# Understanding the pro-cyclicality of capital flows

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**Abstract**

Emerging economies are characterised by frictions in domestic financial system, costly foreign borrowing and permanent income shocks. These generate pro cyclical capital flows. In a model for India, an emerging economy, we find that, at an intermediate stage of financial development and partly open capital account, an increase in financial integration and financial development lowers the pro cyclicality of capital flows. At the same, with an increase in financial integration and financial development, we find that output volatility declines. However the absolute and relative volatility of consumption may go up beyond a threshold level of financial openness and financial development.

JEL Classification: E10, E32
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# Contents

# 1 Introduction

The debate on the costs and benefits of financial liberalisation remains unsettled. On the one hand, emerging economies have investment needs that exceed domestic savings, and access to international capital can bridge this gap. Studies show that financial liberalisation can act as a catalyst for growth as well as improve macroeconomic stability in emerging economies. On the other hand, plenty of evidence suggests that emerging markets fear unfettered capital flows, as it often brings higher volatility, and hence they continue to maintain a system of capital controls. Thus, financial liberalisation entails costs and benefits.

A main potential benefit of liberalisation and openness to international capital flows is consumption smoothing. However, in emerging markets, capital flows are seen to be pro cyclical (Contessi *et al.*, 2013; Broner *et al.*, 2013; Smith and Valderrama, 2009; Kaminsky *et al.*, 2005). Procyclical capital flows prevent such smoothing (Lane, 2001). At a conceptual level, if capital flows in during good times and flows out (or inflows reduce) during bad times, it can exacerbate the business cycle and increase volatility (Pintus, 2007). From the perspective of a policy maker in an emerging economy, the key question is whether greater financial integration can mitigate this feature of capital flows that can be unfavourable to the stability of the economy. In this paper, we inform the debate on the appropriate policy responses to managing risks associated with capital flows, in particular its pro cyclical nature.

A vast literature on financial integration points out that whether integration increases or decreases volatility, and in general whether flows are beneficial or not depends on the initial conditions of the economy. For example, with regard to growth, Kose *et al.* (2011a) find that the benefits from financial openness increasingly dominate the drawbacks once certain identifiable threshold conditions in measures of financial depth and institutional quality are satisfied. Aizenman *et al.* (2008) show that greater financial openness with a high level of financial development can reduce or increase output volatility, depending on whether the level of financial development is high or low. We contribute to this literature by showing that at an intermediate level of financial development and partly open capital account, an increase in financial development and financial integration lowers the pro cyclicality of capital flows. It is the interaction of financial liberalisation and financial development that is important for managing the cyclicality of flows that can affect macroeconomic stability.

The literature focuses on the relation between economic fluctuations and domestic financial development (Aghion *et al.*, 2010), and fluctuations and financial liberalisation (Buch *et al.*, 2005; Leblebicioglu, 2009), and the joint nexus of financial development and financial liberalisation (Aghion *et al.*, 2004). Among these studies, Aghion *et al.* (2004) portray the implications for capital flows due to liberalisation and development policies via the firm channel. The authors argue in a theoretical framework that in periods of boom, greater investment leads to greater output and higher profits of firms. Higher profits improve creditworthiness and fuel borrowing that further promotes higher investment. Capital flows into the country to finance this boom. This explains the pro cyclicality of capital flows in emerging economies. In contrast, a major contribution of our work is that it portrays the role of households in the financial liberalisation, financial development and capital flows nexus.

To summarise, our paper makes three key contributions - first we show that a model with features characteristic of an emerging economy, namely frictions in the domestic financial system, a partially open capital account and the presence of a permanent income shock originating from policy regime switches, can generate pro cyclical capital flows. Second - from an intermediate stage of financial development and openness, domestic financial development alone can only mildly reduce pro cyclicality of capital flows. Third - the interaction of financial liberalisation with financial development can significantly reduce the pro cyclicality of flows. It also reduces output volatility. With full financial liberalisation, along with financial development, capital flows become strongly counter-cyclical. However, in this scenario, the volatility of absolute and relative consumption may increase in the presence of a permanent income shock. The joint impact of liberalisation and domestic development allows more people to borrow without any restrictions on capital movements and increase their current consumption.

We document the empirical properties of the cyclical patterns of capital flows in an emerging economy, India, and find that capital inflows, net flows and gross flows are procyclical. A few empirical studies examine the cyclical behaviour of flows and link it with financial structure to understand their role in influencing the business cycle. Gourinchas *et al.* (2001) present an empirical analysis of the impact of domestic lending booms on macroeconomic indicators in Latin America. The authors find that private capital flows behave in a pro cyclical way increasing significantly by 2.6% of GDP from the build up to the peak of the lending boom. Ocampo (2003) examines the relation between capital flows and growth in Latin America and concludes that capital flows are pro cyclical. The author suggests that this pro cyclicality is related to the

credit constraints faced by the private and public sector in Latin American countries. An increase in capital inflow in this context leads to an increase in government expenditure, private sector investment and consumption and fuels a lending boom. This domestic lending boom further fuels the inflow of foreign capital, thus resulting in pro cyclicality of capital flows. Amongst the more recent papers, Smith and Valderrama (2009); Broner *et al.* (2013); Contessi *et al.* (2013) present an analysis of the cyclical properties of capital flows. Their broad finding is that gross capital flows are pro cyclical in emerging economies with respect to key macroeconomic indicators.

We present a small open economy model in which some households do not have access to finance, i.e., they can neither save nor borrow. These credit constrained households are unable to smooth consumption over their lifetime. The remaining households in the economy are unconstrained and respond to a perceived income shock by smoothing consumption via saving and borrowing from abroad. We introduce restrictions on capital mobility as an adjustment cost of borrowing. The marginal cost is inversely proportional to the level of income. This feature implies that frictions are less in good times and increase in bad times. The borrowers also need to pay an extra premium on the world interest rate, which depends on the total indebtedness of the economy.

These features, typical of an emerging economy, generate pro cyclical capital flows. In emerging economies, frictions in capital mobility are less in boom and increase during recession. In the model, such adjustment costs in foreign borrowing predict a positive relationship between capital flows cycle and the economic business cycle. A policy that facilitates financial liberalisation by reducing the cost on capital movements would also reduce the magnitude of pro cyclicality in capital flows.

Frictions in the domestic financial system may also add to the pro cyclicality in flows, when domestic rate of interest on internationally traded bonds are subject to a country risk premium. In emerging economies, this premium largely depends on the indebtedness of the country. When a large fraction of the population can neither save nor borrow due to an underdeveloped financial system (Honohan, 2006), the total borrowings of the economy generated by the tiny fraction of unconstrained households is small and hence the country premium is negligible. The low country premium allows unconstrained households to borrow at the world rate of interest inducing even higher level of borrowing and higher magnitude of pro cyclicality of capital flows compared to a financially developed system.

An additional feature is that policy regime changes alter the trend growth of productivity in emerging economies (Aguiar and Gopinath, 2007). When

households perceive a permanent income shock, they anticipate a higher growth rate of income which eventually leads to a rise in future income. They respond to this permanent income shock by increasing current consumption more than the rise in current income if consumption motive dominates investment motive. The extra consumption is financed by borrowing against the future income. In an open economy framework, this feature causes an increase in current account deficit in good times that is financed by capital inflows. Hence capital flows become pro cyclical in emerging economies.

We calibrate the model to an emerging economy, India for the period 1992 - 2011. The effects of financial liberalisation and financial development on capital flows and business cycle fluctuations are evaluated by changing the values of associated parameters, keeping one of them fixed at a time at its benchmark level. The joint effect of financial liberalisation and domestic financial development is captured by reducing the degree of restrictions on capital movements and the number of liquidity constrained households simultaneously.

We find that both financial liberalisation and domestic financial development policies reduce pro cyclicality in capital flows. However, these policies may raise the absolute and relative consumption volatilities beyond a threshold level of financial openness and development. Due to a marginal decline in the domestic financial frictions and marginal increase in financial openness, savings and investment motives outweigh the incentive for increasing the current consumption by more than current income via borrowing. Thus absolute and relative consumption volatilities decline. However, at a very high level of financial development and financial openness, a large fraction of population can borrow without incurring any extra cost on capital movements. The incentive to borrow against the future income to finance higher level of consumption dominates the incentive for saving and investing in physical assets. Thus, absolute and relative consumption volatilities increase beyond a threshold level of financial openness and domestic financial development.

The rest of the paper is organised as follows. Section 2 presents a comprehensive overview of cyclicality of capital flows in India. Section 3 presents our model and its prediction and the calibration exercise. Section 4 contains the results. Section 5 discusses the comparative statics results and the policy relevance of our analysis. Section 6 concludes.

# 2 Empirical analysis

To document the cyclical pattern of capital flows in India, we source data from the IMF International Financial Statistics (IFS) database. The IMF IFS provides data on an annual basis on different types of capital flows measured in U.S.dollars. The different types of capital flows are: direct investment (also called foreign direct investment or FDI), portfolio flows, other investments, financial derivatives and international reserves. For each of the components of capital flows, data is available for assets and liabilities. This allows us to analyse separately the cyclical pattern of inflows and outflows. We follow the approach of Broner *et al.* (2013) in defining our measures of gross capital flows- capital inflows by foreign residents and capital outflows by domestic residents.

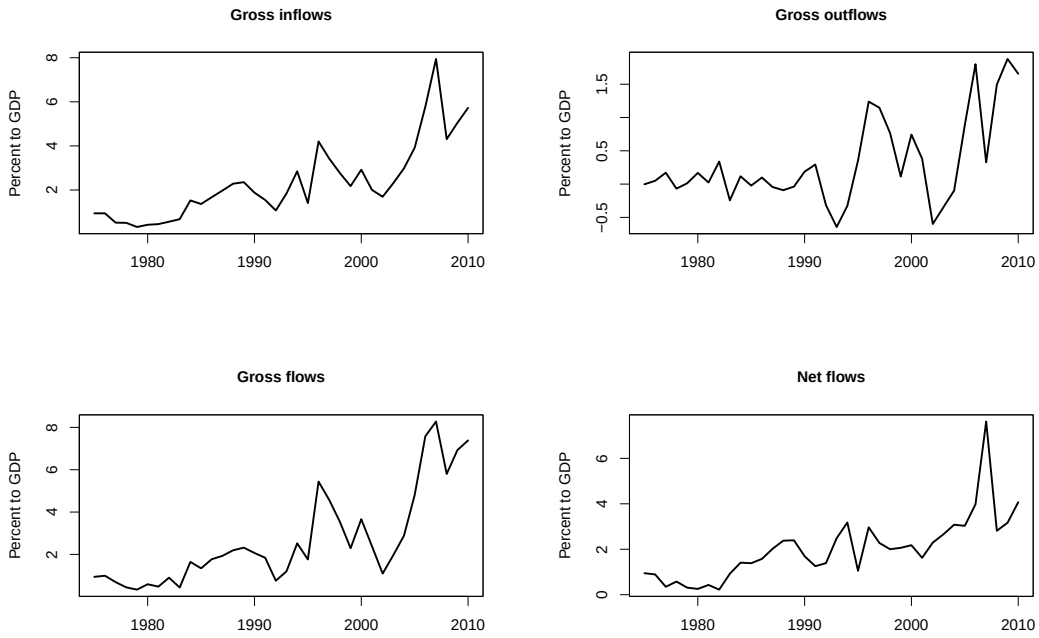
1. Capital inflow (CI): Inflow of capital arises through the net purchases of domestic assets by foreign residents. It is the sum of all liability inflows. In other words, it is the sum of direct investment in the reporting economy, portfolio investment liabilities, financial derivatives liabilities and other investment liabilities.

2. Capital outflow (CO): Outflow of capital arises through the net purchases of foreign assets by domestic residents. Outflow of capital is the negative of the sum of all asset inflows. In other words, it is the negative of the sum of outflows on account of direct investments abroad, portfolio investment assets, financial derivatives assets and other investment assets.

Net capital flows are equal to the difference between capital inflows and capital outflows (CI-CO) and total gross flows is the sum of capital inflows and capital outflows (CI+CO). We use cycles in GDP at current prices as an indicator of the domestic business cycle conditions.

## 2.1 Evolution of capital flows in India

**Figure 1** Evolution of capital flows in India




As a first step to understanding the cyclical pattern of capital flows, Figure 1 traces the evolution of capital inflows and outflows in India. The graph shows that India was essentially in a state of autarky, with very low ratios of gross inflows, outflows, net flows and gross flows relative to GDP. With the introduction of market-oriented reforms since 1992, these series show a dramatic increase. Both inflows and outflows increased substantially in the post-reform period.[1]

Another interesting development in the post-reform period is that capital flows show cyclical fluctuations in response to changes in domestic macroeconomic environment. As can be seen in Figure 1, there have been two major episodes of inflows in the recent decades. The first episode began in the beginning of 1990s, with the opening up of the economy and ended abruptly with the 1997-98 financial crisis, while the second episode of surge began

[1]The data for gross inflows and outflows may be over estimated as FII sales and purchases on the equity market show up as inflows and outflows on the country's capital account.

at the time of domestic boom in the early 2000s and ended with the global financial crisis in 2008. Since then there has been a phase of recovery in flows (Nowak *et al.*, 2012).

## 2.2 Cyclicality of capital flows in India

We use the Hodrick-Prescott filter (Hodrick and Prescott, 1997) to de-trend the series. After de-trending the series to obtain the cyclical components, we can then determine the properties of the business cycle. The cyclical component is used to analyse the co-movement of capital flows with output.

We define the cyclical properties of capital flows as follows (Kaminsky *et al.*, 2005):

1. Capital flows are procyclical when the correlation between the cyclical components of capital flows and output is positive.
2. Capital flows are counter-cyclical when the correlation between the cyclical components of capital flows and output is negative.
3. Capital flows are acyclical when the correlation between the cyclical components of net capital inflows and output is not statistically significant.

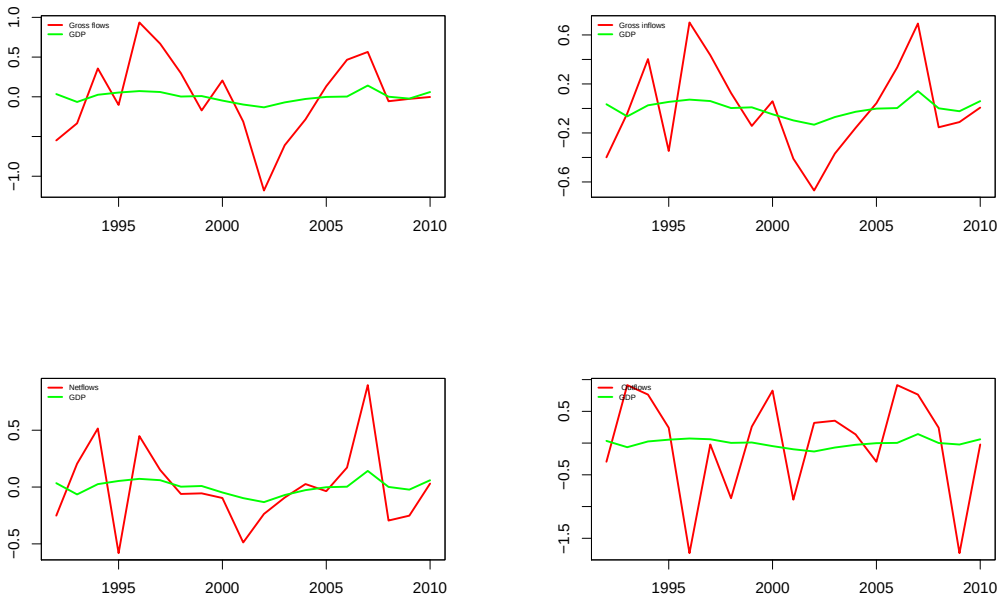
While the earlier empirical research on capital flows focussed on net flows to document business cycle properties, recent literature distinguishes between inflows and outflows and their responses to policy regime changes and shocks (Forbes and Warnock, 2012; Contessi *et al.*, 2013; Broner *et al.*, 2013). We follow the recent literature and document the cyclical properties of inflows, outflows and net flows.

**Table 1** Correlation with GDP and volatility of capital flows

| Variable | Co-movement $\rho$ | Relative Standard Deviation $\sigma$ |
|---|---|---|
| Capital inflows | 0.72 | 5.77 |
| Capital outflows | 0.15 | 67 |
| Gross flows | 0.70 | 7.66 |
| Net flows | 0.54 | 5.38 |

Table 1 reports the correlation and relative standard deviation for gross flows, inflows, outflows and net flows. Gross flows, inflows and net flows are highly procyclical. Our findings are consistent with the findings of Alper (2002);

**Figure 2** Correlation of capital flows with domestic business cycle conditions




Kaminsky *et al.* (2005); Contessi *et al.* (2013); Broner *et al.* (2013) that in good times, foreigners increase their purchases of domestic assets. Figure 2 shows the correlation between the cyclical components of capital flows and domestic business cycle conditions proxied by GDP. As can be seen in the figure that capital inflows, net flows and gross flows co-move with the output cycle.

We do not find a clear pattern pattern in the movement of the cyclical component of outflows and the output cycle. This is visible in the weak correlation number between gross outflows and GDP. Thus while outflows have increased in the post-reform period, it does not show strong pro cyclicality with domestic business cycle conditions.

In the next section we present our theoretical framework featuring frictions in the domestic financial system, partially open capital account and the presence of permanent income shock. When calibrated to an emerging economy like India, the model generates pro cyclical capital flows.

# 3 Financial integration, financial development and cyclicality of capital flows: Theoretical framework

## 3.1 The model

Consider a small open economy populated by a continuum of infinitely lived households and firms, both of measure unity. There exist a fraction $\lambda$ of households who have no access to banking or any other financial services. These consumers, who we refer to as non-Ricardian households, are credit and liquidity-constrained and unable to save or borrow to smooth consumption. They have no assets and spend all their current labour income on consumption in each period. The rest of the population can save and borrow, are referred to as Ricardian households. The mode of international transaction is an internationally traded one-period, risk-free bond, accessible by the Ricardian households only.

Labour supply is inelastic as no labour-leisure choice is made by the representative household. In an emerging economy, it is reasonable to assume that households allocate their available labour-time to production as much as possible. Hence, the representative household supplies one unit of labour inelastically.

Both Ricardian and liquidity-constrained households have identical preferences defined over a single commodity,

$$U(C_t^i) = \ln(C_t^i) \quad i = R, L \tag{1}$$

where $C_t^i$ denotes total consumption of the household of type $i$. Ricardian households are indexed as $R$ and liquidity constrained households as $L$.

A Ricardian household maximises discounted stream of utility

$$V_t = E_t \sum_{t=0}^{\infty} \beta^t \log(C_t^R) \tag{2}$$

subject to the following budget constraint,

$$C_t^R + I_t^R + B_t^R - \frac{B_{t+1}^R}{1+R_t} + \frac{\kappa}{2}\left(\frac{\frac{B_{t+1}^R}{\Gamma_t} - \overline{b^R}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t = R_t^K K_t^R + W_t \tag{3}$$

where $\beta \in (0,1)$ denotes the subjective discount factor. Here $C_t^R$ is consumption of a Ricardian household in period $t$. The variables $I_t^R$ and $K_t^R$ denote investment and capital stock of a Ricardian household respectively. The economy-wide return to physical capital and wage rate are given by $R_t^K$ and $W_t$. The level of debt due in period $t$ held by a Ricardian household is denoted by $B_t^R$ and $R_t$ is the time $t$ interest rate payable for the debt due in period $t+1$. Here $\overline{b^R}$ is the long-run stock of debt holdings by a Ricardian household. In each period the Ricardian household divides her total resources comprised of wage and rental income and the amount borrowed in the international market into consumption, savings and re-payment of the previous debt.

Access to international financial markets is assumed to be imperfect. Financial integration is determined by a quadratic adjustment cost to bond holdings, captured by the expression following (Yakhin, 2008; Bhattacharya *et al.*, 2013),

$$\frac{\kappa}{2}\left(\frac{\frac{B_{t+1}^R}{\Gamma_t}-\overline{b^R}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t,$$

such that $\kappa = 0$ implies full integration and $\kappa \to \infty$ represents financial autarky. The cost can be interpreted as taxes and other restrictions on capital account transactions that prevent free mobility. Note that the marginal tax rate $\frac{\kappa}{2}\left(\frac{\frac{B_{t+1}^R}{\Gamma_t}-\overline{b^R}}{\frac{Y_t}{\Gamma_{t-1}}}\right)$ is inversely proportional to $Y_t$, implying that it is low when $Y$ is high and vice versa. This quadratic cost function shows that frictions are less in boom, but increases in recession.

Further, the interest rate is sensitive to the level of outstanding debt, taking the form used in Schmitt-Grohe and Uribe (2003)

$$R_t = R^* + \psi(e^{\frac{B_{t+1}}{\Gamma_t}-\bar{b}} - 1) \tag{4}$$

where $R^*$ is the world interest rate exogenously given to the small open home country, $\bar{b}$ denotes the steady state level of total debt, and $\psi > 0$ governs the elasticity of interest rate to changes in the indebtedness of the economy. The total debt of the economy $B_t$ is exogenously given to the representative agent who does not internalise the premium payable on the foreign interest rate determined by the indebtedness of the economy. However, in equilibrium, total foreign debt of the economy coincides with the amount of debt acquired by all the representative agents of the Ricardian type. Given the fraction of Ricardian households in the economy equal to $1-\lambda$, the total debt in

the economy amounts to $B_t = (1-\lambda)B_t^R$, while the long run total debt is $\bar{b} = (1-\lambda)\bar{b}^R$. The variable $\Gamma_t$ denotes the non-stationary labour productivity explained in detail below.

The stock of capital of the representative Ricardian household evolves via the following law of motion,

$$K_{t+1}^R = (1-\delta)K_t^R + I_t^R - \frac{\phi}{2}(\frac{K_{t+1}^R}{K_t^R} - \mu_g)^2 K_t^R \tag{5}$$

where $I_t^R$ denotes investment by a Ricardian household in physical assets and $\delta$ is the rate of depreciation of capital. The variable $\mu_g$ is the long run growth in labour productivity explained in detail below. The investment is subject to quadratic capital adjustment cost as in Aguiar and Gopinath (2007).

Households who do not have access to financial services cannot save or borrow. Their behaviour is thus different from that of Ricardian consumers. Liquidity constrained households maximise instantaneous utility $\log C_t^L$ subject to the following budget constraint in each period,

$$C_t^L = W_t, \tag{6}$$

where $C_t^L$ is consumption of a liquidity constrained household in period $t$. In each period, a liquidity constrained household consumes its entire disposable income comprised of wage income $W_t$ only.

The aggregate consumption is the weighted average of consumption of the liquidity-constrained households and the Ricardian households. The weights are the share of each type of households in the population.

$$C_t = \lambda C_t^L + (1-\lambda)C_t^R. \tag{7}$$

The aggregate capital stock and investment are respectively the following,

$$K_t = (1-\lambda)K_t^R, \quad I_t = (1-\lambda)I_t^R, \quad B_t = (1-\lambda)B_t^R, \tag{8}$$

A representative firm produces a homogeneous good, by hiring one unit of labour from households and combining it with capital. The aggregate output is produced by Cobb Douglas technology that uses capital and unit labour as inputs,

$$Y_t = e^{a_t}[(1-\lambda)K_t^R]^{1-\alpha}\Gamma_t^\alpha, \tag{9}$$

where $\alpha \in (0,1)$ represents labour's share of output and $e^{a_t}$ denotes the level of total factor productivity. Here $\Gamma_t$ is the labour productivity. The two productivity processes are characterised by the following stochastic properties: total factor productivity evolves according to an AR(1) process as follows:

$$a_t = \rho_a a_{t-1} + \epsilon_t^a \tag{10}$$

with $|\rho_a| < 1$ and $\epsilon_t^a$ represents *iid* draws from a normal distribution with zero mean and standard deviation $\sigma_a$.

The growth rate of labour productivity $\Gamma_t$ is defined as in (Aguiar and Gopinath, 2007)

$$\Gamma_t = g_t \Gamma_{t-1} \tag{11}$$

The growth rate of labour productivity $g_t$ follows an AR(1) process of the form:

$$\ln\left(\frac{g_t}{\mu_g}\right) = \rho_g \ln\left(\frac{g_{t-1}}{\mu_g}\right) + \epsilon_t^g;\ \epsilon_t^g \sim N(0, \sigma_g^2) \tag{12}$$

The resource constraint of the economy is given by

$$C_t + I_t + TB_t = Y_t \tag{13}$$

where the trade balance $TB_t$ is financed by the net flows of capital,

$$TB_t = B_t - \frac{B_{t+1}}{1+R_t} + \frac{\kappa}{2(1-\lambda)}\left(\frac{\frac{B_{t+1}}{\Gamma_t} - \bar{b}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t \tag{14}$$

In an economy which is open on both trade and financial fronts, imports and total domestic output net of exports is allocated between total consumption and investment, where the difference between exports and imports are balanced by the financial flows as indicated by equations (13) and (14).

The first order conditions from optimisation of life time utility by the Ricardian household are,

$$\frac{1}{C_t^R} = \psi_t \tag{15}$$

$$\begin{aligned}\psi_t[1 + \phi(\frac{K_{t+1}^R}{K_t^R} - \mu_g)] \;=\; & \beta E_t \psi_{t+1}[1 - \delta - \frac{\phi}{2}(\frac{K_{t+2}^R}{K_{t+1}^R} - \mu_g)^2 \\ & + \phi(\frac{K_{t+2}^R}{K_{t+1}^R} - \mu_g)\frac{K_{t+2}^R}{K_{t+1}^R} + R_{t+1}^K]\end{aligned} \tag{16}$$

where the return to physical capital is $R^K_{t+1} = e^{a_t}(1-\lambda)^{1-\alpha}(1-\alpha){K^R_{t+1}}^{-\alpha}\Gamma^{\alpha}_{t+1}$, and,

$$\psi_t \left[ \frac{1}{1+R_t} - \kappa \left( \frac{\frac{B^R_{t+1}}{\Gamma_t} - \overline{b^R}}{\frac{Y_t}{\Gamma_{t-1}}} \right) \frac{\Gamma_{t-1}}{\Gamma_t} \right] = \beta E_t \psi_{t+1} \tag{17}$$

Since the shock to the trend growth rate $g$ permanently changes $\Gamma$, output is subject to a stochastic trend that makes it non-stationary. We detrend output, consumption, investment and capital stock by normalising these variables with respect to the trend productivity through period $t-1$. For any variable $X$, its detrended counterpart is defined as $x_t = \frac{X_t}{\Gamma_{t-1}}$.[2]

With the initial capital stock $K_0$, the competitive equilibrium is defined as a set of prices and quantities $(R^K_t, \omega_t, R_t, y_t, c^R_t, c^L_t, i^R_t, k^R_t, b^R_t, c_t, i_t, k_t, b_t, tb_t)$, given the sequence of shocks to TFP and labour productivity growth, that solves the maximisation problem of the households, optimisation by the firms and satisfies the resource constraint of the economy.

## 3.2 Prediction from the model

In the presence of a permanent income shock, originating from policy changes, Ricardian households anticipate a rise in the future income. They increase consumption of both domestic and foreign goods more than the rise in income by borrowing from abroad. As a result, the economy faces a current account deficit and large inflows of capital. Thus, the correlation of trade balance to output ratio and output is expected to be negative, while the correlation of capital flows and output turns out to be positive. Since the current account deficit is the mirror image of net flows of capital into the economy, net flows are expected to be procyclical.

In the model, capital outflows in the current period is the re-payment of previous period's debt. When the economy is in an expansion, the absolute value of the debt re-payment also increases. This suggests a positive correlation between capital outflows and output. The gross flows of capital, which is the sum of inflows and absolute value of outflows is also expected to be procyclical.

[2]The normalised system of equations are given in Appendix A.

**Table 2** Parameter values used for simulating the model economy

| Parameters | | Values |
|---|---|---|
| Discount factor | $\beta$ | 0.98 |
| Rate of Depreciation | $\delta$ | 5% |
| Share of labour | $\alpha$ | 0.7 |
| Interest rate elasticity of indebtedness | $\psi$ | 0.001 |
| Adjustment cost parameter | $\phi$ | 2.82 |
| Mean trend growth rate of labour productivity | $\mu_g - 1$ | 4.7% |
| Steady state foreign debt to GDP ratio | $B_{ss}/Y_{ss}$ | 23.75% |
| 1-(No. of bank accounts/population) | $\lambda$ | 0.487 |
| Persistence in TFP shock process | $\rho$ | 0.495 |
| Volatility in TFP | $\sigma_a$ | 0.015 |
| Persistence in labour productivity growth shock | $\rho_g$ | 0.261 |
| Volatility in labour productivity growth shock | $\sigma_g$ | 0.020 |

## 3.3 Calibration

We calibrate the model economy for India, an emerging economy for the period 1992-2011. The choice of the time-frame is based on the period when India started experiencing business cycle movements as opposed to the agricultural cycles prevailing in the pre-reform era (Patnaik and Sharma, 2002). In this section, we describe the choice of the values of key parameters of the model. Table 2 summarises the parameter values used in our calibration exercise.

We follow the existing literature in choosing some of the parameter values. We take a period in the model to represent a year. The discount rate $\beta$ is set to 0.98 and the capital adjustment cost parameter $\phi$ is set to 2.82 from Aguiar and Gopinath (2007). The share of labour $\alpha$ is chosen as 0.7 from Verma (2008), while the rate of depreciation is assumed to be 5%, as in Virmani (2004).For the indebtedness elasticity of interest rate $\psi$, we choose a value of the elasticity of 0.001 as in Aguiar and Gopinath (2007).

The steady state level of debt to GDP is set at 23.75%, The average value of the debt to GDP ratios in 1991-92 and in 2010-11.[3]

The access of households to banking is captured by the number of bank accounts in total population. Hence the proxy for $\lambda$, i.e., the share of liquidity constrained households is derived from this ratio. The average number of bank accounts in total population ratio during 1992-2010 is used to calibrate the share of liquidity constrained households. During 1992-2010, on average,

[3]Status Report on India's External Debt, 2010-2011 published by the External Debt Management Unit, Department of Economic Affairs, Ministry of Finance.

**Table 3** Cyclicality of capital flows from data and simulation

| Statistic | Y | C | I | TBY | NF | GF | INFLW | OFLW |
|---|---|---|---|---|---|---|---|---|
| Standard deviation | | | | | | | | |
| Data** | 1.78 | 1.87 | 5.10 | **1.21**$^{\star}$ | | | | |
| Model | | | | | | | | |
| $\psi = 0.001$, $\kappa = 10$ | 3.20 | 3.27 | 6.09 | **1.07** | | | | |
| Relative std dev | | | | | | | | |
| Data** | 1.00 | **1.05** | 2.85 | **0.68** | | | | |
| Model | | | | | | | | |
| $\psi = 0.001$, $\kappa = 10$ | 1.00 | **1.02** | 1.90 | **0.33** | | | | |
| Contemporaneous correlation | | | | | | | | |
| Data** | 1.00 | **0.89** | **0.77** | **−0.60** | 0.54 | **0.70** | **0.72** | **0.15** |
| Model$^{\star}$ | | | | | | | | |
| $\psi = 0.001$, $\kappa = 10$ | 1.00 | **0.99** | **0.73** | **−0.37** | −0.35 | **0.73** | **0.75** | **0.61** |

**Source: Ghate *et al.* (2013)

$^{\star}$Source: Business Beacon, Author's estimate, period:1992-2011

51.28% of the population had access to banking. Thus the share of households without access to finance, i.e., $\lambda$ is derived to be $1 - 0.5128 = 0.4872$.

The value of the risk-free world interest rate is set to satisfy the condition that $\beta(1 + R^*) = \mu_g$, where $\mu_g - 1$ is the mean trend growth rate of labour productivity. The value of this parameter is chosen to be 4.7% along with the estimates of shock processes driving the dynamics of growth in labour productivity and TFP in India from Bhattacharya and Patnaik (2013); Bhattacharya *et al.* (2013).

# 4 Cyclicality of capital flows in a small open economy

We compare the simulated business cycle moments of output, consumption, investment, trade balance to output ratio and capital flows from the small open economy model calibrated for India and the empirical moments observed in the data. In this section, we present simulated business cycle moments where the parameter of adjustment cost of foreign borrowing $\kappa$ is fixed at 10. The effects on business cycle features of various levels of financial integration captured by different values of $\kappa$ are discussed in the next section.

In our theoretical framework, capital flows are modelled using the concept of Balance of Payments equilibrium, where the current account balance is

the mirror image of the net flows of capital into the economy. However, we observe the nature of cyclicality in various categories of capital flows in the data. These categories are namely, inflows (INFLW), outflows (OFLW), net flows (NF) and gross flows (GF). In order to compare the business cycle features of the simulated capital flows with the data, various categories of capital flows in terms of the model are defined as follows.

In any period $t$, the present discounted value of the borrowing to be repaid in the next period, net of adjustment cost of borrowing is the total inflow of capital in the economy at period $t$,

$$\text{INFLW} = \frac{B_{t+1}}{1+R_t} - \frac{\kappa}{2(1-\lambda)}\left(\frac{\frac{B_{t+1}}{\Gamma_t} - \bar{b}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t \tag{18}$$

In the same period, $t$, the economy pays out its previous period's debt. Thus $-B_t$ is the outflow of capital from the economy in period $t$. The absolute value of the outflow, as defined in the data is, thus,

$$\text{OFLW} = B_t \tag{19}$$

The net inflows, that is inflows net of outflows and the gross flows defined as the inflows plus the absolute value of outflows are respectively as follows,

$$\text{NF} = \frac{B_{t+1}}{1+R_t} - \frac{\kappa}{2(1-\lambda)}\left(\frac{\frac{B_{t+1}}{\Gamma_t} - \bar{b}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t - B_t \tag{20}$$

$$\text{GF} = B_t + \frac{B_{t+1}}{1+R_t} - \frac{\kappa}{2(1-\lambda)}\left(\frac{\frac{B_{t+1}}{\Gamma_t} - \bar{b}}{\frac{Y_t}{\Gamma_{t-1}}}\right)^2 Y_t \tag{21}$$

Table 3 presents our main findings. Trade balance to output ratio from the simulation is strongly counter cyclical as observed in the data. The simulated inflows, outflows and gross flows of capital show positive correlations with output. The magnitude of the correlations are in general in the comparable ranges observed in the Indian data. However, our model produces strongly pro cyclical outflows of capital, unlike a feeble pro cyclical capital outflows observed in the data. These results support our key predictions. A permanent income shock that raises both current and future income, allows Ricardian households to borrow against the future income in the international market to pay increased import bills. This leads to current account deficit and inflows of capital and causes re-payment of debts of higher value i.e., more outflow of capital. Hence, the model economy generates a counter

cyclical trade balance to output ratio and pro cyclical capital flows. However, net inflows from the simulated model are found to be counter cyclical in our simulation.

Apart from the cyclicality of capital flows, our model is able to replicate the correlation of consumption and investment fairly well, as these correlation numbers are within the comparable ranges observed in the data.

Our model also satisfactorily replicates the pattern of fluctuations in the Indian macroeconomic indicators. Although the volatilities of output and consumption are found to be higher than in the data, the simulated absolute volatility of trade balance to output ratio is fairly close to the empirical number.

Consumption volatility relative to output exceeds unity as observed in the data. In the presence of permanent income shock, domestic residents can easily borrow against the future income to raise their current consumption more than the current income, a standard behavioural pattern of the economic agents highlighted in the emerging market business cycle literature (Aguiar and Gopinath, 2007; Kim *et al.*, 2003; Alp *et al.*, 2012; Ghate *et al.*, 2013; Bhattacharya and Patnaik, 2013). Our model also generates the relative volatility of trade balance to output ratio lower than one as found empirically.

To summarise, our model economy, characterised by permanent income shock, friction in the domestic financial structure and costly financial integration is able to replicate the empirical business cycle regularities of the Indian economy satisfactorily. The shock to the trend growth of output is found to play the central role in determining business cycle properties of the simulated model economy. In response to a permanent income shock, consumers increase consumption of both domestic and foreign goods by more than the rise in current income. This causes consumption to fluctuate more than output. Net exports decline as consumption of imported goods increases, causing a counter cyclical trade balance. The consumers finance this extra consumption by borrowing in the international market against the future income. Thus a positive shock to the trend growth of output results in inflows of capital and repayment of debt, i.e., outflows of capital as well. This makes capital flows in an emerging economy pro cyclical.

# 5 Financial integration, financial development and business cycle properties of key macroeconomic indicators: Policy relevance

This section discusses the effects of financial integration and financial development on the business cycle properties of the simulated model economy which replicates the dynamics of the Indian economy. The effects of financial liberalisation and financial development on capital flows and business cycle fluctuations are evaluated by changing the values of associated parameters, keeping one of them fixed at a time at its benchmark level. The joint effect of financial liberalisation and domestic financial development is captured by reducing the bond adjustment cost parameter $\kappa$ and the share of liquidity constrained households $\lambda$ simultaneously.

Comparing the second and third columns of Table 4, we find that policies reducing frictions in the domestic financial system at the given level of financial openness can only reduce pro cyclicality of capital flows marginally compared to the benchmark scenario. Output volatility declines marginally, while absolute and relative consumption volatilities rise. Financial development allows more people to respond to permanent income shock by increasing income via borrowing. Domestic development policies increase the total debt of the economy and hence country premium. Higher interest rate acts against the incentive to borrow. Capital flows, in response to growth shocks although rises, are now marginally smaller compared to the benchmark case. As a result, domestic financial development marginally reduces the pro cyclicality of capital flows.

Financial liberalisation policies without domestic financial development turns capital flows into mildly countercyclical. A reduction of the adjustment cost parameter on borrowing $\kappa$ also reduces the sensitivity of marginal cost of borrowing to the level of income. Hence unlike the pre-liberalisation scenario, when Ricardian households could borrow only at good times, now they can borrow without incurring any extra adjustment cost, in response to a negative income shock, too. As a result, capital flows become counter cyclical. Financial liberalisation reduces output volatility, but has hardly any effect on absolute consumption volatility. Financial liberalisation, without domestic developments does not alter the fraction of population who can access finance. Hence the gross consumption pattern also remains unaltered in this case. These results can be seen by comparing the second and fourth columns of Table 4.

**Table 4** Effects of financial integration and development on business cycle moments

This table compares the individual as well as joint effects of financial liberalisation and financial development on business cycle moments in an emerging economy whose business cycle facts resemble with that of India. We compare the impacts of either domestic development (in 3rd column) or of liberalisation (in 4th column) with the benchmark case given in the 2nd column. The joint impacts of both domestic development and liberalisation (in columns 5th and 6th) are also compared with the benchmark scenario.

| Statistic | Scenario | | | | |
|---|---|---|---|---|---|
| | Benchmark | Development | Liberalisation | Liberalisation & Development | Liberalisation & Developm |
| | $\kappa = 10$, $\lambda = 0.487$, $\psi = 0.001$ | $\kappa = 10$, $\lambda = 0.001$, $\psi = 0.001$ | $\kappa = 0$, $\lambda = 0.487$, $\psi = 0.001$ | $\kappa = 1$, $\lambda = 0.350$, $\psi = 0.001$ | $\kappa = 0$, $\lambda = 0.001$, $\psi = 0.0$ |
| $\sigma^y$ | 3.20 | 3.19 | 2.59 | 3.16 | 2.61 |
| $\sigma^c$ | 3.27 | 3.34 | 3.21 | 3.23 | 4.32 |
| $\frac{\sigma^c}{\sigma^y}$ | 1.02 | 1.05 | 1.23 | 1.02 | 1.65 |
| $\sigma^{\text{TBY}}$ | 1.07 | 1.05 | 5.57 | 1.44 | 8.16 |
| $\rho^y_{\text{TBY}}$ | −0.37 | −0.33 | 0.17 | −0.04 | 0.13 |
| $\rho^y_{\text{GF}}$ | 0.72 | 0.70 | −0.29 | 0.20 | **−0.37** |
| $\rho^y_{\text{INFLW}}$ | 0.75 | 0.70 | −0.30 | 0.14 | **−0.38** |
| $\rho^y_{\text{OFLW}}$ | 0.61 | 0.61 | −0.29 | 0.25 | **−0.36** |

A comparison of the benchmark scenario shown in the second column of Table 4 with the fifth and sixth columns of the table shows that the interaction of financial liberalisation with financial development can significantly reduce the procyclicality of flows. It also reduces output volatility. With full financial liberalisation, along with financial development, capital flows become strongly counter cyclical. However, these policies may raise the absolute and relative consumption volatilities beyond a threshold.

From an intermediate stage of openness and development, partial liberalisation reduces the sensitivity of cost of debt adjustment to the business cycle condition of the economy. Domestic development allows more people to borrow and save, but at the same time increases country premium. At this stage incentive for saving and investing is stronger than incentive to borrow to raise the current level of consumption. Hence pro cyclicality in capital flows reduces and absolute and relative volatilities in consumption may fall at this stage.

With full financial liberalisation and substantial domestic developments, a large fraction of population can save and invest and access foreign finance without any restrictions. At this stage, incentive to borrow from abroad against future income in response to growth shock in order to raise current level of consumption dominates the incentive to save and invest in physical assets. Fluctuations in total consumption as well as in total consumption relative to output fluctuations rise compared to the benchmark scenario. In absence of frictions in bond adjustments, borrowing does not depend on business cycle conditions of the economy. Agents can borrow without incurring any extra adjustment costs, not only in good times, but in response to negative shocks, too. Capital flows become counter cyclical at this stage.

# 6 Conclusion

Emerging economies are characterised by frictions in domestic financial system, costly foreign borrowing and permanent income shocks. These generates pro cyclical capital flows. We develop a small open economy model portraying these key features of an emerging economy and calibrate it to Indian data. The model does well in matching features of the data by replicating the pro cyclicality in capital flows, the counter cyclical trade balance, and relative volatility of consumption greater than unity.

We also find that in an intermediate stage of financial development and

partly open capital account, an increase in financial integration and financial development lowers the pro cyclicality of capital flows. At the same, with an increase in financial integration and financial development, we find that output volatility declines. However the absolute and relative volatility of consumption may go up beyond a threshold level of financial openness and financial development.

The implications of financial integration and domestic financial development policies for growth and stability have gained considerable attention in the debate on the costs and benefits of financial liberalisation. The question of appropriate policy responses to managing risks associated with capital flows, in particular, of pro cyclical nature is relatively less explored in the literature. Our work attempts to contibute to this debate by portraying households as a channel for transmission of financial liberalisation and domestic development policies. One important policy implication of our work is that, financial development in nexus with financial liberalisation can stabilise the capital flows of pro cyclical nature. Similar implications can be found in Aghion *et al.* (2004) emphasising the importance of domestic financial development to stabilise capital flows in the back drop of financial liberalisation. The authors argue that domestic financial development by reducing the dependency of ability to borrow by firms on their net worth can reduce the pro cyclicality of capital flows.

The benefits of financial liberalisation is found to have stabilising effect after a threshold level of financial development is attained (Aghion *et al.*, 2004; Kose *et al.*, 2011b). These literature suggest that financial liberalisation may stabilise economic fluctuations beyond the threshold. On the contrary, this paper highlights the scenario where the joint impact of fiancial liberalisation and development may add to absolute and relative consumption volatilities beyond the threshold. In our work, in the presence of permanent income shock, financial liberalisation along with development allow more people to borrow from abroad without incurring any adjustment costs. At a high level of financial liberalisation and domestic development, incentive to borrow and raise current consumption more than current income dominates saving and investment motives. While the role of permanent income shock as an important propagation mechanism is emphasised in the literature (Aguiar and Gopinath, 2007), this paper portrays its implications for the impact of policy changes in domestic and external financial sectors.

In this paper, we have abstracted from the international portfolio alloaction mechanisms. Our framework represents an open economy where net capital flows are based on a single internationally traded bond. In this framework,

net capital flows represent the mirror image of the current account. There exists a significant strand of literature that distinguishes between foreign bonds and domestic bonds. This literature explicitly models capital flows in terms of foreign demand for domestic bonds and domestic demand for foreign bonds to analyse the pattern of cross border asset holding (Benigno and Nistico, 2009; Tille and Wincoop, 2010). It will be interesting to incorporate these two types of bonds and explicitly model the capital account for the better understanding of capital flows determined by the household behaviour in emerging economies.

# A Appendix A

## A.1 Normalised system

Normalising all variables by the trend labour productivity at period $t-1$, we arrive at the following detrended system where the first order conditions are

$$\begin{aligned}\Lambda_t g_t \left[1+\phi(\frac{k^R_{t+1}g_t}{k^R_t}-\mu_g)\right] &= \beta\Lambda_{t+1}[R^K_t+(1-\delta)-\frac{\phi}{2}\left(\frac{k^R_{t+2}g_{t+1}}{k^R_{t+1}}-\mu_g\right)^2 \\ &\quad +\phi\left(\frac{k^R_{t+2}g_{t+1}}{k^R_{t+1}}-\mu_g\right)\left(\frac{k^R_{t+2}g_{t+1}}{k^R_{t+1}}\right)] \qquad \text{(A.1)}\end{aligned}$$

where $R^K_t=(1-\alpha)(1-\lambda)^{1-\alpha}e^{a_{t+1}}{k^R_{t+1}}^{-\alpha}g^{\alpha}_{t+1}$, and,

$$\Lambda_t\left[\frac{g_t}{1+R_t}-\kappa\left(\frac{b^R_{t+1}-\overline{b^R}}{y_t}\right)\right]=\beta E_t\Lambda_{t+1} \qquad \text{(A.2)}$$

The budget constraint of a Ricardian household and a liquidity-constrained household are respectively as follows,

$$c^R_t+i^R_t+b^R_t-g_t\frac{b^R_{t+1}}{1+R_t}+\frac{\kappa}{2}\left(\frac{b^R_{t+1}-\overline{b^R}}{y_t}\right)^2 y_t = R^K_t k^R_t+\omega_t \qquad \text{(A.3)}$$

$$\text{(A.4)}$$

and,

$$c^L_t=\omega_t \qquad \text{(A.5)}$$

where

$$i^R_t=g_t k^R_{t+1}-(1-\delta)k^R_t+\frac{\phi}{2}(g_t\frac{k^R_{t+1}}{k^R_t}-\mu_g)^2k^R_t \qquad \text{(A.6)}$$

and the normalised return to labour is $\omega_t=\alpha e^{a_t}(1-\lambda)^{1-\alpha}{k^R_t}^{1-\alpha}g^{\alpha}_t$. The aggregate consumption, investment, capital stock and debt are respectively,

$$c_t=\lambda c^L_t+(1-\lambda)c^R_t, \quad i_t=(1-\lambda)i^R_t, \quad k_t=(1-\lambda)k^R_t, \quad b_t=(1-\lambda)b^R_t \qquad \text{(A.7)}$$

The output produced in the economy and the interest rate on bond are

$$y_t=e^{a_t}[(1-\lambda)k^R_t]^{1-\alpha}g^{\alpha}_t \qquad \text{(A.8)}$$

and

$$R_t=R^*+\psi(e^{b_{t+1}-\bar{b}}-1) \qquad \text{(A.9)}$$

respectively. The economy-wide resource constraint is

$$c_t + i_t + tb_t = y_t \tag{A.10}$$

where

$$tb_t = b_t - g_t \frac{b_{t+1}}{1+R_t} + \frac{\kappa}{2(1-\lambda)} \left( \frac{b_{t+1} - \bar{b}}{y_t} \right)^2 y_t \tag{A.11}$$

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