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Abstract

Since the crises of the late 1990's, most emerging market economies have built up substantial positive holdings of low risk assets (notably US dollar treasury bills), while at the same time experiencing a boom in FDI capital inflows. This paper develops a two country model of the interaction between an emerging market economy that requires investment for growth and an advanced economy that issues nominal riskfree bonds. An optimally diversified portfolio in the model is for the emerging market to take a short position in FDI equity and a long position in riskfree nominal bonds. Quantitively, the model predicts very large optimal gross positions. Our analysis can also decompose the movement in net capital flows into the movement in the individual gross asset and liability components.

Keywords: Country portfolios, Emerging Markets.

JEL: E52, E58, F41

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In the decade since the crises of the 1990's, the international financial landscape has evolved and changed in ways that few observers would have predicted at that time. Emerging economies have generally experienced strong and uninterrupted economic growth with no major crisis experiences. Capital flows from industrial countries in the form of FDI as well as portfolio and bond investment have been strong. Sovereign spreads have been low by historic standards for a number of years. For most emerging countries, external accounts have swung sharply from positions of net deficits in the mid-1990's to generally strong surpluses at present. In addition, these countries have eliminated their financial vulnerabilities displayed so clearly during the crisis years by correcting the currency and maturity mismatches in their national balance sheets. Some countries have abandoned tight exchange rate pegs and moved towards flexible inflation targeting. More generally, the quality of policy-making in the fiscal and financial domain has improved greatly.

There is no single explanation for this surplus of good economic news from the emerging markets. High global saving has led to a prolonged period of low real interest rates, reducing the potential for crises. The buildup of strong positive net external positions as well as large stocks of foreign exchange rate reserves has had the same effect, and more generally has instilled a strong confidence in the investment potential of emerging economies. But in addition, real economic growth has been stimulated by high demand for exports from the industrial world (in particular the US), and commodity prices booms have generated huge net gains for many emerging countries.

One general feature of emerging economies recent experience that differs from previous episodes of high capital inflows and economic growth is the degree to which they have been participants in the globalization of financial markets. Rather than simply being recipients of net capital inflows or outflows, many emerging countries have displayed growth in gross external financial assets and liabilities that are much larger than net positions. In this sense, their experience mirrors that of many advanced economies, as documented in the seminal work of Lane and Milesi Ferretti (2001, 2005, 2006). While most recent discussion of global imbalances has fixated on the size of net external surpluses of China and other emerging economies indicating the apparently perverse situation of capital outflows from the developing world to developed economies (or more accurately, the US), in the background there is a large degree of two way capital flow. Emerging economies have been accumulating large stocks of US treasury bills going into official reserve assets, but they have also been receiving large inflows of FDI and portfolio equity investment, as well as private bond market inflows. Lane and Milesi Ferretti (2006) document this turnaround on the portfolio position of emerging market economies taken as a whole. From the situation in the mid 1990's, where many of these economies were substantial net debtors in non-contingent assets such as bank loans and short term US dollar bonds, now they have substantial net positive positions in fixed income assets, while being on the whole net debtors in FDI and portfolio equity investment. There is an argument that this is in fact a much more efficient form of financing development lending for emerging market economies, in terms of achieving the most desired degree of international sharing risk.

This paper investigates the impact of financial globalization in emerging market economies, paying particular attention to the determinants of country portfolio positions. We explore the factors underlying the determinants of an optimal risk-sharing portfolio for an emerging market economy that requires a high rate of investment. This loosely approximates the positions of the fast-growing Asian exporting economies. The question is, how should this investment be financed? One possibility is for these countries to borrow substantially in the form of non-contingent foreign bank loans, or international bond markets in order to finance their own investment. In the mid 1990's, this could roughly describe the financing patterns of many emerging economies. Another option however is to accept FDI and equity investment. As mentioned above, this is becoming more the norm for emerging economies in recent years. In our analysis, we interpret this financing choice as an implication of financial globalization. In an environment where emerging market economies can avail of a more enhanced menu of international asset markets, an optimal financing pattern is to accept inflows of FDI and portfolio investment, but balance this with outflows of investment in fixed income, noncontingent assets. This offers one way to interpret the build-up of international reserve assets on the part of emerging economies.

Our analysis is built around a dynamic stochastic general equilibrium (DSGE) model of the interaction between an emerging market economy and the rest of the world. However, unlike the standard DSGE framework, we incorporate new developments in the study of portfolio choice in general equilibrium environments (see Devereux and Sutherland 2006, 2007), in order to isolate the determinants of gross portfolio positions for an emerging market economy.[1]

Our results indicate that financial globalization, wherein an emerging market economy may simultaneously build up positive gross positions in non-contingent international bond assets, and negative positions in FDI and portfolio equity, offers both welfare benefits and a more stable form of financing than that available in the mid 1990's. In the model, the emerging economy holds nominal bonds of the advanced economy, while issuing FDI-equity claims which are held by the advanced economy. Quantitively, our frictionless, one-good model suggests that gross portfolio positions should be substantially larger than GDP. Since nominal bond returns depend on the monetary policy of the advanced economy however, this depends on the stability of monetary policy. As monetary policy becomes more stable, in a sense defined below, the overall magnitude of gross positions may increase substantially. In addition, we find that gross positions will tend to increase, as the underlying GDP volatility in the advanced economy diminishes.

We compare the models response to shocks coming from the two regions. Optimal portfolio diversification tends to reduce the gap between the overall consumption responses to shocks, but at the same time tends to increase the movement in the current account. We also decompose the movement in net assets for the advanced economy (i.e. the current account), into the separate movement in gross liabilities (nominal bonds) and gross assets (FDI equity). In some cases, gross assets and liabilities tend to move in opposite directions, while in other cases they move in the same direction.

We may also measure the excess returns on gross assets relative to gross liabilities... to be added.

1 Empirical Evidence on Emerging Market Portfolios

To be added..

[1] See also Engel and Matsumoto, 2005, Evans and Hnaktkovska, 2005, and Tille and Van Wincoop, 2007, among other papers, for recent contributions to the literature on portfolio choice in general equilibrium.

2 The Model

The world is assumed to consist of a developed country (home) and an emerging market country (foreign). In the home country, output is produced using labor and a fixed factor (e.g. capital or land). In the foreign country, output is produced with labor, but also requires investment in new capital. We think of this as the situation where the emerging economy needs capital in order to achieve convergence to a developed level of income. The key question we address is how this investment is financed. This may be done either by foreign residents, in which case it is labeled FDI, or by issuing debt to the developed country and taking direct ownership of capital. The aim of the paper is to determine the optimal portfolio structure for financing growth in the emerging market country.

2.0.1 Household choices

Households in each country receive wage income and asset income. The two traded assets are claims to ownership of the emerging market firm, and non-contingent debt of the emerging market country. For home country households, the budget constraint may be defined as

$$C_t + q_{kt} S_t + q_{bt} B_t = Y_t + (D_t^* + q_{kt}) S_{t-1} + \widetilde{B}_{t-1} \tag{1}$$

Here, C_t is real consumption, Y_t is income, q_{kt} and q_{bt} are respectively the price of emerging market equity and the price of non-contingent emerging market debt. S_t represents the real holdings of emerging market equity, and D_t^* represents the dividend payment on equity. We let S_t be of either sign, as the developed country residents may hold long or short positions on the emerging market firm. B_t represents the real value of emerging market debt, and $\widetilde{B}_{t-1}$ represents the time t real value of debt purchased in time $t-1$.

We allow for two alternative possibilities with respect the the denomination of debt. If debt is nominal, denominated in terms of the developed country currency (e.g. US dollars), then $\widetilde{B}_{t-1} = B_{t-1}\pi_t^{-1}$, where $\pi_t = P_t/P_{t-1}$ is the ex-post rate of US inflation. If debt is in real terms, then $\widetilde{B}_{t-1} = B_{t-1}$.

We may re-write (1) in terms of net wealth $W_t = q_{kt} S_t + q_{bt} B_t$ as follows

$$C_t + W_t = Y_t + r_{xt}\alpha_{t-1} + r_{bt} W_{t-1} \tag{2}$$

Here $\alpha_{t-1} = q_{kt-1}S_{t-1}$ is the real holding of equity, $r_{xt} = r_{kt} - r_{bt}$ represents the excess return on equity relative to debt, where $r_{kt} = \frac{D_t + q_{kt}}{q_{kt-1}}$ and r_{bt} is the real return on debt. In case of nominal debt, then $r_{bt} = \frac{1}{q_{bt-1}\pi_t}$, while in the case of real debt, $r_{bt} = \frac{1}{q_{bt-1}}$. This representation of the budget constraint allows us to solve the portfolio problem for the home economy using the procedure of Devereux and Sutherland (2006, 2007).

We define income for the home economy as $Y_t = w_t H_t + \Pi_t$, where w_t is the real wage, H_t is employment, and Π_t is profit income from the fixed home capital stock.

Home households have utility functions of the form:

$$U = E_0 \sum_{t=0}^{\infty} \left[\frac{C_t^{1-\rho}}{1-\rho} - \frac{1}{1+\mu} H_t^{1+\mu} \right] \tag{3}$$

where $\rho > 0$, $\mu > 0$, C is consumption and E is the expectations operator.

The budget constraint for the foreign economy is written analogously, and foreign agents have identical preferences.

2.0.2 Firms

Firms in the home economy simply maximize profits subject to the home country production function, written as

$$Y_t = A_t H_t^{\phi}, \quad 0 < \phi < 1. \tag{4}$$

Here, A_t represents a stochastic productivity shock, which is characterized by

$$\log A_t = \zeta_Y \log A_{t-1} + \varepsilon_{A,t} \tag{5}$$

where $0 \leq \zeta_Y \leq 1$ and ε_Y is an i.i.d. shock symmetrically distributed over the interval $[-\epsilon, \epsilon]$ with $Var[\varepsilon_Y] = \sigma_Y^2$.

In the emerging market (foreign) economy, production requires variable capital. We write the foreign production function as

$$Y_t^* = A_t^* H_t^{\phi *} K_t^{*\gamma}, \quad 0 < \gamma + \phi^* < 1. \tag{6}$$

Here K_t^* represents capital. We also allow for a factor of production which is in net fixed supply, as in the case of the home economy. In addition, we assume that

$$\log A_t^* = \zeta_A \log A_{t-1}^* + \varepsilon_{A,t} \tag{7}$$

where $0 \leq \zeta_A \leq 1$ and ε_A is an i.i.d. shock symmetrically distributed over the interval $[-\epsilon, \epsilon]$ with $Var[\varepsilon_A] = \sigma_A^2$.

Foreign firms choose a path of capital accumulation to maximize their value, net of payments to domestic labor and the fixed factor. Let the capital stock accumulate as follows

$$K_{t+1}^* = I_t^* + (1-\delta)K_t^*. \tag{8}$$

The representative foreign firm then chooses I_t^* to maximize its value, given

$$E_t \sum_{i=0}^{\infty} \Omega_{t+i} D_{t+i}, \tag{9}$$

where $D_t = A_t^* H_t^{*\phi} K_t^{\gamma} \gamma - I_t^*$, and E_t is the expectations operator.[2]

2.0.3 The Price Level

We assume that the price level is determined by monetary policy in the home country, which amounts to an assumption that the foreign country is maintaining a fixed exchange rate against the home currency. In the home economy, the dollar price of the consumption good is assumed to determined by a simple quantity theory relationship of the form

$$M_t = P_t Y_t. \tag{10}$$

where M_t is the nominal money supply in the US. This is a short-cut approach to a more involved specification incorporating an explicit cash in advance constraint on expenditures.[3] M_t is assumed to be determined by an autoregressive process of the form

$$\log M_t = \log M_{t-1} + \varepsilon_{M,t} \tag{11}$$

[2] We assume that the firm uses a discount factor Ω_{t+i} that is a convex combination of the home and foreign households stochastic discount factor. In fact, in the linear approximation of the model used to obtain zero order portfolios, the discount factor is constant at its steady state value β.

[3] In the case of explicit cash in advance constraints, there would also appear distortionary wedges in the optimality equations for labor and capital. To make (10) exactly identical to a cash-in-advance economy, it would be necessary to assume that a separate lump-sum tax financed fiscal policy was used to eliminate these distortions.

where ε_M is an i.i.d. shock symmetrically distributed over the interval $[-\epsilon, \epsilon]$ with $Var[\varepsilon_M] = \sigma_M^2$.

2.0.4 Optimality conditions

Households in the home economy holdings of foreign equity and debt to maximize expected utility. As shown in (2), this may be represented by the choice of α_t and W_t. For W_t, this gives the condition

$$C_t^{-\rho} = \beta E_t C_{t+1}^{-\rho} r_{b,t+1}, \tag{12}$$

while the optimal portfolio allocation implies

$$E_t C_{t+1}^{-\rho} (r_{k,t+1} - r_{b,t+1}) = 0. \tag{13}$$

The first-order condition for labor supply is

$$C_t^{\rho} H_t^{\mu} = w_t \tag{14}$$

Identical conditions hold for the foreign household.

2.0.5 Firms

In the home economy, firms choose employment to maximize profits, so that

$$\phi A_t H_t^{\phi-1} = w_t. \tag{15}$$

In the foreign economy, the firms' optimal employment and investment decisions are characterized by

$$1 = E_t \Omega_{t+1} (\gamma A_{t+1}^{*} H_t^{*\phi*} K_t^{*\gamma-1} + (1-\delta)) \tag{16}$$

$$\phi A_t^{*} H_t^{*\phi*-1} K_t^{*\gamma} = w_t^{*} \tag{17}$$

2.0.6 Market Clearing Conditions

The model is closed with the following market clearing conditions for goods and asset markets

$$Y_t + Y_t^{*} = C_t + C_t^{*} + K_{t+1}^{*} - (1-\delta) K_t^{*}, \tag{18}$$

$$S_t + S_t^* = 1, \tag{19}$$

$$B_t + B_t^* = 0. \tag{20}$$

The model determines a stochastic distribution of output, consumption, employment, and capital, as well as a (generally) time-varying path of debt and equity holdings. In the next section, we solve the model by the approximation methods developed in Devereux and Sutherland (2006, 2007). This involves a two part solution. First, using a second-order approximation of (13), and the equivalent expression for the foreign economy, in combination with a first order approximation of the rest of the model, we may solve for the zero-order, or steady state portfolio division between equity and debt. This allows us determine how the stochastic structure of the model determines portfolio allocation, and to characterize the economy's first order response to stochastic shocks under an optimal portfolio. But we are also interested in how portfolio holdings themselves respond to stochastic shocks in the economy. To compute this, we follow Devereux and Sutherland (2007) in taking a third order expansion of (13) and its foreign equivalent, in combination with a second order expansion of the rest of the model.

3 Computing Optimal Portfolios

Before we describe the solution of the model in detail, we briefly describe the approach to computing optimal portfolio behaviour in DSGE models such as that of the previous section. In any two-country DSGE model, there will be a set of portfolio choice equations such as (13) and an equivalent for the foreign country. Thus, we have conditions

$$E_t U'(C_{t+1}) r_{xt+1} = 0, \quad E_t U'(C^*_{t+1}) r_{xt+1} = 0, \tag{21}$$

where r_{xt} represents the excess return on the asset portfolio, relative to the reference asset. In addition, any DSGE model will have a set of equations which may be characterized as

$$E_t(x_{t+1}, x_t, y_{t+1}, y_t, z_{t+1}, z_t) = 0, \tag{22}$$

where $x_t, y_t,$and z_t represent respecivtively a vector of endogenous state variables, control variables, and exogenous shock processes. We assume that the shock processes are governed by an AR(1) equations

$$z_{t+1} = \Gamma z_t + \varepsilon_t, \tag{23}$$

where ε_t is a vector of *i.i.d.* mean zero disturbances.

The solution for (21) and (22) will give a vector of real portfolio holdings $\alpha(x_t, z_t)$ for each traded asset. In general, it is difficult to obtain solutions for portfolios in DSGE models, or even to characterize the properties of the solutions. In Devereux and Sutherland, (2006, 2007), a simple method is developed for solving for the chacteristics of $\alpha(x_t, z_t)$, at the zero and first order.

A brief description of the method is as follows. In a static, partial equilibrium environment with one investor, Samuelson (1970), shows that in order to obtain the properties of the portfolio at the order N, is necessary to approximate the investors utility function up to the order $N + 2$. Samuelson's method involves identifying the optimal portfolio for small shocks. We employ Samuelson's method in the case of a dynamic, general equilibrium environment. In our case, the optimal portfolio is approximated as

$$\alpha(x_t, z_t) \approx \alpha(\overline{x}, \overline{z}) + \alpha_x(\overline{x}, \overline{z})\widehat{x}_t + \alpha_z(\overline{x}, \overline{z})\widehat{z}_t,$$

where $\overline{x}$, $\overline{z}$, represent the steady state values of x and z, and $\widehat{x}$, $\widehat{z}$ represent log deviations from the steady state. The term $\alpha(\overline{x}, \overline{z})$ represents the zero-order, or steady state portfolio, while the $\alpha_x(\overline{x}, \overline{z})$ and $\alpha_z(\overline{x}, \overline{z})$ terms represent the first-order components of the portfolio, capturing the way in which real portfolio holdings adjust to predictable changes in state variables. Devereux and Sutherland (2006) show that $\alpha(\overline{x}, \overline{z})$ may be obtained by a combination of a second-order approximation of (21) and a first order approximation of (22), where the approximation is taken at the non-stochastic steady state point. Devereux and Sutherland (2007) show that $\alpha_x(\overline{x}, \overline{z})$ and $\alpha_z(\overline{x}, \overline{z})$ may be obtained by a third-order approximation of (21) in combination with a second order approximation of (22).

In the next section, we describe the analogous solutions for the portfolio holdings in our model of equity and debt holdings in the two-country model of section 2.

4 Solving for steady state portfolios

4.1 Calibration

In order to solve the model, we first need to take a stand on parameter values. As a first pass, we choose a set of parameter values in a relatively arbitrary manner, where possible being guided by previous literature. Table 1 describes the calibration

Table 1

Parameter	Value	Parameter	Value
β	0.96	δ	0.1
ρ	1	ϕ	0.65
μ	1	ϕ^*	0.5
γ	.3	σ_A	0.02
ζ_A	0.9	σ_{A^*}	0.05
ζ_{A^*}	0.95	σ_M	0.03

We choose a discount factor so that the steady state real interest rate is 4 percent, and agents have log utility of consumption. The consumption constant elasticity of labor supply is set to unity. The share of capital in the emerging market production function is .3. Both countries have persistent productivity shocks, but we assume, following Aguiar and Gopinath (2006), that the emerging market country has more persistent shocks. The capital depreciation rate is set at 0.1, and the share of labor is set at 0.65 in the home economy, and 0.5 in the emerging market economy, in view of the typical estimates. Finally, we choose the volatility of productivity disturbances to roughly match the standard deviation of productivity shocks in the US, and the much higher volatility found in emerging markets (e.g. Uribe et al. 2006). Hence the standard deviation of home productivity shocks are set at 2 percent, and the standard deviation of foreign productivity is set at 5 percent. The standard deviation of money growth is set to approximately match the quarterly standard deviation of M1 for the US economy.

4.2 Solution for Zero-Order Portfolios

Here we describe the optimal solutions for steady state portfolios, under the baseline calibration of Table 1 and under some alternative parameter values. The results are illustrated in Figures 1 and 2. For the parameter and moments of the baseline model, home country agents should take a large positive position in foreign FDI, matched by a large negative nominal debt position. The scale is interpreted as a ratio of steady state GDP, so interpreted literally, this indicates that the home country should take a positive gross FDI position equivalent to 2.7 times GDP. This involves a very large nominal debt position. Since the steady state capital stock for the foreign economy is just over 2 times GDP, this implies that the foreign country takes a large short position in its own capital. Realistically of course, the model lacks frictions that would substantially reduce the size of gross asset holdings, such as non-traded goods, and endogenous terms of trade, or home bias in preferences.

Why does the home country take a positive position in FDI? The zero-order portfolio represents a solution to the orthogonality condition

$$E_t[(\widehat{C}_t - \widehat{C}_t^*)\widehat{r}_{xt+1}] = 0.$$

The motive for portfolio diversification may be obtained by computing, from a first order approximation of the model, the covariance between relative consumption and the ex-post excess return, when there is a *zero* portfolio, i.e. in the absence of any portfolio diversification. For a zero portfolio, a rise in A_1, the home country productivity, leads to a rise in relative home consumption, but a fall in the excess return on foreign equity. This is primarily due to the appreciation of the nominal exchange rate, increasing the return on the holding of home currency bonds. A rise in A_2, the foreign productivity shock, leads to a rise in the excess return on foreign equity, since it directly increases the dividend payment of the foreign firm, but a fall in relative home consumption. Thus, on both counts, holding a positive (negative) position in foreign equity (home bonds) represents an optimal diversification strategy for home country residents.

We would anticipate a fall in home productivity volatility to increase the foreign investors holdings of home currency bonds. But in fact, this is not necessarily the case. Figure 1 and 2 illustrate the dependence of the optimal portfolio on the volatility of the home country productivity disturbance. Figure 1 involves a reduction in σ_A from the baseline case, when $\sigma_{A^*} = 0.05$ and $\sigma_M = 0.03$. In this case, the optimal portfolio is increasing in σ_A, i.e. as the volatility of home country productivity falls, home investors reduce their holdings of foreign equity. By contrast, Figure 2 shows the case where $\sigma_M = 0$. In this case, the optimal portfolio is decreasing in σ_A, so that as the volatility of home productivity falls, the foreign equity position is increased. Intuitively, in the case of Figure 1, the fall in σ_A, beginning from a position where households are holding the optimal portfolio, leads to a rise in the covariance between relative consumption and excess returns. This is because, when home investors are holding the optimal portfolio, a monetary policy shock leads to a rise in r_x, and a rise in relative consumption. The optimal response is to reduce the scale of the portfolio. In Figure 2 however, when monetary policy shocks are unimportant, a fall in the volatility of home productivity leads to a rise in the portfolio position, as it increases the diversification benefit from holding foreign equity.

4.3 The effects of optimal diversification

Figures 3 and 4 show the implications of an optimal portfolio for the response of relative consumption to a shock to home and foreign productivity. The Figures contrast the case where there is no portfolio diversification (the ND loci) to the response when agents are holding the optimal portfolio, under the baseline case of Table 1. The effect of optimal diversification is to substantially narrow the gap in the response of consumption to both types of shocks. In the response to a home productivity shock, consumption rises in both countries. With full diversification, the foreign country gets an immediate capital gain on its portfolio, while the home country experiences a capital loss. This leads to a greater increase in foreign consumption, and a smaller response of home consumption. Likewise, in the response to a shock to foreign productivity, without portfolio diversification, home consumption would fall (since the world real interest rate is higher), while foreign consumption would rise. Under opitmal diversification, the gap is narrowed. The home country receives an immediate capital gain on its portfolio, increasing its consumption response, while the opposite applies to the foreign country.

The response of the (home) current account with and without portfolio diversification is illustrated in Figures 5 and 6. The role of the optimal portfolio is to generate a capital gain or loss, in response to a stochastic shock, leading to an offsetting of the response of wealth in the non-diversified economy. In the case of a home country productivity shock, without diversification, the home country would experience an immediate current account surplus. But with optimal diversification, the fall in the excess return on the home country's portfolio leads to an immediate rise in the real value of the countries gross liabilities (denominated in home currency) relative to its gross foreign assets. This generates an immediate one-time fall in the countries net external assets, or a current account deficit.

Table 2 illustrates the effect of international portfolio diversification on the volatility and cross correlation of consumption across the two regions.

Table 2

Variable	σ_c	σ_{c^*}	ρ_{cc^*}
ND	0.039	0.082	0.52
Baseline	0.044	0.058	0.81
$\sigma_M^2 = 0$	0.46	0.49	.99

Without portfolio diversification, the foreign country has a significantly higher consumption volatility, and the cross country correlation of consumption is 0.52. In the baseline case, with all three shocks, international diversification leads to a significant reduction in consumption volatility for the foreign country, but a small rise in volatility for the home country. The cross correlation of consumption is increased to 0.81. Eliminating monetary policy shocks in the home country significantly increases the degree of risk sharing. Consumption volatility is almost equalized across countries, and the correlation of consumption is almost perfect.

4.4 Portfolio Dynamics

Figures 7 and 8 describe the decomposition of the home country current account movement into the gross flows of equity and debt, in response to shocks to home and foreign productivity. To do this decomposition, we need to solve for the first order component of optimal portfolios, as described in Section 3 above.

Following a home productivity shock, we saw in Figure 5 that the home country current account initially deteriorates, brought on by a negative wealth effect. Figure 7 shows that the net fall in the current account is decomposed into two opposing forces. There is a fall in the real value of bond holdings that exceeds the current account deterioration. This is partly offset however by a rise in the real value of equity holdings. In sum, the current account deteriorates, as the fall in gross liabilities (bonds) substantially offsets the rise in gross assets (equity).

By contrast, in response to a foreign productivity shock, gross assets and liabilities move in the same direction. Figure 8 illustrates the decomposition of the current account following a positive shock to A^*. From Figure 6, we know that the current account initially improves. Figure 8 shows that this improvement is decomposed into a rise in bond holdings (a fall in gross liabilities), and a rise in equity holdings (a rise in gross assets) of a roughly equal magnitude. The improvement in the current account is then approximately twice as great as the movement in individual gross positions.

5 Conclusions

To be added...

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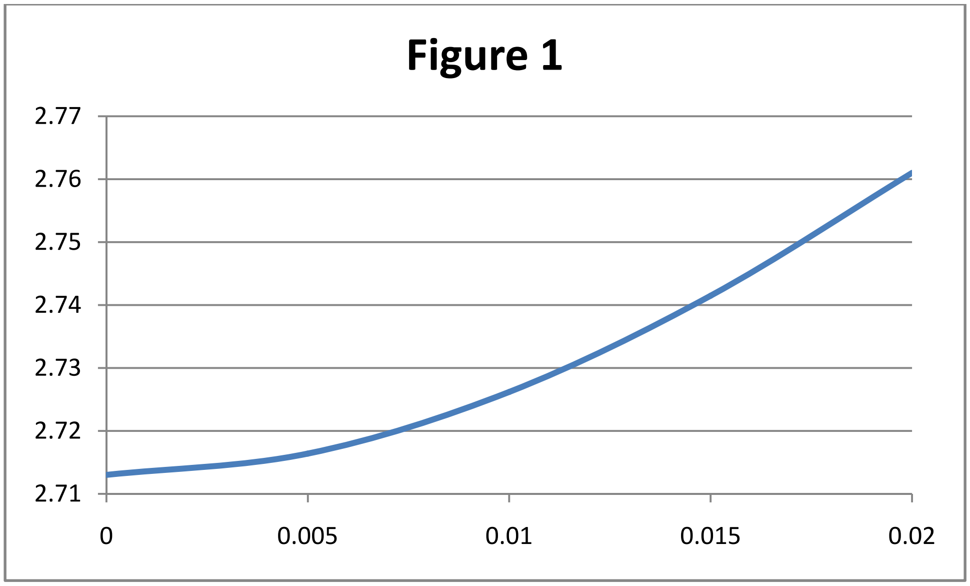
Figure 1
2.77
2.76
2.75
2.74
2.73
2.72
2.71
0
0.005
0.01
0.015
0.02

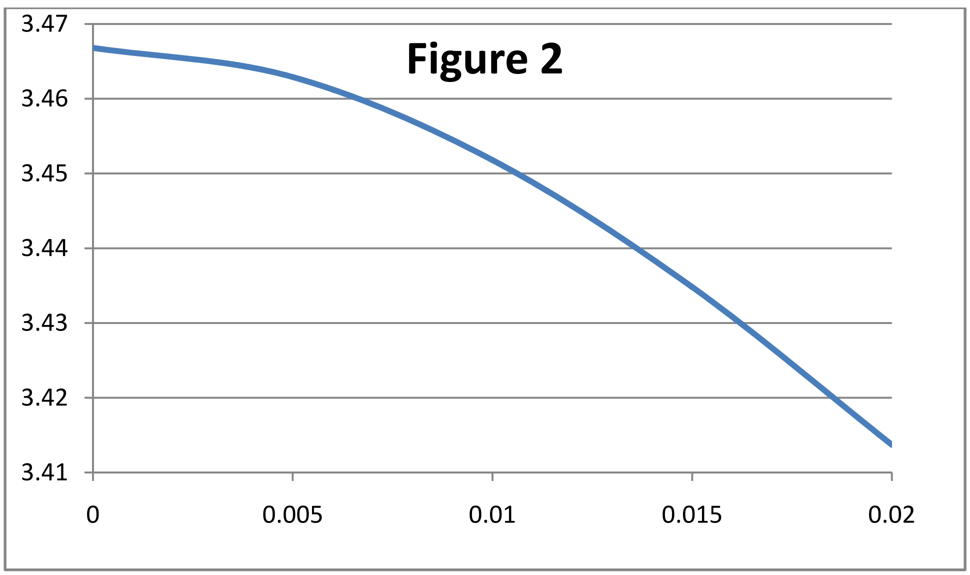
Figure 2
3.47
3.46
3.45
3.44
3.43
3.42
3.41
0
0.005
0.01
0.015
0.02

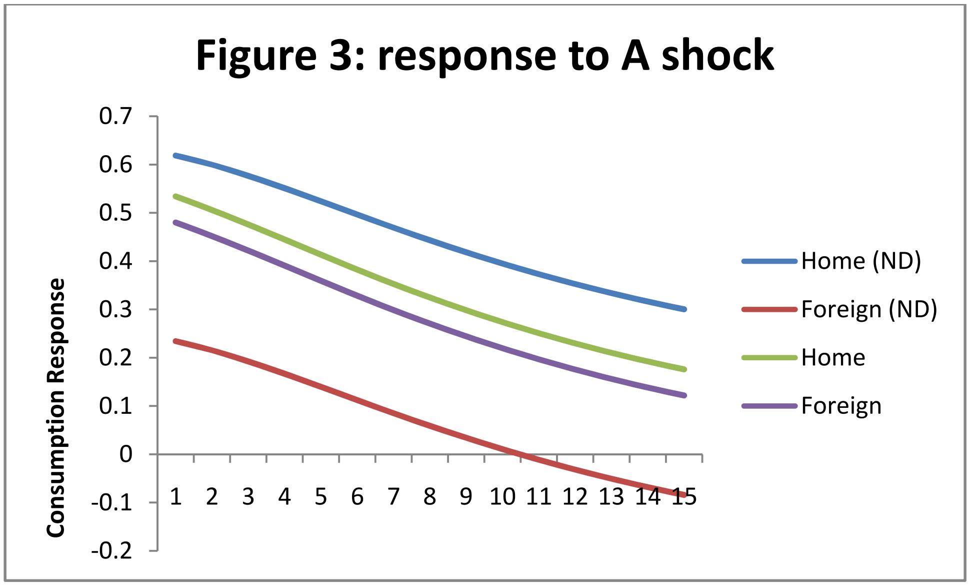
Figure 3: response to A shock
Consumption Response
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Home (ND)
Foreign (ND)
Home
Foreign

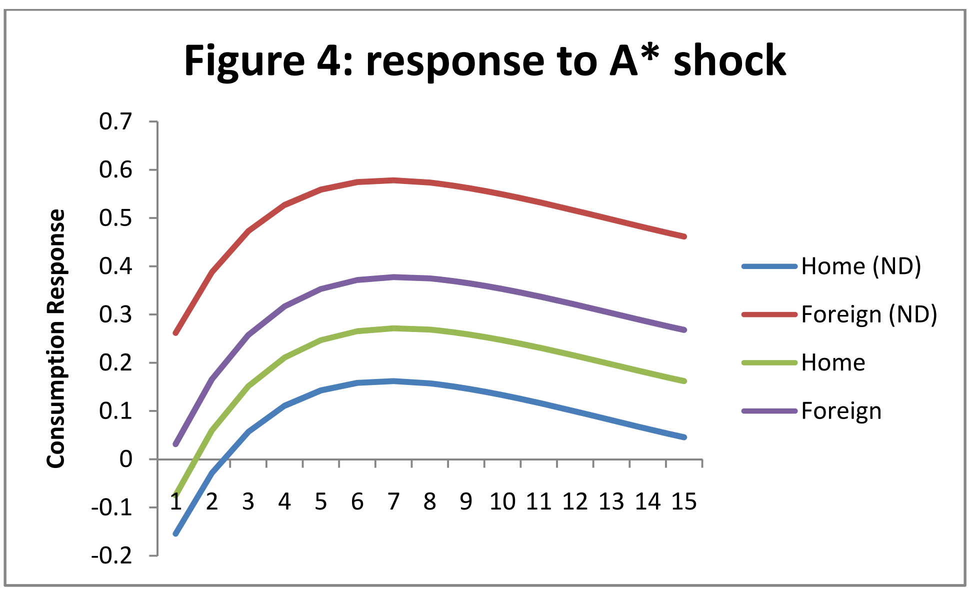
Figure 4: response to A* shock
Consumption Response
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Home (ND)
Foreign (ND)
Home
Foreign

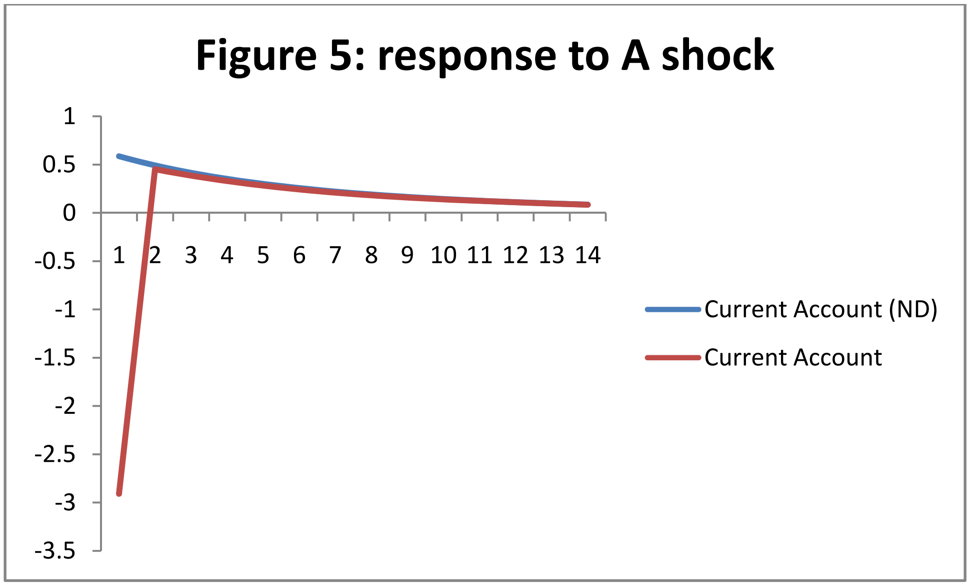

Figure 5: response to A shock
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Current Account (ND)
Current Account

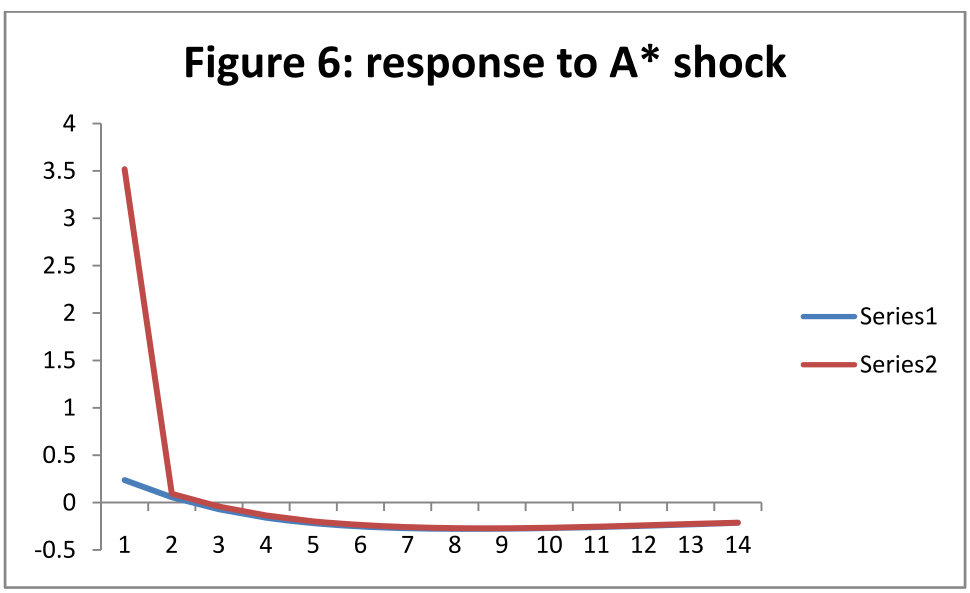

Figure 6: response to A* shock
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Series1
Series2

Figure 7: response to A1 shock

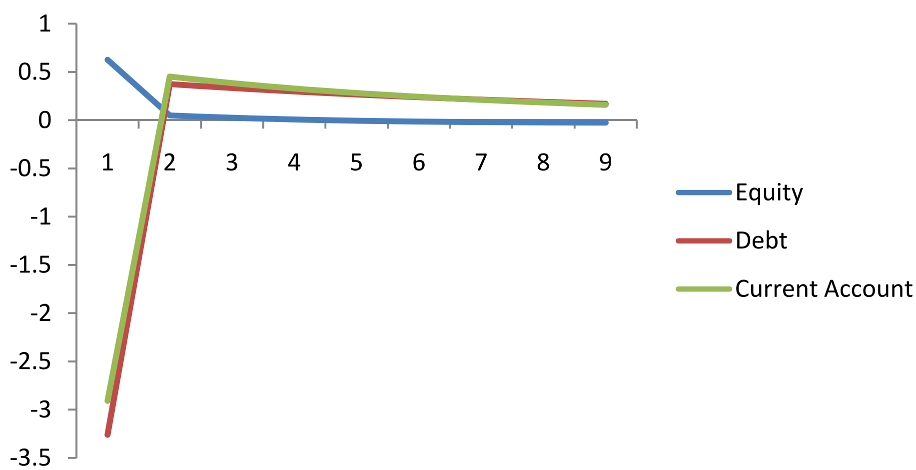

Figure 8: response to A2 shock