. The structure of our model is directly linked to the risk of assets and the optimizing behavior of financial intermediaries. This will be explained in detail later. We will first focus attention on relevant models available in the current literature.

1.3.2 Asset demand in the current literature

There has been significant progress in the modelling of demand for risky assets. A notable contribution is a series of papers including Adrian and Shin (2009, 2010) and Bruno and Shin (2012, 2013) that have carefully modelled the behavior of US market based banks and their demand for risky domestic and foreign securities. However, these are partial equilibrium models and do not take other sectors of the economy into account. They also do not model the households or financial intermediary in the recipient economy, and therefore can not model portfolio flows, but rather cross-border lending. That said, the findings are of high importance and have significantly inspired parts of the model presented in this paper. Most significantly, they argue forcefully for the importance of leverage and risk targeting by these financial intermediaries.

Adrian and Shin (2010) show that market based banks tend to increase leverage when total assets increase. They point out that this must be caused by active leverage management, as an increase in asset prices would otherwise reduce leverage [5]. The positive correlation between assets and leverage may indicate that an increase in the valuation of assets induces the bank to expand its balance sheet even further by taking up debt to purchase more assets. They do this to such an extent that leverage becomes pro cyclical. Adrian and Shin (2009) build a model which produces this outcome from profit maximizing behavior of banks. The model shows

[5] For example, as the price of a home increases the home owner will be less leveraged because her equity in the home increases by the same absolute amount as the home price itself, while debt remains unchanged.

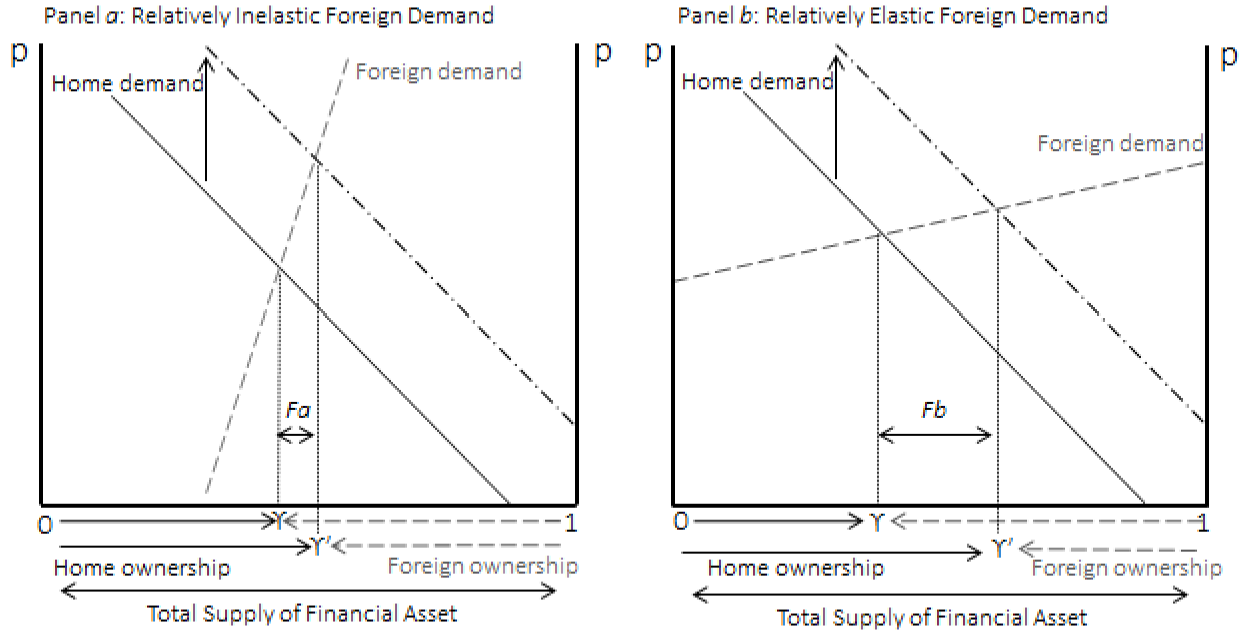

Figure 4: ***Home demand is plotted from left to right and foreign demand plotted from right to left***. *Panel a:* Relatively inelastic demand by the foreign agent. A shock to home demand causes a small capital outflow (the foreign agent sells Fa assets to the home agent). *Panel b:* Relatively elastic demand by the foreign household. A shock to home demand causes a large capital outflow (the foreign agent sells Fb assets to the home agent).

that banks maximize profits by keeping their *Value at Risk* (*henceforth* VaR) at a binding constraint where the probability of bankruptcy is constant. [6]

Furthermore, Adrian and Shin (2009) demonstrate how higher asset prices, *ceteris paribus* will reduce leverage and *Value at Risk (VaR)* on bank's balance sheets. This leads to increased risk appetite as the market based banks aim to increase *VaR* back to its binding limit. Investment banks are now willing to pay more for risky assets, including assets in foreign economies. Based on these insights, Bruno and Shin (2012) and construct a model of cross border financial flows. Bruno and Shin (2013) utilize this model in a study of the relationship between monetary policy in advanced economies (the USA) and capital flows across borders, particularly into emerging markets. Bruno and Shin argue and demonstrate formally how financial intermediary behaviour may affect these capital flows. They build on the result from Adrian and Shin (2009) that market based banks actively keep *VaR* its binding limit to maximize profits and therefore must increase leverage as soon as markets are less volatile (risky). One way of adding risk to their balance sheet is by investing in *EM* assets.

There are several papers that build general equilibrium models where risk and leverage plays an important role. Mendoza (2010) develops a model where leverage is growing with economic expansion, but once leverage reaches a threshold the collateral constraint becomes binding. This causes the cost of credit to increase and may force agents to liquidate assets used as collateral. If this liquidation leads to lower asset prices it may turn into a so called "debt deflation" scenario (ala Fisher (1933)) where the value of collateral falls relative to the book value of debt or revenue. However, this paper focuses on net flows and does not distinguish between different asset classes.

Pavlova and Rigobon (2011) provide a thorough overview of other strands of the portfolio flow literature. A large part of this literature has focused on investor demand for foreign debt and equity. An important example is the extensive research on the so-called home bias in international portfolio allocation (see for exam-

[6] Commercial deposit based banks do not tend to have pro cyclical leverage. This is because deposits are rather stable and the banks can not actively increase leverage unless they turn to wholesale markets for funding. (Hahm, Shin, and Shin (2011) show that a large increase in wholesale funding indicates a lending boom and increased vulnerability to financial crises.) The liabilities of an investment bank, on the other hand, are continuously marked to market and can be expanded or reduced at the will of the bank, typically through repurchase or reverse-repurchase agreements (*henceforth* repo). The high leverage of these institutions make their balance sheet highly sensitive to changes in the borrowing cost. This strengthens the pro-cyclical tendencies of asset and leverage growth, as rapid de-levering will push down asset prices which induces further de-levering(Adrian and Shin, 2009) (further explanations of how leverage accelerates falling asset prices can be found in Brunnermeier and Oehmke (2012) and Brunnermeier (2009)).

ple French and Poterba (1991),Obstfeld and Rogoff (2001), Kollmann (2006),Engel and Matsumoto (2006) and Coeurdacier and Gourinchas (2011)). However, this literature is not able to describe the actual portfolio flows as it ignores demand from investors in the host economy. Secondly, the literature does not study the effects of their asset demand on the host economy. For these purposes, we require a two-country general equilibrium model, where asset demand is explicitly modelled from each economy for each asset class.

Such a general equilibrium model will include agents that maximize expected utility from future consumption. In most models the agents are risk averse (due to decreasing marginal utility of consumption) and will therefore seek to maximize returns while minimizing risk. Importantly, the variance and covariance between the financial assets will therefore affect the optimal allocation. In order to preserve these characteristics in the solution, the model must either be solved using second order approximations (otherwise the second moments will disappear and asset demand depends solely on expected return) or these characteristics must be explicitly included in the optimization problem. The former approach has been explored and solved by Devereux and Saito (2006),Devereux and Sutherland (2009) and Devereux and Sutherland (2011). These models are able to find an interior solution for the allocation of ownership of financial assets between foreign and domestic investors by using an endogenous discount rate in the households utility function. The outcome is a downward sloping $less-than-perfectly$ elastic demand for financial assets. Devereux and Sutherland (2009) applies this model to a study of portfolio flows to emerging markets. As such, they answer many of the questions we raise in this paper.

However, there is still scope to merge the findings from Shin and co-authors with those of Devereux and Sutherland. In this paper we construct a model with similar households and firms as Devereux and Sutherland (2009), but we include a financial intermediary with characteristics similar to Bruno and Shin (2012) and Adrian and Shin (2010). We also add an exogenous risk process which affects the financial intermediary. The financial intermediary is risk-constrained and maximises profits by targeting this constraint. This process allows us to capture the variance and covariance between assets and thereby find the optimal asset allocation without the need for second order approximations. The following section will provide a detailed derivation of this model before the results are analysed.

2 The model

2.1 Summary of the model

We develop a two-country Real Business Cycle (RBC) model, where each economy includes a representative household, a financial intermediary, a government and a firm. We label the economies *home* and $foreign$, where *home* is thought of as an emerging market and $foreign$ is thought of as an advanced economy. The focus of the analysis is on the *home* economy, which recieves capital flows from the $foreign$ economy. The capital flow takes the shape of $foreign$ agent sales or purchases of *home* bonds and shares. However, we impose a capital control that prohibits the *home* agents from investing in $foreign$ assets. This is simply thought of as a form of capital controls on portfolio outflows found in several emerging economies (Schindler, 2009). Using data on financial transactions for 91 countries between 1995 and 2005, Schindler (2009) finds that emerging markets tend to impose more controls on outflows than on inflows, and they do so to a much larger extent than developed economies. These controls are most prominent in South Asia and Sub-Saharan Africa, while least prominent in North America and Western Europe (Schindler, 2009).

There are further distinctions between the *home* and $foreign$ economy, and these will be highlighted as we introduce equations represting the respective agents of the model.

See $AppendixA$ for a key to the notation. All numbered equation are part of the final model. There are 27 equations for 27 endogenous variables (of which quite a few are definitions in terms of other variables).

2.2 Households

2.2.1 Home household:

The representative *home* household maximises expected utility by choosing consumption, labour and deposits in the *home* financial intermediary subject to a budget constraint:

$$\max \Sigma_{t=0}^{\infty} \beta^t E_0 \left[\frac{c_t^{1-\rho}}{1-\rho} - \chi \frac{h_t^{1-\gamma}}{1+\gamma} \right] \qquad \text{s.t}$$

$$c_t + d_t = g_t + w_t h_t + (1 + r_t^d) d_{t-1} - \frac{\psi_d}{2} d_t^2 \tag{1}$$

which gives the following first order conditions:

$$c_t^{-\rho} = \chi \frac{h_t^{\gamma}}{w_t} \tag{2}$$

$$1 + r_t^d = E_t\left[\frac{1}{\beta}(\frac{c_{t+1}}{c_t})^{\rho}\right](1 + \psi_d d_t) \tag{3}$$

Note that we have imposed a small cost (baseline calibration has $\psi_d = 0.05$) on squared deposits. This is done to avoid perfect elasticity of household demand for deposits (i.e: supply of liabilities to the intermediary). A key difference between financial intermediaries funded by deposits to intermediaries funded in the wholesale market is that the supply of deposit liabilities is relatively inelastic. In this model we therefore impose this inelastic behaviour on the *home* intermediary to capture this trait. Below, we will see that the baseline calibration of our model keeps the $foreign$ household's cost of deposits at zerp. This ensures a perfectly elastic supply of deposit liabilities to the foreign intermediary. This distinction in the calibration is motivated by (Adrian and Shin, 2010) and (Bruno and Shin, 2013) who argue that market based banks in the US have highly elastic liabilities that are actively managed. This is less true for commercial deposit based banks that are more common in emerging economies.

It is important to note that the hosehold saves by supplying deposits to the financial intermediary. This deposit is assumed to be risk free as it would be if a credible government provided deposit insurance. The household is thus inhibited from investing directly in shares and bonds, but they do get indirect exposure through the intermediary. An increase in financial asset returns will indeed increase the deposit rate, as we will see later.

2.2.2 Foreign household:

The $foreign$ household is identical to the *home* household except that they recive an exogenous endowment instead of working. This simplication is done in order to keep the model as parsimonious as possible, and does not cause a loss of value as we are interested here in analysing the fluctuations in the *home* econony. The $foreign$ household maximises expected utility by choosing consumption and deposits in the $foreign$ financial intermediary subject to a budget constraint:

$$\max \Sigma_{t=0}^{\infty}\beta^t E_0\left[\frac{c_t^{*1-\rho}}{1-\rho}\right] \qquad \text{s.t}$$

$$c_t^* + d_t^* = n_t + (1 + r_t^{*d})d_{t-1}^* - \frac{\psi_d^*}{2}(d_t^*)^2 \tag{4}$$

which gives the following first order condition:

$$1 + r_t^{*d} = E_t\left[\frac{1}{\beta}(\frac{c_{t+1}^*}{c_t^*})^{\rho}\right](1 + \psi_d^* d_t^*) \tag{5}$$

As for the *home* household, there is a cost of holding deposits which depends on the amount held. In our baseline calibration, this cost is calibrated to be zero for the $foreign$ household.

2.3 Financial Intermediaries

The financial intermediaries take deposits from households and invest in shares and bonds. They construct a portfolio at time t to maximize the payoff (θ) in the following period ($t+1$) subject to a binding risk constraint. We will interchangeably use returns and prices in equations, where the relation between the two are as usual:

$$E_t(1 + r_{t+1}^s) \equiv E_t\frac{p_{t+1} + \pi_{t+1}}{p_t} \tag{6}$$

$$E_t(1 + r_{t+1}^{sf}) \equiv E_t\frac{p_{t+1}^f + y_{t+1}^f}{p_t^f} \tag{7}$$

$$1 + r_t^b \equiv \frac{1}{q_t} \tag{8}$$

$$1 + r_t^{rf} \equiv \frac{1}{q_t^{rf}} \tag{9}$$

The return series are independent with exogenous variance $\sigma_s^2 > 0$, $\sigma_{sf}^2 > 0$, $\sigma_b^2 = 0$ and $\sigma_{rf}^2 = 0$. For the $foreign$ intermediary there is a third source of risk affecting *home* bonds and shares via the foreign exchange rate return r_t^x. The exchange rate return has expected value, $E_t(r_t^x) = 0$ and variance, σ_x^2.

2.3.1 Home intermediary:

The *home* intermediary borrows from *home* households by raising deposits. These deposits are then invested in bonds and equity in order to maximize the profit in the investment period. The profit is simply the difference between the payoff on assets and the total deposit and interest liabilities. The constraints are that assets must equal liabilities and that the leverage of portfolio cannot exceed a limit depending on the risk of the portfolio. If there is zero risk, the intermediary can have leverage approaching infinity. If the risk approaches infinity, the leverage must approach zero. We will see that in steady state, this constraint is binding and the firms will respond to any shocks by adjusting leverage back to this binding constraint.

This leverage / risk constraint can be thought of as a simplified *Value at Risk* target, or as an externally imposed macroprudential policy. The outcome is that the intermediary will behave in manner similar to that described by Adrian and Shin (2010) and Bruno and Shin (2013).

The decision problem of the financial intermediary can be formally expressed as:

$$
\begin{aligned}
&\max E_t(\theta_{t+1}) \\
&\text{subject to:} \\
&E_t(\theta_{t+1}) = E_t\left[(1+r^s_{t+1})p_t s_t + b_t - (1+r^d_{t+1})d_t\right] \\
&p_t s_t + q_t b_t = d_t \\
&\frac{q_t b_t}{d_t} \geq 1 - e^{-\psi\sigma_\theta^2}
\end{aligned}
$$

where the only risky asset is the shares. The expected risk on shares is an exogenous process, σ_s^2. Thus the variance of the portfolio and its derivative with respect to s_t is:

$$\sigma_\theta^2 = \sigma_s^2 (p_t s_t)^2 \tag{10}$$

$$\frac{\delta\sigma_\theta^2}{\delta s_t} = 2p_t^2\sigma_s^2 s_t \tag{11}$$

As long as the expected return on shares and bonds are greater than the cost of deposits, the financial intermediaries will always be operating at the maximum allowed risk (the leverage constraint is binding). Thus we have the following first order conditions:

$$p_t = E_t\left[\frac{p_{t+1} + \pi_{t+1} - d_t\psi\frac{\delta\sigma_\theta^2}{\delta s_t}(r^d_{t+1} - r^b_{t+1})}{1 + r^b_{t+1} + e^{\psi\sigma_\theta^2}(r^d_{t+1} - r^b_{t+1})}\right] \tag{12}$$

$$b_t = \frac{p_t s_t}{q_t}(e^{\psi\sigma_\theta^2} - 1) \tag{13}$$

$$d_t = p_t s_t e^{\psi\sigma_\theta^2} \tag{14}$$

It appears from equation 13 that as long as $r_t^d > r_t^b$, the demand for shares is downward sloping with respect to s_t and σ_s^2. This is intuitive: the intermediary will add risk by increasing the position in high yield assets (shares) and reducing the position in low yielding bonds. This is done until the risk constraint is binding. At this point, adding more shares is only possible if the price is reduced (thereby keeping the exposure unchanged). This implies a downward sloping demand function. Similarly, if the risk of shares increases, the constraint becomes more binding and the share position must be reduced.

This is a vital characteristic of the financial intermediary's behavior. Without this downward sloping, *less-than-perfect* elasticity of demand, there would be no interior solution in the asset allocation problem. Thus, the risk constraint serves three purposes in the model: It enables an interior solution, it ensures that the agents take the variance and covariance between assets into account when building a mean-variance optimal portfolio, and lastly it allows us to study the effects of macroprudential policy on capital flows and the macro economy.

2.3.2 Foreign intermediary:

The $foreign$ intermediary maximises expected profit by investing in *home* and $foreign$ assets. All *home* assets carry an additional risk orthogonal on the other risk factors. This risk factor may be thought of as an exchange rate risk, country risk, emerging market risk or intermediation risk that only affects $foreign$ investors when investing in *home* assets. The $foreign$ bonds are perfectly risk free.

We can express the maximization problem as:

$$
\begin{aligned}
&\max E_t(\theta^*_{t+1}) \\
&\text{subject to:} \\
&E_t(\theta^*_{t+1}) = E_t\Bigg[(1+r^s_{t+1})p_t s^*_t + (1+r^{s,f}_{t+1})p^f_t s^f_t + b^*_t + b^{rf}_t - (1+r^{*d}_{t+1})d^*_t\Bigg] \\
&p_t s^*_t + p^f_t s^f_t + q_t b^*_t + q^{rf}_t b^{rf}_t = d^*_t \\
&\frac{q^{rf}_t b^{rf}_t}{d^*_t} \geq 1 - e^{-\psi^* \sigma^2_{\theta^*}}
\end{aligned}
$$

where the required return on *home* shares by the foreigner can be decomposed into required compensation for the share risk and orthogonal emerging market risk. Similarly, the required return by the foreigner on the *home* bond can be decomposed to the risk free bond return and the emerging market risk:

$$
\begin{aligned}
E_t\Bigg[1 + r^s_{t+1}\Bigg] &= E_t\Bigg[(1+r^i_{t+1})(1+r^x_{t+1})\Bigg] \\
E_t\Bigg[1 + r^b_{t+1}\Bigg] &= E_t\Bigg[(1+r^{rf}_{t+1})(1+r^x_{t+1})\Bigg]
\end{aligned}
$$

The variance of the $foreign$ intermediary's payoff is therefore more complex than for *home*, as it depends on the emerging market risk (σ^2_x), idiosyncratic *home* share risk (σ^2_s) and idiosyncratic $foreign$ share risk (σ^2_{sf}). Importantly, the foreigner's expected *total* return on *home* shares and bonds is correlated via the emerging market risk compensation. It is also worth noting that the realised correlation between *home* and $foreign$ share prices is very high in response to all types of risk shocks, despite the underlying return processes being independent. Importantly this *ex post* correlation is not taken into account in the portfolio optimisation problem.

The variance of the total payoff and its derivatives are then:

$$
\begin{aligned}
\sigma^2_{\theta^*} &= (p_t s^*_t)^2\Bigg(\sigma^2_s + \sigma^2_x(1+\sigma^2_s + (E_t[r^i_{t+1}])^2 + 2E_t[r^i_{t+1}])\Bigg) \\
&+ (q_t b^*_t)^2\sigma^2_x\Bigg(1 + (r^{rf}_{t+1})^2 + 2r^{rf}_{t+1}\Bigg) \\
&+ 2p_t s^*_t q_t b^*_t \sigma^2_x\Bigg(1 + (E_t[r^i_{t+1}])^2 + (r^{rf}_{t+1})^2 + E_t[r^s_{t+1}]r^{rf}_{t+1})\Bigg) \\
&+ (s^f_t p^f_t)^2\sigma^2_{sf} \qquad (15) \\
\frac{\delta\sigma^2_{\theta^*}}{\delta s^*_t} &= 2p^2_t s^*_t\Bigg(\sigma^2_s + \sigma^2_x(1+\sigma^2_s + (E_t[r^i_{t+1}])^2 + 2E_t[r^i_{t+1}])\Bigg) \\
&+ 2p_t b_t \sigma^2_x\ \Bigg(1 + (E_t[r^i_{t+1}])^2 + (r^{rf}_{t+1})^2 + E_t[r^s_{t+1}]r^{rf}_{t+1})\Bigg) \qquad (16) \\
\frac{\delta\sigma^2_{\theta^*}}{\delta b^*_t} &= 2b^*_t\sigma^2_x\Bigg(1 + (r^{rf}_{t+1})^2 + 2r^{rf}_{t+1}\Bigg) \\
&+ 2p_t s_t \sigma^2_x\Bigg(1 + (E_t[r^i_{t+1}])^2 + (r^{rf}_{t+1})^2 + E_t[r^s_{t+1}]r^{rf}_{t+1})\Bigg) \qquad (17) \\
\frac{\delta\sigma^2_{\theta^*}}{\delta s^f_t} &= 2s^f_t(p^f_t)^2\sigma^2_{sf} \qquad (18)
\end{aligned}
$$

As long as the risk free rate of return is less than the funding rate (deposit rate) the first order conditions are:

$$p_t = E_t\left[\frac{p_{t+1} + \pi_{t+1} - d_t^* \psi^* \frac{\delta\sigma_{\theta*}^2}{\delta s_t^*}(r_{t+1}^{d*} - r_{t+1}^{bf})}{1 + r_{t+1}^{bf} + e^{\psi^*\sigma_{\theta*}^2}(r_{t+1}^{d*} - r_{t+1}^{bf})}\right] \tag{19}$$

$$p_t^f = E_t\left[\frac{p_{t+1}^f + \pi_{t+1}^f - d_t^* \psi^* \frac{\delta\sigma_{\theta*}^2}{\delta s_t^f}(r_{t+1}^{d*} - r_{t+1}^{bf})}{1 + r_{t+1}^{bf} + e^{\psi^*\sigma_{\theta*}^2}(r_{t+1}^{d*} - r_{t+1}^{bf})}\right] \tag{20}$$

$$1 = E_t\left[\frac{1 + r_{t+1}^* - d_{t+1}^* \psi^* \frac{\delta\sigma_{\theta*}^2}{\delta b_t^*}(r_{t+1}^{d*} - r_{t+1}^{bf})}{1 + r_{t+1}^{bf} + e^{\psi^*\sigma_{\theta*}^2}(r_{t+1}^{d*} - r_{t+1}^{bf})}\right] \tag{21}$$

$$b_t^* = (p_t s_t^* + p_t^f s_t^f)(e^{\psi\sigma_\theta^2} - 1) \tag{22}$$

$$d_t^* = (p_t s_t^* + p_t^f s_t^f)e^{\psi\sigma_\theta^2} \tag{23}$$

2.4 The firm

The *foreign* firm is not modelled explicitly and simply provides an exogenous dividend stream to the share holders. The *home* firm produces a global good using *home* labour and it's own invested capital. The firm is a price taker and earns profits sufficient to compensate for the required return on capital owned by the firm itself.

The *home* firm maximizes share holder value by maximizing the present value of current and future expected dividends. The firm's decision involves investing in physical capital as well as hiring employees. Note that the firm owns the capital used in production and funds investment in capital by reinvesting profits. The investment decision for the firm depends on whether the present value of the capital investment is greater than the foregone dividend payment. There is an adjustment cost (ϕ) associated with investing in physical capital.

$$\max\ E_0\Sigma_{t=0}^{\infty}\beta^t\left[a_t k_t^{\mu} h_t^{1-\mu} - w_t h_t - i_t - \frac{\phi}{2}i_t^2\right] \qquad \text{s.t:}$$

$$k_{t+1} = i_t + (1-\delta)k_t \tag{24}$$

which yields the FOCs:

$$w_t = (1-\mu)a_t\left(\frac{k_t}{h_t}\right)^{\mu} \tag{25}$$

$$i_t = E_t\frac{\beta}{\phi}\left[\mu a_{t+1}\left(\frac{h_{t+1}}{k_{t+1}}\right)^{1-\mu} + (1-\delta)(1+\phi i_{t+1})\right] - \frac{1}{\phi} \tag{26}$$

Dividends paid to the share owners are equal to total revenue less labour cost, investment and investment cost:

$$\pi_t = a_t k_t^{\mu} h_t^{1-\mu} - w_t h_t - i_t - \frac{\phi}{2}i_t^2 \tag{27}$$

2.5 Government

The respective governments borrow by issuing bonds and raise taxes (g) on the domestic household to fund the debt service cost:

$$g_t = b_t^S - (1 + r_t^b)b_{t-1}^S \tag{28}$$

$$g*_t = b_t^{S*} - (1 + r_t^{bf})b_{t-1}^{S*} \tag{29}$$

2.6 Market Clearing

The *home* bond and equity markets clear when domestic and foreign agents demand all issued bonds and shares. The *foreign* bond and share markets clear when all issued assets are demanded by the *foreign* intermediary.

$$b_t + b_t^* = b_t^S \tag{30}$$

$$b_t^{rf} = b_t^{S*} \tag{31}$$

$$s_t + s_t^* = 1 \tag{32}$$

$$s_t^f = 1 \tag{33}$$

2.7 Exogenous processes

The following exogenous variables are modelled as autoregressive processes with i.i.d shocks:

$$b_t^S = \bar{b}(1-\alpha) + \alpha b_{t-1}^S + \epsilon_t^b \tag{i}$$
$$b_t^{S*} = \bar{b}(1-\alpha) + \alpha b_{t-1}^{S*} + \epsilon_t^{b*} \tag{ii}$$
$$\pi_t^* = (1-\alpha) + \alpha \pi_{t-1}^* + \epsilon_t^{\pi} \tag{iii}$$
$$a_t = \bar{a}(1-\alpha) + \alpha a_{t-1} + \epsilon_t^a \tag{iv}$$
$$\sigma_t^s = \bar{\sigma}^s(1-\alpha) + \alpha \sigma_{t-1}^s + \epsilon_t^{\sigma^s} \tag{v}$$
$$\sigma_t^{sf} = \bar{\sigma}^{sf}(1-\alpha) + \alpha \sigma_{t-1}^{sf} + \epsilon_t^{\sigma^{sf}} \tag{vi}$$
$$\sigma_t^x = \bar{\sigma}^x(1-\alpha) + \alpha \sigma_{t-1}^x + \epsilon_t^{\sigma^x} \tag{vii}$$
$$\psi_t = \bar{\psi}(1-\alpha) + \alpha \psi_{t-1} + \epsilon_t^{\psi} \tag{viii}$$
$$\psi_t^* = \bar{\psi}^*(1-\alpha) + \alpha \psi_{t-1}^* + \epsilon_t^{\psi^*} \tag{ix}$$
$$\beta_t^* = \bar{\beta}^*(1-\alpha) + \alpha \beta_{t-1}^* + \epsilon_t^{\beta^*} \tag{x}$$
$$n_t = \bar{n}(1-\alpha) + \alpha n_{t-1} + \epsilon_t^n \tag{xi}$$
$$r_t^x = \epsilon_t^x \tag{xii}$$

where in the base calibration: $\bar{\sigma}_s = 0.1$, $\bar{\sigma}_x = 0.005$, $\bar{\sigma}_{sf} = 0.001$, and $E(\epsilon_t^i) = 0$ for all processes i. Note that there is a significant simplification (approximation) in that the *ex ante* variance of share returns (σ^s) is independent of the variance of the technology (a_t) that drives these returns.

3 Capital Flows; causes and consequences

The asset demand functions of the intermediaries are best studied by plotting the numerical impulse responses. Here we focus on the response of demand functions to understand how capital flows respond to a set of shocks. We further study the response of other macroeconomic variables in the *home* economy in response to the same shock, and discuss the role of capital flows in transmitting the shock from one economy to the other. We also discuss whether the capital flows and the intermediaries' binding risk constraint serves to dampen or amplify the response to the respective shocks.

A key finding of our analysis is that the *consequences* of capital flows are highly dependent on the *causes* of the capital flow. We find that the flows will amplify the macroeconomic response to certain risk shocks and dampen the response to a productivity shock. We also find that capital flows and asset prices respond differently depending on whether the shock is expected to be completely transitory or long lasting. Lastly we find that macroeconomic variables respond similarly to most risk shocks, but may be associated with different signs on the capital flows and asset prices. This underscores the danger in applying a one-size-fits-all policy response to capital flows. Despite the model's crude simplification of reality, we argue that these insights provide a valuable guide to policy makers.

3.1 A shock to total factor productivity

The section begins with a shock to the total factor productivity in the *home* economy. There are two advantages of opening the analysis with a study of this shock: Firstly, because virtually every publication of a DSGE model includes a shock to total factor productivity, we are by now well aware of the expected responses. Thus, we will immediately learn where our model is in line with the literature, and where it deviates. Secondly, the shock to total factor productivity provides a neat example of how the structure of the model allows us to gain insights into the causes and consequences of capital flows that we would otherwise be ignorant of. The importance of this structure is made clear by comparing the effects of a temporary shock to that of a long lasting shock.

3.1.1 A temporary productivity shock

First, in $Figure$ 5, we shock total factor productivity (a_t from the Cobb Douglas production function of the firm, equation 27) with zero autocorrelation in the shock; that is, the productivity is unusually high for one period, before it returns to the steady state level. All the usual effects are found: We see that contemporaneous wages increase due to higher marginal productivity of labour. The higher wages lead to higher supply of labour in the same period, followed by labour supply temporariliy below steady state. Higher labour and wages means a higher income which is divided into to higher consumption and higher savings. There is a temporary increase in GDP.

The effects on capital flows depend on the change in demand for *home* shares and bonds by the two intermediaries. This demand depends on a variety of factors including the expected payoff from shares and bonds, the risk of the assets and the supply of liabilities to fund asset purchases. In response to this productivity shock, there is no effect on the riskiniess of the assets, so any change in demand will come from the other two factors.

First, both the *home* and *foreign* intermediary will consider the shock's impact on expected payoff from *home* shares. Higher productivity, *ceteris paribus*, should mean a greater payoff, and thus more demand for shares from both intermediaries. However, the payoff on shares depends on future production, while the shock only directly affects contemporaneous production. Thus, there is no direct effect on the expected payoff on the shares. Indirectly, the positive productivity shock turns out to have a negative effect on future production and therefore leads to less demand from both intermediaries.

This counter intuitive response is explained by the firm itself responding to the temporary shock by reducing the stock of capital. Remember that the firm owns the capital and invests in order to maximise expected current and future dividends (profits). An investment today only increases the stock of capital in the next period, but by that time the total factor productivity is back to normal. Therefore, if the shock has zero autocorrelation, the shock itself gives no reason to invest in capital. On the other hand, the supply of labour is lower than usual in the following periods, leading to lower marginal product of capital. The optimal response of the firm is therefore to reduce the stock of capital and pay the proceeds as dividends today. Since the shares are claims on future profits, and (unfortunately) the future profits of the firm are lower than before, the demand and price of shares will fall. But this effect is identical on both intermediaries and has an ambiguous effect on capital flows.

However, demand for shares depends on more than just the expected payoff. Importantly, the shock has increased the marginal product of labour, and thereby increased the wage paid on labour, which in turn leads the *home* households to work more, earn more and save more while productivity is high. Households save by supplying deposits to the intermediary. The intermediary uses the deposits to fund investment in shares and bonds. Thus, the *home* intermediary will increase demand for assets. In sum, we see that the *foreign* intermediary will reduce demand for shares, while the *home* intermediary is faced with two opposing forces: lower expected payoffs reduce demand while increased supply of liabilities will increase demand. The net effect is a higher demand from the *home* intermediary *relative to* the *foreign* intermediary.

This change in relative demand causes a capital outflow from *home* shares and bonds in the period of the shock: the *foreign* intermediary sells *home* assets to the *home* intermediary. In the following periods, the initial capital outflow is reversed by recurring small capital inflows until the portfolio positions have returned to steady state. It takes approximately 20 months for the portfolio *inflows* to reverse the full amount of the portfolio *outflow* caused by the shock.[7]

Coincidentally we observe a negative correlation between capital flows and share prices, as one would normally expect. Naive observers will likely conclude that the capital outflow led to lower share prices, despite the temporary increase in productivity. But this is not correct; the lower share price is caused by lower future profits, not by capital outflows. The direction of the capital flow is largely irrelevant. This is illustrated well by studying the responses of the bond market. Here, the shock has no effect on the expected payoff, nor on the risk of the asset. The only effect is due to higher demand for assets caused by the higher savings at *home*. This higher demand pulls up bond prices and causes a capital outflow as *home* agents increase demand relative to *foreign* agents. Note that the correlation between capital flows and asset prices are of opposite sign in the two markets. To further illustrate the lack of consistency in price responses to capital flows, the following section will demonstrate that the same shock will have the same effect on capital flows, but the opposite effect on prices if we add autocorrelation to the shock.

3.1.2 An autocorrelated productivity shock ($\alpha = 0.8$)

In *Figure* 6 we again shock total factor productivity, but this time with *high* autocorrelation in the shock. Similarly to the temporary shock, higher total factor productivity at home leads to higher *home* savings and thus higher *home* intermediary demand for shares and bonds. However, by introducing autocorrelation to the shock, it is now optimal for the firm to invest in capital to exploit the higher marginal product of capital in the following periods. This leads to higher future expected profits, and thus higher demand for shares from both

[7] When reviewing the plotted impulse responses; note that `s_f` indicates the response of *foreign* holdings of *home* shares. Thus a drop in `s_f` indicates a capital outflow, while an increase in `s_f` indicates a capital inflow. All shocks lead to an initial capital flow, which is then gradually reversed by capital flows in the opposite direction over the following periods until the portfolio positions return to their steady state value.

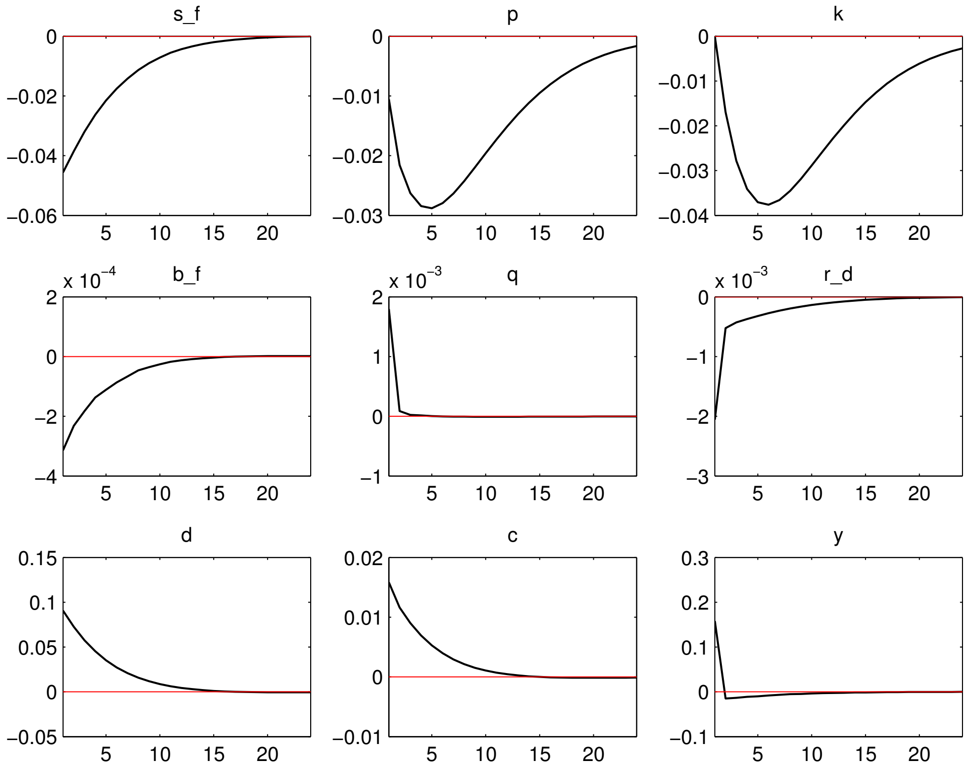

Figure 5: One-Period Shock to firm productivity

home and *foreign* intermediaries. In response to higher demand, the share price will increase. But, interestingly, this higher share price is associated with a capital outflow. The outflow is caused by *home* demand for shares increasing more than *foreign* demand, due to the higher savings at *home*.

The expectation of higher future total factor productivity and profits lead to other interesting responses as well. The supply of deposits increase with higher savings, but interestingly the deposit rates also increase. This indicates that demand for deposits increase quicker than supply, leading to a higher "price". The cause of the higher demand is the fact that share returns are expected to be higher, so the intermediary will try to increase leverage by borrowing from households to invest in shares. The intermediary will also shift exposure from bonds to shares and we therefore see lower bond prices. This is standard, an expansion of GDP and profits increase the expected return on investment in general and thereby increases the opportunity cost of holding bonds.

3.1.3 Implications for policy

The macroeconomic fluctuations following the productivity shock are reduced by the presense of free capital flows for *foreign* investors. Note that GDP increased in response to this shock because the *home* households work more, produce more and consume more. However, the households also save more leading to sharply lower deposit rates. These deposit rates depend on both supply and demand for deposits. In this case, the *home* intermediary puts these deposits to use by purchasing *home* shares from the *foreign* intermediary. Now consider the responses of this option was not available, say the *foreign* intermediary was restricted from selling shares or even holding them in the first place. In this scenario, the *home* intermediary will still increase demand for shares, but this time the entire change in demand must be adjusted in the price of the shares. This reduces the expected return on the shares, and therefore reduces the demand for deposits. This means that the drop in deposit rates will be even greater, the increase in deposits will be smaller and the increase in consumption greater.

3.1.4 Summary

We have shocked the same variable twice, once with no autocorrelation and once with high autocorrelation. Both instances lead to capital outflows in both shares and bonds. But in the former case, bond prices increased and share prices dropped. In the latter case, bond prices dropped and share prices increased. This will be a recurring story in the paper: The correlation (and causation) between capital flows, asset prices and other

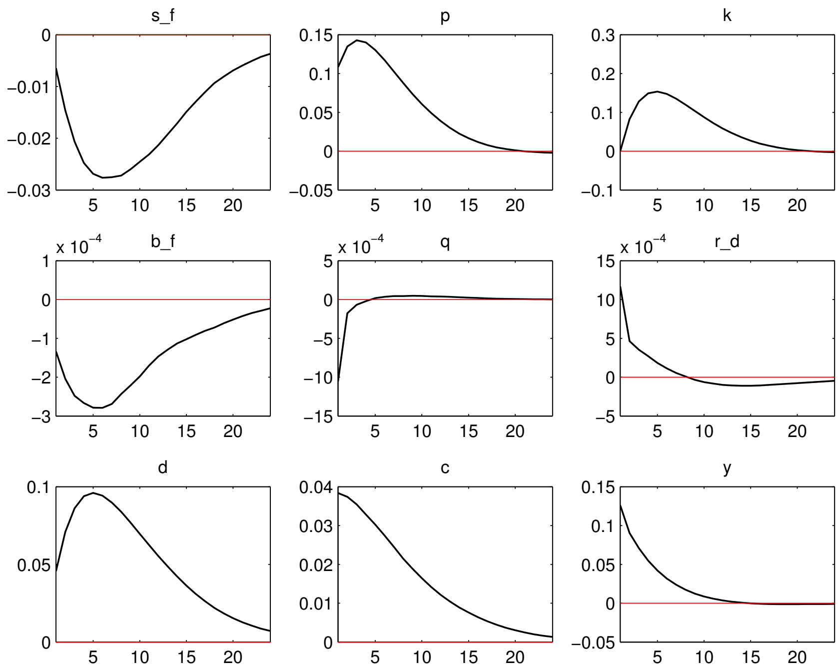

Figure 6: Autocorrelated ($\alpha = 0.8$) shock to firm productivity

economic variables is highly dependent on the underlying causes of the capital flow. In this latter example the outflow was associated with an expansion at home and higher share prices, the opposite of what would typically be expected. This is where the use of our model is the most valuable: it enables the policy maker to better understand the appropriate response to different causes of capital flows.

In the following sections we will systematically go through the effects of three different types of risk shocks and their effect on capital flows and the *home* economy. The optimal policy response to the capital flows will be discussed for each individual shock.

3.2 Risk shocks

We will now shift focus to the effects of risk shocks on capital flows and economic variables at *home*. We have three sources of risk in our model: idiosyncratic home equity risk, home country risk (exchange rate risk), and idiosyncratic foreign equity risk. One would generally expect an increase in risk to cause capital flows out of emerging markets. The model's predictions are in line with these expectations: No matter what the source of risk, higher risk leads to a capital flow from *home* to $foreign$. But there is more to the story. By decomposing the causes of capital flows, the model allows us to study the macroeconomic consequences of the different risk shocks and the associated portfolio flows.

3.3 Shock: Increased risk on $Home$ shares

Here we impose a shock on the expected standard deviation of *home* share returns. The shock is first modelled as temporary, with zero autocorrelation. The effect on capital flows are as follows: Financial intermediaries reduce leverage as the risk constraint is now tightened. Delevering can be done by selling shares and investing the proceeds in bonds, or by taking more deposits and issuing these proceeds in bonds. We see from the impulse responses in $Figure$ 7 that the *home* intermediary does both of the above, while the $foreign$ intermediary does only the former. Thus, there is a drop in demand for shares from both intermediaries, but *home* demand falls less than $foreign$. The result is a capital flow from *home* to $foreign$ in the share market. This response lasts for more than 12 months, and has an autocorrelation of 0.7, despite the fact that the shock has zero autocorrelation.

The long lasting effect of the shock is caused by the behavior of the firm and *home* households. The firm does not care about the risk of its stock's return[8], but it is affected indirectly by the decisions of the household. The increased risk forces the *home* intermediary to demand more deposits in order to invest some of these in bonds and thereby reducing leverage. The higher demand for deposits from the intermediary will pull up

[8]The risk does not affect the firm directly, and the firm has no impact on risk. The expected variance of asset returns is exogenous in the model.

the rate paid on deposits, which increases the supply of deposits from households. Households therefore save more, work more and consume less. The incresed supply of labour will push down wages, and therefore capital becomes less attractive. The cost of capital (loss of dividends) is now higher than the cost of labour, and the firm will disinvest capital to pay dividends. Thus the stock of capital is gradually reduced before it is gradually rebuilt. During this adjustment the profits paid as dividends gradually revert to steady state.

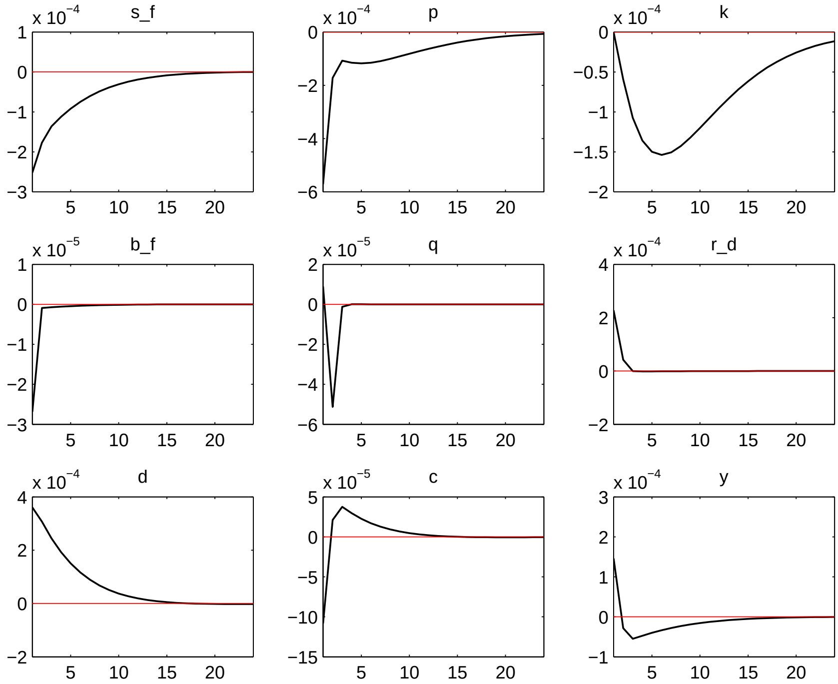

Figure 7: One-Period Shock to expected standard deviation of *home* shares

We see that *home* consumption initially drops as the *home* household increases saving in response to the higher demand for savings (and thus higher return on deposits) from the intermediary. The drop is followed by multiple periods of consumption modestly above steady state, as the household consumes the deposits added in the initial period of the shock. GDP response in the opposite manner, driven by the initially increased employment. The added production is largely invested in financial assets causing a current account surplus in this period. In the following periods, we see GDP below steady state, as the firm now has less capital and less employment. The lower employment in these subsequent periods is largely explained by the household now consuming the savings accumulated in the period of the shock.

Notice that we observe a negative correlation between capital flows and GDP, and a positive correlation between capital flows and consumption. The correlation between *home* GDP and foreign holdings of *home* shares and bonds is -0.1145 and -0.7799 respectively. In the period of the shock there is a sharp capital outflow at the same time as a sharp increase in GDP. In the following periods we have modest capital inflows while GDP temporarily falls below steady state. However, despite the negative correlation, the effect of the capital flow itself is positive.

The share prices first respond sharply negatively to the drop in demand, despite the higher payoff expected on shares. It should be noted here, that the behavior of the household and the firm reduces the impact on the share price by increasing expected profits at the time the price drops. Most of the loss in the share price is recovered within three months, but from here the recovery slows down and it takes several months before share prices have completely returned to steady state.

In contrast to the gradual, long lasting effects on the share market, the bond market responds very briefly. There is a capital outflow from the *home* bond market, but this is very quickly reversed by a bond inflow in the next periods. The price of bonds is slightly lower in the period following the shock, but then immideately returns to steady state. The capital outflow is associated with an increase in the price of foreign risk free bonds, as the $foreign$ intermediary shifts from *home* bonds to $foreign$ bonds. The opposite happens in the following period when the $foreign$ intermediary shifts back to *home* bonds. [9]

[9] **Adding autocorrelation to the shock:** If we add autocorrelation to the risk shock, meaning the risk of *home* shares stays higher for longer, there are no drastic changes to the impulse responses. We see that the share outflows last longer (approximately 4 months) before they start flowing back in. Share prices adjust more slowly. In the bond market there is capital outflows from

3.3.1 Implications for policy

In total, we see an immediate sharp drop in consumption followed by approximately 12 months of consumption above steady state. The initial drop in consumption was caused by the increased demand for savings from the *home* intermediary. The intermediary demands this saving to fund purchases of home assets, both shares and bonds. However, the share purchases happen despite the *home* intermediary's *reduced* demand for shares and are explained by an even more extreme drop in demand from the $foreign$ intermediary. Thus, the share prices drop more than they would in a closed economy. Furthermore, this increased holdings of risky shares forces the *home* intermediary to purchase more bonds than would otherwise be necessary in order to reduce the leverage of the portfolio. This requires more deposit liabilities and thus more saving and less consumption. Hence, we see that the free capital flows for the $foreign$ intermediary causes higher volatility both in asset prices, deposit rates, savings and consumption.

Note that this chain of events was not only exaggerated by the capital flow, but also by the behavior of the intermediary. Because the intermediary is always maximizing leverage to be at the binding constraint, they are forced to adjust to any change in the risk profile of their assets. If they were not operating at this binding constraint, there would be no strict need for the added bond purchases in response to this shock. Thus, there would be no need to raise deposit liabilities to fund these purchases, and therefore no drop in consumption.

We have observed that the presense of $foreign$ investors in the *home* asset market exaggerates the volatility, and the optimal policy may therefore be to limit some of this trading. If the authorities responded by unexpectedly forcing the $foreign$ investors to keep their position in *home* assets, they would dampen the increased demand for deposits, and thereby reduce the consequent swings in macroeconomic variables. That is, the volatility would be partly shifted to the $foreign$ intermediary and households. Now the $foreign$ intermediary would share the burden of increasing deposits to invest in risk free assets. In other words, even when the $foreign$ agents are invested in the *home* economy's asset, the *home* agents still carry the full burden of the risk shock as the $foreign$ investor will unload their positions in response to any added risk. If the flow is restricted, some of this risk is distributed between *home* and $foreign$ by forcing the $foreign$ intermediary to keep the position and the resulting delevering will be distributed between the two economies.

The logic of this policy clearly hinges on the assumption that this policy response was *unexpected*. If this lack of liquidity was known in advance, it would affect the decision to invest in *home* assets and most likely lead to less $foreign$ ownership. However, since the volatility in the responses was exaggerated by the $foreigners$ unloading their positions, this should indeed be less pronounced the smaller this initial position is. Hence, lower $foreign$ ownership and more restricted capital flows would both reduce macroeconomic volatility in response to this risk shock. This is in contrast to the findings above with regards to a shock to productivity, where capital flows and foreign ownership reduced the macroeconomic volatility. Clearly, the cause of the capital flow matters not only for the direction of macroeconomic responses, but also for the volatility of macroeconomic responses.

3.4 Shock: Increased risk on $Home$ shares and bonds

In $Figure$ 8 we shock the so-called emerging market risk, or exchange rate risk. This is the risk factor that both *home* shares and bonds have exposure to. However, the factor is only relevant for the $foreign$ intermediary. This can be justified by viewing this as expected exchange rate risk (although exchange rates are not explicitly present in the model). Alternatively, it can be viewed as an added risk due to asymmetric information, where the $foreign$ intermediary is less capable of accurately predicting returns on *home* assets.

Again we see that the increased risk leads to an immedeate capital outflow followed by smaller capital inflows that continue until the portfolio positions have returned to steady state. This response is similar for shares and bonds. However, bond prices respond less than share prices and return more quickly to steady state. This shock does not affect the *home* intermediary directly, and thus have no direct impact on their demand for assets. It does, on the other hand, increase the expected risk of the $foreign$ intermediary's balance sheet and thus forces the $foreign$ intermediary to reduce risk. They do so by demanding less of all risky assets, including *home* shares and bonds. This relative drop in demand compared to *home* intermediary causes a capital outflow outflow in which the $foreign$ sells *home* assets to the *home* intermediary.

To fund the purchase of shares and bonds, the *home* intermediary demands more deposits leading to higher deposit rates. The higher rates motivate increased saving by *home* households who fund this by working more and consuming less. The higher labour supply means lower wages and thus less capital investment (due to the relatively high cost of capital compared to the now low cost of labour).

home to $foreign$ only in the period of the shock, and the capital flow turns back *home* in the following period and continues until the portfolio positions are back to steady state. Bond prices return to steady state very quickly. Most other responses have the same sign as with no autocorrelation in the shock, but last longer and are sometimes of a greater magnitude.

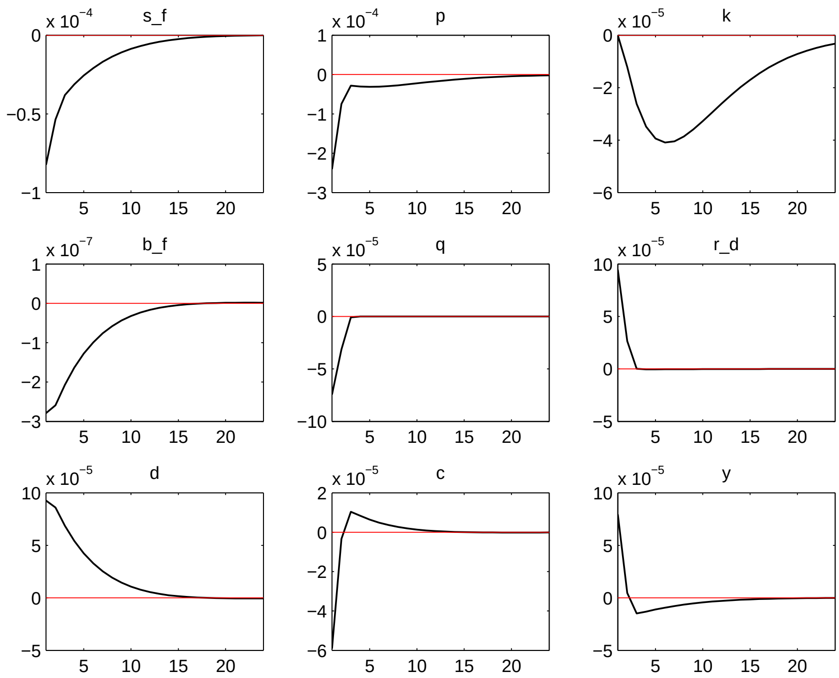

Figure 8: One-Period Shock to expected standard deviation of *home* shares and bonds

The effect on the *home* economy is an immediate drop in consumption but increased GDP, followed by GDP slightly below steady state and consumption slightly above steady state. In this case it is clear that the macroeconomic fluctuations in the *home* economy are fully caused by the capital flows. The risk shock has no direct impact on any *home* agents, and all responses at *home* are consequences of the initial response by *forein* agents.

3.5 Shock: Increased risk on *Foreign* shares

An increase in the expected risk of *foreign* share returns will only directly affect the *foreign* intermediary who owns the full issue of shares. The balance sheet is now more risky and must be readjusted to meet the binding risk constraint. This can be done by increasing deposit liabilities and investing these in risk free assets, or by selling risky assets and invest the proceeds in risk free assets. We see that the optimising behavior of the intermediary involves the latter approach. The *foreign* intermediary actually takes less deposits and compensates by selling risky *home* shares, *home* bonds and reduces demand for *foreign* shares leading to a price drop and thus smaller total holdings.

Firstly, we see from *Figure* 9 that an increase in the risk of *foreign* assets leads to a flow away from *home* assets. This may seem slightly surprising, but is in line with empirical observations that capital flows to emerging markets tend to turn negative when expected risk increases in advanced economies (see for example McCauley (2012)). Secondly, we note that the price response on *home* shares is of smaller magnitude than *foreign* shares, but the response lasts much longer due to the response of capital in the *home* firm. Thirdly, we see that the riskiness of the *home* portfolio has increased to the higher holdings of *home* shares. This is funded by increased demand for deposits. Deposits must be increased even further to invest some in risk free *home* bonds in order for the *home* intermediary to meet the binding risk constraint. Thus the increased risk on assets not held by *home* agents do have significant effects on *home* agents through the capital flows. Demand for deposits by the intermediary has increased, causing higher deposit rates and thus more saving funded by less consumption and more employment. Wages drop, capital investment drops (due to relatively high cost of capital compared to the now lower cost of labour). Output and profits temporarily increase, before they temporarily fall below steady state.

Again, we see as in the previous shock, that there are no direct effects on the *home* agents. But despite their lack of exposure to this risk, the *home* agents are affected via the responses of the *foreign* agents. Hence, we see that in response to all three risk shocks, the capital flows exaggerate the macroeconomic fluctuations in the *home* economy.

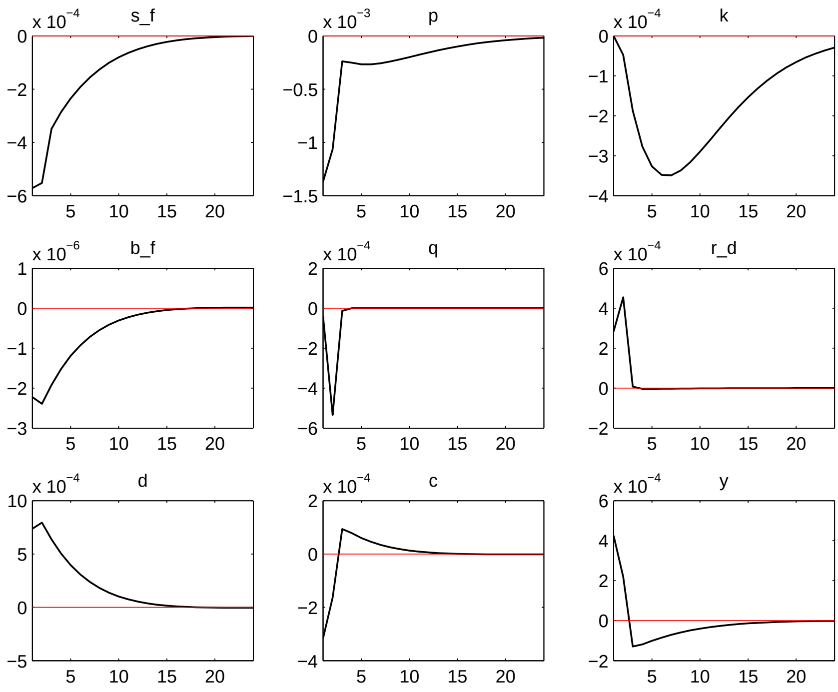

Figure 9: One-Period Shock to expected standard deviation of $foreign$ shares

3.6 Shock: Increase supply of *home* bonds

Lastly, in $Figure$ 10 we shock the supply of bonds issued by the *home* government. This shock is motivated by the observation that portfolio flows to emerging markets have recently shifted from being dominated by share purchases to be dominated by bond purchases. A good example is South Africa, where the cumulative bond flows between 1990 and 2009 remained around zero, while the cumulative share flows over the same time period added up to USD 50 billion. In contrast, the following five years from 2009 to 2014 saw the bond market receiving cumulative inflows of USD 20 billion, while the share market saw a cumulative outflow of USD 10 billion (in Rand terms, the cumulative flows were close to zero) (SARB, 2014). The only shock in our model that produces a capital flow response similar to this, with strong inflows in the bond market and modest outflow in the share market is a shock to the supply of bonds at home.

This response is intuitive given the risk constraints on the financial intermediaries. An increased supply of bonds, *ceteris paribus*, should reduce the price and increase the expected return on these bonds. The total portfolio position in *home* assets by the $foreign$ intermediary is limited by the risk constraint, and thus the $foreign$ intermediary will fund the higher demand for *home* bonds by reducing the position in *home* shares. The response is also consistent with what we observe from empirical data. Figure 11 plots the bond flows to selected emerging economies with the cumulative net borrowing requirement of the respective governments. These graphs provide support for this story that much of the observed change in bond flows may be caused by increased issuance of government bonds (though, it is of course possible that the observed issuance of bonds responded to the increased demand for bonds by foreigners. However, this is not the story suggested by our model). The timing coincides with the start of the recovery from the global financial crisis and the introduction of quantitative easing (QE) in the US, which makes it a challenging task to deduct the true cause of this change in portfolio flows. Nevertheless, we do observe a sharp change in the behavior of the net borrowing requirement at the exact time when bond flows accellerate to a new higher pace and share flows slow down to a new slower pace, exactly as predicted by the model.

Thus, to conclude this section we note that QE and global risk shocks are often used to explain changes in observed capital flows. And while our model results support the view that volatility in portfolio flows can indeed be explained by changes to risk (including global risk that is affected by QE), the model suggests that risk shocks are not the reason for why the composition of portfolio flows has shifted away from equities towards bonds. This shift is better explained as the consequence of increased bond issuance.

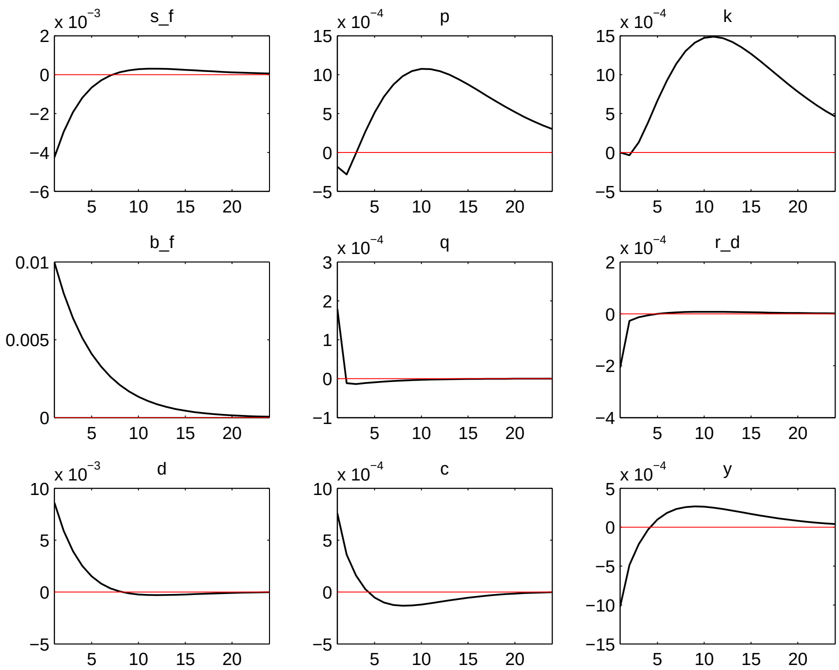

Figure 10: Autocorrelated ($\alpha = 0.6$) shock to supply of *home* government bonds

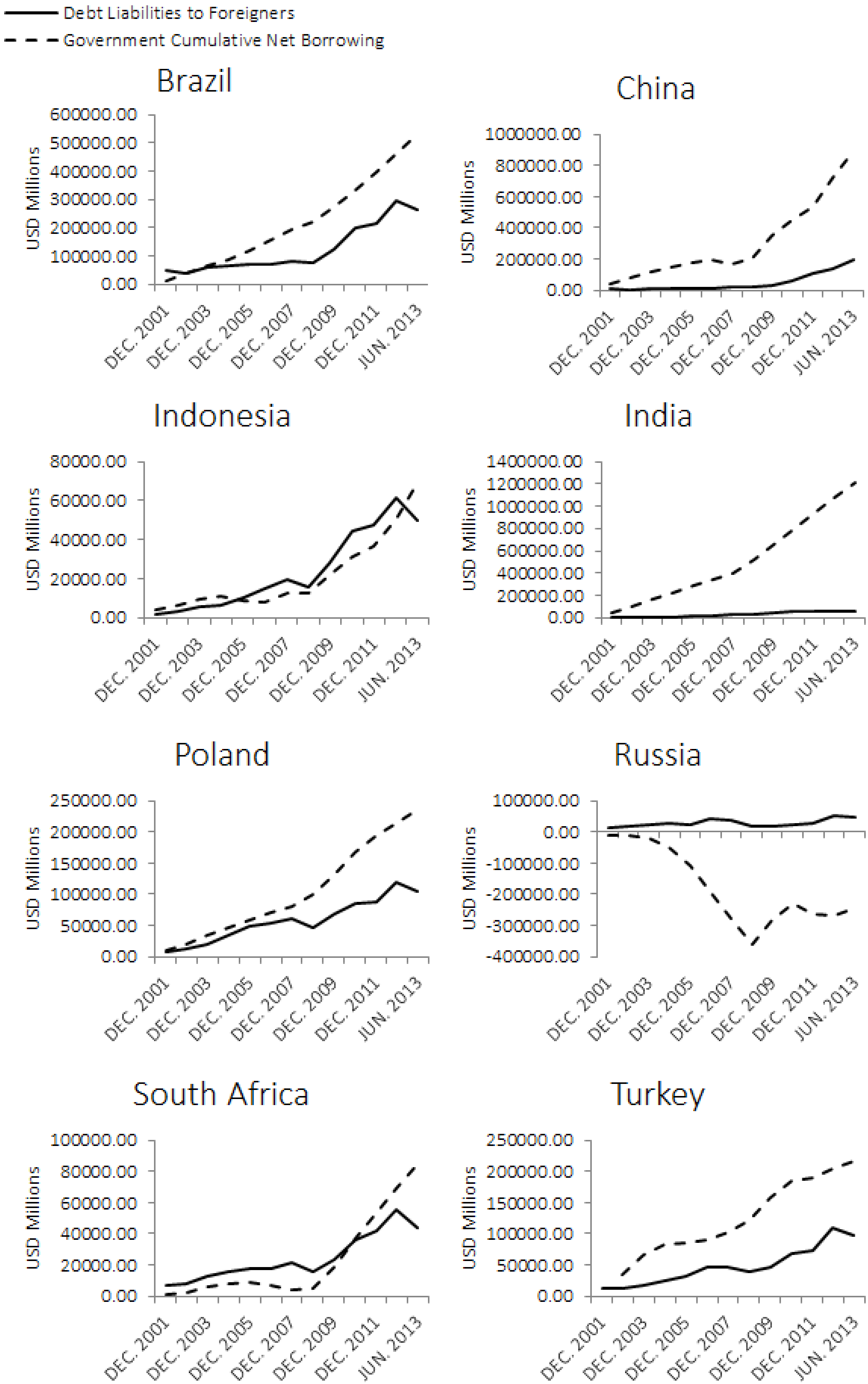

Figure 11: Debt held by non-residents and cumulative government borrowing since 2001. Source: IMF (2014a,b)

4 The effect of portfolio flows

			Shock to productivity		Shock to share risk	
	Mean		Standard Deviation		Standard Deviation	
Name	Open	Closed	Open	Closed	Open	Closed
Share return	0.078	0.117	0.001	0.003	0.016	0.039
Bond return	0.03	-0.033	0.002	0.007	0.009	0.080
Deposit return	0.042	0.032	0.001	0.003	0.005	0.038
Share price	3.712	2.566	0.039	0.000	0.245	0.300
Bond price	0.972	1.039	0.002	0.007	0.009	0.087
Deposits	5.937	3.566	0.057	0.000	0.142	0.300
Home portfolio risk	0.113	0.066	0.001	0.000	0.016	0.007
Firm profit	0.293	0.299	0.009	0.009	0.010	0.037
GDP	2.873	2.933	0.063	0.057	0.021	0.091
Investment	0.634	0.646	0.016	0.016	0.007	0.012
Consumption	2.136	2.113	0.031	0.035	0.016	0.072
Labour	0.972	0.998	0.008	0.003	0.010	0.046
Wages	1.962	1.96	0.030	0.032	0.006	0.029
Capital	25.353	25.856	0.096	0.102	0.054	0.077
Leverage	2.4	3.449	0.020	0.024	0.256	0.534

Table 1: Theoretical mean and standard deviation for closed economy and economy open to foreign portfolio investors. The standard deviations are calculated in response to a a shock in productivity and share risk

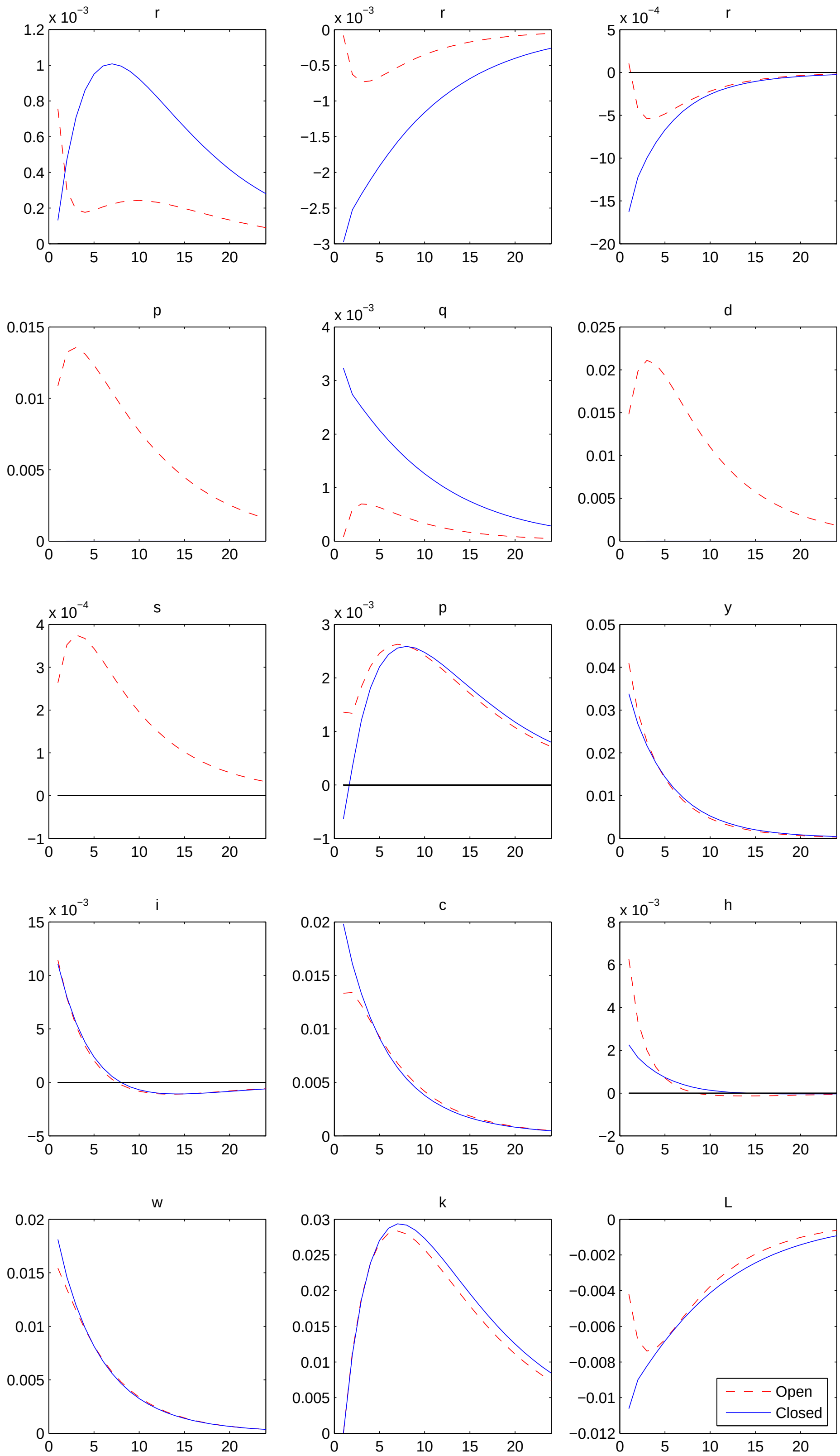

Figure 12: Autocorrelated shock to productivity. Solid blue line indicates impulse response from the closed economy model. Dashed red line indicates the impulse response from the model where the foreign intermediary can invest in home shares and bonds.

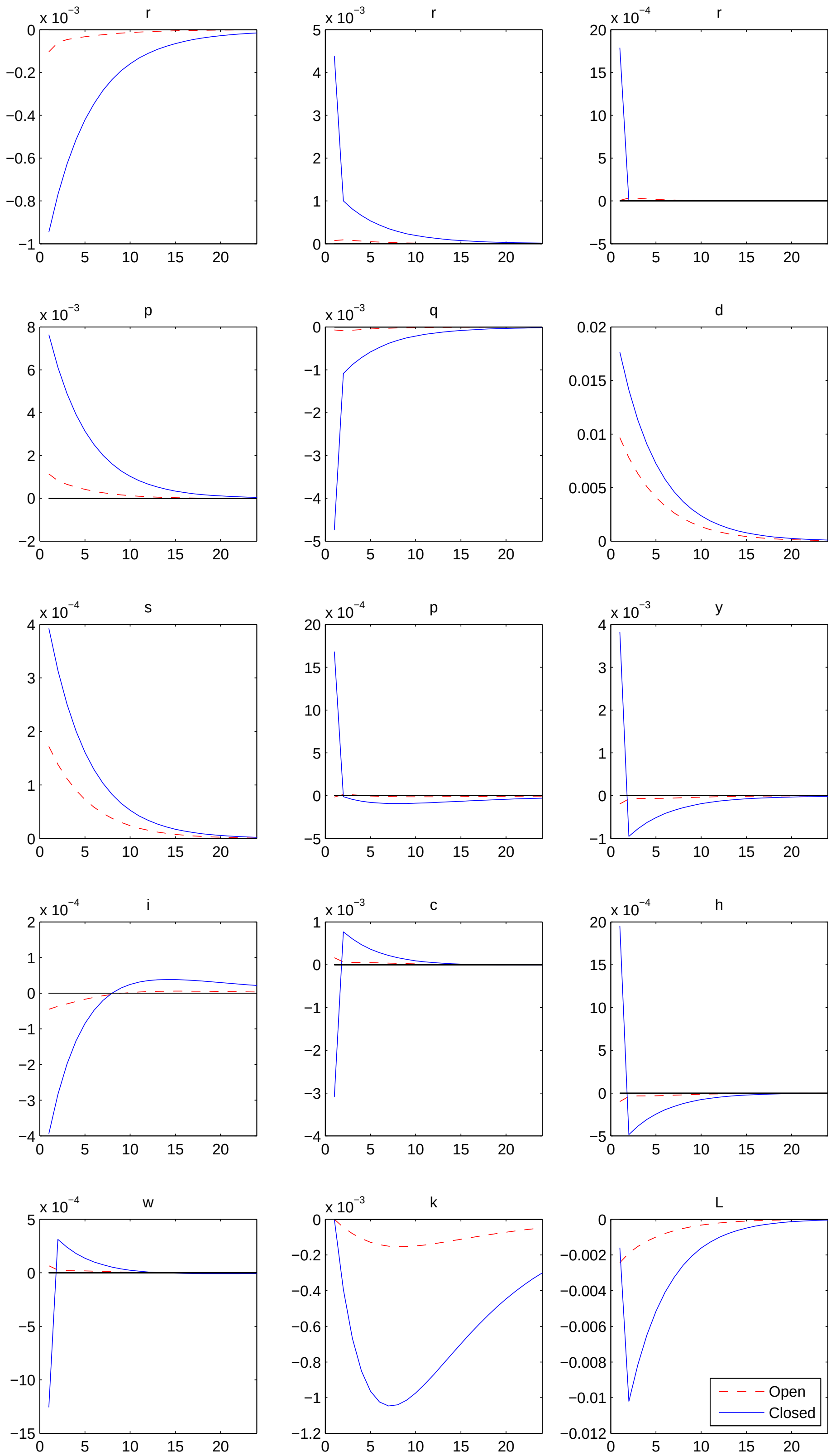

Figure 13: Autocorrelated shock to home bond supply. Solid blue line indicates impulse response from the closed economy model. Dashed red line indicates the impulse response from the model where the foreign intermediary can invest in home shares and bonds

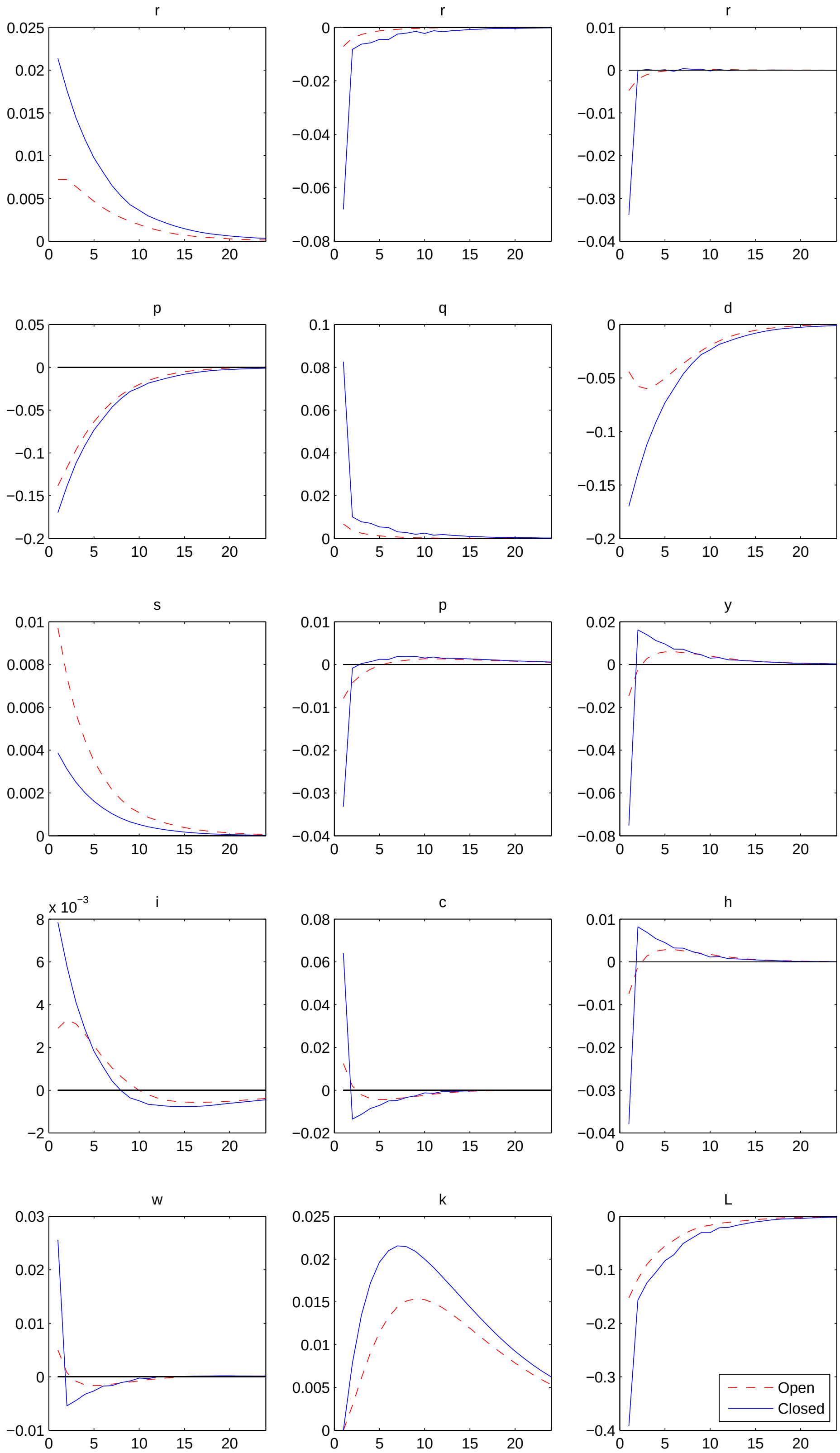

Figure 14: Autocorrelated shock to expected risk of home shares. Solid blue line indicates impulse response from the closed economy model. Dashed red line indicates the impulse response from the model where the foreign intermediary can invest in home shares and bonds

5 Concluding Remarks

Several emerging markets may be well described by the *home* economy in this model. A notable result of our model is that these economies will experience capital outflows in response to any risk shocks, no matter where the risk is increased. The extent of the outflows and the impact on the economy depends on the type of risk that is affected, but the sign of responses is always the same. An increase in risk would generally reduce asset prices by increasing the risk premium. However, we see that prices are sensitive not only to the risk of the asset itself, but also to the risk of other assets. The only asset whose price is positively affected by any risk shock is the $foreign$ risk free bond.

All the risk shocks lead to an immediate drop in consumption in the *home* economy. This is followed by several periods with consumption slightly above steady state. The cause of these responses has been repeatedly outlined above: The relative demand for *home* assets shifts from the $foreign$ to the *home* intermediary. This leads the *home* intermediary to demand more deposits to fund these asset purchases. The higher demand pull up the rate of return on deposits, inspiring households to save more. They save more by working more (thus producing more and increasing GDP) and consume less. In the following periods the rate of return on deposits has returned to steady state. Thus, the households now have higher savings than what is optimal and chose to gradually dissave by consuming their deposits. This means they will work less and consume more.

Overall, the risk shocks cause swings in macroeconomic variables, most importantly in consumption. The risk averse households maximise utility by smoothing expected consumption over time, and the risk shocks cause fluctuations in this consumption plan. In cases where capital flows are caused by risk shocks, consumption drops in periods of capital outflows and then increase in periods of capital inflows. However, when the capital flow is caused by increased productivity, consumption increases with the capital outflow and decreases with capital inflows.

In the cases where the capital flow was caused by risk shocks, the capital flow is destabilising on the *home* macroeconomic variables. That is, the capital flow exaggerates the responses. In the case of a productivity shock, the capital flows reduce the volatility by allowing some of the response to be absorbed by the $foreign$ economy.

The paper has made a first step towards a more comprehensive model of portfolio flows and macroprudential policy. The model can be extended by imposing a variety of capital controls and other restrictions on the intermediaries. Such a model would provide a more rigorous support for the policy discussion presented in this paper.

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6 Appendix A: Notation

Endogenous Variables:

$c =$ *home* household consumption of global good (34)

$c^* =$ *foreign* household consumption of global good (35)

$d =$ *home* household deposits in *home* intermediary (36)

$d^* =$ *foreign* household deposits in *foreign* intermediary (37)

$s =$ *home* intermediary's holding of *home* shares (38)

$s^* =$ *foreign* intermediary's holding of *home* shares (39)

$s^f =$ *foreign* intermediary's holding of *foreign* shares (40)

$b =$ *home* bond holdings by *home* intermediary (41)

$b^* =$ *home* bond holdings by *foreign* intermediary (42)

$b^{rf} =$ risk free global bond holdings by *foreign* intermediary (43)

$p =$ price of *home* shares (44)

$p^f =$ price of *foreign* shares (45)

$q =$ price of *home* risk free bonds (46)

$q^{rf} =$ price of *foreign* risk free bonds (47)

$r^d =$ risk free rate on one period deposit at *home* intermediary (48)

$r^{*d} =$ risk free rate on one period deposit at *foreign* intermediary (49)

$r^b =$ risk free rate on one period *home* government bond (50)

$r^{rf} =$ risk free rate on one period risk free *foreign* government bond (51)

$r^s =$ return on *home* shares (52)

$r^{sf} =$ return on *foreign* shares (53)

$g =$ government taxes levied on *home* households (54)

$g^* =$ government taxes levied on *foreign* households (55)

$\pi =$ profits of home firm after investment (paid as dividends) (56)

$k =$ stock of capital owned by *home* firm (57)

$i =$ investment in capital by firm (58)

$h =$ labour supplied by *home* household to *home* firm (59)

$w =$ wages paid to labour (60)

Exogenous Processes:

$b^S =$ total supply (issuance) of *home* bonds (i)

$b^{S*} =$ total supply (issuance) of *foreign* risk free bonds (ii)

$\pi^* =$ exogenous endowment given to *foreign* household (iii)

$a =$ total factor productivity of *home* firm (iv)

$\sigma^s =$ variance of *home* share returns (v)

$\sigma^{sf} =$ variance of *foreign* share returns (vi)

$\sigma^x =$ variance of exchange rate returns (vii)

$\psi =$ risk constraint imposed on *home* intermediary (viii)

$\psi^* =$ risk constraint imposed on *foreign* intermediary (ix)

$\beta^* =$ impatience of *foreign* household (x)

$n =$ endowment of *foreign* household (xi)

$r^x =$ exchange rate return (xii)

7 Appendix B: Calibration and Steady State Results

7.1 Calibration

$\beta = 0.99$	$\bar{\beta}^* = 0.99$	$\beta^{firm} = 0.99$
$\rho = 0.9$	$\chi = 5$	$\gamma = 0.35$
$\bar{\psi} = 1$	$\bar{\psi}^* = 0.1$	$\psi_d = 0.05$
$\psi_d^* = 0$	$\phi = 0.1$	$\mu = 0.33$
$\bar{\sigma}_x = 0.01$	$\bar{\sigma}_s = 0.05$	$\bar{\sigma}_{sf} = 0.05$
$\delta = 0.025$	$\alpha = 0$	$\bar{b}^s = 1$

7.2 Steady State Results

$c = 0.580685$	$c^* = 1.17795$	$d = 0.634767$
$d^* = 17.617$	$s = 0.31176$	$s^* = 0.68824$
$b = 0.000637811$	$b^* = 0.999362$	$b^{rf} = 1$
$p = 2.03403$	$q = 0.964521$	$q^{rf} = 1.74557$
$r^d = 0.04216$	$r^{d*} = 0.010101$	$r^{rf} = -0.427122$
$r^b = 0.036784$	$r^s = 0.0421762$	$g = -0.036784$
$g^* = 0.427122$	$\pi = 0.0857876$	$k = 8.12381$
$i = 0.203095$	$h = 0.2953$	$w = 2.00036$
$\sigma_{\theta^*} = 0.58438$	$\sigma_\theta = 0.0010053$	$p^f = 15.2171$
$r^{sf} = 0.0657155$		

8 Appendix C: Impulse responses to autocorrelated shocks

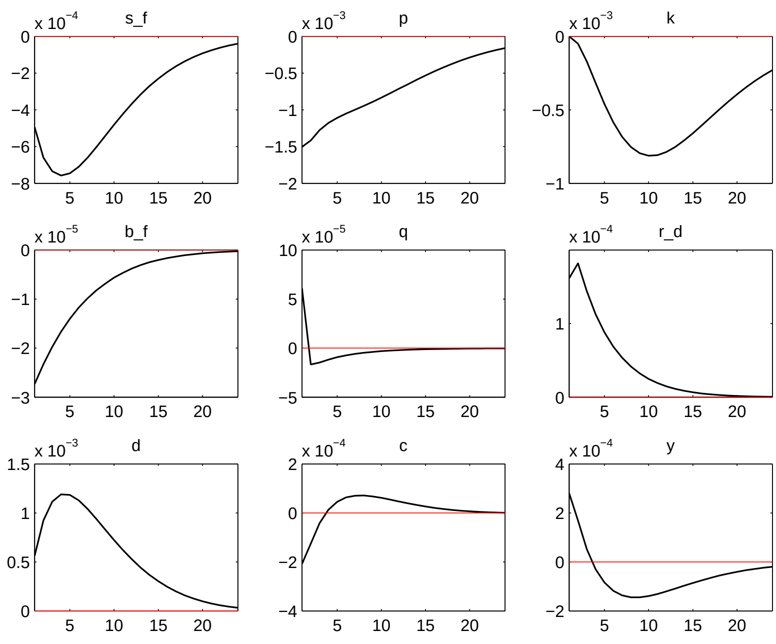

Figure 15: Autocorrelated ($\alpha = 0.8$) shock to expected standard deviation of *home* shares

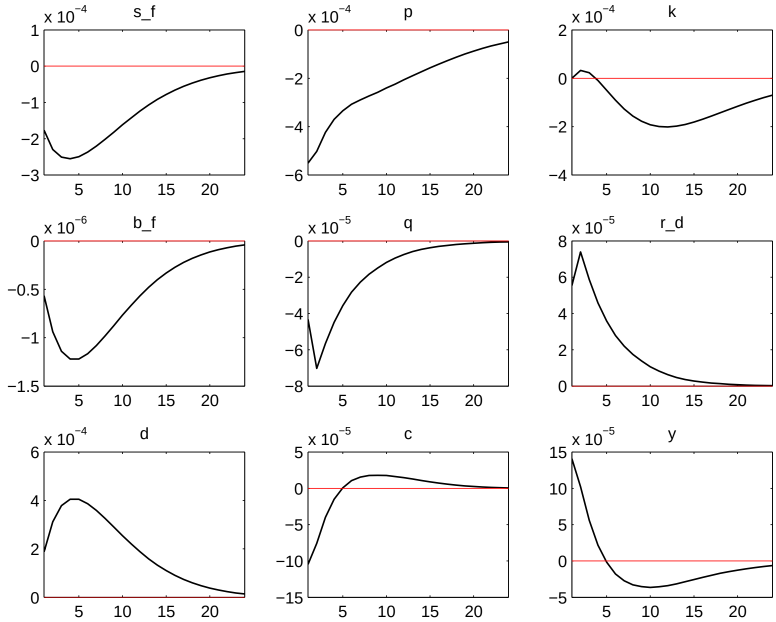

Figure 16: Autocorrelated ($\alpha = 0.8$) shock to expected standard deviation of *home* shares and bonds

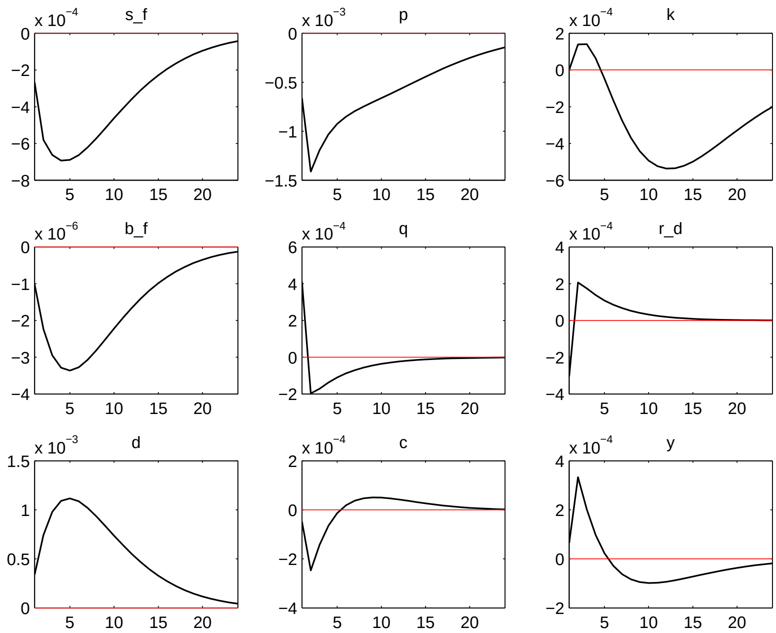

Figure 17: Autocorrelated ($\alpha = 0.6$) shock to expected standard deviation of $foreign$ shares