Financial integration, financial frictions and business cycles of emerging market economies

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Abstract

International financial integration has the potential benefit of mitigating the effects of shocks through risk sharing. However, in many instances, emerging market economies experienced increased business cycle volatilities following financial integration. Using a small open economy real business cycle model with an embedded financial accelerator, I identify two key channels that can deliver a potential solution to this puzzle. The leverage channel, combined with the standard smoothing channel, reveals that the response of business cycles to financial integration depends on the extent of domestic financial frictions. Financial integration reduces business cycle volatilities for economies with well developed financial markets, but raises volatilities for economies with poor financial conditions.

Keywords: Financial integration, Financial accelerator, Leverage channel, Business cycle volatilities, Emerging economies

JEL: E44, F41, F44, F62

1. Introduction

A striking feature of business cycles is the heterogeneity between industrial and emerging economies in the response to international financial integration. In developed countries, there has been a significant decline in macroeconomic volatilities with increasing financial openness. This is in line with the perceived benefit of financial integration that is mitigating the effects of shocks.


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through international risk sharing. Empirical studies (Kose et al. (2003), Prasad et al. (2003), Kose et al. (2009)), however, have shown that emerging economies have not attained this potential benefit, i.e., there has not been a robustly negative relationship between financial integration and macroeconomic volatilities in emerging economies. As shown in Fig. 1, developed economies experienced less volatile consumption with greater financial openness. On the contrary, financial integration appears to have been associated with an increase in consumption volatilities for emerging economies. The stylized facts have stirred passionate discussions among researchers and policymakers of the link between financial integration and business cycle fluctuations.

The goal of this paper is to provide an unified framework for understanding the impact of financial integration on macroeconomic volatilities in both industrial and emerging economies, and more importantly, to rationalize the perplexing effects of financial integration on emerging economies. I build a small open economy real business cycle (RBC) model focusing on the interaction between domestic financial frictions and international financial integration. I show how the existence of financial frictions can alter the standard smoothing mechanism of financial integration.

The model incorporates domestic financial frictions as a financial accelerator originally studied by Bernanke et al. (1999). Emerging economies have less developed domestic financial markets and institutions than industrial economies, indicating an important role of domestic financial frictions.¹

For instance, the number of bank branches per 100,000 adults, which measures the access to financial institutions, is about 15 on average in emerging economies while more than 30 in industrial economies.

¹Conventional macro models fail to explain business cycle behaviors in emerging economies with increasing financial integration. One important reason is that in such models, financial structure does not affect the real economy.
Table 1
Percentage of firms identifying access to finance as a constraint.
Data source: Global financial development database.

<table>
<thead>
<tr>
<th>Region</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro area</td>
<td>14.28</td>
</tr>
<tr>
<td>Europe &amp; Central Asia (developing only)</td>
<td>24.37</td>
</tr>
<tr>
<td>Latin America</td>
<td>37.56</td>
</tr>
<tr>
<td>Middle income</td>
<td>27.24</td>
</tr>
<tr>
<td>Low &amp; Middle income</td>
<td>35.43</td>
</tr>
</tbody>
</table>

economies. Furthermore, more firms in emerging economies identify themselves as financially constrained. Table 1 documents that in regions such as Latin America and Central Asia, the percentage of firms identifying the access to financial markets as a constraint is much higher than that of the Euro area. The empirical literature has suggested the importance of the quality of domestic financial market. A study on volatility and financial liberalization by Bekaert et al. (2006) shows that the response of business cycles to financial integration depends on domestic financial sectors. Prasad and Rajan (2008) and Kose et al. (2011) point out that the quality of domestic financial institutions has to be above a certain threshold in order for it to be beneficial to integrate.

The model features two competing channels in determining macroeconomic volatilities with respect to the level of financial integration: the smoothing channel and the leverage channel. The smoothing channel represents the regular smoothing mechanism provided by financial integration. A higher financial openness makes it cheaper for domestic producers to smooth out production in the face of changes in terms of trade and productivity. This offers a smoothing path of output and consumption of households. The smoothing channel dominates for economies with few domestic financial frictions such as developed countries. As a result, rising financial integration works to lower aggregate macroeconomic volatilities. This prediction is consistent with the experience of industrial economies.

The leverage channel is a new finding of this paper. Changes in the financial integration level can be transmitted into domestic economy via firms’ financial positions. Cheaper credits following greater financial integration encourage firms to load up on more debt and build higher leverage. Intuitively, booming leverage coupled with fragile domestic financial market may put the open economy in a risky position that is vulnerable to both domestic and international adverse shocks. At higher level of leverage, the model generates larger movements in the borrowers’ net worth, and consequently, in output and consumption. Overall, this works to raise aggregate macroeconomic
volatilities. This is the leverage channel induced by financial leverage and domestic financial frictions. The leverage channel dominates for economies with higher degree of domestic financial frictions such as emerging economies. Econometric estimation of my model using data from major emerging economies produces more volatile business cycles after their financial integration in the early 1990s.

In my model, the degree of domestic financial frictions is endogenously determined by the level of financial integration. Low level of financial integration impedes borrowing activities. As a consequence, the measured degree of financial frictions is low. With high financial integration level and thus low cost of borrowing, domestic agents are encouraged to take leverage and hence financial frictions emerge. Therefore, in the regime of high (low) financial integration, the leverage (smoothing) channel plays the essential role. The interplay between the smoothing and leverage channel generates a non-monotonic V-shape behavior of macroeconomic volatilities as a function of the financial integration level. In comparison, in the absence of domestic financial frictions, only the smoothing channel plays a part, driving down business cycle volatilities monotonically with increasing financial integration level.

The crucial role of financial frictions is further supported by analyzing the effects of domestic financial development on macroeconomic volatilities. Financial development reduces the degree of financial frictions. As a result, it leads to a less volatile business cycle. Therefore, a well-developed domestic financial market is essential in reducing the adverse effect of financial integration.

The model mechanism is shown to be robust in the sensitivity analysis with respect to one key model assumption that financial integration affects the economy only through the firm-bank connection. I relax this assumption in an extended model which includes household saving and borrowing. The estimated extended model presents the same V-shape pattern.

This paper relates to two lines of literature: one on the effects of financial integration on business cycle volatilities and the other on financial frictions. Compared to the rich literature dealing with the empirical impact of financial integration on aggregate volatilities, the number of theoretical work is more limited. Moreover, existing theories do not provide clear-cut predictions. Most early studies are based on standard two-country models with dynamic general equilibrium setups and their predictions depend on the nature of shocks (see e.g. Baxter and Crucini (1995), Sutherland (1996)). With open economy macro models, Mendoza (1994) finds that consumption and output

\[^4\]Note that the relevance of borrowers’ financial structure only applies in the presence of financial market frictions (Modigliani and Miller (1958)). In a frictionless financial market, borrowers’ aggregate characteristics, e.g., leverage or equity position, do not matter for the borrowing capacity and financing cost, and hence the determination of the investment path. Therefore they are irrelevant to aggregate cyclical fluctuations.
volatilities are not sensitive to changes in the degree of capital mobility; Buch et al. (2005) show that the link between financial openness and business cycle volatilities depends on the nature of the underlying shock. Evans and Hnatkovska (2007) develop a two-sector RBC model and produce a hump-shaped relation between the degree of financial integration and macroeconomic volatilities as a result of the interaction between risk sharing and production specialization.

Financial frictions have been widely used in explaining business cycle fluctuations in emerging economies. The literature is too extensive to list. Notable recent work include Neumeyer and Perri (2005), García-Cicco et al. (2010), Chang and Fernández (2013), Bhattacharya and Patnaik (2013), and Fernández and Gulan (2015). This line of literature typically builds on financial accelerator framework originally proposed by Bernanke and Gertler (1989), Carlstrom and Fuerst (1997), Kiyotaki and Moore (1997), and Bernanke et al. (1999).

There has been a limited strand of literature exploring the implications of financial integration and of financial market frictions for business cycle volatilities. Levchenko (2005) shows that deteriorated risk sharing after financial liberalization may lead to an increase in individual consumption volatility. However, aggregate consumption volatility will decrease. Leblebicioğlu (2009) develops a two-country two-sector RBC model where the small country faces credit constraints. The model generates more volatile consumption under financial liberalization relative to financial autarky. However, the degree of credit market imperfections does not affect the impact of financial integration on aggregated volatilities. This paper contributes to the literature by providing a first study that explicitly links financial integration and domestic financial frictions and uses their interaction to interpret the effect of financial integration on business cycle volatilities of both industrial and emerging economies.

The rest of the paper is organized as follows. Section 2 presents the model economy. Section 3 describes the estimation and calibration. Section 4 shows the results and model mechanism. Section 5 explores the effect of domestic financial development. Section 6 discusses sensitivity analysis. Section 7 concludes.

2. The model

In this section, I construct a small open economy dynamic general equilibrium model with financial frictions. The model consists of five types of agents: households, importers, domestic goods producers, distributors, and banks. Each type has a continuum of agents. The representative household works, consumes, and supplies physical capital to the representative goods producer.
Households also borrow and lend among each other. In aggregate, household savings and borrowings are zero. The representative importer imports raw goods from the rest of the world. It finances its expenditures via loans borrowed from the bank. The representative domestic goods producer and distributor produce consumption goods in the economy. Both of them are owned by households. The representative bank acts as a financial intermediary, transferring funds from international depositors to domestic importers. Following Bernanke et al. (1999), I endogenize financial market frictions by introducing an agency problem between importers and banks.

2.1. Production

There are two production sectors in this economy: the domestic goods sector and the foreign goods sector (foreign goods serve as the numeraire). Firms in the domestic goods sector face perfect competition. They employ capital $K_t$ and labor $H_t$ to produce domestic goods $Y_t^d$ according to the Cobb-Douglas production technology

$$Y_t^d = z_t^d K_t^{\alpha_d} H_t^{1-\alpha_d}. \quad (1)$$

The parameter $\alpha_d \in (0, 1)$ represents the capital share in the production function. The term $z_t^d$ denotes total factor productivity (TFP) that follows an $AR(1)$ process. Each firm pays the capital and labor in accordance with their marginal productivities

$$r_t = \alpha_d Y_t^d / K_t, \quad (2)$$
$$w_t = (1 - \alpha_d) Y_t^d / H_t, \quad (3)$$

where $r_t$ and $w_t$ are the equilibrium factor prices.

Foreign goods are produced by distributors. Distributors buy imported raw goods from importers, repackage, and sell them to consumers. In this sense, we can treat distributors as the second type of goods producers in the economy. They employ imported raw goods ($M_t$) as intermediate inputs and produce final outputs $Y_t^m$ (foreign goods) using

$$Y_t^m = z_t^m M_{t-1}^m, \quad (4)$$

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3 In Section 6, I will relax this assumption and show that the model results do not rely on it.

4 Financial frictions affect the real economy through the balance sheet constraint on non-financial borrowers (importers). To see how disruptions in financial intermediation induce fluctuations in real activity, one can refer to Gertler and Kiyotaki (2010).

5 The estimation of the model reveals that the shock to $z^d$ does not play a significant role in determining the model moments. Therefore, in the estimated model, the shock to $z^d$ is removed and $z^d$ takes the value of 1.
where $\alpha_m \in (0, 1)$ represents the production technology. The decision on how much raw goods to import is made by importers at time $t - 1$. $z_t^m$ represents the TFP of distributors and follows an $AR(1)$ process

$$\ln z_t^m = \rho_m \ln z_{t-1}^m + \nu_t,$$

(5)

with $\rho_m \in (0, 1)$ being the persistence parameter. The innovation term $\nu_t$ is a serially independent normal random process with mean zero and variance $\sigma^2_{\nu}$. As households are the owners of the business, profits of distributors are transferred as a lump sum to households, which can be written as

$$\Xi_t = Y_t^m - R_t^m q_t M_{t-1},$$

(6)

where $R_t^m$ is the marginal product of raw goods and $q_t$ is the terms of trade in unit of the numeriare goods. $q_t$ evolves according to an $AR(1)$ process

$$\ln q_t = \rho_q \ln q_{t-1} + \varsigma_t,$$

(7)

with $\rho_q \in (0, 1)$ being the persistence parameter. The innovation to terms of trade $\varsigma_t$ is drawn from a normal distribution with mean zero and variance $\sigma^2_{\varsigma}$. Note that the lump sum transfer to households depends on the terms of trade $q_t$. This implies that households’ income will be subject to the terms of trade shock on top of the productivity shock.

2.2. Importers, banks, and domestic financial frictions

Financial frictions are introduced in the interactions between importers (borrowers) and banks (lenders). Importantly, importers need to borrow from banks to finance their purchases of imported raw goods. While importers learn the true payoff of the project ex-post, banks do not. Only if banks pay some monitoring cost can they learn the true payoff. As in Bernanke et al. (1999), the asymmetric information between borrowers and lenders together with the monitoring cost paid in the case of default give rise to the financial frictions.

The assets of the importer $i$ are the sum of her net worth $N_t^i$ and borrowed funds $B_t^i$,

$$q_t M_t^i = N_t^i + B_t^i,$$

(8)

Here $q_t M_t^i$ represents the total value of imported raw goods. Additionally, every importer is subject to an idiosyncratic disturbance $\omega$ that is a random variable following the lognormal distribution.
with mean of unity. Its cumulative distribution function is \( F(-\frac{\sigma^2}{\omega^2}, \sigma) \) with \( \sigma \) being the standard deviation. The ex-post realized disturbance \( \omega_{t+1} \) is a random draw from the distribution. As a result, the realized value of imported raw goods received by the importer is \( \omega_{t+1} q_t M_t \).

Note that the realized \( \omega_{t+1} \) is only observable by the importer. In order to learn the specific state of the importer, the bank needs to pay a per unit monitoring cost \( \mu \). The optimal contract between a bank and an importer specifies a threshold value of \( \omega_{t+1}, \bar{\omega}_{t+1} \), such that

\[
\text{loan repayment at } t + 1 = \begin{cases} 
\bar{\omega}_{t+1} R^m_{t+1} q_t M_t, & \text{if } \omega_{t+1} \geq \bar{\omega}_{t+1}, \\
\omega_{t+1} R^m_{t+1} q_t M_t, & \text{if } \omega_{t+1} < \bar{\omega}_{t+1}.
\end{cases}
\]

The importer defaults if the realized \( \omega_{t+1} \) is below the threshold value \( \bar{\omega}_{t+1} \). In the case of bankruptcy \( \omega_{t+1} < \bar{\omega}_{t+1} \), the importer is monitored and her asset \( \omega_{t+1} R^m_{t+1} q_t M_t \) will be taken over by the bank. In the case of \( \omega_{t+1} \geq \bar{\omega}_{t+1} \), the importer repays the bank according to the contract \( \bar{\omega}_{t+1} R^m_{t+1} q_t M_t \), and retains the profit \( (\omega_{t+1} - \bar{\omega}_{t+1}) R^m_{t+1} q_t M_t \). The contract guarantees that it is optimal not to monitor solvent importers.\(^6\) For a given size \( M_t \) of the importer, the auditing threshold \( \bar{\omega}_{t+1} \) is set such that the bank breaks even:\(^7\)

\[
[\Gamma(\bar{\omega}_{t+1}) - \mu G(\bar{\omega}_{t+1})] R^m_{t+1} q_t M_t = R^*_t B_t,
\]

where

\[
G(\bar{\omega}_{t+1}) \equiv \int_0^{\bar{\omega}_{t+1}} \omega_{t+1} dF(\omega_{t+1}), \quad (10)
\]

\[
\Gamma(\bar{\omega}_{t+1}) \equiv [1 - F(\bar{\omega}_{t+1})] \bar{\omega}_{t+1} + G(\bar{\omega}_{t+1}). \quad (11)
\]

The left-hand side of (9) expresses the return on risky loans to the bank net of the monitoring cost. It includes the repayment from both solvent and defaulted importers. The right-hand side of (9) expresses the cost of raising funds \( B_t \) from the international depositors. \( R^*_t \) is the inter-period interest rate this economy faces in the international financial market.

The importers treat the break even condition as a menu of contracts, which lists all combinations of the leverage and threshold value \( \bar{\omega}_{t+1} \). The timing of the events of importers and banks is summarized in Appendix A. At the beginning of time \( t \), the shock to \( z^m_t \) is realized and importers

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\(^6\)According to Townsend (1979), in such an environment debt is the optimal contract since it minimizes the socially wasteful monitoring cost. As long as the debt is paid off in full, there is no need to verify the true state. Only in case of default, the lender verifies the state.

\(^7\)Banks provide homogeneous and standard contracts to all importers. So the superscript \( i \) is omitted.
learn the return to imported raw goods $R_t^{m}$. The value of $\omega_t$ is also revealed and a pooled importers with net worth $N_t$ remain solvent. Those importers decide upon the demand level of $M_t$, and hence the level of debt $B_t$. The optimal threshold value of $\bar{\omega}_{t+1}$ is found by maximizing the importer’s expected profit subject to the break even condition,

$$
\max_{L_t, \bar{\omega}_{t+1}} \int_{\bar{\omega}_{t+1}}^{\infty} (\omega_{t+1} - \bar{\omega}_{t+1}) dF(\omega_{t+1}) R^{m}_{t+1} L_t,
$$

(12)

where $L_t \equiv q_t M_t / N_t$ is the financial leverage of the importer. The solution of the importer’s problem yields the contract $(L_t, \bar{\omega}_{t+1})$ that maximizes the expected profit.

Although de-jure it is the bank who has to pay the monitoring cost, de-facto the bank passes the cost on to the importer by charging a higher interest rate. This makes external funding more expensive for borrowers and creates a wedge between $R^{m}$ and $R^*$. The difference between the expected return that businesses earn from capital and the market cost of capital measures the degree of financial frictions. Define

$$
\tau \equiv E_t (R^{m}_{t+1}) - R^*_t,
$$

(13)

as the external financing premium of borrowers. The higher the external financing premium is, the higher the measured degree of financial frictions is.\(^8\) In the extreme case of a perfect financial market, $\tau = 0$.

Finally, at the end of each period a fraction $1 - \gamma$ of importers will die and be replaced by a new cohort so as to keep the number of importers constant.\(^9\) In order to endow these new born importers with initial wealth, households transfer $W^e$ as a lump sum to them. Therefore, the aggregate net worth of importers evolves according to

$$
N_{t+1} = \gamma \left[ 1 - \Gamma(\bar{\omega}_{t+1}) \right] R^{m}_{t+1} q_t M_t + W^e.
$$

(14)

The importers then take this net worth to period $t + 1$, get loans, and purchase imported raw goods. The net worth of dead importers $(1 - \gamma) \left[ 1 - \Gamma(\bar{\omega}_{t+1}) \right] R^{m}_{t+1} q_t M_t$ is transferred to households.

\(^8\)The focus on external financing premium is motivated by the linkage between borrowers’ balance sheet quality and their access to external finance. Gilchrist and Zakrajšek (2012) offers a detailed discussion about the role of credit spread during financial turmoils.

\(^9\)This dying process ensures that importers do not accumulate enough wealth so that the financing problem becomes irrelevant.
Therefore, the net transfer from importers to households is

\[ \Omega_t = (1 - \gamma)[1 - \Gamma(\bar{\omega}_{t+1})] R^m_{t+1} q_t M_t - W^e. \]  

(15)

2.3. Households

There is a continuum of infinitely-lived risk-averse households. Each household is endowed with one unit of labor and supplies labor and capital to domestic goods producers. The utility function of a representative household is

\[
E_0^t \sum_{t=0}^{\infty} \beta^t \frac{1}{1 - \kappa} \left( C^h_t - \psi H_t^{1+\theta} \right)^{1-\kappa},
\]

(16)

where \( E_0[\cdot] \) is the expectation operator. \( C^h_t \) is the CES aggregate of foreign goods (\( C^m_t \)) and domestic goods (\( C^d_t \))

\[
C^h_t = \pi (C^d_t)^\rho + (1 - \pi)(C^m_t)^\rho \]

(17)

where \( \pi \in (0, 1) \) denotes the share of domestic goods in the CES aggregate and \((1 - \rho)^{-1}\) represents the elasticity of substitution between foreign and domestic goods. The household’s utility also depends on hours worked \( H_t \). Here, I adopt the preferences of Greenwood et al. (1988). The parameter \( \beta \in (0, 1) \) denotes the subjective discount factor, \( \kappa \) denotes the value of risk averse, \( \psi \) governs the relative importance of leisure, and \( \theta \) denotes the inverse of Frisch elasticity of labor supply.

Households can smooth their consumption by issuing one-period bond among each other. It is assumed that they never default. The net supply of bond is zero in equilibrium. Households choose consumption \( \{C^d_t, C^m_t\} \) and labor supply \( \{H_t\} \) to maximize the utility function in (16) subject to the sequence of budget constraints,

\[
C^m_t + p_t(C^d_t + X_t) = p_t(w_t H_t + r_t K_t) + \Xi_t + \Omega_t,
\]

(18)

where \( p_t \) denotes the relative price of domestic goods and \( X_t \) denotes the investment of physical capital. Alongside the income from supplying labor and capital, households also receive dividends \( \Xi_t \) and transfer payment \( \Omega_t \). Therefore, the household’s income and consumption are sensitive to unexpected shifts in the distributor’s profit and the importer’s net worth.
As households own physical capital and make investment, capital accumulates as

\[ K_{t+1} = (1 - \delta)K_t + \Phi \left( \frac{X_t}{K_t} \right) K_t, \]

where \( \delta \in (0, 1) \) denotes the depreciation rate of capital and \( \Phi(X_t/K_t) \) represents the investment adjustment cost

\[ \Phi \left( \frac{X_t}{K_t} \right) = \frac{w_1}{1 - \xi^{-1}} \left( \frac{X_t}{K_t} \right)^{1-\xi^{-1}} + w_2. \]  

(19)

The parameter \( \xi \) measures the elasticity of investment to Tobin’s q. As \( \xi \to +\infty \), the above accumulation process reduces to \( K_{t+1} = X_t + (1 - \delta)K_t \). Parameters \( w_1 \) and \( w_2 \) are set so that in the steady state \( \Phi(\cdot) = \delta \) and \( \Phi(\cdot)' = 1 \).

2.4. International financial market

In this economy, the aggregate household borrowings and lendings are zero. Therefore, the debt position of the economy is determined by the importers’ borrowing \( B_t \). The interest rate in the international financial market \( R^*_t \) is augmented by a small risk premium term

\[ R^*_t = \bar{R} + \phi[\exp(B_t) - 1], \]

(20)

where \( \bar{R} \) is the international risk-free interest rate and \( \phi > 0 \) represents the sensitivity of the interest rate to the debt level. The higher \( \phi \) is, the higher obstacle the economy needs to overcome to obtain credit. So \( \phi \) denotes the international borrowing premium.

In this paper, I model the increase in the financial integration level as a reduction in \( \phi \) (see e.g. Liu and Spiegel (2015) and Chang et al. (2015) for similar reduced-form treatments). Because one important aspect of financial integration is removing obstacles for countries to participate in the international financial market, it is reasonable to assume that a decrease in \( \phi \) represents a more integrated financial market. Miyamoto and Nguyen (2016) model the frictions in the international financial market in a similar way and find that \( \phi \) captures the difference in the borrowing premium for countries with different income levels.

2.5. Market clearing

Because of the importers’ debt position, the economy exports to balance its national account. I assume that domestic goods are non-tradable. The economy exports part of its foreign goods \( Y^m_t \). The market clearing conditions for both domestic and foreign goods are (see Appendix B for the
C^d_t + X_t = Y^d_t. \quad (22)

C^m_t + EX_t + d_t = Y^m_t. \quad (23)

The produced domestic goods $Y^d_t$ are consumed and invested. In the resource constraint (23), $EX_t$ denotes total amount of exports,

$$EX_t = N_t + \tilde{R}_{t-1}^* B_{t-1}$$

$$= q_t M_t + \tilde{R}_{t-1}^* B_{t-1} - B_t. \quad (24)$$

It equals the sum of imports $q_t M_t$ and net exports $\tilde{R}_{t-1}^* B_{t-1} - B_t$, as shown in (24). The term $d_t$ denotes the monitoring cost,

$$d_t = \mu \int_{0}^{\tilde{\omega}} \omega t dF(\omega_t) R_t M_{t-1} - B_t. \quad (25)$$

Therefore, the produced foreign goods $Y^m_t$ are consumed, used to cover the monitoring cost, and exported.

Importantly, I derive from the household’s budget constraint (18) and the market clearing conditions (22)

$$C^m_t = \Xi_t + \Omega_t. \quad (26)$$

That is households’ consumption of foreign goods equals the sum of dividends $\Xi_t$ and transfer payments $\Omega_t$. Recall that, besides the TFP shock, both $\Xi_t$ and $\Omega_t$ are subject to the terms of trade shock. Therefore, the household consumption is subject to both the TFP shock and terms of trade shock. Due to the independence of shock processes, the volatility of consumption will be shown to be higher than that of output.\(^{10}\)

3. Estimation

I fit the small open economy DSGE model to a panel of thirteen key emerging market countries. To this end, the model is solved based on log-linearized equilibrium in the neighborhood of the

\(^{10}\)The idea of generating volatile consumption shares the view of Boileau and Normandin (2014) who show that countries depending heavily on imports of equipment are at the mercy of terms of trade shock and that variations in the price of imported goods can generate more response in consumption than in output.
non-stochastic steady state and the resulting linear difference equations are solved as in Blanchard and Kahn (1980). The model with the TFP and terms of trade shock is then confronted with five quarterly time series from 1993 Q4 to 2011 Q4. The series include output ($Y$), private consumption ($C$), trade balance ($TB$), real investment ($I$), and real interest rate ($R^*$). All series are in per capita form and are logged and Hodrick-Prescott filtered. The exception is the trade balance that is directly filtered. Appendix C provides the details of the data.

I use the method of Generalized Method of Moments (GMM) to estimate the model. Because the dataset is an unbalanced panel, the estimator has to adjust for both autocorrelation and cross-correlation among countries. Therefore, I choose the Driscoll and Kraay (1998) estimator. Due to the availability of data, the model is estimated and calibrated in the post financial integration period, i.e., 1993 and after. I then evaluate the model to see its implications along the financial integration path. The key model parameters that are estimated are the persistence parameter of the TFP shock $\rho_m$, the persistence parameter of terms of trade shock $\rho_q$, the standard deviation of innovations to the TFP $\sigma_\nu$, the standard deviation of innovations to terms of trade $\sigma_z$, international financial market borrowing premium $\phi$, and the investment adjustment cost parameter $\xi$.

I calibrate other parameter values of the model prior to the estimation to match steady-state observations. Table 2 displays the targeted steady state values and the calibrated parameter values. The coefficient of relative risk aversion $\kappa$ is set to be 2 as common in the literature. The parameter $\theta$ is calibrated to 0.65 so that Frisch elasticity of labor supply is 1.7. The parameter $\psi$ is calibrated to 1.6 such that in the steady state households spend around 33% of time on working. The elasticity of substitution between domestic goods and foreign goods is $(1 - \rho)^{-1} = 2$. The weight of domestic goods in the CES aggregate $\pi$ is 0.5. The capital depreciation rate $\delta$ is set to be 0.02. The discount factor $\beta$ is fixed at 0.98 so that the annual interest rate is around 8%. The share of capital goods $\alpha_d$ in the gross output $Y^d$ is set to be 0.33. The production technology parameter $\alpha_m$ is set to be 0.33. The parameter $\gamma$ denotes the fraction of importers that survives to the next period. I follow Bernanke et al. (1999) and set this parameter to be 0.97. In a quarterly-based model, this value implies that the lifetime of firms $1/(1 - \gamma)$ is around 33 quarters or 8 years.

Two parameters govern the level of financial development in the domestic economy, the monitoring cost $\mu$ and the standard deviation $\sigma_\omega$ of the distribution of the idiosyncratic disturbance. Bernanke et al. (1999) calibrates $\mu$ as 0.12. Fernández and Gulan (2015) estimate this parameter

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11 Unlike many existing literatures, whose purpose of introducing $\phi$ is solely to induce stationarity of the model, I estimate this parameter. This allows me to test whether the value of $\phi$ affects the volatility of business cycles along the financial integration path.
Table 2
Calibration of basic model parameters.

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<th>Parameters</th>
<th>Description</th>
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<th>Target</th>
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</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>Discount factor</td>
<td>0.98</td>
<td>Average annual interest rate of 8%</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Inverse of Frisch elasticity of labor supply</td>
<td>0.65</td>
<td>Labor supply elasticity of 1.7</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Value of risk aversion</td>
<td>2</td>
<td>Common in small open economy models</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Relative importance of leisure</td>
<td>1.6</td>
<td>Households spend 1/3 time on working</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Elasticity of substitution $(1 - \rho)^{-1}$</td>
<td>0.5</td>
<td>Common in macro literature</td>
</tr>
<tr>
<td>$\sigma_d$</td>
<td>Capital income share</td>
<td>0.33</td>
<td>Standard capital share of 0.3</td>
</tr>
<tr>
<td>$\sigma_m$</td>
<td>Distributor production function</td>
<td>0.33</td>
<td>Benchmark production technology</td>
</tr>
<tr>
<td>$\delta$</td>
<td>Capital depreciation rate</td>
<td>0.02</td>
<td>Average investment ratio of 17%</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Monitoring cost</td>
<td>0.32</td>
<td>Fernández and Gulan (2015)</td>
</tr>
<tr>
<td>$\pi$</td>
<td>Share of foreign goods in consumption</td>
<td>0.5</td>
<td>Benchmark consumption share</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>Survival rate of importers</td>
<td>0.97</td>
<td>Bernanke et al. (1999)</td>
</tr>
<tr>
<td>$\sigma_\omega$</td>
<td>Standard deviation of $F(\mu_\omega, \sigma_\omega)$</td>
<td>0.3</td>
<td>Leverage around 1.6</td>
</tr>
</tbody>
</table>

using data from twelve emerging market economies and get 0.32, a value close to the upper bond of Carlstrom and Fuerst (1997). In this paper, I calibrate $\mu$ to be 0.32. The parameter $\sigma_\omega$ is calibrated by matching the average leverage of non-financial firms in emerging market economies. Its value is fixed at 0.3 so that the steady state leverage is around 1.6.

For the estimation of $\rho_m$, $\rho_q$, $\sigma_v$, $\sigma_\zeta$, $\phi$, and $\xi$ using the method of GMM, I choose the following nine second moments:

$$m(\Theta) = \begin{bmatrix} \sigma^2(Y), \sigma^2(C), \sigma^2(X), \sigma^2(TB), \sigma^2(R^*) \end{bmatrix},$$

where $\Theta = [\phi, \xi, \rho_m, \rho_q, \sigma_v, \sigma_\zeta]$ is the vector of the six parameters, $\sigma^2(\cdot)$ and $\rho(\cdot)$ denote the variance and correlation operator respectively. The trade balance $TB$ is defined as the ratio of net exports $(NX)$ to output. Here, country’s risky interest rate $R^*$ takes into account the country specific risk spread on top of the non-risky benchmark interest rate.

Table 3 reports the estimated model parameter values. The parameter $\phi$, which measures the level of financial integration, is estimated to be 0.08. A recent work by Miyamoto and Nguyen (2016) estimates this parameter for seventeen small open economies including both developed and emerging economies using a long panel data from 1900 to 2013. They find that $\phi$ falls into the range of 0.2-1.4 for emerging economies. The estimated value of $\phi$ is smaller here. Because the presented model is estimated in the period from 1993 to 2011 characterized by high level of financial integration, the estimated value of $\phi$ would be appropriately small.

The estimated value of the investment adjustment cost parameter $\xi$ is 2.873. The relative standard deviation of investment to output is largely determined by the value of $\xi$. There is no consensus on the value of $\xi$, because it depends on the model specification and the actual functional
Table 3
Estimated model parameters.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>φ</th>
<th>ξ</th>
<th>ρₘ</th>
<th>ρₜ</th>
<th>σᵥ</th>
<th>σₓ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated value</td>
<td>0.080</td>
<td>2.873</td>
<td>0.994</td>
<td>0.890</td>
<td>0.020</td>
<td>0.102</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(1.264)</td>
<td>(0.010)</td>
<td>(0.218)</td>
<td>(0.002)</td>
<td>(0.015)</td>
</tr>
</tbody>
</table>

Note: Standard errors of the estimated parameter values are reported in the brackets.

The persistence of the TFP shock ρₘ is estimated to be 0.994. The standard deviation σᵥ of innovations to the TFP is estimated to be 0.02, close to the values reported in previous studies. The persistence ρₜ and standard deviation σₓ of terms of trade shock are estimated to be 0.89 and 0.102, respectively. The value of σₓ implies that terms of trade shock plays a non-negligible role in generating the model moments. Table 4 reports the variance decomposition of the two shocks. The innovations to the TFP and terms of trade contribute roughly equally to the fluctuations in the output. However, innovations to terms of trade contributes substantially more to the volatility of consumption, which explains the high volatility of consumption in emerging economies. Moreover, the fluctuations in the interest rate, trade balance and investment all rely heavily on terms of trade shock.

Table 4
Variance decomposition.

<table>
<thead>
<tr>
<th>Shock</th>
<th>Y</th>
<th>C</th>
<th>X</th>
<th>TB</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>zₜ</td>
<td>55.11</td>
<td>25.05</td>
<td>6.50</td>
<td>0.90</td>
<td>1.02</td>
</tr>
<tr>
<td>q</td>
<td>44.89</td>
<td>74.95</td>
<td>93.50</td>
<td>99.10</td>
<td>98.98</td>
</tr>
</tbody>
</table>

Note: Entries are contributions of innovations to the TFP and the terms of trade to the variance of selected macroeconomic variables. The variance decomposition is performed on the estimated model.

Table 5 presents generated moments of the estimated model along with their empirical counterparts. Panel A shows the targeted moments in the GMM estimation and Panel B shows the other second moments. The model does a good job in matching the key second moments of emerging market economies. It is able to generate a high standard deviation of output, and a more volatile consumption than output. Moreover, the model generates countercyclical interest rate and countercyclical trade balance. The model is also able to match moments that are not included in the estimation. As shown in Panel B of Table 5, the model matches the magnitude and sign of the correlations for several empirical moments except for the correlation between R* and TB.

Although ρₘ is rather close to unity, the model does not rely on the trend shock assumption as in Aguiar and Gopinath (2007) to produce more volatile consumption than output.
Table 5
Model generated moments.

<table>
<thead>
<tr>
<th>Second moment</th>
<th>Data</th>
<th>Model</th>
<th>Second moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: targeted moments</strong></td>
<td></td>
<td></td>
<td><strong>Panel B: other moments</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma(Y)$</td>
<td>3.13</td>
<td>3.78</td>
<td>$\rho(R^*, C)$</td>
<td>-0.39</td>
<td>-0.51</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.220)</td>
<td>(0.088)</td>
<td>(0.108)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma(C)/\sigma(Y)$</td>
<td>1.31</td>
<td>1.40</td>
<td>$\rho(R^*, X)$</td>
<td>-0.35</td>
<td>-0.50</td>
</tr>
<tr>
<td>(0.004)</td>
<td>(0.032)</td>
<td>(0.057)</td>
<td>(0.060)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma(X)/\sigma(Y)$</td>
<td>3.95</td>
<td>3.07</td>
<td>$\rho(R^*, TB)$</td>
<td>0.29</td>
<td>-0.37</td>
</tr>
<tr>
<td>(0.014)</td>
<td>(0.306)</td>
<td>(0.096)</td>
<td>(0.082)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho(C,Y)$</td>
<td>0.78</td>
<td>0.95</td>
<td>$\rho(TB, C)$</td>
<td>-0.68</td>
<td>-0.40</td>
</tr>
<tr>
<td>(0.054)</td>
<td>(0.010)</td>
<td>(0.057)</td>
<td>(0.072)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho(X,Y)$</td>
<td>0.64</td>
<td>0.82</td>
<td>$\rho(TB, X)$</td>
<td>-0.71</td>
<td>-0.55</td>
</tr>
<tr>
<td>(0.063)</td>
<td>(0.050)</td>
<td>(0.053)</td>
<td>(0.101)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho(TB,Y)$</td>
<td>-0.34</td>
<td>-0.34</td>
<td>$\rho(TB,Y)$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.086)</td>
<td>(0.029)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho(R^*, Y)$</td>
<td>-0.39</td>
<td>-0.34</td>
<td>$\sigma(TB)$</td>
<td>2.86</td>
<td>1.48</td>
</tr>
<tr>
<td>(0.052)</td>
<td>(0.048)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\sigma(TB)$</td>
<td>0.003</td>
<td>0.327</td>
<td>$\sigma(R^*)$</td>
<td>0.87</td>
<td>0.19</td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.032)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: $\sigma(\cdot)$ denotes the standard deviation of the variable and $\rho(\cdot, \cdot)$ denotes the correlation of two variables. Standard errors of the moments are reported in the brackets.

The model generated standard deviation of the interest rate is small compared to the data. The main reason can be seen from (21). $\phi$ affects the sensitivity of $R^*$ to changes in the debt position. For the estimated value of $\phi$, debt changes affect the interest rate insignificantly. So it is not surprising to see a low volatility for the interest rate. In the work of Fernández and Gulan (2015), they produce a higher volatility of interest rate in their model by using the return to capital as a proxy for the interest rate. However, the interest rate defined in this paper (as country specific spreads plus benchmark interest rate) is more consistent with the empirical counterpart.\(^{13}\)

4. Financial integration and macroeconomic volatilities

I now use the estimated model to assess the model performance with different levels of financial integration. I begin with a discussion of what happens to the volatilities of output and consumption once the level of financial integration changes. I then analyze the economic mechanism that drives the results: the leverage channel and the smoothing channel. Finally, I examine the different role of terms of trade and the TFP shock in the model.

\(^{13}\)One way to generate consistent second moments of interest rate is to introduce interest rate shocks. That is modeling the international benchmark interest rate as a stochastic process.
4.1. V-shape behavior of aggregated volatilities

Fig. 2 plots standard deviations of output and consumption as a function of $\phi$ with the other parameters estimated and calibrated as in Section 3. $\phi$ represents the degree of international financial integration. Both volatilities of output and consumption exhibit a V-shaped behavior with a minimum at $\phi$ around 0.15. To facilitate the discussion, I divide both plots in Fig. 2 into two regions, Region I and II.

In Region I, the model produces a considerable drop in both standard deviation of output and consumption when $\phi$ goes up. Specifically, as $\phi$ increases from 0.08 to 0.15, the standard deviation of output drops from 3.78% to around 3.71%, and the standard deviation of consumption drops from 5.29% to 5.22%. Compared to the existing literature, for instance, Bhattacharya and Patnaik (2013), the magnitude of changes in the presented results is large. Note that the estimated parameter value of $\phi$ in Section 3 is 0.08, placing emerging economies in the estimation in Region I. In this region, the volatilities of output and consumption increase as $\phi$ goes down. This is
consistent with the empirical fact that many emerging market economies experience more volatile business cycles with increasing financial integration.

In Region II, the model produces decreasing standard deviation of output and consumption when $\phi$ goes down, which is opposite to the behavior in Region I. A major difference here is that in Region II the degree of financial frictions is low because of the relatively large value of $\phi$ (see Section 4.2). As a result, the mechanism that drives the behavior in Region I is dominated by a different channel in Region II. As will be shown later, the underlying channel in region II illustrates the experience of industrial economies in which increasing financial integration lowers the volatilities of business cycles.

Therefore, the model is able to account for the effects of financial integration on the aggregate volatilities for both emerging and industrial economies. For countries with high degree of financial frictions, an increase in the level of financial integration (a reduction in $\phi$) results in an increase in volatilities. While for countries with few financial frictions such as industrial economies, increasing financial integration reduces volatilities of business cycles.

4.2. The leverage channel

It is found that the model behavior in Region I stems from the response of borrowers’ leverage and external financing premium to the degree of financial integration. Fig. 3 plots the steady state value of financial leverage of importers and external financing premium as a function of $\phi$. The figure shows that a reduction in $\phi$ raises both the leverage and external financing premium. Evidently, as international financial integration lowers the cost to obtain credit, borrowers are encouraged to borrow and increase their leverage. However, an increasing leverage comes at the cost of a higher financing premium. The is because higher efficiency loss must be incurred as increasing value of credits are intermediated through a frictional financial market. To see this, note that the bank’s break even condition (9) can be rewritten as the supply curve for investment finance,

$$ E_t \left[ \frac{R^m_{t+1}}{R^s_t(\phi)} \right] = \Upsilon(L_t), \quad \Upsilon'(\cdot) > 0. \quad (28) $$

This implies a positive correlation between the leverage and the external financing premium. In other words, the external financing premium inversely depends on the borrower’s percentage equity holding that is net worth relative to the gross value of asset. This arises because, when the borrower has little wealth to contribute to the project financing, the likelihood of default increases. In equilibrium, lenders must be compensated by a larger premium for higher agency cost. When
financial integration lowers the cost of borrowing, i.e., as the value of \( \phi \) drops, importers borrow more and take a higher leverage. This in turn drives up the external financing premium. As a result, a reduction in \( \phi \) raises both the leverage and the degree of financial frictions.

It is the increasing leverage coupled with financial frictions that explains higher volatilities as \( \phi \) goes down, as observed in Region I. Consider the net worth accumulation process (14). Using the relation (9), we obtain

\[
N_t = \gamma \left[ R_t^m q_{t-1} M_{t-1} - R^s_{t-1} B_{t-1} - \mu G(\bar{\omega}_t) R^m_{t-1} q_{t-1} M_{t-1} \right] + W^e \\
= \gamma V_t + W^e ,
\]  

(29)
where

\[ V_t = R_t^m q_{t-1} M_{t-1} - \left[ R_{t-1}^* + \mu G(\bar{\omega}_t) R_t^m q_{t-1} M_{t-1} / (q_{t-1} M_{t-1} - N_{t-1}) \right] B_{t-1}, \]

(30)

is defined as the equity holding by importers at \( t \). Let \( U_{t}^{rm} \equiv R_t^m - E_{t-1}[R_t^m] \) denote the unexpected shift in the gross return to imported goods. Differentiating \( V_t \) with respect to \( U_t^{rm} \) yields

\[ \frac{\partial V_t / E_{t-1}[V_t]}{\partial U_t^{rm} / E_{t-1}[R_t^m]} = \frac{E_{t-1}[R_t^m q_{t-1} M_{t-1}]}{E_{t-1}[V_t]}, \]

(31)

which represents the ratio of the percentage change in the importer’s equity to the percentage change in the return to imported goods. This ratio depends on the leverage of the importer. To the extent that the importer is more leveraged, this ratio is higher. In this case, an unexpected change in the asset price leads to a more than proportional change in the net worth, and hence a more than proportional change in output, consumption, and so forth. This summarizes the mechanism that gives rise to the model behavior in Region I. The mechanism is dubbed “the leverage channel” in the spirit of the financial accelerator from Bernanke et al. (1999). The leverage channel reflects the role of financial frictions in amplifying and propagating shocks.

4.3. The smoothing channel

In Region II, the leverage channel plays a negligible role. As shown in Fig. 3, borrowers’ leverage and the measured degree of financial frictions stay at very low level in this region. Intuitively, this is because when the borrowing premium is too large, firms are discouraged from borrowing or taking leverage.

In this region, conventional smoothing channel of financial integration plays the predominant role. Consider the terms of trade shock. It will be shown later that external shock such as the terms of trade is much more important for the smoothing channel. According to Bhattacharya et al. (2013), financial integration affects the extent to which the economy can absorb external shocks. This can be seen from the resource constraint

\[ C_t^m + q_t M_t + R_{t-1}^* B_{t-1} + d_t = Y_t^m + B_t. \]

(32)

With low level of financial integration (large \( \phi \)), the economy cannot borrow and lend freely to help smooth fluctuations in \( q_t \). Consumption and output must absorb the shock to keep trade balanced. When \( \phi \) decreases, the economy is less constrained and can borrow and lend more freely
to smooth shocks. Therefore, external terms of trade shocks are not transmitted to output and consumption. As a consequence, volatilities of output and consumption go down. This mechanism is dubbed “the smoothing channel”.

It is worth emphasizing that the smoothing channel always exists along the financial integration path. However, it is dominated by the leverage channel in Region I. Whether the smoothing channel or the leverage channel dominates depends on the degree of financial frictions. For Region I with high degree of financial frictions, the leverage channel dominates and we observe rising volatilities with increasing financial integration. In the case of few financial frictions, the smoothing channel always outweighs the leverage channel, and financial integration reduces the volatilities of business cycles.
4.4. Role of terms trade and the TFP shock

To investigate different roles of terms of trade and the TFP shock in the model mechanism, I perform detailed analysis of impulse responses of the model. Fig. 4 (upper panel) shows the impulse response of importers’ net worth to a one standard deviation increase in the innovations to $q$ for different values of $\phi$. A visual inspection suggests that $\phi$ affects the magnitude and persistence of the impulse responses in a non-monotonic way. It can be shown that with only the terms of trade shock, the standard deviations of output, consumption, and investment all display V-shaped pattern across values of $\phi$. The results imply that the impact of terms of trade shock on the economy is subject to both the leverage and the smoothing channel.

Fig. 4 (lower panel) plots the impulse response of importers’ net worth to a one standard deviation increase in the innovation to $z^m$ for different values of $\phi$. Generally, with an one standard deviation increase in the TFP, net worth rises. When the value of $\phi$ is lower, the net worth rises more and is more persistent, suggesting higher volatilities. It can be shown that with only the TFP shock, standard deviations of output, consumption, and investment all increase with decreasing values of $\phi$. The results imply that the leverage channel is much more important for an internal shock such as the TFP shock.

5. Financial development, financial frictions and business cycle volatilities

The results in previous section reveal the pivotal role of domestic financial frictions. In this section, I analyze the effect of domestic financial development on macroeconomic volatilities, by which the model mechanism will be further supported.

According to Arellano et al. (2012), financial development can be modeled as a reduction in the monitoring cost $\mu$ of the banking sector. The monitoring cost arises because of poor financial supervision or low efficiency of financial intermediaries. It generates frictions in the financial market. Financial integration can help improve the quality of financial services and the techniques of the banking sector, thus reducing $\mu$. From the equity holding by importers (30), the quantity

$$\frac{\mu G(\tilde{\omega}_{t+1}) R_{it+1} M_t}{q_t M_t - N_t},$$

(33)

reflects the external financing premium that measures the degree of financial frictions. It is proportional to the value of $\mu$. A decrease in the monitoring cost $\mu$ reduces the external financing premium and hence the frictions in the financial market.
The standard deviation $\sigma_\omega$ of the lognormal distribution of the idiosyncratic disturbance also affects financial development. The value of $\sigma_\omega$ measures the difficulty for lenders to monitor the state of borrowers. When $\sigma_\omega$ approaches zero, the asymmetric information between borrowers and lenders disappears. Therefore, lower value of $\sigma_\omega$ implies a more efficient domestic financial market.

Accordingly, domestic financial development is modeled as a reduction in $\mu$ or $\sigma_\omega$ in this paper. Fig. 5 plots the steady state leverage and external financing premium as a function of $\mu$ and $\sigma_\omega$. As $\mu$ and $\sigma_\omega$ get lower, financial leverage of importers rises. Meanwhile, external financial premium decreases. The figures show that financial development reduces financial frictions and encourages firms to raise leverage. This is in contrast with the effect of financial integration. Recall that in Fig. 3, financial integration increases firms’ leverage, but with the cost of raising financial frictions. Therefore, it is expected that changes in the level of financial development affect business cycles differently from the leverage channel. Fig. 6 plots the standard deviations of output and consumption as a function of $\mu$ and $\sigma_\omega$. In both figures, as $\mu$ and $\sigma_\omega$ get lower, volatilities go down. This is because an improvement of financial development reduces the degree of financial frictions.
in the domestic economy. The latter leads to less volatile business cycles.

The above results suggest that for economies with high domestic financial frictions such as many developing countries, the effect of international financial integration and domestic financial development on business cycle volatilities is opposite. To alleviate the detrimental impact brought by the leverage channel, it is necessary to improve domestic financial conditions. With well-developed domestic financial market, the leverage channel would be suppressed, making the smoothing channel dominate and therefore enabling the economy to enjoy the benefits of financial integration.

6. Sensitivity analysis

The model assumes that the household aggregate borrowings and savings are zero so that the only channel that financial integration affects the economy is through the importer-bank connec-

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14Note that as a “collateral benefit” of financial integration (see Prasad and Rajan (2008) for a detailed discussion), exposure to international capital flows may spur a country’s financial sector development.
tion. In this section, I analyze the sensitivity of the results to this assumption.

To this end, I build an extended model in which households can access the international financial market via banks. Banks collect deposits from both international and domestic savers and make loans to importers. As a result, the budget constraint of the household becomes

\[ C^m_t + p_t(C^d_t + X_t) + S_t = p_t(w_t H_t + r_t K_t) + R^h_{t-1} S_{t-1} + \Xi_t + \Omega_t, \]  

(34)

where the term \( S_t \) denotes household savings at period \( t \) and \( R^h_t \) is the interest rate faced by domestic savers. Banks’ break even condition changes to

\[ \Gamma(\bar{\omega}_{t+1}) - \mu G(\bar{\omega}_{t+1})] R^m_t q_t M_t = R^*_{t} (D_t - S_t) + R^h_{t} S_t, \]  

(35)

where the term \( D_t \) denotes the amount of loans that the importer takes from the bank. The right hand side of (35) represents the cost of raising funds from domestic and international savers. Here, it is assumed that the bank first collects deposits from domestic savers and then fills the credit gap from international funds. Finally, the market clearing conditions for foreign goods becomes

\[ C^m_t + q_t M_t + d_t + R^*_{t-1} B_{t-1} - (D_t - S_t) = Y^m_t. \]  

(36)

The two interest rates \( R^*_{t} \) and \( R^h_{t} \) are modeled as in Schmitt-Grohé and Uribe (2003):

\[ R^*_{t} = \bar{R} + \phi [\exp(D_t - S_t) - 1], \]  

(37)

\[ R^h_{t} = \bar{R} + \tilde{\phi} [\exp(S_t) - 1], \]  

(38)

where \( \phi \) again represents the international borrowing premium, and the parameter \( \tilde{\phi} < 0 \) induces stationarity. Specifying different interest rates is justified in the sense that the economy is only partially opened depending on the value of \( \phi \). An international financial integration process can be viewed as a reduction in \( \phi \), or an increase in \( \tilde{\phi} \), or both at the same time. Given that the financial integration process is best represented as removing obstacles in obtaining credit, the key parameter determining the degree of international financial integration is still \( \bar{\phi} \).

The model is estimated with the inclusion of \( \tilde{\phi} \) using the method of GMM (See Appendix D for the estimation results). With the estimated extended model, Table 6 reports the standard deviations of output, consumption, and investment across different values of \( \phi \). As shown from the table, the second moments still exhibit the V-shape pattern as before. Therefore, the leverage
and smoothing channel of the original model are robust to the inclusion of household savings and borrowings.

Table 6
Extended model: aggregated volatilities and financial integration.

<table>
<thead>
<tr>
<th></th>
<th>$\phi = 0.5$</th>
<th>$\phi = 0.3$</th>
<th>$\phi = 0.2$</th>
<th>$\phi = 0.1$</th>
<th>$\phi = 0.05$</th>
<th>$\phi = 0.0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma(Y)$</td>
<td>3.87</td>
<td>3.77</td>
<td>3.72</td>
<td>3.78</td>
<td>3.81</td>
<td>3.83</td>
</tr>
<tr>
<td>$\sigma(C)$</td>
<td>6.44</td>
<td>6.34</td>
<td>6.30</td>
<td>6.36</td>
<td>6.40</td>
<td>6.41</td>
</tr>
<tr>
<td>$\sigma(X)$</td>
<td>13.88</td>
<td>13.52</td>
<td>13.36</td>
<td>13.54</td>
<td>13.65</td>
<td>13.71</td>
</tr>
</tbody>
</table>

Note: $\sigma(\cdot)$ denotes the standard deviation of the variable and $\rho(\cdot, \cdot)$ denotes the correlation of two variables. Entries are computed based on the estimated extended model.

7. Conclusion

Although international financial integration has been considered as a source of important benefits including international risk sharing and consumption smoothing, it could also be a source of greater macroeconomic volatilities. This paper develops a small open economy RBC model to explicitly investigate the interactive effects between financial integration and domestic financial frictions in their relationship to business cycle volatilities. The model incorporates domestic financial imperfections as a variant of financial accelerator. I show that the leverage channel combined with the smoothing channel provides a non-monotonic V-shape behavior of macroeconomic volatilities with respect to the degree of financial integration. The response of business cycle fluctuations to international financial integration depends on the degree of domestic financial frictions. For economies with few financial frictions, the smoothing channel works to drive the volatilities down. While for economies with high degree of financial frictions, the leverage channel dominates over the smoothing channel. Financial integration provides additional liquidity to domestic banks and encourages firms to take higher leverage. The leverage boom increases the vulnerability of the economy to shocks, thus amplifying business cycle volatilities. This paper also shows that domestic financial development matters in relationship between financial integration and business cycle fluctuations. Financial integration stabilizes business cycles when the country has a well developed financial market. In terms of policy implication, the results of this paper suggest that good domestic financial market should be a prerequisite for emerging market economies to benefit from international financial integration.
Appendix A. Timing

The timing of the events of importers is as following. At time $t$,

- get paid $R_m^m q_{t-1} M_{t-1}$ from selling imported goods $M_{t-1}$ to distributors,
- learn the disturbance $\omega_t$,
- pay back the bank either $\bar{\omega}_t R_m^m q_{t-1} M_{t-1}$ or $\omega_t R_m^m q_{t-1} M_{t-1}$,
- learn its net worth at time $N_t = \max \{0, (\omega_t - \bar{\omega}_t) R_m^m q_{t-1} M_{t-1}\}$,
- and decide how much $M_t$ to buy with its net worth $N_t$ and loans $B_t$.

The timing of the events of banks is as following. At time $t$,

- pay back $R^*_{t-1} B_{t-1}$ to its depositors,
- write the contract (zero-profit condition),
- and lend $B_t$ to importers and collect this much from depositors.

Appendix B. Market clearing conditions

In general, the household’s budget constraint is

$$C_t^m + p_t (C_t^d + X_t) + R_{t-1} B_t^d = p_t (w_t H_t + r_t K_t) + B_t^d + \Xi_t + \Omega_t,$$  \hfill (B.1)

where $B_t^d$ is the household borrowing or lending and $R_t$ denotes domestic interest rate. Note that the aggregate borrowings and lendings among households are zero, so we neglect the household borrowing and lending in (18). From (B.1), we can get

$$C_t^m + p_t (C_t^d + X_t) = p_t Y_t^d + \Xi_t + \Omega_t$$

$$= p_t Y_t^d + Y_t^m - R_t^m q_{t-1} M_{t-1} - (1 - \gamma) [1 - \Gamma(\bar{\omega}_t)] R_t^m q_{t-1} M_{t-1} - W^e,$$ \hfill (B.2)

by plugging in (6) and (15). With relations (9) and (14), we derive from (B.2)

$$C_t^m + p_t (C_t^d + X_t)$$

$$= p_t Y_t^d + Y_t^m - N_t - \Gamma(\bar{\omega}_t) R_t^m q_{t-1} M_{t-1}$$

$$= p_t Y_t^d + Y_t^m - N_t - R_{t-1}^* B_{t-1} - \mu G(\bar{\omega}_t) R_t^m q_{t-1} M_{t-1}$$

$$= p_t Y_t^d + Y_t^m - EX_t - dt,$$ \hfill (B.3)
where \( EX_t = N_t + R^*_t B_{t-1} \) is the total amount of exports and \( d_t = \mu G(\bar{\omega}_t)R^m_t q_{t-1} M_{t-1} \) is the monitoring cost. Assuming domestic goods is non-tradable, we obtain the market clearing conditions

\[
C^d_t + X_t = Y^d_t, \tag{B.4}
\]
\[
C^m_t + EX_t + d_t = Y^m_t. \tag{B.5}
\]

From the exports \( EX_t \), we can easily obtain the net exports \( NX_t \)

\[
NX_t = EX_t - q_t M_t \text{ imports} = N_t + R^*_t B_{t-1} - (N_t + B_t) = R^*_t B_{t-1} - B_t. \tag{B.6}
\]

Note that each period this economy borrows \( B_t \) and pays back \( R^*_t B_{t-1}. \) So the current account of this economy is \( R^*_t B_{t-1} - B_t \), which is identical to the net exports.

### Appendix C. Data

#### Table C.7
Timing of financial liberalization.
Data source: Bekaert et al. (2005)

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1993</td>
<td>Brazil</td>
<td>1991</td>
</tr>
<tr>
<td>Chile</td>
<td>1992</td>
<td>Colombia</td>
<td>1991</td>
</tr>
<tr>
<td>Korea</td>
<td>1992</td>
<td>Malaysia</td>
<td>1988</td>
</tr>
<tr>
<td>Mexico</td>
<td>1989</td>
<td>Peru</td>
<td>1991</td>
</tr>
<tr>
<td>Philippines</td>
<td>1991</td>
<td>South Africa</td>
<td>1984</td>
</tr>
<tr>
<td>Thailand</td>
<td>1987</td>
<td>Turkey</td>
<td>1989</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1986</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The estimation of the DSGE model is performed on a set of key emerging market economies. They include Argentina, Brazil, Chile, Colombia, Ecuador, Korea, Malaysia, Mexico, Peru, Philippines, South Africa, Thailand, and Turkey. These countries are relatively more financially opened according to Kose et al. (2003). Table C.7 lists the timing of their financial liberalization. Most of them became fully integrated in the late 1980s and early 1990s. The most recent one is Argentina in 1993. The dataset contains five time series of output, private consumption, trade balance, real investment, and real interest rate. The data sources are the International Monetary Fund’s In-
ternational Financial Statistics and Emerging Market Bond Index (EMBI), whose original source is Bloomberg. The countries’ real interest rates are constructed as a product of country specific EMBI spreads and the 3-Month real US T-Bill rate. Because EMBI data is reported at a higher frequency, the quarterly frequency is constructed as a simple average.

Appendix D. Estimation of the extended model

Table D.8 reports the estimated parameter values of the extended model introduced in Section 6. The estimated $\phi$ is 0.099, which is close to the value obtained in the original model. The estimated $\tilde{\phi}$ is large at -10.854. However, its standard error implies that $\tilde{\phi}$ does not have significant impact on the model moments.

Table D.9 shows the generated model moments of the estimated extended model. It targets well the second moments of output, as well as the relative volatility between investment and output. All other moments remain consistent with those obtained in the estimation of original model in terms of signs and magnitudes.

Table D.8

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$\phi$</th>
<th>$\tilde{\phi}$</th>
<th>$\xi$</th>
<th>$\rho_m$</th>
<th>$\rho_q$</th>
<th>$\sigma_v$</th>
<th>$\sigma_\xi$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated value</td>
<td>0.099</td>
<td>-10.854</td>
<td>17.293</td>
<td>0.993</td>
<td>0.986</td>
<td>0.019</td>
<td>0.123</td>
</tr>
<tr>
<td></td>
<td>(0.0185)</td>
<td>(12.623)</td>
<td>(14.424)</td>
<td>(0.024)</td>
<td>(0.023)</td>
<td>(0.002)</td>
<td>(0.009)</td>
</tr>
</tbody>
</table>

Note: Standard errors of estimated parameter values are reported in the brackets.

Table D.9

<table>
<thead>
<tr>
<th>Targeted Moments</th>
<th>Non-targeted Moments</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma(Y)$</td>
<td>3.78 (0.265)</td>
</tr>
<tr>
<td>$\sigma(C)/\sigma(Y)$</td>
<td>1.68 (0.067)</td>
</tr>
<tr>
<td>$\rho(R^*, C)$</td>
<td>-0.67 (0.094)</td>
</tr>
<tr>
<td>$\rho(R^*, X)$</td>
<td>-0.35 (0.244)</td>
</tr>
<tr>
<td>$\rho(R^*, TB)$</td>
<td>-0.30 (0.038)</td>
</tr>
<tr>
<td>$\rho(TB, C)$</td>
<td>-0.28 (0.112)</td>
</tr>
<tr>
<td>$\rho(TB, X)$</td>
<td>-0.72 (0.137)</td>
</tr>
<tr>
<td>$\rho(TB, Y)$</td>
<td>-0.30 (0.059)</td>
</tr>
<tr>
<td>$\sigma(TB)$</td>
<td>-0.35 (0.077)</td>
</tr>
<tr>
<td>$\sigma(R^*)$</td>
<td>1.79 (0.227)</td>
</tr>
<tr>
<td>$\rho(R^*, Y)$</td>
<td>0.27 (0.044)</td>
</tr>
</tbody>
</table>

Note: $\sigma(\cdot)$ denotes the standard deviation of the variable and $\rho(\cdot, \cdot)$ denotes the correlation of two variables. Standard errors of the moments are reported in the brackets. See Appendix C for data sources.

References


