Growth Shocks and Portfolio Flows

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Abstract

This paper studies the cyclicality of portfolio flows under the presence of productivity growth rate shocks. Productivity growth rate shocks successfully replicate countercyclical net equity outflows and procyclical bond inflows for advanced countries, which couldn't be captured in a model with only level shocks. Similarly, for an emerging market economy, the model with growth rate shocks generates countercyclical net equity inflows and procyclical bond inflows in accordance with data. Following a growth rate shock, home agents experience a decrease both in equity inflows and outflows on impact. Inflows decrease due to sales of home equity to realize capital gains and outflows decrease due to initial dissaving to finance increases in consumption and investment. Equity inflows increase later, as home dividends rise. Equity outflows pick up also as wealthier home agents increase purchases of foreign assets to hedge against home productivity shocks.

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1 Introduction

Advanced and emerging market economy portfolio flows feature distinct characteristics. Table 1 displays cyclical properties of disaggregated portfolio flows of 22 advanced countries and emerging market economies over the period 1992-2005 from Contessi, De Pace, and Francis (2009). Direction and cyclicality of portfolio flows exhibit significant deviations across different groups of countries. There are differences at times, even between G7 countries and other advanced countries. What could be the factors behind such deviations across countries? In particular, what are the determinants of portfolio flows between emerging market and advanced economies? Aguiar and Gopinath (2007) suggested that varying composition and predominance of productivity level and growth rate shocks help understand the differences between emerging market and advanced economies business cycles. They were successful in replicating the observed strong countercyclicality of net exports for emerging market economies and acyclicality of net exports for advanced economies simply by modifying the persistence and volatilities of these two types of productivity shocks across the countries according to the data. Broner and Rigobon (2006) also attributed the volatile behavior of emerging market economy capital flows to relatively more persistent shocks experienced in these countries.

This paper aims at exploring the significance of the differentiation between level productivity and productivity growth rate shocks in replicating the observed distinct cyclical behavior of equity and debt flows across advanced and emerging market

	Tot. in	Tot. out	Net tot. out	FDI in	FDI out	Net FDI out
G7	?/+	?/+	-	+	?/+	-
Advanced	+	-	-	+	-	-
Emerging	+	-	-	-	?	+
	FPI in	FPI out	Bond in	Bond out		
G7	+	?/+	?/-	-		
Advanced	+	?/-	+	-		
Emerging	+	-	+	+		

Table 1: Source: Contessi, De Pace and Francis (2009), Table 11. Correlations of total inflows (abbreviated as "Tot. in"), total outflows (abbreviated as "Tot. out"), net total outflows, foreign direct investment (FDI) inflows, FDI outflows, net FDI outflows, foreign portfolio investment (FPI) inflows and outflows and bond inflows and outflows with log GDP over the period of 1992-2005.

economies. I solve a two-country, single good model of the world economy with capital accumulation and endogenous labor choice. The model features an explicit portfolio choice problem in both countries, which makes it possible to study not only the net capital flows, but also debt and equity outflows and inflows separately.

I find that growth rate shocks significantly alter the predictions of the standard model for moments of capital flows. My results suggest that inclusion of growth rate shocks contribute in generating the observed countercyclical net equity outflows in advanced countries and countercyclical net equity inflows in emerging market economies. The model also captures procyclical bond inflows in both groups of countries, as in data. The main mechanism driving these results is the difference in the optimal actions of agents and firms between each shock. A temporary expansion in output leaves relative consumption profile roughly unchanged and results in a one-time investment boom. The increase in domestic absorption is limited as the output increase is only temporary. Transitory shock causes a decline in equity inflows and bond inflows as well as an increase in equity outflows. This result suggests that the country experiences initial repatriation of foreign holdings of its equity to realize the capital gains and the windfall is saved by purchasing foreign equity.

When the shock is to the productivity growth rate, on the other hand, households shift their consumption profile up and investment exhibits a prolonged boom. In this case, the country experiences a decline in all equity inflows, equity outflows and bond inflows. The change in the direction of equity outflows is due to the dissaving of home households to finance the increase in consumption and investment. Following the initial impact, both equity inflows and outflows experience a surge. Equity inflows increase due to the higher future stream of home dividends with higher expected future productivity. Equity outflows increase as home households enjoy the attractive hedge provided by the foreign equity. In portfolio models with endogenous labor choice, it is established that the covariance between wage income and dividend income determines the home equity bias and foreign equity bias.[1] When this covariance is positive, equilibrium portfolio allocation exhibits foreign equity bias, as is the case in the analysis here.

This study is related to two big strands of the economics literature. First strand studies the effects of different macroeconomic shocks within otherwise standard models and assesses their implications. Edge, Laubach, and Williams (2007) study impli-

[1] See Baxter and Jermann (1997), Heathcote and Perri (2008) and Coeurdacier, Kollmann and Martin (2010) for details.

cations of transitory and permanent shocks in a closed economy framework. Cova, Pisani, Batini, and Rebucci (2008) argue that productivity shocks are main determinants of global imbalances experienced across countries. Aguiar and Gopinath (2007) express the importance of growth rate shocks in understanding and explaining emerging market economies' business cycles, within a small open economy framework. Nguyen (2010) studies growth rate shocks within a similar two-country model, however he doesn't have time-varying portfolio analysis and his focus is different.

The other related strand of literature studies endogenous portfolio choice within a general equilibrium framework of the world economy. Evans and Hnatkovska (2005) set a benchmark in studying and understanding capital flows in a two-country two-sector world economy, but they don't explore growth shocks. Tille and Van Wincoop (2010) study equity flows in an incomplete markets setting with transitory productivity shocks. Although their focus is home equity bias, Coeurdacier, Kollman, and Martin (2010) also present some of their findings regarding capital flows for G7 countries using a combination of level productivity and investment efficiency shocks. Within the strand of literature studying international portfolio flows, a separate branch focuses on investigating and understanding emerging market economy capital flows. The closest work to the one presented here is Devereux and Sutherland (2009) in terms of both their focus on financial flows between an emerging market and an advanced economy, and their solution technique. However, they use level productivity shocks only and attain their results by restricting the available menu of financial assets and the financial market structure. In their empirical analysis of volatility of the emerging market capital flows, Broner and Rigobon (2006) conclude that emerging markets have more volatile capital flows. They argue that the higher volatility is mostly the result of relatively more persistent shocks in EMs. Kaminsky, Reinhart, and Vegh (2004) find that net capital inflows are more strongly procyclical in emerging markets and this could also be attributed to trend shocks.[2]

This work contributes to the literature on several grounds. First, this is the first paper that analyzes the implications of capital accumulation and endogenous labor choice on portfolio choice in the presence of productivity growth rate shocks. Second, it is the first paper to analyze time-varying portfolio flows both between two advanced economies and an emerging market economy and an advanced economy under a combination of level and growth rate productivity shocks.

The remainder of the chapter is organized as follows. Section 2 describes the model, including the portfolio choice problem faced by each country. Section 3 summarizes quantitative analysis. Section 4 concludes.

2 Model

The model features two countries, Home (H) and Foreign (F), and a single good. A continuum of identical, perfectly competitive firms in each country produce the single good using physical capital and labor as inputs. Each country has a stochastic

[2] See Gopinath (2004) comment on Kaminsky, Reinhart, and Vegh (2004).

process governing productivity. The productivity process in each country includes both a labor-augmenting trend component and a transitory component, as in Aguiar and Gopinath (2007). The population consists of identical households who decide, in an optimizing framework, how much to consume and work as well as what assets to hold. There is no restriction on the trade of goods.

2.1 Firms

In both countries, $i = \{H, F\}$, firms produce output using a Cobb-Douglas production function:

$$Y_t^i = e^{z_t^i}(K_t^i)^{\theta}(\Gamma_t^i L_t^i)^{1-\theta}, \quad 0 < \theta < 1 \tag{1}$$

where K_t^i and L_t^i denote capital and labor inputs employed in the production of output Y_t^i and $\theta \; \epsilon \; (0,1)$ is the share of capital in output. z_t^i is the transitory component of productivity in country i. It represents shocks to the level of productivity and it follows a stationary autoregressive process:

$$z_t^i = \rho_z z_{t-1}^i + \varepsilon_t^{iz} \;, \quad |\rho_z| < 1 \text{ and } \varepsilon^{iz}\tilde{\ } iidN(0, \sigma_{iz}) \tag{2}$$

Γ_t^i stands for the cumulative product of labor-augmenting growth shocks. It represents transitory changes in the growth rate of productivity, which implies permanent changes in the level of productivity. It is defined recursively as follows:

$$\Gamma_t^i = e^{g_t^i}\Gamma_{t-1}^i\left(\frac{\Gamma_{t-1}^j}{\Gamma_{t-1}^i}\right)^{\lambda}, 0 < \lambda < 1,\ for\ i \neq j$$

where g_t^i denotes the shocks to the growth rate of productivity and it evolves according to:

$$g_t^i = (1-\rho_g)\bar{g} + \rho_g g_{t-1}^i + \varepsilon_t^{ig},\quad |\rho_g| < 1 \text{ and } \varepsilon^{ig}\tilde{\ } iidN(0, \sigma_{ig}) \tag{3}$$

$\bar{g}$ is the long-run average growth rate, which is assumed to be the same in both countries. In a two-country model framework with trend growth, a restriction pertaining to the countries' relative total factor productivity is required to guarantee stationarity. This restriction assures that, even though productivities can diverge for some time, overall process is consistent with absolute long run convergence. In other words, the cumulative growth shocks across the two countries are assumed to be cointegrated. $\left(\frac{\Gamma_{t-1}^j}{\Gamma_{t-1}^i}\right)^{\lambda}$ is the convergence factor, as in Nguyen (2010), which keeps the detrended model stationary. [3] This convergence factor is denoted as $\pi_t \equiv \frac{\Gamma_{t-1}^F}{\Gamma_{t-1}^H}$ and it evolves according to

$$\pi_{t+1} \equiv \frac{\Gamma_{t-1}^F}{\Gamma_{t-1}^H} = \frac{e^{g_t F}}{e^{g_t^H}}\left(\pi_t\right)^{1-2\lambda}$$

The speed of convergence depends on the choice of parameter λ.[4]

This representation of the growth shocks could be interpreted as a vector error

[3] See Rabanal, Rubio-Ramirez and Tuesta (2009) for further information on cointegration of productivity processes in two-country models.

[4] When $\lambda > 0$,the convergence process π_t makes the productivity processes cointegrated across the countries. A small λ means long convergence.

correction model:

$$\ln \Gamma_t^i = \ln \Gamma_{t-1}^i + g_t^i + \lambda \left(\ln \Gamma_{t-1}^j - \ln \Gamma_{t-1}^i \right)$$

Suppose that $\Gamma_{t-1}^F > \Gamma_{t-1}^H$. The last expression on the right hand side increases Γ_t^H by adding the difference between cumulative growth shocks. Similarly, this difference is subtracted from Γ_t^F, decreasing it. Eventually, this system guarantees the convergence of productivity processes.

Firms choose labor demand, dividends, and investment to maximize the expected present discounted value of dividend payments to shareholders. The representative firm's objective function is:

$$\max \ E_t \left[\sum_{s=0}^{\infty} M_{t+s,t}^i D_{t+s}^i \right] \tag{4}$$

where $M_{t+s,t}^i$ is the stochastic intertemporal marginal rate of substitution (SMRS) of the country i household.

Dividends are defined as:

$$D_t^i = Y_t^i - W_t^i L_t^i - I_t^i \tag{5}$$

where D_t^i, W_t^i, I_t^i denote dividend payments, real wages, and investment, respectively.

Investment, in turn, is defined as follows:

$$I_t^i = K_{t+1}^i - (1-\delta)K_t^i + \frac{\varphi}{2}\left(\frac{K_{t+1}^i}{K_t^i} - e^{\bar{g}}\right)^2 K_t^i \tag{6}$$

I assume that capital depreciates at the rate δ, and firms face quadratic capital adjustment costs, as in Aguiar and Gopinath (2007) and Nguyen (2010), where φ is the adjustment cost parameter.

2.2 Assets

There are three types of financial assets in this world: equity in home country firms (A_t^H), equity in foreign country firms (A_t^F), a one-period, and a risk-free real international bond (B_t) . The prices of these securities are P_t^H, P_t^F, and P_t^B , respectively. The holder of an equity claim from period $t-1$ receives a dividend payment in period t and can also collect capital gains by selling the equity for its current price. Thus, the overall return on a country equity is:

$$R_t^i = \frac{D_t^i + P_t^i}{P_{t-1}^i} \tag{7}$$

An international bond purchased in period $t-1$ delivers one unit of the global consumption good in period t, so the return on the bond is:

$$R_t^B = \frac{1}{P_{t-1}^B} \tag{8}$$

2.3 Households

Infinitely lived households in each country choose consumption (C^i), labor supply (L^i), and asset holdings (A^{iH}, A^{iF}, B^i) to maximize their expected present discounted utility:

$$U_t^i = E_t \left[\sum_{s=0}^{\infty} \Psi_{t+s}^i \frac{\left((C_{t+s}^i)^{\gamma}(1 - L_{t+s}^i)^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} \right] \tag{9}$$

where γ is the weight on consumption, $\sigma > 0$ is the coefficient of relative risk aversion, and Ψ_t^i is endogenous discount factor that depends on the detrended, lagged consumption of country i household ($c_{t-1}^i = C_{t-1}^i / \Gamma_{t-2}$) and is defined as:

$$\Psi_t^i = \Psi_{t-1}^i \beta(c_{t-1}^i), \Psi_0 = 1$$

$$\beta(c_{t-1}^i) = \omega^i (c_{t-1}^i)^{-\eta}$$

This form of the (internalized) endogenous discount factor ensures stationarity of the cross-country wealth distribution and uniqueness of the steady state, as in Schmitt-Grohé and Uribe (2003) and Devereux and Sutherland (2008). As the rate of impatience rises with the level of consumption, a stationary consumption profile is possible.[5]

The model features international trade in both equities and the real international bond. A representative household in country i maximizes (9) by choosing how much to

[5] See Schmitte-Grohe and Uribe (2003) for further details.

consume and how much to borrow or lend subject to the following budget constraint:

$$C_t^i + P_t^i A_t^{ii} + P_t^j A_t^{ji} + P_t^B B_t^i = W_t^i L_t^i + (D_t^i + P_t^i) A_{t-1}^{ii} + (D_t^j + P_t^j) A_{t-1}^{ji} + B_{t-1}^i \quad (10)$$

every period, where $i, j = \{H, F\}$ and $i \neq j$. The variable A_t^{ji} denotes household i's holdings of country j's equity at the end of period t and the variable P_t^j denotes the price of equity j. P_t^B is the price of the real bond and B_t^i denotes household i's holdings of the international bond.

It will be convenient while solving the portfolio choice problem to rewrite the budget constraint in terms of net foreign assets. Define the net foreign assets of a representative household in each country as:

$$NFA_t^i = P_t^j A_t^{ji} + P_t^i (A_t^{ii} - 1) + P_t^B B_t^i$$

Then, I can rewrite the budget constraint of the country i household as:

$$\begin{aligned} C_t^i + NFA_t^i &= W_t^i L_t^i + R_t^B NFA_{t-1}^i - P_t^i + R_t^B P_{t-1}^i + R'_{x,t} \alpha_{t-1}^i \qquad (11) \\ \alpha_t^i &= \left[P_t^i A_t^{ii} \quad P_t^j A_t^{ji} \right] \\ R'_{x,t} &= \left[R_t^H - R_t^B, \quad R_t^F - R_t^B \right] \end{aligned}$$

2.4 Equilibrium Conditions

Households maximize (9) subject to the budget constraint relevant with the asset configuration, taking wages, dividends, and prices as given. The first-order conditions for households in each country can be written as follows:

$$L_t^i \quad : \quad \frac{C_t^i}{\gamma} = \frac{W_t^i(1-L_t^i)}{1-\gamma} \tag{12}$$

$$A_t^{ii} \quad : \quad 1 = E_t M_{t+1,t}^i R_t^i \tag{13}$$

$$A_t^{ji} \quad : \quad 1 = E_t M_{t+1,t}^i R_t^j \tag{14}$$

$$B_t^i \quad : \quad 1 = E_t M_{t+1,t}^i R_t^B \tag{15}$$

$$M_{t,t-1}^i \quad \equiv \quad \beta\left(c_{t-1}^i\right)\frac{\mu_t^i}{\mu_{t-1}^i}, where \tag{16}$$

$$: \quad \mu_t^i = \left[(C_t^i)^{(\gamma(1-\sigma)-1)}(1-L_t^i)^{(1-\gamma)(1-\sigma)}\right] + \varsigma_t^i \eta \omega c_{t-1}^{i(-1-\eta)} \tag{17}$$

$$: \quad \varsigma_t^i = E_t\left[\varsigma_{t+1}^i \omega c_{t+1}^{i(-\eta)} + \frac{\left[(C_{t+1}^i)^{\gamma}(1-L_{t+1}^i)^{(1-\gamma)}\right]^{(1-\sigma)}}{(1-\sigma)}\right] \tag{18}$$

$M_{t,t-1}^i$ is the intertemporal marginal rate of substitution. μ_t is the lagrange multiplier of the budget constraint and ς_t is the lagrange multiplier associated with the internalized endogenous discount factor. An increase in current consumption decreases the discount factor and reduces the period t utility. It could be interpreted as the present discounted value of the utility from period $t+1$ onwards.

Similarly, firms maximize (4) subject to (5) and the capital-accumulation equation (6). The first-order conditions for firms in each country can be written:

$$
\begin{aligned}
L_t^i &: \quad W_t^i = (1-\theta)\frac{Y_t^i}{L_t^i} && (19)\\
K_{t+1}^i &: \quad \left(1+\varphi\left(\frac{K_{t+1}^i}{K_t^i} - e^{\bar{g}}\right)\right) && (20)\\
&= \quad E_t\left[\Phi_{t+1,t}^i\left(\begin{array}{c} e^{z_{t+1}^i}\theta(K_{t+1}^i)^{\theta-1}(\Gamma_{t+1}^i L_{t+1}^i)^{1-\theta} \\ +(1-\delta)+\frac{\varphi}{2}\left(\left(\frac{K_{t+2}^i}{K_{t+1}^i}\right)^2 - (e^{\bar{g}})^2\right)\end{array}\right)\right]
\end{aligned}
$$

Firms demand labor until cost of one additional unit of labor and marginal product raised due to the additional hire are equalized. They invest in capital until marginal product of capital is equal to marginal cost of investing in an additional unit of capital.

The market-clearing conditions for goods and financial assets are as follows:

$$
\begin{aligned}
Y_t^H + Y_t^F &= C_t^H + C_t^F + I_t^H + I_t^F && (21)\\
1 &= A_t^{HH} + A_t^{HF} && (22)\\
1 &= A_t^{FF} + A_t^{FH} && (23)\\
0 &= B_t^H + B_t^F && (24)
\end{aligned}
$$

The supply of equity shares in each country is normalized to unity. International bonds are in zero net supply.

3 Analysis

3.1 Parameterization

The model incorporates a portfolio choice problem to the conventional growth model using recent computational methods. The menu of internationally traded assets consists of home equity, foreign equity and an international risk-free bond. Pairs of countries are identified by symmetry of the the standard deviations of the shocks. In the symmetric model, I assume that both countries receive the same level and growth rate shocks. As asserted by Aguiar and Gopinath (2007), emerging market economies have a different productivity shock composition compared to advanced economies. Following their steps, in the "asymmetric" benchmark calibration of the model, I modify the standard deviations of the shocks in the foreign country (emerging market) such that shocks to level productivity are "less important" and shocks to the growth rate of productivity are "more important". Although, this could be a vital part of a differentiation between an emerging market and an advanced economy, it is by no means complete. Especially, assuming that both countries have the same level of effect on the prices would not be realistic. Therefore, introducing size differences among the countries, as in Mendoza (1995), could be a natural feature to add to the asymmetric version of the model. However, since the nature of this study is more qualitative than quantitative, it is more important to understand what different productivity shock compositions can deliver in terms of cyclicality of portfolio flows,

Parameter	Value	Description
$\beta(\bar{C})$	0.98	steady state discount factor
γ	0.36	consumption component (utility)
σ	2	risk aversion
η	0.001	elasticity of discount factor
δ	0.05	depreciation rate
θ	0.36	share of capital
λ	0.001	convergence parameter
φ	4	adjustment cost
$\bar{g}$	0.0055	long-run growth rate

Table 2: Baseline model calibration

when everything else is constant. One could think of the asymmetric pair of countries as US-E7 or G7-E7, which have similar sizes, but completely different productivity processes.

Table 2 summarizes the parameter specifications that are common to both the symmetric and the asymmetric models analyzed. $\beta(\bar{C})$ is the steady state value of the endogenous discount factor in accordance with quarterly data. Using the steady state value of consumption for each country and equating η to 0.001, I pick the proper ω value. The following parameters are specified as in Aguiar and Gopinath (2007). The exponent of consumption in the period utility function, γ, is set to 0.36, such that households spend one-third of their time working in the steady state. The coefficient of relative risk aversion, σ, is set to 2 for both countries. The share of capital in output, θ, is 0.36 and the depreciation rate, δ, is 0.05. The persistence parameters for the two types of productivity shocks are also as in Aguiar and Gopinath (2007). The cross-country convergence parameter for the growth processes, λ, is set at 0.001, and the long run mean growth rate, μ_g, is 0.0055 as in Nguyen (2010).

Symmetric	ρ_z^H	ρ_g^H	ρ_z^F	ρ_g^F	σ_z^H	σ_g^H	σ_z^F	σ_g^F
	0.84	0.56	0.84	0.56	0.0055	0.0042	0.0055	0.0042
Asymmetric	ρ_z^H	ρ_g^H	ρ_z^F	ρ_g^F	σ_z^H	σ_g^H	σ_z^F	σ_g^F
	0.95	0.01	0.95	0.01	0.0088	0.0078	0.0281	0.0048

Table 3: Parameter values for productivity processes.

To asses the impact of different composition of the shocks on the economy and the financial flows, I study two different sets of volatility calibration. The first, "symmetric" calibration, imposes that the countries are similar to each other and both economies receive the same level and growth rate shocks. The persistence and volatility parameters are taken from Nguyen (2010) calibration for U.S. and G-6 countries. Standard deviation of transitory shock is the average of the estimated standard deviations of the shock for U.S. and G-6 countries. In the "asymmetric" specification, the persistence and volatility parameters are taken from Aguiar and Gopinath (2007) estimations for an advanced economy and an emerging market economy. In this second case, I assume that the home is the advanced economy and the foreign is the emerging market economy .

3.2 Solution Method

I use lower-case letters to denote detrended variables. For any variable X_t, the detrended variable x_t is defined as follows:

$$x_t = \frac{X_t}{\Gamma_{t-1}}$$

Note that the following variables are already stationary and do not need to be detrended: $A^{ij}, R^i, R^B, R_x, L^i$ for all $i, j = \{H, F\}$.

The solution approach is to take local approximation of the model around the non-stochastic steady state and solve the approximated model for locally accurate decision rules and laws of motion. However, it is well known that in this class of models, the asset holdings A^{ij} are indeterminate in both the non-stochastic steady state and in first-order approximation of the model. I address this challenge by using the solution technique of Devereux and Sutherland (2008) (henceforth, DS). DS show how to characterize asset holdings in a "near-non-stochastic" steady state by examining the implications of a second-order approximation of the households' first-order conditions for asset holdings, together with a first-order approximation of the rest of the model. In a companion paper Devereux and Sutherland (2010), DS also show how to derive first-order variation in asset holdings ("portfolio dynamics") by looking at higher-order approximations of the model. I apply both techniques, identifying both the near-non-stochastic steady state asset holdings as well as the first-order portfolio dynamics.

3.3 General Equilibrium Dynamics

Figure 1 displays the the impulse response of the general economy to the positive 1% level and growth rate productivity shocks, under the symmetric model calibration. When there is positive shock to the home productivity level, output increases. This impact effect is the same under the productivity growth rate shock, however the duration and the persistence of the increase is different across the two shocks. When the shock is transitory,the highest increase in output is achieved right after the shock and the increase dies out eventually following that. Under the growth rate shock, relative home output rises on impact and continues to rise (above the initial impact level) as the shock to the growth rate has effects in output that goes beyond near future.

As a result of the increase in output, home consumption rises relative to foreign country. Note, once again, the difference between the impacts of the two shocks. As the growth rate shock promises an output path that is going to be above the balanced growth path level far into the future, consumption smoothing incentive dictates agents to shift their consumption profile up. In contrast, the relative home consumption profile is roughly unchanged under the transitory shock. Capital and investment increase under both shocks; however the effect is short-lived under the transitory shock. The increase is more significant and lasts longer under the growth

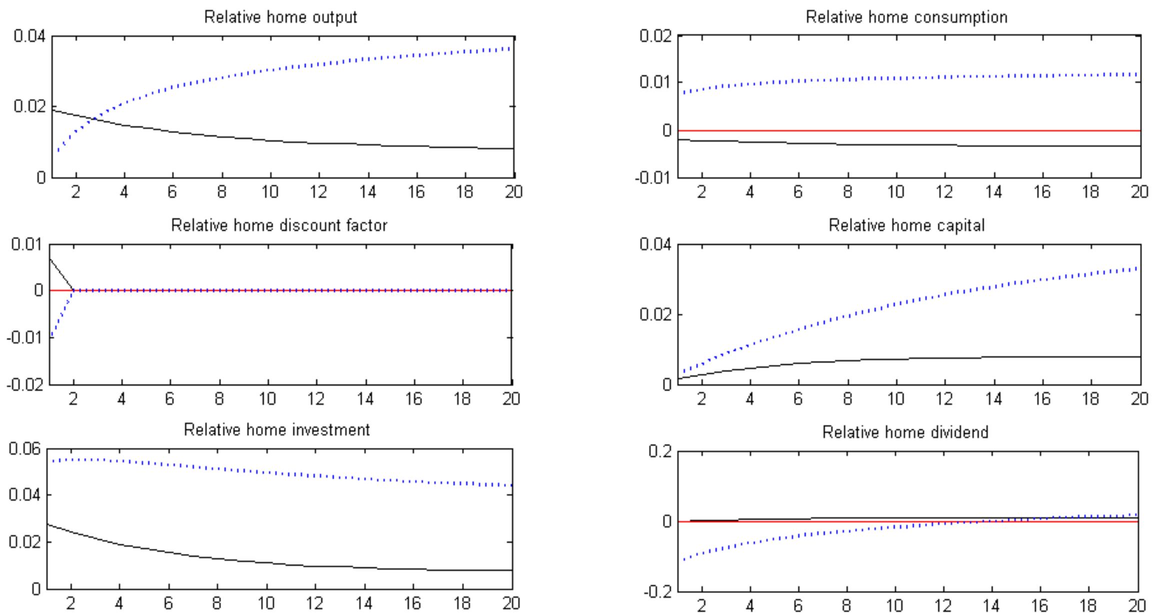

Figure 1: IRFs from the symmetric model with positive one standard deviation level and growth rate shock. The black solid line represents responses to the level shock, whereas the blue dashed line represents responses to the growth rate shock.

rate shock, as the investment is a function of expected future productivity.

Another key difference between these two shocks is in terms of their impact on labor supply. Figure 2 presents the impulse responses of relative home labor supply, relative home wage rate and relative and labor income. As the output increases, marginal productivity of labor also rises. The resulting wage hike and the gap between the home and foreign country wage rate intensifies when the shock is to the productivity growth rate and the gap shrinks after twenty periods under the transitory shock. Relative home labor income follows a similar path in response to shocks. The increase in wage rate causes the opportunity cost of leisure to increase, pushing the household

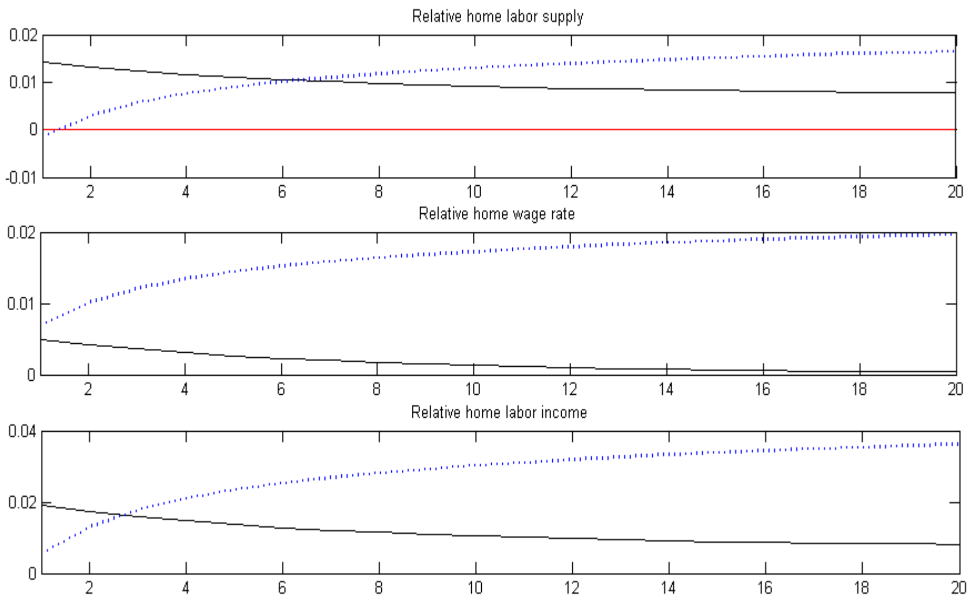

Figure 2: IRFs from the symmetric model with positive one standard deviation level and growth rate shock. The black solid line represents responses to the level shock, whereas the blue dashed line represents responses to the growth rate shock.

to work more. Simultaneously, due to the isoelastic preferences in consumption and leisure, an increase in consumption causes a decline in labor supply. When the shock is transitory, since the consumption profile is not altered significantly, the former dominates and relative home labor supply increases. When the shock is permanent, as the relative consumption profile shifts up, the latter effect dominates, causing a decline in the relative home labor supply.

In summary, two results stand out in comparison to transitory increases in productivity. Permanently higher productivity and, thus output, causes upwards shift of consumption profile and induces the income effect to dominate in labor supply choice, causing households to work less. Following the growth shock, investment experiences a prolonged boom. Both of these results imply a much larger and long-lasted increase in domestic absorption after a growth shock in contrast to the limited and short-lived increase experienced after a level shock.

3.4 Dynamics of External Financial Positions

The impulse responses displayed in Figure 3 are from the symmetric model with 1% standard deviation positive shocks, as in the preceeding subsection. Before proceeding to interpret the figures, it is useful to define the measures of portfolio flows the graphics contain. Each asset category (bond vs. equity) is measured in two different ways. The first set of measures identify the changes in the net holdings of the assets. Net foreign equity assets (NEQ) for home country household are defined as the difference between

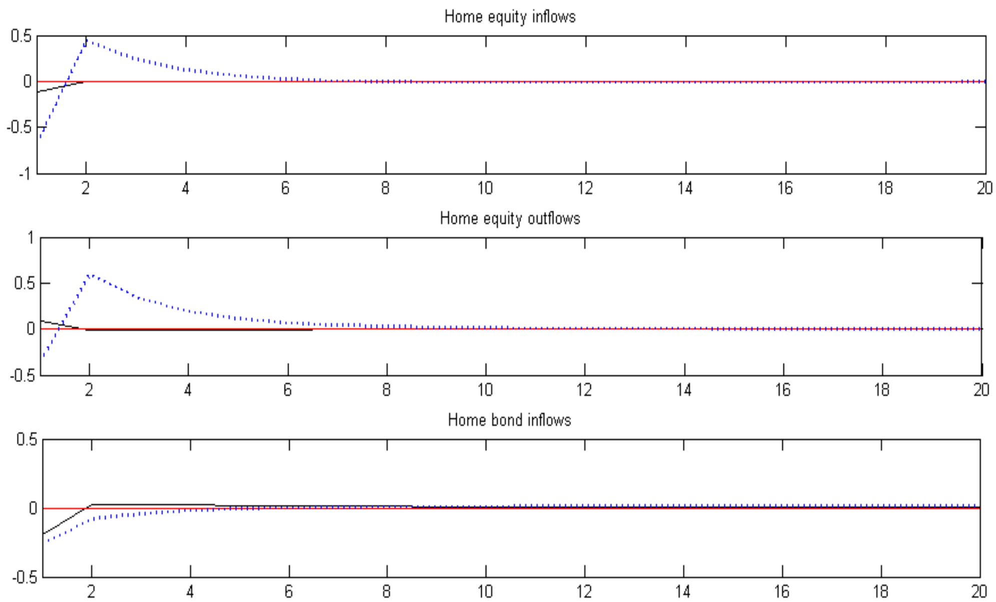

Figure 3: IRFs from the symmetric model with positive one standard deviation level and growth rate shocks. The black solid line represents responses to the level shock, whereas the blue dashed line represents responses to the growth rate shock. All variables are represented as a share of GDP.

home holdings of foreign equity (gross foreign equity assets) and foreign holdings of home equity (gross foreign equity liabilities), $(P_t^F A_t^{FH} - P_t^H A_t^{HF})$. Home net bond assets at the end of period t are $P_t^B B_t^H$. Sum of net foreign equity assets and net bond assets is net foreign assets.

Net equity inflows for home country are defined as $P_t^H (A_t^{HF} - A_{t-1}^{HF})$ and net equity outflows as $P_t^F (A_t^{FH} - A_{t-1}^{FH})$, similar to Evans and Hnatkovska (2005). Debt inflows are measured as $(P_t^B B_t^H - B_{t-1}^H)$. The definitions are similar for the foreign country portfolio flows measures. Foreign country net equity inflows are the foreign firm equities owned by the home household, $P_t^F(A_t^{FH} - A_{t-1}^{FH})$, net equity outflows are home firm equities purchased by foreign household, $P_t^H(A_t^{HF} - A_{t-1}^{HF})$. Debt inflows are represented by $(P_t^B B_t^F - B_{t-1}^F)$. Note that, home country net equity inflows are equal to foreign country net equity outflows, and, similarly, home bond inflows are equal to foreign bond outflows. For this reason I only discuss bond inflows.

Home current account is specified as $P_t^F(A_t^{FH} - A_{t-1}^{FH}) - P_t^H(A_t^{HF} - A_{t-1}^{HF}) + (P_t^B B_t^H - B_{t-1}^H)$. Comparing the measures of change in net foreign assets and current account, it is understood that they are not equivalent and the difference is the capital gains and losses incurred on the existing holdings from past period due to changes in the asset prices. Those valuation effects are defined as $A_{t-1}^{FH}(P_t^F - P_{t-1}^F) - A_{t-1}^{HF}(P_t^H - P_{t-1}^H) + B_{t-1}^H(P_t^B - P_{t-1}^B)$. Adding the current account and the valuation effects gives the change in net foreign assets, which could equivalently be expressed by adding the change in net foreign equity assets and the change in net bond assets.

The positive transitory shock causes a decline in home equity inflows and an increase in home equity outflows. The transitory productivity hike causes a one-time investment boom. This boom initally causes a decline in dividends, which later increases due to increase in the capital stock. As the home dividend rises slightly above foreign dividend, price of the home firm equity also rises relative to foreign equity price. The relative home dividend overall doesn't change too much in response to the transitory shock. Since the investment boom is short-lived and the home consumption profile stays roughly the same relative to its foreign counterpart, the increase in domestic absorption is less than the increase in output. So the windfall is saved by investing in the foreign firm equity, which is an attractive hedge against the home productivity shock. Although the net export is in surplus, the bond position is negative meaning that to finance foreign equity purchases they are borrowing in bonds.

At a first glance to the economy dynamics following the growth rate shock, two major differences stand out. First difference between the level and growth rate shocks is that almost all the impact effects are larger for the growth rate shock due to its permanent nature. Second noticable difference is the plunge in both home equity inflows and outflows on impact. Even after the second period, both equity flows follow a similar pattern up, above their trend level, in contrast to the initial downwards impact. This symmetry in dynamics of equity flows results from the high expected future productivity and the proceeding hike in domestic absorption that were not present under the transitory level shock. Home households still enjoy the hedging potential of foreign equity, while home equity becomes very attractive for foreign households due to its promising future dividend stream. The downward impact effect on home equity outflows stems from the dissaving of home households to finance the consumption profile shift and the investment boom. Equity outflows plunge on impact as foreign houeholds sell their holdings of home equity to the realize capital gains due to the increase in the price of home equity.

Specification 1	Shocks to			
Symmetric Model	z	g	z and g	Data
Correlations with GDP				
Δ(Net foreign assets)	0.11	0.01	-0.02	-0.22
Δ(Net foreign equity assets)	0.16	-0.00	-0.04	-0.02
Δ(Net bond assets)	-0.05	0.01	-0.01	-0.24
Net equity inflows	0.00	-0.02	-0.03	0.10
Net equity outflows	0.09	-0.02	-0.02	-0.03
Net bond inflows	-0.67	0.38	0.26	0.01

Table 4: Symmetric model. Data is from Table 4 of Contessi et al. (2009), which show the correlations with log output of different components of portfolio flows. All measures of capital flows are expressed as a share of GDP.

3.5 Numerical Results

Tables 4 and 5 display the predicted correlations for home country and foreign country portfolio flows under both the symmetric and asymmetric parameter specifications. The comparison data for the advanced country change in net foreign assets, net foreign equity assets and bond assets are from Coeurdacier, Kollman, and Martin (2010) estimates for G7 countries. Data for inflows and outflows are Contessi, De Pace, and Francis (2009) estimates. Since in the asset structure employed here, there is no distinction between foreign direct investment and portfolio equity flows, to find correlations for net equity iflows and outflows, I calculated averages of foreign direct investment and foreign portfolio investment correlations.

The model captures the fact that advanced countries have countercyclical changes in their net foreign assets; that is, as the economy enters a period of high output, net foreign equity and bond holdings decline. I have shown in the previous subsection that, although level productivity shocks imply improving equity outflows, growth rate shocks result in declines in both inflows and outflows. With only transitory shocks, the model predicts procyclical changes in net foreign assets. The sign of the correlation changes as growth rate shocks are added to the model. In a similar fashion, the model generates countercyclical net equity inflows and outflows. This prediction is consistent with data for net equity outflows, however the correlation coefficient is positive for net equity inflows. The model is successful in terms of matching the sign of the cyclicality for bond flows only when there are also growth rate shocks; however the countercyclicality predicted for change in net bond assets is not strong enough and the correlation coefficient predicted for bond inflows is too strong.

Table 5 displays the results for asset inflows and outflows from the asymmetric model. The comparison data values for the emerging market economy are also from 1992-2005 estimates of Contessi, De Pace, and Francis (2009) Table 4. Home country represents the advanced economy, whereas the foreign country represents the emerging market economy. The advanced country predictions are similar to the results from Table 4. Emerging market economies experience countercyclical equity inflows, which is matched closely by the model. Similarly, the direction of the cyclicality for bond inflows is generated by the model, only after including the growth rate shocks.

Overall, the model generates countercyclical equity inflows and outflows, along with procyclical bond inflows. The results support the Aguiar and Gopinath (2007) argument that advanced economies and emerging market economies experience dif-

Specification 2	Shocks to			
Correlations with GDP	z	g	z and g	Data
Advanced				
Net equity inflows	0.01	-0.07	-0.03	0.10
Net equity outflows	0.04	-0.07	-0.00	-0.03
Net bond inflows	0.53	-0.05	0.28	0.01
Emerging	z	g	z and g	Data
Net equity inflows	0.04	-0.07	-0.00	-0.05
Net equity outflows	0.01	-0.07	-0.03	0.04
Net bond inflows	-0.53	0.05	0.55	0.13

Table 5: Asymmetric model. Data is from Table 4 of Contessi et al. (2009), which show the correlations with log output of different components of portfolio flows. All measures of capital flows are expressed as a share of GDP.

ferent combinations of transitory and permanent shocks. The transitory shock model predictions are more consistent with the observed cycles for advanced economy net foreign equity inflows. I have also established that predictions for GDP correlations of portfolio asset flows are remarkably different across different combinations of shocks, making differentiation and examination of growth rate shocks versus transitory shocks a necessary and useful improvement in the study of international portfolio flows, especially between emerging markets and advanced economies.

4 Conclusion

This paper studied the time varying portfolio flows and their cyclical properties in the presence of productivity growth rate shocks. Growth shocks seem to play an important role in terms of influencing the direction of financial flows. Different stochastic properties of shocks affect the choice of whether to lend or borrow, as well as the preferences of agents in terms of assets chosen to carry out lending and borrowing. Future work calls for a finer parameter calibration and estimation of the model for particular country cases.

Imposing observed home equity bias in contrast to the foreign equity bias present in this study is required to achieve more realistic results. Although various shocks such as demand shocks, fiscal shocks and investment efficiency shocks started to take their place alongside productivity shocks recently, most efforts are limited to the analysis of equilibrium portfolio allocations. Complementary analysis of time-varying portfolio flows would benefit economic literature tremendously. Specifically, in forming economic policy relating to external accounts, understanding patterns and determinants of portfolio flows play a crucial role.

5 Appendix

5.1 Equilibrium Conditions of the Normalized Model

Let $u_{c^H,t} = \frac{\partial U(c_t^H, l_t^H)}{\partial c_t^H}$ and $m_{t,t-1}^H = \beta(c_{t-1}^H)\frac{u_{c^H,t}}{u_{c^H,t-1}} = \beta(c_{t-1}^H)\frac{\left(c_t^{H\gamma}(1-l_t^H)^{1-\gamma}\right)^{1-\sigma}}{\left(c_{t-1}^{H\gamma}(1-l_{t-1}^H)^{1-\gamma}\right)^{1-\sigma}}\frac{c_{t-1}^H}{c_t^H}\left(\frac{A_{t-1}^H}{A_{t-2}^H}\right)^{\gamma(1-\sigma)} = \beta(c_{t-1}^H)\frac{\left(c_t^{H\gamma}(1-l_t^H)^{1-\gamma}\right)^{1-\sigma}}{\left(c_{t-1}^{H\gamma}(1-l_{t-1}^H)^{1-\gamma}\right)^{1-\sigma}}\frac{c_{t-1}^H}{c_t^H}\left(e^{g_{t-1}^{HA}}\right)^{\gamma(1-\sigma)}$.

Home households' budget constraint and first-order conditions:

$$c_t^H + nfa_t^H = w_t^H l_t^H + \frac{R_t^B nfa_{t-1}^H}{e^{g_{t-1}^H}\pi_{t-1}^\lambda} + d_t^H + \frac{R'_{x,t}\tilde{\alpha}_{t-1}}{e^{g_{t-1}^H}\pi_{t-1}^\lambda}$$

$$\begin{aligned}
l_t &: \quad \frac{c_t^H}{\gamma} = \frac{w_t^H(1-l_t^H)}{1-\gamma} \\
nfa_t &: \quad 1 = E_t m_{t+1,t}^H R_{t+1}^H \\
\alpha_t &: \quad E_t m_{t+1,t}^H R_{t+1}^F = E_t m_{t+1,t}^H R_{t+1}^H
\end{aligned}$$

Home country firms' budget constraint and first-order conditions

$$d_t^H = y_t^H - w_t^H l_t^H - (k_{t+1}^H e^{g_t^H}\pi_t^\lambda - (1-\delta)k_t^H) - \frac{\varphi}{2}\left(\frac{k_{t+1}^H}{k_t^H}e^{g_t^H}\pi_t^\lambda - e^{\bar{g}}\right)^2 k_t^H$$

$$
\begin{aligned}
l_t^H &: \quad w_t^H = (1-\theta)\frac{y_t^H}{l_t^H} \\
k_{t+1}^H &: \quad \left(1+\varphi(\frac{k_{t+1}^H}{k_t^H}e^{g_t^H}\pi_t^\lambda - e^{\bar{g}})\right) \\
&= \quad E_t\left[m_{t+1,t}^H\left(\begin{array}{c} e^{z_{t+1}^H}\theta k_{t+1}^{H\theta-1} {l_{t+1}^H}^{1-\theta}\left(e^{g_{t+1}^H}\right)^{1-\theta} \\ +1-\delta+\frac{\varphi}{2}\left(\left(\frac{k_{t+2}^H}{k_{t+1}^H}e^{g_{t+1}^H}\pi_{t+1}^\lambda\right)^2-(e^{\bar{g}})^2\right) \end{array}\right)\right]
\end{aligned}
$$

Market clearing conditions:

$$
\begin{aligned}
y_t^H + y_t^F &= c_t^H + c_t^F + (k_{t+1}^H e^{g_t^H}\pi_t^\lambda - (1-\delta)k_t^H) + (k_{t+1}^F e^{g_t^H}\pi_t^\lambda - (1-\delta)k_t^F) \\
&\quad + \frac{\varphi}{2}\left(\frac{k_{t+1}^H}{k_t^H}e^{g_t^H}\pi_t^\lambda - e^{\bar{g}}\right)^2 k_t^H + \frac{\varphi}{2}\left(\frac{k_{t+1}^F}{k_t^F}e^{g_t^H}\pi_t^\lambda - e^{\bar{g}}\right)^2 k_t^F
\end{aligned}
$$

$$
\left[R_{t+1}^H = \frac{(p_{t+1}^H + d_{t+1}^H)}{p_t^H}e^{g_t^H}\pi_t^\lambda \quad R_{t+1}^F = \frac{(p_{t+1}^F + d_{t+1}^F)}{p_t^F}e^{g_t^H}\pi_t^\lambda \quad R_{t+1}^B = \frac{1}{p_t^B}\right]
$$

$$
\begin{aligned}
0 &= b_t^H + b_t^F \\
1 &= A_t^{HH} + A_t^{HF} \\
1 &= A_t^{FH} + A_t^{FF}
\end{aligned}
$$

$$
\begin{aligned}
nfa_t^H + nfa_t^F &= 0 \\
\tilde{\alpha}_t^H + \tilde{\alpha}_t^F &= p_t^F
\end{aligned}
$$

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