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The Impact of Imperfect Financial Integration and Trade on Macroeconomic Volatility and Welfare in Emerging Markets

by

Lathaporn Ratanavararak

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The Impact of Imperfect Financial Integration and Trade on Macroeconomic Volatility and Welfare in Emerging Markets

Lathaporn Ratanavararak[1]

Abstract

This study examines how international integration impacts macroeconomic volatility and welfare in emerging market economies (EMEs), employing a two-country real business cycle model with constrained cross-border borrowing and imperfect access to international financial market. Parameter calibration employs 2000-2013 trade and external debt data from EMEs. The simulation shows that higher foreign debt raises output volatility, slightly reduces consumption volatility of entrepreneurs who can borrow abroad, and brings about welfare loss due to higher debt interest payments and less consumption. Households who can only save in domestic markets are largely unaffected. Restricted financial integration does not have much adverse impact when people face no other frictions domestically, suggesting the importance of domestic financial development. Higher international trade tends to be favorable for output variability, consumption smoothing, and welfare, but does not play a significant role on how cross-border borrowing affects macroeconomic volatility. The results suggest that the impacts of financial and trade integration are generally independent. It might be difficult for EMEs to achieve evident gains from greater financial integration even with high trade intensity when market imperfection exists. Increasing only trade or both types of integration together can be Pareto improving that lowers aggregate fluctuation, whereas increasing only private external debt is not.

Keywords: financial integration; trade integration; emerging market economies; macroeconomic volatility; consumption smoothing; business cycles.

JEL classification: E32, F15, F30, F41.

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1. Introduction

In globalization era, raising funds in international financial markets has become more important for emerging market economies (EMEs). Firms in emerging markets can now sell debts in local currency to foreign investors and raise a larger proportion of funds in foreign markets such as corporate bonds (International Monetary Fund, 2014b; World Bank, 2015). International markets, especially in countries with developed financial centers, could offer alternative funding that is not available in domestic financial market, but they could also make the countries more exposed to foreign currency and exchange rate risks.

Although financial integration in EMEs has progressed in recent decades, it still lags far behind industrial economies (Aizenman, Jinjarak, & Park, 2013; Borensztein & Loungani, 2011). The degree of financial openness also does not match higher level of trade intensity, especially for East Asian countries (Pongsaparn & Unteroberdoerster, 2011). There are initiatives to integrate deeper into global and regional financial markets as well as policy debates whether financial integration benefits emerging markets or not given its trade-off between benefits and costs. Financial integration should provide diversification, improve risk sharing, smooth consumption, alleviate capital scarcity, and promote efficient allocation of capital, but these come with the risk of greater fluctuation, vulnerability to sudden capital reversal, and financial crisis contagion as witnessed through a number of crises. Moreover, EMEs have less developed financial markets, lower institutional quality and possibly more market imperfection, which might hinder them from achieving presumed gains from financial integration like the developed countries.

A number of studies have investigated the effects of financial integration on macroeconomic volatility, business cycle synchronization, and welfare. This strand of literatures usually includes trade integration in the analysis since the two types of integration are closely related (Aizenman & Noy, 2009; Aviat & Coeurdacier, 2007) and trade is viewed as able to mitigate the crisis associated with financial integration (Arteta, Eichengreen, & Wyplosz, 2001; Kose, Prasad, Rogoff, & Wei, 2006). Overall findings show that both financial and trade integration influence international business cycles and welfare, but whether the relationship is positive or negative is inconclusive particularly for financial integration whose consumption smoothing benefits and welfare gains are disputed when market frictions exist.

The literature usually examines the separate effect of financial and trade integration on business cycles and only few investigate the combined effect of the two especially under dynamic stochastic general equilibrium (DSGE) framework. One intriguing finding is from Senay (1998) who argues that consequences of financial and trade integration are generally independent of each other. However, these researches typically focus on general or developed countries rather than emerging and developing economies, whereas studies on emerging markets mainly focus at financial integration without exploring the role of trade.

Motivated by the above, the objective of this paper is to investigate the impact of financial and trade integration together on macroeconomic volatility and welfare in EMEs focusing at constrained cross-border borrowing and imperfect access to international financial markets. The research questions are whether access to foreign funds could help lower output volatility, smooth consumption, and enhance welfare when asymmetric market imperfections exist; whether the effect of financial integration depends on the level of trade intensity; how different types of market participants with unequal financial access are affected; and how domestic financial market plays a role when financial integration is imperfect.

The study has developed a two-country real business cycle (RBC) model, in which home country represents an emerging economy with market imperfections and foreign country represents a frictionless advanced economy. Not everyone in home country can access international financial markets. Home entrepreneurs can borrow from both domestic and foreign markets. Domestic debt is unconstrained, but borrowing from abroad involves leverage constraints, which is only incurred by the home economy. Household consumers in the emerging country do not have international access and can only save in domestic markets. The model is set up to contrast that emerging markets are less financially developed than industrial countries and have more frictions.

Three aspects of financial integration are explored. Firstly, it studies cross-border borrowing when home emerging economy is a borrower. Secondly, the higher level of financial integration is determined by a reduction of financial constraint, implementing through the leverage constraint coefficient that represents the ability of home entrepreneurs to borrow abroad. This approach enables the examination of intermediate levels of financial integration between autarky and complete. Lastly, the study features asymmetric access to international markets among home residents. These reflect the view that financial integration does not only refer to cross-border financial flows, but also involves equal financial access and reduction of asymmetric frictions.[2]

Trade integration is defined as the amount of cross-border goods trade and determined by the weight parameter that represents preference for foreign goods relative to domestic goods. Parameter calibration employs financial and trade data of emerging markets. Three levels each of financial and trade integration – low, medium, and high – are explored, resulting in nine cases under the main analysis.

The simulation results show that the impact of increasing cross-border borrowing on macroeconomic volatility and welfare does not significantly depend on the degrees of trade, and vice versa, although their separate impacts are mostly in opposite directions. Increasing private foreign debt contributes to more volatile output. It is associated with slightly lower consumption fluctuation and small welfare

[2] This is the view adopted by European Central Bank that financial integration means all participants are under same set of rules, have equal financial access, and face symmetric frictions (European Central Bank, 2015).

cost of home entrepreneurs. Home households who are excluded from cross-border financial transactions are not significantly affected by higher financial integration in terms of both consumption smoothing and welfare. This suggests that financial integration affects people with and without international financial access differently, and borrowers might not be much negatively affected by the international leverage constraint when they have other sources of unconstrained funds. On the other hand, higher trade integration tends to benefit both aggregate fluctuation and welfare. These findings from the main scenarios are robust to alternative parameter values.

The implications are that it might be difficult for EMEs to achieve evident gains from foreign borrowing even with high trade intensity when there are financial constraint and imperfect accessibility. Maintaining medium level of financial integration seems preferable due to their trade-off consequences on aggregate fluctuation. With restricted international access, domestic financial markets could serve as an important provider of funds and risk-sharing opportunity. Improvement of financial accessibility and frictions should be taken into account since they might help EMEs to better achieve gains from financial integration.

This study contributes to the literature by largely combining two strands of literature – researches examining the impact of financial and trade integration on business cycle in developed countries and researches investigating the impact of financial integration in emerging markets with asymmetric financial frictions and access. The model is built upon existing models to incorporate financial integration, international trade, asymmetric financial frictions, imperfect access to international finance, and domestic financial market altogether. Intermediate levels of integration are explored, which could expand earlier studies that usually investigate financial integration in the aspect of different asset market structures[3] and extreme cases of complete-or-none integration. These might help explaining the inconclusive effect of financial integration on business cycles found in the literature. Adopting a quantitative general equilibrium approach provides a framework that could analyze hypothetical scenarios and complement the empirical evidences. The findings hope to widen the understanding of the relationship between two types of international integration and business cycles when market imperfections are present, and provide useful suggestion for policy making.

The rest of the paper proceeds as follows. Section 2 presents the trend of financial and trade integration and stylized facts of business cycles in EMEs compared to advanced economies. Section 3 reviews related literatures. The model is described in Section 4. Section 5 discusses how financial and trade integration are determined and Section 6 lays out parameter calibration. Section 7 presents and discusses results, and Section 8 concludes.

[3] Studying different asset market structures refers to the comparison of international financial autarky, integration in only the bond markets, integration in both bond and equity markets, and complete asset market. This is related to the study of potfolio choices. See Heathcote and Perri (2002), Devereux and Sutherland (2011) and Evans and Hnatkovska (2007) for example.

2. International Integration and Business Cycles in Emerging Economies

2.1 Financial and Trade Integration in EMEs

Financial integration is a multifaceted concept and does not have a universal definition. In a narrow sense, it can represent the size of cross-border financial flows such as foreign direct investment (FDI) and foreign portfolio investment (FPI). In a broader sense, it relates to symmetric frictions and equal financial access (Baele, Ferrando, Hördahl, Krylova, & Monnet, 2004; European Central Bank, 2015).

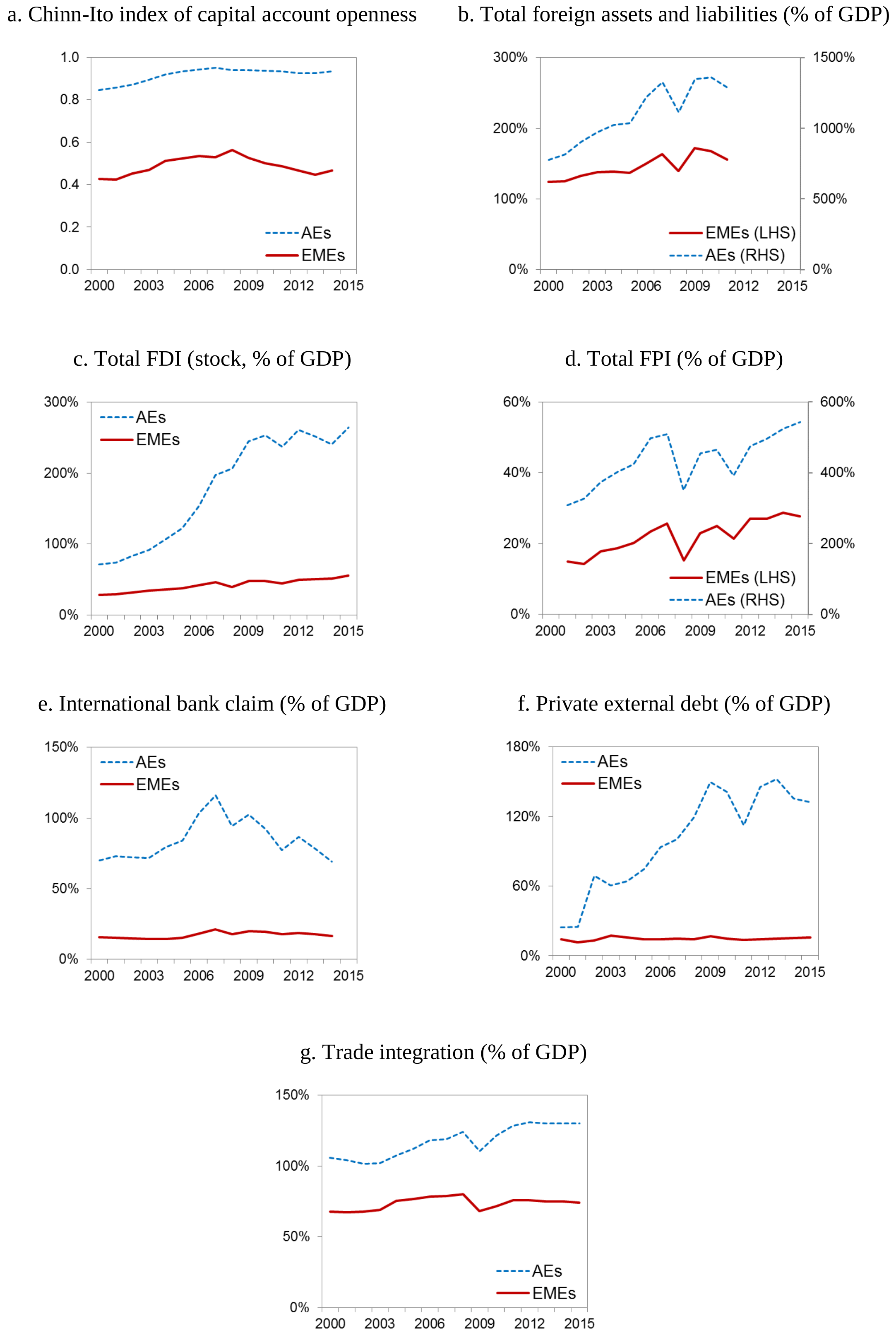
Financial integration can be measured by various indicators as shown in Figure 1 that compares the overall trend of financial and trade integration between emerging market and advanced economies during the period of 2000 to 2015.[4] An example of de jure measure that indicates the liberalization or the removal of controls on capital account transaction is the Chinn-Ito index of capital account openness (panel a.). The index in EMEs is only about half the size of advanced economies. The two series do not show significant change during the period likely due to the nature of de jure indicators that cannot fully assess the magnitude of financial integration once a country is liberalized (Kose et al., 2006; Quinn, Schindler, & Toyoda, 2011).

The other five measures depicting various aspects of financial integration are quantity-based indicators expressed as ratios to GDP. They are all smaller for EMEs as compared to developed countries. Total foreign assets and liabilities (panel b.) is a very broad measure of financial integration that covers all types of foreign amount outstanding including foreign exchange reserves. FDI stock of EMEs only increased slightly during this period (panel c.), while FDI stock of advanced economies significantly increased. The size of FPI in industrial countries (panel d., right axis) is more than ten times larger than that of the EMEs (left axis). The cross-border bank claims of EMEs (panel e.) fluctuate around 20 percent of GDP during this period, while the size of international bank claims in industrial economies has been above 70 percent of GDP since 2001 and peaked at 116 percent. The level of private external debt shows similar pattern with FDI stock (panel h.). The private external debt of advanced economies increased drastically from 2000 to 2015, whereas that of EMEs is much smaller. Most measures show apparent drops during the 2007-2008 and 2011 financial crises.

All indicators suggest that EMEs are less financially integrated than advanced economies. Possible reasons are capital flow restriction and cross-border regulation that are still in place for some economies, information cost associated with investing in foreign markets, and transaction costs due to inefficient trading infrastructure (Auster & Foo, 2015; Park & Shin, 2013; Pongsaparn & Unteroberdoerster, 2011).

[4] See Quinn et al. (2011), Kose et al. (2006), Baele et al. (2004), European Central Bank (2015), and Stavarek, Repkova, and Gajdosova (2011) for a review and discussion on different types of financial integration measures.

Figure 1 Trend of financial and trade integration in emerging market and advanced economies 2000-2015

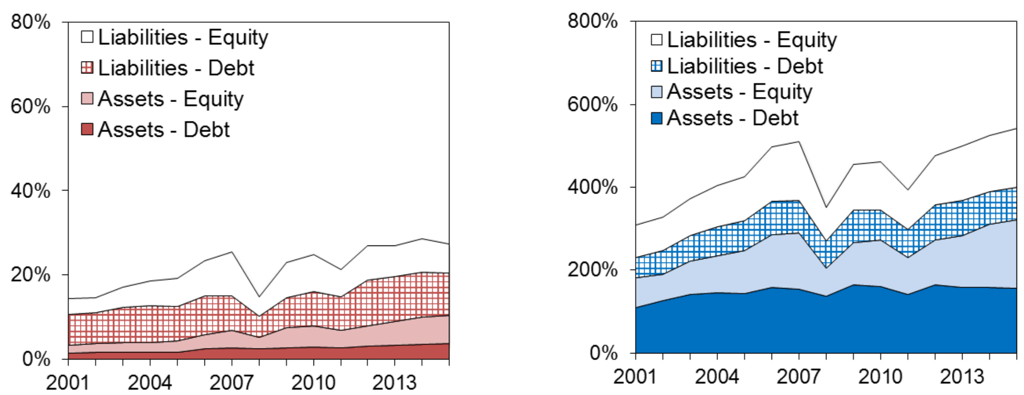


Note: AEs = advanced economies; EMEs = emerging market economies; LHS = left hand side; RHS = right hand side; FDI = foreign direct investment; FPI = foreign portfolio investment. The year coverage depends on the availability of data from the sources. Data description and country grouping are presented in Appendix A.

Unlike financial integration, trade integration has a more standard definition as the sum of exports and imports of goods and services as a share of GDP. The term is largely used interchangeably with trade intensity and trade openness. Figure 1 shows that the EMEs also have lower trade intensity than the developed countries (panel g.), but the gap is considerably smaller than that of financial integration. The degree of trade openness in advanced economies averages around 117 percent of GDP, while that of EMEs increases only slightly from around 68 percent in 2000 to 74 percent in 2015.

Figure 2 FPI composition by asset types 2001-2015 (in percent of GDP)

a. Emerging markets b. Advanced economies



Note: Equity = equity and investment fund shares; Debt = debt securities.

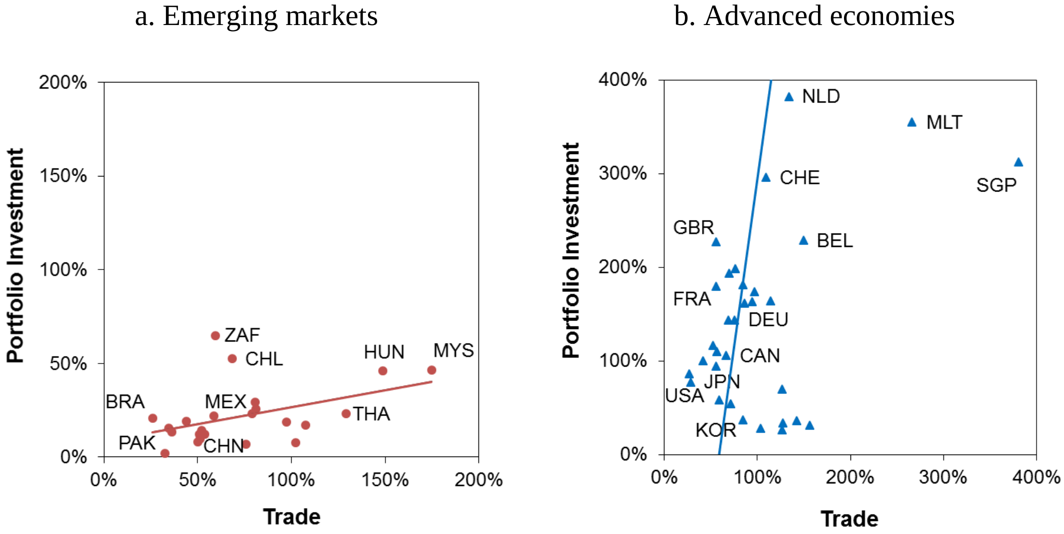
Breaking down the composition of FPI in Figure 2 also contrasts emerging market and advanced economies. The majority of FPI in the emerging markets is the portfolio liabilities with debt securities being the largest (panel a.). Foreign portfolio asset holding in EMEs has been largely increasing from 2001 to 2015, but the assets size is still below the liabilities. In contrast, industrial economies have more portfolio assets than liabilities especially the debt securities (panel b.). This might reflect the observation that EMEs have received a large share of portfolio investment from industrial economies in recent years (International Monetary Fund, 2014a).

Figure 3 plots the size of FPI on the vertical axis against the degree of trade openness on the horizontal axis for two groups of countries. The figures clearly show different integration mixes between them. The emerging markets greatly incline towards higher trade with little presence in international finance (panel a.).[5] The advanced economies incline toward higher cross-border portfolio investment, while also have high trade intensity (panel b.). Among the EMEs themselves, the degree of integration also varies. South Africa (ZAF) has the largest size of FPI, and trade

[5] The unmatched levels of higher international trade but significantly lower financial integration in EMEs have also been pointed out by Committee on the Global Financial System (2014).

intensity ranges from low levels in Brazil (BRA) and Pakistan (PAK), to very high levels in Malaysia (MYS), Hungary (HUN), and Thailand (THA).

Figure 3 FPI and trade integration in emerging markets and advanced economies (2001-2015 average, in percent of GDP)

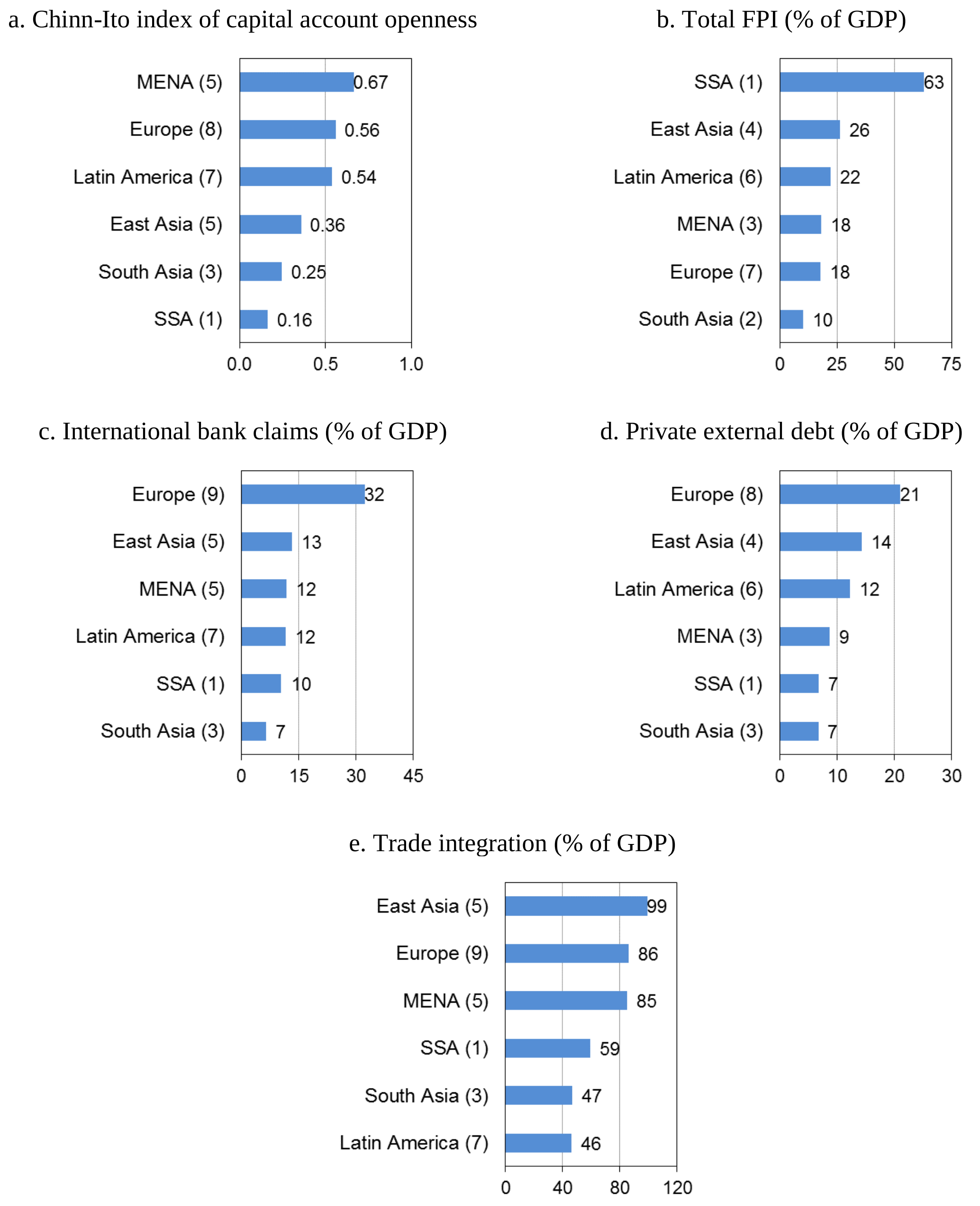


Note: The scatter plots include only the economies with data from the two series. For advanced economies, the figure does not show Hong Kong, Ireland, and Luxembourg because of their sizeable FPI above 400 percent of GDP, but they are included when constructing the trend line.

Different degrees of integration across emerging market regions are further explored in Figure 4. Middle East and North Africa (MENA), emerging Europe, and Latin America regions have more open capital accounts based on de jure measure of liberalization (panel a.). Although MENA countries have the highest score on de jure index, they do not have correspondingly higher degree of financial integration based on the other three quantity-based measures. On the other hand, South Africa has the lowest average score on capital account openness, but has the largest size of cross-border portfolio investment among the EMEs (panel b.). These show that countries that are more liberalized on paper need not have larger amounts of foreign asset positions, and countries with less open capital accounts could have larger cross-border financial flows.[6] Emerging Europe has the highest levels of international banking transaction (panel c.) and private external debt (panel d.), which is possibly due to the financial hubs and economic integration in European Union. Emerging South Asia is the region that has the lowest level of financial integration in all three quantity-based measures.

[6] This view is also pointed out by Kose et al. (2006).

Figure 4 Financial and trade integration of EMEs by region (2001-2014 average)



Source: author's calculation.

Note: MENA = Middle East and North Africa. SSA = Sub-Saharan Africa. The only country in SSA is South Africa. The grouping of region is based on World Bank's WDI 2015. The numbers in parenthesis after the region name denote the number of countries used in calculation. Availability depends on the data sources. The list of countries is presented in Appendix A.

For trade intensity (panel e.), emerging East Asia has the highest degree of trade averaging almost 100 percent of GDP. This is heavily influenced by the four

ASEAN countries.[7] Emerging Europe and MENA also have high level of trade around 85 percent of GDP. The other three regions have relatively lower trade intensity below 60 percent of GDP.

2.2 Stylized Facts of Business Cycles in Emerging Markets

The business cycles in emerging markets have been extensively studied and shown to exhibit distinctive characteristics. Two most widely-documented stylized facts are that the output in EMEs is more volatile than that of advanced economies, and consumption in EMEs fluctuates more than their output, leading to a ratio of consumption to output volatility greater than one, which is larger than that of industrial countries.[8] The discrepancies are due to various factors. The economies could be driven by different kinds of shocks – global, regional, or country-specific (Benhamou, 2016). More volatile output in EMEs might come from emerging markets depending too much on a few and possibly volatile sectors, their weak policies and institutions, and more vulnerability to external shocks (Calderon & Fuentes, 2010). Additionally, unlike advanced economies, emerging markets are more prone to unpredictable changes of economic policies, leading to frequent regime switches (Agénor, McDermott, & Prasad, 2000; Aguiar & Gopinath, 2007). The business cycles of emerging markets do not only differ from developed countries, but there is also noticeable heterogeneity across different emerging market regions and economies (Agénor et al., 2000; Benhamou, 2016).

Other findings on business cycles in EMEs are as follow. Agénor et al. (2000) found that output fluctuations in EMEs and advanced economies are positively correlated, suggesting that activities in industrial countries could influence EMEs. Aguiar and Gopinath (2007) and Benczúr and Rátfai (2014) show that emerging markets largely have more countercyclical and volatile net exports than developed countries. Their real interest rates are also countercyclical and very volatile (Calderon & Fuentes, 2010). The results regarding the persistence are less conclusive. Benczúr and Rátfai (2014) observed that the output of EMEs is marginally less persistent than advanced economies, Agénor et al. (2000) found sizable output persistence in developing countries, and Benhamou (2016) argued that persistence of output and consumption varies by region group.

From the irregularities of emerging market business cycles, the standard RBC framework that usually applies to developed countries may not be able to capture these stylized facts (Agénor et al., 2000). Various modifications are suggested. Aguiar and Gopinath (2007) advocate adding shocks to trend growth in standard RBC and DSGE models. They argue that these shocks could help replicate the fluctuations in

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[7] Only four countries considered as EMEs are Indonesia, Malaysia, Philippines, and Thailand. Singapore is considered as advanced economies according to country classification by International Monetary Fund (2014c).

[8] See Aguiar and Gopinath (2007), Calderon and Fuentes (2010), Benczúr and Rátfai (2014), and Benhamou (2016) for example.

emerging markets. Neumeyer and Perri (2005) and Uribe and Yue (2006) suggest including foreign interest rate shocks and financial frictions instead. Chang and Fernández (2013) investigate a combination of two alternatives and establish that the encompassing model can match the data well. Moreover, they observe that the model with financial frictions also yield good results similarly to the encompassing models. This is broadly owing to the interaction between financial imperfection and traditional productivity shock, suggesting that frictions could influence the transmission of shocks and help explain aggregate fluctuation in EMEs (Calderon & Fuentes, 2010; Chang & Fernández, 2013).

3. Related Literature

Empirical researches on financial integration usually include trade integration since they are closely related. The relationships are mostly found to be that trade encourages higher financial integration (Aizenman, 2008; Rose & Spiegel, 2002), or the two types of integration are complimentary (Aizenman & Noy, 2009; Aviat & Coeurdacier, 2007). Trade could enhance economic growth and mitigate the crisis associated with financial integration (Arteta et al., 2001; Kose et al., 2006). Moreover, it is conjectured that an economy could achieve gain from financial liberalization when domestic financial reform and trade liberalization are put in place first (Ito, 2001; Kose et al., 2006).

The empirical evidences generally show that financial and trade integration influence aggregate fluctuation and cross-country comovement, but whether the relationship is positive or negative is inconclusive especially for the consequences of financial integration in developing countries.[9] Only one robust finding is that international trade enhances business cycle synchronization.

Studies employing quantitative general equilibrium framework have similarly found inconclusive results. There are some evidences of risk sharing and consumption smoothing benefits from financial integration, but the gains are controversial when market frictions exist. The literature usually examines the individual effect of financial integration alone on international business cycle. Not many papers investigate the effect of financial and trade integration together. Pancaro (2010) found that financial liberalization increases consumption volatility and trade integration reduces it, whereas Senay (1998) found that greater financial integration largely lowers the volatility of output and consumption, whereas trade raises the volatility. Kose and Yi (2006), Faia (2007), and Ueda (2012) found that trade openness leads to stronger output comovement. Faia (2007) observed that financial openness dampens

[9] See for example, Calderon, Chong, and Stein (2007), Dées and Zorell (2012), Duval, Cheng, Oh, Saraf, and Seneviratne (2014), Imbs (2006), Bekaert, Harvey, and Lundblad (2006), and Kose, Prasad, and Terrones (2003).

business cycle synchronization, but Ueda (2012) found the opposite. One intriguing finding is from Senay (1998) who argues that the impacts of financial and trade integration are broadly independent of each other, which seems counterintuitive given the established relationship between them.

These quantitative researches usually incorporate financial frictions as they could help explain business cycles and shock transmission (Brunnermeier, Eisenbach, & Sannikov, 2012; Quadrini, 2011). However, they typically focus on general or developed countries with homogeneous agents and neglect the investigation of domestic financial markets. This implies that countries are mostly identical and everyone is implicitly assumed to have equal financial access. This setting may not be applicable to emerging markets, which have lower financial development, higher aggregate fluctuation, more institutional and market imperfection, and not everyone has access to international finance (Calderon & Fuentes, 2010; Levchenko, 2005).

There are DSGE papers that study EMEs with financial frictions and imperfect access to international markets, but they mainly focus at financial integration and neglect to consider the role of trade. For example, Leblebicioğlu (2009) and Levchenko (2005) found that financial integration tends to benefit people with international access more than people without access in terms of consumption smoothing and welfare gain. Araujo (2008) found that financial integration increases consumption volatility when access is restricted, but decreases consumption volatility when all people have access to international finance.

In a related paper to this one, Ratanavararak (in press) investigates the combined effect of financial and trade integration on business cycles in emerging markets, but explores outward foreign portfolio investment with adjustment cost and credit-constrained domestic markets. The impacts of two integrations are found to be intertwined. Increasing foreign asset holding largely has weaker impact on macroeconomic volatility and cross-country comovement when trade intensity is high, and people with restricted financial access face significantly larger consumption volatility from increased financial integration under low trade. The finding suggests that trade could help mitigate the negative effect of financial integration on consumption smoothing, and financial integration could help lower output fluctuation and dependency on foreign economies while trade increases them.

4. The Model Economy

This section describes the methodology. The model economy is a two-country, two-sector international RBC model. The structure of firms and trade closely follows Heathcote and Perri (2002). The financial structure is adapted from Leblebicioğlu (2009) and Pancaro (2010). The world population comprises of a continuum of infinitely lived agents. Two countries – home and foreign – have the same population mass. Home country is assumed to be an emerging economy with frictions and asymmetric financial access. Financial frictions are not only essential components that influence shock transmission and help explain business cycles, but they also serve to reflect lower financial development in the emerging home country than the foreign advanced economy.

Home country has two kinds of heterogeneous consumers. One is the *households* who supply labor to the production sector and saves to smooth consumption. They do not have access to foreign financial markets and are restricted to domestic saving. The other one is the *entrepreneurs* who own the traded intermediate goods firms. They invest in physical capital and need external fund to finance their investment. They can borrow from households in both countries, but face the leverage constraint only when borrowing from abroad. This is to contrast that there is possibly more information asymmetry and more difficulty to receive loans in foreign credit market than the local one.

Having heterogeneous households has two important implications. Firstly, when they act as opposite kinds of market participants, it enables the investigation of domestic financial market with both domestic savers and borrowers. This is not possible if there is only one type of homogeneous consumers. Secondly, it enables the analysis when not everyone have access to international finance and domestic residents face different frictions.[10]

Home country has two types of firms. The *intermediate goods firms* produce intermediate goods and supply to domestic and foreign productions of final goods. The last agent is the *final goods firm* that combines intermediate inputs from both domestic and abroad into final goods for domestic consumption and investment.

Foreign country is assumed to be a developed country with frictionless markets. Its setting resembles the home country but with only one type of homogeneous consumers who face no financial friction and have full access to international financial markets. Since foreign markets are assumed to be perfect and all consumers have equal financial access, it is sufficient to have only one type of populations. Foreign intermediate and final goods firms are similar to the home counterparts. All merchandise goods are differentiated and can be traded freely across countries without any trade friction.[11]

Financial transactions are assumed to be facilitated by financial intermediaries that are not present in the model.[12] The financial assets traded are modeled by a risk-

[10] Incorporating heterogeneity within the economy expands earlier papers such as Senay (1998), Kose and Yi (2006), Heathcote and Perri (2002), and Pancaro (2010), which study homogeneous agents and neglect the examination of asymmetric financial access and domestic financial markets.

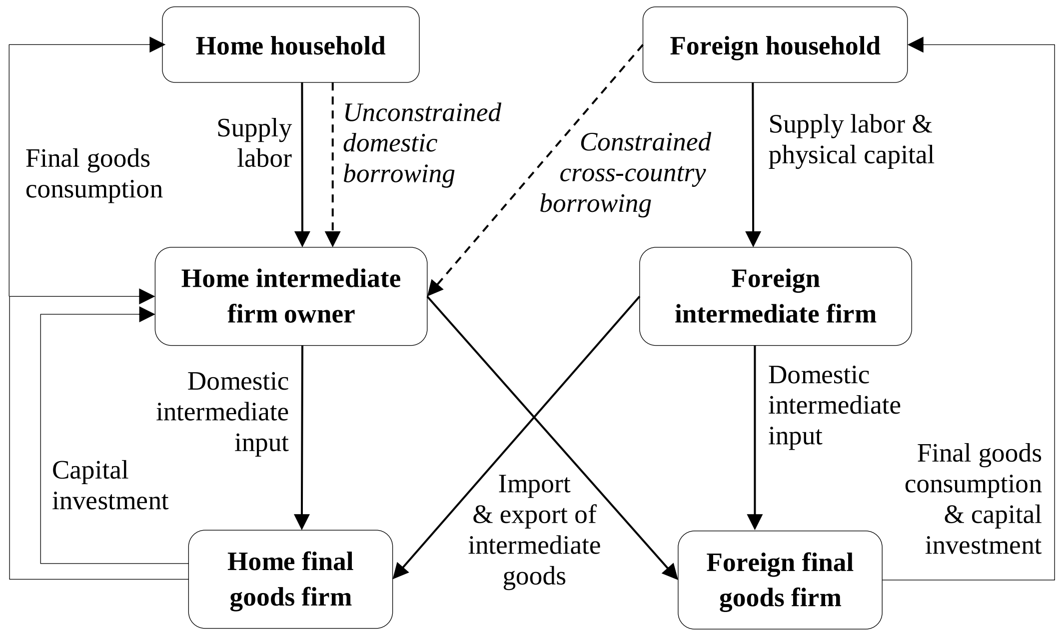
[11] Trade frictions such as transportation cost are omitted to focus more on financial frictions and to avoid unnecessarily complicating the model. Including different frictions may make the model difficult to operate and the interaction among frictions might lead to difficulties in interpreting the results.

[12] The aim of including the banking sector is typically to explain the role and behavior of financial institutions or to investigate certain aspects of financial crises (Brázdik, Hlaváček, & Marsal, 2012). Since those are not the research purpose of this study, the explicit financial intermediaries are omitted.

free non-contingent bond as a proxy for deposits, loans, and corporate bonds. The study focuses on agent's overall accessibility to international asset markets rather than distinguishing the access among different classes of financial assets such as bonds and equities or investigating portfolio choice. Debts, mainly from banks, are considered as a major source of external financing for firms and are less difficult to raise than external equity (World Bank, 2015). Thus, the bond economy seems adequate. Furthermore, this could be viewed as imperfect financial integration in the sense that certain financial assets cannot be traded, which likely suits emerging markets more than perfect financial integration.

Figure 5 illustrates the model structure. The dash lines in the figures represent financial flows. The arrows show the direction of the flows. The following sub-sections describe each agent in details. Subscript *1* and *2* denote the variables related to home country and foreign country respectively. Superscript h denotes home households and superscript o denotes home entrepreneurs.

Figure 5 The model structure



4.1 Home Country

Home Households

Home households supply labor to intermediate goods sector and can hold only domestic financial assets. They maximize an expected lifetime utility defined over consumption C_{1t}^h and labor L_{1t}.

$$U_{1t}^{h} = E_t \sum_{t=0}^{\infty} \beta_1^t \left[\ln\left(C_{1t}^{h}\right) - \kappa L_{1t}\right] \tag{1}$$

where β_1 is the discount factor of home households, and κ is the labor weight parameter in the utility. The functional form is taken from Leblebicioğlu (2009).

Households receive wage w_{1t} from working and can save or lend in domestic financial market in the form of non-contingent bonds with the amount Z_t and the price of Q_t^Z.[13] The bonds are in the unit of intermediate goods produced by home country; hence, the amount is multiplied by q_{1t}^a, the price of home intermediate goods.[14] These result in the following budget constraint.

$$P_{1t}C_{1t}^{h} + q_{1t}^{a}Q_t^{Z}Z_t \leq w_{1t}L_{1t} + q_{1t}^{a}Z_{t-1} - q_{1t}^{a}\frac{\psi}{2}(Z_t - \bar{Z})^2 \tag{2}$$

where P_{1t} is the price of the home final goods, and $\frac{\psi}{2}(Z_t - \bar{Z})^2$ is a small cost of portfolio adjustment included to make the law of motion for domestic bond stationary (Schmitt-Grohé & Uribe, 2003).[15] $\bar{Z}$ denotes the corresponding steady state values of Z_t. This small cost does not affect the non-stochastic steady state.

The home households choose the optimal levels of consumption, labor, and domestic saving to maximize the utility subject to the budget constraint. First order conditions with respect to L_{1t} and Z_t are

$$w_{1t} = \kappa P_{1t}C_{1t}^{h} \tag{3}$$

$$\frac{q_{1t}^{a}}{P_{1t}C_{1t}^{h}}\left[Q_t^{z} + \psi(Z_t - \bar{Z})\right] = \beta_1 E_t\left[\frac{q_{1,t+1}^{a}}{P_{1,t+1}C_{1,t+1}^{h}}\right] \tag{4}$$

Equation (3) describes the optimal decision of labor supply, equating real wage and marginal disutility of labor. Equation (4) is the Euler equation describing the intertemporal consumption choice. The term $\psi(Z_t - \bar{Z})$ is negligible and absent in the non-stochastic steady state.

[13] Modeling financial assets using the price of the bond Q_t^Z instead of the interest rate provides numerical convenience to deal with time convention in Dynare software.

[14] This assumption is based on Heathcote and Perri (2002).

[15] When only international risk-free bonds are traded, the steady state does not depend only on model parameters, but also on the initial position of the country's net foreign asset (Schmitt-Grohé & Uribe, 2003). The transitory shock to the economy can have long-run effects, meaning that equilibrium dynamics contain a unit root component. It in turn makes unconditional variance of some variables infinite. Adding convex costs of adjusting bond holding helps solve this problem of non-stationarity, as adopted by Iacovielloa and Minetti (2006) and Pancaro (2010), for example. Other stationarity-inducing approaches are using endogenous discount factor that depends on consumption and employing interest rate which is dependent on net foreign debt of the country.

Home Entrepreneurs and Intermediate Goods Firms

Home entrepreneurs own the traded intermediate goods firms. Their preference is

$$U_{1t}^{o} = E_t \sum_{t=0}^{\infty} \beta_1^t [\ln(C_{1t}^{o})] \tag{5}$$

where C_{1t}^{o} is the consumption of the entrepreneurs. They invest in the physical capital K_{1t} according to

$$X_{1t} = K_{1t} - (1-\delta)K_{1,t-1} \tag{6}$$

where X_{1t} is the capital investment and δ is the depreciation rate.

The home entrepreneurs are assumed to need financial support to invest in capital and pay wages w_{1t} to worker. They can borrow Z_t from domestic markets without any constraint and they can borrow from international credit markets through non-contingent risk-free bond, B_t, but with the following borrowing constraint[16]

$$q_{1t}^{a} B_t \leq m E_t\left[P_{1,t+1} K_{1t}\right] \tag{7}$$

The constraint limits the entrepreneurs' borrowing not to exceed a certain proportion m of the value of the assets that the entrepreneurs possess or the collateral pledged. In this model, the asset is the physical capital owned by the entrepreneurs. The leverage constraint can be interpreted in two ways. First, it represents the level of foreign debt the entrepreneurs can or are willing to borrow as a proportion of the asset value. Second, the constraint describes the problem of asymmetric information and debt contract enforceability (Iacoviello & Minetti, 2006; Leblebicioğlu, 2009). The lender requires collateral from the borrower and only gives out loans that do not exceed the value of collateral pledged minus liquidation and overhead costs. The costs associated with liquidation process in the event of borrowers' default are reflected by a fraction $1-m$ of the collateral value. Thus, the parameter m can be viewed as representing both the severity of the contract enforceability problem and the loan-to-value (LTV) ratio. A higher value of m is then associated with more relaxing credit constraint, less severe contract enforcement problem, and larger size of foreign debt. This issue is further discussed in Section 5.1.

In each period, the entrepreneurs borrow from domestic and foreign households and pay back the debt from the previous period. Trading both domestic and international bonds is subject to small costs of portfolio adjustment $q_{1t}^{a}\frac{\psi}{2}(Z_t -$

[16] The leverage constraint originally comes from Kiyotaki and Moore (1997). Modifications are as follows. The form closely follows Leblebicioğlu (2009) and Pancaro (2010). Using physical capital as a collateral is the same as Leblebicioğlu (2009). The price of home intermediate goods q_{1t}^{a} is included to convert the bond which is in the unit of intermediate goods. The scale parameter m is added according to Devereux and Sutherland (2011), Leblebicioğlu (2009), and Pancaro (2010).

$\bar{Z})^2 + q_{1t}^a \frac{\psi}{2}(B_t - \bar{B})^2$, included to make the bonds' law of motion stationary. The entrepreneurs freely choose the optimal level of domestic borrowing, but the optimal level of cross-country borrowing is subject to the leverage constraint.

Home entrepreneurs also receive earnings from the intermediate goods firms which produce intermediate goods a_t using labor L_{1t} from households and physical capital K_{1t} belonging to the entrepreneurs themselves. The firms sell their products to both domestic and foreign final goods producing firms. The firm's technology is

$$Y_{1t} = A_{1t} K_{1,t-1}^{\alpha_1} L_{1t}^{1-\alpha_1} \tag{8}$$

where Y_{1t} is the intermediate goods output and A_{1t} is the autoregressive technology shock for the home traded sector. The physical capital $K_{1,t-1}$ is set to be the stock at the end of period for time convention convenience in the numerical analysis process.

From all the characteristics outlined, the entrepreneur's budget constraint is

$$\begin{aligned} P_{1t}C_{1t}^o + P_{1t}X_{1t} + q_{1t}^a B_{t-1} + q_{1t}^a Z_{t-1} + w_{1t}L_{1t} \\ \le q_{1t}^a Q_t^B B_t + q_{1t}^a Q_t^Z Z_t + q_{1t}^a Y_{1t} - q_{1t}^a \frac{\psi}{2}(Z_t - \bar{Z})^2 \\ - q_{1t}^a \frac{\psi}{2}(B_t - \bar{B})^2 \end{aligned} \tag{9}$$

The optimization problem of the entrepreneurs is to choose the levels of consumption, labor, capital, domestic borrowing, and cross-border borrowing to maximize the utility in equation (5) subject to the budget constraint, leverage constraint, capital accumulation equation, and production technology (equation (6) to (9)). The intermediate goods firms are modeled as a part of entrepreneurs, so there is only one optimization. This setting is borrowed from Leblebicioğlu (2009).

First order conditions with respect to L_{1t}, K_{1t}, Z_t and B_t are;

$$w_{1t}L_{1t} = (1-\alpha_1) q_{1t}^a Y_{1t} \tag{10}$$

$$\frac{1}{C_{1t}^o} = \beta_1 E_t \frac{1}{C_{1,t+1}^o}\left[\frac{\alpha_1 q_{1,t+1}^a Y_{1,t+1}}{P_{1,t+1}K_{1t}} + (1-\delta)\right] + m\lambda_t E_t\left[P_{1,t+1}\right] \tag{11}$$

$$\frac{q_{1t}^a}{P_{1t}C_{1t}^o}\left[Q_t^z - \psi(Z_t - \bar{Z})\right] = \beta_1 E_t\left[\frac{q_{1,t+1}^a}{P_{1,t+1}C_{1,t+1}^o}\right] \tag{12}$$

$$\frac{q_{1t}^a}{P_{1t}C_{1t}^o}\left[Q_t^B - \psi(B_t - \bar{B})\right] = \beta_1 E_t\left[\frac{q_{1,t+1}^a}{P_{1,t+1}C_{1,t+1}^o}\right] + \lambda_t q_{1t}^a \tag{13}$$

where λ_t is the Lagrange multiplier on the leverage constraint.

Equation (10) shows the optimal choice of labor demand, equating the marginal cost and the marginal benefit. Equation (11) describes the optimal choice of capital allocation. It equates the marginal utility of consumption to the marginal benefit of investing in capital across time. An additional term $m\lambda_t E_t\left[P_{1,t+1}\right]$ is due to the leverage constraint. This shows the benefit of having extra capital collateral for additional borrowing. Equation (12) and equation (13) are consumption Euler equations. Equation (12) is standard. Equation (13) has an additional term that describes the marginal value of borrowing $\lambda_t q_{1t}^a$. The presence of borrowing constraint impacts the intertemporal choices of both consumption and capital (Iacoviello & Minetti, 2006).

Home Final Goods Firms

Home final goods producing firms combine domestic and foreign intermediate goods, a_{1t} and b_{1t} respectively, using the following Armington (1969) aggregator.[17]

$$G_{1t} = \left[(1-\omega_1)a_{1t}^{\frac{\sigma-1}{\sigma}} + \omega_1 b_{1t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{14}$$

where G_{1t} is home final goods; σ denotes the elasticity of substitution between domestic and foreign goods, $1-\omega_1$ is the weight of domestic intermediate goods used and represents the home bias, and ω_1 is the weight of foreign intermediate goods used and a measure of trade integration in this model. Higher ω_1 leads to higher imports, exports, and cross-border trade. The relationship between ω_1 and trade will be addressed in Section 5.2.

The firms choose the optimal levels of intermediate inputs to maximize the profits as

$$\pi_{1t}^f = P_{1t}G_{1t} - q_{1t}^a a_{1t} - q_{1t}^b b_{1t} \tag{15}$$

where q_{1t}^a and q_{1t}^b are the corresponding prices of intermediate goods in the home country. The prices are in the form of relative prices to the price of final goods P_{1t}. First order conditions with respect to a_{1t} and b_{1t} are

$$(q_{1t}^a)^\sigma a_{1t} = (1-\omega_1)^\sigma P_{1t}^\sigma G_{1t} \tag{16}$$

$$\left(q_{1t}^b\right)^\sigma b_{1t} = \omega_1^\sigma P_{1t}^\sigma G_{1t} \tag{17}$$

[17] The Armington aggregator is commonly used in financial and trade integration literature. Its separate structure of tradable intermediate goods and non-tradable final goods firms provides a clear framework to work with. The form and the notation are taken from Heathcote and Perri (2002).

4.2 Foreign Country

Foreign Households

Foreign households supply labor L_{2t} and rent physical capital K_{2t} to the intermediate goods sector, receiving wage w_{2t} and rent r_{2t} . They can hold international assets B_t with the price Q_t^B. Their preference is

$$U_{2t} = E_t \sum_{t=0}^{\infty} \beta_2^t [\ln(C_{2t}) - \kappa L_{2t}] \tag{18}$$

where C_{2t} is the foreign households' consumption, and β_2 is the discount factor of the foreign households, which is assumed to be larger than home entrepreneur's discount factor β_1 to ensure that the international leverage constraint binds in the equilibrium and home entrepreneurs are net borrowers. Foreign households' budget constraint is

$$\begin{aligned} &P_{2t}C_{2t} + P_{2t}X_{2t} + q_{2t}^a Q_t^B B_t \\ &\qquad \le w_{2t}L_{2t} + r_{2t}K_{2,t-1} + q_{2t}^a B_{t-1} - q_{2t}^a \frac{\psi}{2}(B_t - \bar{B})^2 \end{aligned} \tag{19}$$

They invest in capital according to

$$X_{2t} = K_{2t} - (1-\delta)K_{2,t-1} \tag{20}$$

Unless specified, variables and parameters are defined analogously to the home counterparts.

Foreign households maximize utility in equation (18) subject to budget constraint equation (19) and capital accumulation equation (20), choosing the optimal levels of labor, capital, and cross-country investment. First order conditions with respect to L_{2t}, K_{2t} and B_t are

$$w_{2t} = \kappa P_{2t} C_{2t} \tag{21}$$

$$\frac{1}{C_{2t}} = \beta_2 E_t \frac{1}{C_{2,t+1}} \left[\frac{r_{2,t+1}}{P_{2,t+1}} + (1-\delta) \right] \tag{22}$$

$$\frac{q_{2t}^a}{P_{2t}C_{2t}} [Q_t^B + \psi(B_t - \bar{B})] = \beta_2 E_t \left[\frac{q_{2,t+1}^a}{P_{2,t+1}C_{2,t+1}} \right] \tag{23}$$

Foreign Intermediate Goods Firms

Foreign traded intermediate goods firms produce intermediate goods b_t using labor and physical capital from households. They sell their products to domestic and foreign final goods producing firms. Their technology is

$$Y_{2t} = A_{2t} K_{2,t-1}^{\alpha_2} L_{2t}^{1-\alpha_2} \tag{24}$$

They maximize profit according to

$$\pi_{2t}^{i} = q_{2t}^{b} Y_{2t} - w_{2t} L_{2t} - r_{2t} K_{2,t-1} \tag{25}$$

Variables and parameters are defined analogously to the home counterparts.

First order conditions with respect to L_{2t} and $K_{2,t-1}$ that describe the optimal demands for factors of production are

$$w_{2t} L_{2t} = (1 - \alpha_2) q_{2t}^{b} Y_{2t} \tag{26}$$

$$r_{2t} K_{2,t-1} = \alpha_2 q_{2t}^{b} Y_{2t} \tag{27}$$

<u>*Foreign Final Goods Firms*</u>

Similar to the home country, foreign final goods producing firms combine home and foreign intermediate goods, a_{2t} and b_{2t} respectively, using Armington aggregator;

$$G_{2t} = \left[\omega_2 a_{2t}^{\frac{\sigma-1}{\sigma}} + (1 - \omega_2) b_{2t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{28}$$

The parameters are defined in the same way as aforementioned in the home country section. They maximize their profit according to

$$\pi_{2t}^{f} = P_{2t} G_{2t} - q_{2t}^{a} a_{2t} - q_{2t}^{b} b_{2t} \tag{29}$$

First order conditions with respect to a_{2t} and b_{2t} are

$$(q_{2t}^{a})^{\sigma} a_{2t} = \omega_2^{\sigma} P_{2t}^{\sigma} G_{2t} \tag{30}$$

$$\left(q_{2t}^{b}\right)^{\sigma} b_{2t} = (1 - \omega_2)^{\sigma} P_{2t}^{\sigma} G_{2t} \tag{31}$$

4.3 Market Clearing Conditions

Home intermediate goods market:

$$Y_{1t} = a_{1t} + a_{2t} \tag{32}$$

Foreign intermediate goods market:

$$Y_{2t} = b_{1t} + b_{2t} \tag{33}$$

Home final goods market:

$$G_{1t} = C_{1t}^{h} + C_{1t}^{o} + X_{1t} \tag{34}$$

Foreign final goods market:

$$G_{2t} = C_{2t} + X_{2t} \tag{35}$$

Moreover, the law of one price applies and implies that

$$e_t = \frac{q_{1t}^a}{q_{2t}^a} = \frac{q_{1t}^b}{q_{2t}^b} \tag{36}$$

where e_t is the exchange rate and for each goods;

$$q_{1t}^a = e_t q_{2t}^a \tag{37}$$

$$q_{1t}^b = e_t q_{2t}^b \tag{38}$$

4.4 Equilibrium, Solution Method, and Quantitative Assessment

Equilibrium is a set of all prices and quantities that satisfies the optimization problems of all agents, their respective first order conditions, and all market clearing conditions. As the model does not have a closed-form analytical solution, the solutions are obtained by the second-order perturbation method, which applies a second-order Taylor approximation around the non-stochastic steady state.[18] A system of linear stochastic difference equations is then solved using the calibrated parameters that will be discussed in Section 6.

The model solutions and simulations are computed using Dynare software and MATLAB.[19] The models are simulated under varying degrees of financial and trade integrations described in Section 6.3. Second moments are calculated as the averages of 500 simulations, each 400 period long. The resulting simulated moments, welfare criteria, and impulse response function (IRF) from different scenarios will be compared to examine the effect of financial and trade integration on emerging economy.

5. Modeling Financial and Trade Integration

This section discusses how the varying levels of financial and trade integration are modeled by the international leverage constraint and the Armington aggregator respectively. Other related issues are also included.

[18] As linear approximation can lead to large inaccuracy that can spuriously cause welfare reversal when comparing different financial arrangements (Kim & Kim, 2003), a second-order approximation is employed instead as proposed by Schmitt-Grohé and Uribe (2004).

[19] The methodology and approaches within Dynare are based on Collard and Juillard (2001) and Schmitt-Grohé and Uribe (2004). The steps of model solving and simulating in Dynare are provided in Adjemian et al. (2011).

5.1 International Leverage Constraint and Financial Integration

In this paper, the level of financial integration is determined by the parameter m in international leverage constraint. The parameter can be interpreted in two ways. First, it represents the inverse severity of the contract enforceability problem. A higher value of m is associated with less severe problem and a reduction of borrowing constraint in international financial markets. This mean more ease of cross-border borrowing and lending, which could stimulate the lenders to lend more and the borrowers to borrow more, and hence higher financial integration. Second, m can be interpreted as the maximum or desirable amount of cross-border loan the firms can or are willing to borrow as a proportion of the asset value or pledged collateral value. In this regards, m can be viewed as the LTV ratio. A higher value of m reflects an increased ability or appetite of the firm to raise larger foreign fund, and leads to higher foreign debt, which is one component of financial integration. For both interpretations, m is a structural parameter that captures the financial market imperfection and financing choice of the firms. Hence, larger m is associated with higher degree of financial integration. The use of leverage constraint parameter m as a measure of financial integration level is similarly used by Pancaro (2010), Pisani (2011) and Faia (2011).

The advantage of modeling financial integration as a reduction of friction is that the intermediate levels of integration can be investigated. Certain degrees of financial integration seems to suit the current situation that most EMEs are generally no longer closed economies, but still have not yet reached perfect integration. This extends previous researches that usually compare financial autarky versus complete integration like studies by Senay (1998), Heathcote and Perri (2002), Kose and Yi (2006), and Leblebicioğlu (2009).

It can be shown mathematically that the degree of financial integration increases with the parameter m in the model. Based on the leverage constraint in equation (7), the non-stochastic steady state relationship between parameter m and the ratio of aggregate financial integration to GDP in home country defined as $FI_1 = \overline{q_1^a}\bar{B} \big/ \overline{q_1^a}\overline{Y_1}$ can be rearranged as

$$FI_1 = \frac{m\alpha_1\beta_1}{1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)} \tag{39}$$

The derivation of equation (39) is presented in Appendix B.1. The variables with bar denote the variables in the steady state. The first derivative of FI_1 with respect to m can be derived as

$$\frac{\partial FI_1}{\partial m} = \frac{\alpha_1\beta_1[1 - \beta_2(1-\delta)]}{[1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)]^2} \tag{40}$$

Since the standard values of all parameters are positive and both depreciation rate δ and discount rate β_2 are normally less than one, $\frac{\partial FI_1}{\partial m}$ is greater than zero. An increase in m leads to an increase in FI_1 given other things being equal.

From equation (40), the ratio of financial integration relative to GDP depends solely on the values of parameters. In other words, percentage financial integration is exogenously determined by the parameters. However, the size of the financial asset position per se endogenously depends on other variables within the model and proportionately varies with GDP.

$$\overline{q_1^a}\bar{B} = \left[\frac{m\alpha_1\beta_1}{1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)}\right]\overline{q_1^a}\overline{Y_1} \tag{41}$$

One crucial factor that underlies the steady-state relationship in equation (39) is that the leverage constraint in this model is always binding in the equilibrium. This is due to the assumption that foreign population is more patient than the home population.[20] The difference in their discounting behavior and discounting factors ($\beta_2 > \beta_1$), leads to higher price of foreign financial assets ($Q^B = \beta_2 > Q^Z = \beta_1$), which is equivalent to lower foreign interest rate. The foreign loans appear to be cheaper than the domestic credit. Consequently, the entrepreneurs always borrow from foreign credit markets to the maximum amount possible according to the leverage constraint and the ratio m, and then adjust the domestic borrowing accordingly. A binding leverage constraint is also needed to obtain a unique value of asset positions in order to determine the financial integration level (see Faia, 2011). In contrast, an occasionally binding constraint could lead to multiple equilibria (Perri & Quadrini, 2011). It is often employed in studies of financial crisis and recessions.

It can be argued that within-country lending also involves credit constraint. The reason for absent domestic constraint in this model is to contrast the difficulty for borrowers in emerging markets between borrowing from foreign developed countries and from local lenders. International and domestic financial markets are differentiated and the funding options they provide are not the same (World Bank, 2015). There is likely more information asymmetry problem in foreign credit markets. Foreign creditors might not know the domestic borrowers well enough before granting the loan and may not be able to closely monitor the behaviors of the debtors after the loans are granted like the local lenders could. The international leverage constraint serves to reflect this more limited ability to access foreign credit markets.

Furthermore, incorporating borrowing constraints both within and across countries could result in the constraints interacting with each other (Caballero & Krishnamurthy, 2001). This may be an undesirable effect since the study aims to investigate the cross-country borrowing and financial integration. Constraining both domestic and foreign borrowing could be carried out to investigate particular issues.

[20] This assumption and the binding leverage constraint are adopted by a number of authors, such as Faia (2011), Iacoviello and Minetti (2006), Pisani (2011), and Leblebicioğlu (2009).

For example, Iacoviello and Minetti (2006) explore different liquidation technologies and the allocation of collateral between the two markets. However, under those settings, the domestic borrowers are unable to adjust the borrowing amount flexibly in any market and the degree of accessibility to both markets would have little difference. Thus, only the cross-border constraint is included in this paper.

5.2 Armington Aggregator and Trade Integration

Trade integration is defined as the amount of intermediate goods traded across countries. The degree of trade intensity is endogenously determined within the model by the interaction of demand, production, and prices of intermediate and final goods. It is also determined by the weight parameter ω in the Armington aggregator. The Armington weight is a structural parameter that can be interpreted as the preference for foreign intermediate goods relative to domestic goods or the technology of final goods production using intermediate inputs. A higher value of ω such as from a shift of relative preference or production technology means the final goods production favors more imported intermediate goods, leading to higher imports. Relatively smaller use of domestic intermediate goods could lead to more domestic goods for exports. These would contribute to higher trade across countries.

The use of Armington weight ω as a measure of trade is adapted from Faia (2007) and Ueda (2012). Both authors use the weight in Dixit-Stiglitz CES consumption index to determine the degree of trade intensity. The functional forms of the two aggregators are similar, but the practical usage differs slightly.[21] Varying the degree of trade integration by using different values of the weight parameter also works under the Armington aggregator similarly to the CES index. This approach is an alternative to modeling higher international trade from a reduction of trade friction such as transportation cost, which is commonly employed in trade literature. The two approaches – varying the weight parameter and lowering trade frictions – yield similar influences on the level of trade, albeit different methods and interpretations.

It can be shown mathematically that the degree of trade integration increases with the weight ω. Using Armington equations and market clearing conditions, the steady-state relationship among the home Armington weight ω_1, the home import share $MS_1 = \overline{q_1^b}\overline{b_1}/\overline{q_1^a}\overline{Y_1}$, and the home export share $XS_1 = \overline{q_1^a}\overline{a_2}/\overline{q_1^a}\overline{Y_1}$ can be written in three interchangeably ways as follows;

$$\omega_1 = \frac{1}{1 + TOT_1^{\frac{1-\sigma}{\sigma}} \left(\frac{1 - XS_1}{MS_1}\right)^{\frac{1}{\sigma}}} \tag{42}$$

[21] The Armington aggregator is usually adopted in the trade general equilibrium models (Backus, Kehoe, & Kydland, 1994) to combine the domestic and foreign intermediate goods into final goods. The CES aggregator typically serves as a consumption composite index aggregating consumption of domestic and foreign goods.

$$XS_1 = 1 - \left[\left(\frac{1}{\omega_1} - 1 \right)^{\sigma} TOT_1^{\sigma-1} MS_1 \right] \tag{43}$$

$$MS_1 = \frac{TOT_1^{1-\sigma}(1 - XS_1)}{\left(\frac{1}{\omega_1} - 1 \right)^{\sigma}} \tag{44}$$

where $TOT_1 = \overline{q_1^b} / \overline{q_1^a}$ is the terms of trade.[22] This is a common way to express home bias parameter ω_1 as a function of the export share, the import share, and the terms of trade, and typically used for the calibration of parameter ω_1. See Ravn and Mazzenga (2004) for example. The derivation of above relationships is shown in Appendix B.2.

The relationships of ω_1 with XS_1 and MS_1 are positive and corresponding first derivatives can be derived as;

$$\frac{\partial XS_1}{\partial \omega_1} = \frac{\sigma MS_1 TOT_1^{\sigma-1} \left(\frac{1}{\omega_1} - 1 \right)^{\sigma-1}}{\omega_1^2} \tag{45}$$

$$\frac{\partial MS_1}{\partial \omega_1} = \frac{\sigma TOT_1^{1-\sigma}(1 - XS_1)}{\omega_1^2 \left(\frac{1}{\omega_1} - 1 \right)^{1+\sigma}} \tag{46}$$

Since the model setup does not allow exporting the imports and $Y_{1t} = a_{1t} + a_{2t}$; hence, $0 \leq XS_1 = \overline{q_1^a} \overline{a_2} / \overline{q_1^a} \overline{Y_1} < 1$. Under standard parameters, $0 < \omega_1 < 1$ and both $\frac{\partial XS_1}{\partial \omega_1}$ and $\frac{\partial MS_1}{\partial \omega_1}$ are positive. An increase in ω_1 given other things being equal would lead to an increase in the export share and the import share, and thus contribute to higher trade integration.

6. Parameter Calibration

The model is calibrated to the benchmark parameter values reported in Table 1.[23] One period corresponds to one quarter. The home and foreign countries represent emerging and advanced economies respectively. Two key parameters in this study are the leverage constraint parameter m and the Armington weights ω. They are derived based on the data of emerging and advanced economies and will be discussed in the

[22] Defining the terms of trade as the price of imports to exports is typical in the financial-trade literature, see for example, Backus et al. (1994), Heathcote and Perri (2002), and Kose and Yi (2006).

[23] The parameter calibration is chosen instead of parameter estimation because, first, the main parameters concerning financial markets and trade can be derived from the data using the steady-state relationship. Secondly, parameter estimation requires a large set of data from a number of emerging markets, which might not be consistently available across different countries. Thirdly, this study examines a large group of countries and does not calibrate the model to one specific country.

following sub-sections. Other parameters are standard values in RBC literatures mostly drawn from Backus et al. (1994), Leblebicioğlu (2009), and Pancaro (2010), and have been used in both emerging market and advanced economy studies. The discount factor of home population, β_1, is assumed to be lower than that of the foreign households and equals to 0.95 following Pancaro (2010). The capital share in production for the home emerging economy α_1 is set to equal 0.34 which is slightly lower than the standard value of 0.36 usually employed with developed countries. This choice of value indicates that the home country is relatively more labor intensive than the foreign country and is in line with literatures on emerging markets and developing countries.[24] The elasticity of substitution between domestic and foreign goods, σ, is set to 1.5 in the main analysis. An alternative value of σ will be investigated in the sensitivity analysis.

Table 1 Benchmark parameters

Discount factor of home population	β_1= 0.95
Discount factor of foreign population	β_2= 0.99
Labor effort weight in the utility	κ = 1
Proportion of home households	n = 0.2
Depreciation rate	δ = 0.025
Capital share of output for home country	α_1 = 0.34
Capital share of output for foreign country	α_2 = 0.36
Elasticity of substitution between home and foreign goods	σ = 1.5
Armington weight in home country	ω_1 = 0.33, 0.42, 0.50
Armington weight in foreign country	ω_2 = 0.41
Leverage constraint parameter	m = 0.05, 0.10, 0.15
Bond holding coefficient	ψ = 0.003

Table 2 Productivity process

Autocorrelation matrix	$\begin{bmatrix} 0.970 & 0.025 \\ 0.010 & 0.970 \end{bmatrix}$
Standard deviation of productivity shock	σ_{ε_1} = 0.015, σ_{ε_2} = 0.0073
Correlation of productivity shock	$corr(\varepsilon_1, \varepsilon_2)$ = 0.290

Source: Pancaro (2010)

The productivity process for A_{1t} and A_{2t} is a vector autoregressive taken from Pancaro (2010) and is described in Table 2. It is chosen due to its asymmetry between home and foreign shocks. First, the degree of shock spillover from the foreign advanced country to the home emerging economy is more significant than the opposite direction. Second, the standard deviation of the shock in the home country is set to 0.015 which is larger than that of the foreign country suggesting more fluctuation in the home country. These are in line with a stylized fact that the business

[24] See Almekinders, Mourmouras, Zhou, and Fukuda (2015), Sarel (1997), Mallikamas, Thaicharoen, and Rodpengsangkaha (2003), and Bhattacharya and Patnaik (2013) for example.

cycles of EMEs are more volatile than the advanced economies. Moreover, developing countries tend to have larger domestic and exogenous shocks than industrial countries (Loayza, Ranciere, Servén, & Ventura, 2007).

6.1 Leverage Constraint Parameter m

The leverage constraint parameter, m is derived from average private external debt of the emerging markets according to the steady-state relationship in equation (39), which can be rearranged as;

$$m = \frac{1 - \beta_1(1-\delta)}{\frac{\alpha_1\beta_1}{FI_1} + \beta_2 - \beta_1} \tag{47}$$

Equation (47) shows that m depends on the model parameters and $FI_1 = q_1^a B / q_1^a Y_1$, which represents the total private foreign borrowing to GDP. The data are non-financial-institution private external debt from World Bank's Quarterly External Debt Statistics (QEDS) and GDP from World Development Indicator (WDI). The data is available for 24 EMEs and averaged over 2000-2013.[25] This gives the value of 14 percent of GDP and corresponding m = 0.03.[26]

Based on m = 0.03, three cases are generated for simplicity with the value of m equal to 0.05, 0.10, and 0.15 for the case of low, medium, and high financial integration respectively. These values of m only indicate the ratio of entrepreneur's foreign borrowing to the value of physical capital, exclusive of domestic borrowing. Small size of m at the individual level does not necessarily translate into small financial integration at the aggregate level. For instance, the corresponding level of external debts in the non-stochastic steady state when m equals to 0.15 is about 72 percent of GDP, which is already around five times higher than the actual level of 14 percent in EMEs. Higher values of m will be explored in the sensitivity analysis.

6.2 Armington Weight ω

The weight parameters ω in Armington aggregator are derived from trade data of emerging market and advanced economies according to the steady-state relationship in equation (42). The data used are 2000-2013 averages of imports, exports, and terms of trade from WDI. Imports and exports are adjusted to remove

[25] The period of 2000 to 2013 is chosen based on the common data availability across different series and data sources. The period in the model is quarterly, but the data used are yearly because most of the parameters are borrowed from other literatures that usually calibrate the parameters quarterly. However, data used in parameter computation requires availability and consistency for a broad range of EMEs. Those data are typically reported on an annual basis. Deriving quarterly parameters from yearly data would not be unacceptably misleading because the actual series used are in the form of percentage ratio to GDP, not the amount; thus, it deems usable as a proxy for the quarterly one.

[26] Pancaro (2010), for example, also calibrates the leverage constraint parameter m to match the level of external debt to GDP.

imported contents in exports using information from joint OECD – WTO Trade in Value-Added (TiVA) database.[27] This adjustment is to make sure that the parameter values are in line with the model setup that there is no exporting the imports. The EMEs are divided into two groups; emerging ASEAN economies, which have evidently higher trade intensity than peers as pointed out in Section 2.1, and other emerging markets that have relatively lower trade. The weights obtained from emerging markets will be used as ω_1 for the home country and the weight from advanced economies will be used as ω_2 for the foreign country.

Table 3 reports trade data from WDI, adjusted trade, and corresponding values of ω. Appendix B.3 explains this computation. The values of ω obtained are in line with other papers adopting Armington aggregator or CES index, which range from 0.15 to 0.50 (see Faia, 2007, Ueda, 2012, Pancaro, 2010, and Bacchetta and Van Wincoop, 2013). Emerging ASEAN countries have higher trade than advanced economies, resulting in slightly higher weight of ω_1= 0.42 versus ω_2= 0.41.

From the two values of home Armington weights, another case of symmetric weight using ω_1 equals to 0.5 is added. This choice of value is adopted by Bacchetta and Van Wincoop (2013) to represent the case of perfect integration. In total, there would be three levels of trade; low, medium, and high correspond to ω_1 equal to 0.33, 0.42, and 0.50 respectively.

Table 3 Total trade, adjusted trade, and corresponding Armington weights

	Obs.	Raw trade data (% of GDP)			TOT	Adjusted trade (% of GDP)			ω
		Ex	Im	Total		Ex	Im	Total	
Advanced economies	35	58%	55%	113%	1.04	39%	35%	74%	ω_2= 0.41
Emerging ASEAN	4	61%	55%	116%	1.05	40%	35%	76%	ω_1= 0.42
Other EMEs	26	32%	35%	68%	0.94	24%	26%	51%	ω_1= 0.33

Sources: author's calculation using data from WDI and TiVA.
Note: Obs.=observations; Ex = exports; Im = imports; TOT = terms of trade.

6.3 Main Cases

From the parameter choices, three levels each of financial and trade integration are examined under the main analysis. This results in the total of nine combinations as shown in Table 4.

[27] A recent database constructed by Koopman, Wang, and Wei (2014) also reports trade in value added using a sophisticated calculation, but covers fewer countries and only provides data up to 2009 at the time this study was conducted. Thus, TiVA is adopted due to its larger country coverage and more updated data.

Table 4 Summary of main cases

#	Case	Level of FI	Level of TI	Value of m	Value of ω_1
1	LFI, LTI	Low	Low	0.05	0.33
2	LFI, MTI	Low	Medium	0.05	0.42
3	LFI, HTI	Low	High	0.05	0.50
4	MFI, LTI	Medium	Low	0.10	0.33
5	MFI, MTI	Medium	Medium	0.10	0.42
6	MFI, HTI	Medium	High	0.10	0.50
7	HFI, LTI	High	Low	0.15	0.33
8	HFI, MTI	High	Medium	0.15	0.42
9	HFI, HTI	High	High	0.15	0.50

Note: FI = financial integration; TI = trade integration; L = low; M = medium; H = high.

7. Results and Discussion

7.1 Macroeconomic Volatility

The simulation results of key macroeconomic volatility for nine main scenarios are presented in Table 5. The focus of the analysis is the home emerging economy.

The results show that higher foreign debt, moving from LFI to MFI and HFI, raises the volatility of home output regardless of the degree of trade intensity. To illustrate, under low trade, increasing financial integration from LFI to HFI raises output volatility from 12.86 percent to 13.16 percent. Financial integration in the form of external borrowing is connected to the production sector and output mainly through the use of capital in the leverage constraint that governs the level of foreign debt. Larger borrowing results in larger fluctuation of the borrowing itself, as can be seen in Table 5, where the volatility of foreign debt B increases noticeably with the size of the borrowing. The volatility of capital also increases with higher financial integration but with less extent. These could contribute to increased output volatility.

The finding agrees with the conjecture that external debt tends to be highly volatile, easily reversible, and procyclical and could amplify the negative shocks especially in underdeveloped and poorly supervised financial systems (Kose et al., 2006; Kose, Prasad, & Terrones, 2009). Nevertheless, borrowing from abroad has benefit of generating more liquidity in the domestic markets and financing investment projects of firms (Kose et al., 2006).

The empirical evidence on this relationship is mixed. For example, Bekaert et al. (2006) and Prasad, Rogoff, Wei, and Kose (2007) found that financial integration contributes to lower output variability, while Dabla-Norris and Srivisal (2013) found the opposite, and Kose et al. (2003) found that the effect is insignificant.

Table 5 Simulated volatility of key variables

	LTI			MTI			HTI		
	LFI	MFI	HFI	LFI	MFI	HFI	LFI	MFI	HFI
<u>*Volatility of home variables (%SD)*</u>									
Output (Y_1)	12.86	13.01	13.16	12.22	12.38	12.53	11.78	11.95	12.11
Household consumption (C_1^h)	5.08	5.13	5.18	4.22	4.26	4.30	3.68	3.71	3.74
Entrepreneur consumption (C_1^o)	1.02	1.01	0.99	0.90	0.89	0.88	0.83	0.83	0.83
Aggregate consumption (C_1)	5.97	6.00	6.03	5.00	5.03	5.05	4.40	4.42	4.44
Capital (K_1)	27.33	28.36	29.29	23.11	24.01	24.85	20.44	21.26	22.03
Investment (X_1)	1.78	1.89	2.00	1.47	1.57	1.67	1.27	1.36	1.46
Foreign borrowing (B)	2.48	5.17	8.05	2.39	4.99	7.79	2.33	4.88	7.64
Domestic borrowing (Z)	21.23	21.63	21.99	19.37	19.63	19.87	17.99	18.18	18.34
Exports (a_2)	3.39	3.41	3.43	4.51	4.54	4.58	5.55	5.60	5.66
Imports (b_1)	3.91	3.92	3.93	4.30	4.32	4.34	4.62	4.64	4.66
Terms of trade (TOT_1)	2.40	2.41	2.43	2.92	2.94	2.97	3.37	3.41	3.45
Exchange rate (e)	1.25	1.25	1.25	0.86	0.86	0.87	0.47	0.48	0.48
<u>*Volatility of foreign variables (%SD)*</u>									
Output (Y_2)	11.66	11.62	11.58	12.07	12.05	12.02	12.40	12.39	12.37
Consumption (C_2)	3.38	3.39	3.40	3.74	3.75	3.77	4.05	4.06	4.08
<u>*Consumption volatility relative to output (%SD/%SD of Y)*</u>									
Home households (C_1^h)	0.39	0.39	0.39	0.35	0.34	0.34	0.31	0.31	0.31
Home entrepreneurs (C_1^o)	0.079	0.077	0.075	0.074	0.072	0.071	0.071	0.070	0.069
Home aggregate (C_1)	0.46	0.46	0.46	0.41	0.41	0.40	0.37	0.37	0.37
Foreign households (C_2)	0.29	0.29	0.29	0.31	0.31	0.31	0.33	0.33	0.33

Note: The statistics are the averages of 500 simulations, each 400 periods long; Y = output; SD = standard deviation; LFI = low financial integration; MFI = medium financial integration; HFI = high financial integration; LTI = low trade integration; MTI = medium trade integration; HTI = high trade integration.

Table 5 reports two measures of consumption variability; the standard deviation of consumption in the upper two panels, and the consumption volatility relative to output volatility in the bottom panel. The ratio of consumption volatility to output volatility is one proxy that indicates the degree of consumption smoothing and risk sharing (Bekaert et al., 2006). Consumption fluctuation is viewed as inversely related to welfare (Prasad et al., 2007).

For home households who have no access to foreign financial markets, higher financial integration slightly increases their consumption volatility, but when considered relative to output volatility, they are largely unaffected. The volatility of consumption relative to output is almost the same across different levels of financial integration given certain degree of trade. For instance, the relative consumption volatility ratio remains at about 0.31 for all three levels of financial integration under high trade case. Home households do not have direct cross-border financial linkage and their consumption seems to depend more on wage and labor supply than financial asset holding. Additionally, the linkage between foreign and domestic debts of the entrepreneurs might not be strong enough to transfer the effect of financial integration to the households because only the foreign borrowing is constrained, while domestic borrowing is not.

For home entrepreneurs who can borrow abroad, increasing external debt slightly decreases their consumption volatility. The effect is a little larger at low trade, and smaller at high trade. With more opportunity to borrow in foreign markets, it seems that the entrepreneurs can diversify the risk and smooth consumption better. However, the overall impact is very small, likely because they can still borrow domestically without any constraint, so they are not significantly affected by financial integration. Aggregating the consumption at the home country level, the household consumption appears to dominate and the pattern of aggregate consumption volatility is similar to that of the home households.

Empirical studies usually find a negative or insignificant impact of financial integration on consumption smoothing in more financially-opened developing countries (See for example, Kose et al., 2003, Bekaert et al., 2006, and Prasad et al., 2007). Studies adopting DSGE mostly found that financial integration increases consumption volatility when there are frictions or imperfect access to finance since these market imperfections could amplify the impacts of shocks on consumption (See for example Levchenko, 2005, Leblebicioğlu, 2009, Pancaro, 2010, and Pisani, 2011).

Although home consumers are constrained internationally – entrepreneurs with leverage constraint, and households with no access– they both face no further frictions in domestic markets and can freely choose the amount of asset holding. These could be another reason why their consumption volatility is not negatively impacted by cross-border financial flows like the findings from other studies with market imperfections.[28]

Increased trade integration lowers the volatility of output and volatility of consumption for both types of domestic residents. Larger international trade linkages could allow exports, imports, and terms of trade of the home country to adjust more flexibly in response to shocks. This reflects in the results as these three variables broadly become more volatile as trade increases. On the other hand, for the countries with weaker trade linkages, a negative shock to the production sector may lead to fewer goods for consumption, and with the inflexibility to adjust imports and exports, the output and consumption might have to adjust instead and become more volatile. The findings suggest that trade could help dissipate the shocks and transmit them across countries through trade channel.

Empirical literatures have found both positive and negative relationships between trade and the volatility of output and consumption growth. Kose et al. (2003)

[28] Some DSGE researches that examine generic countries or the model economy without constraints found that increased financial integration is associated with lower consumption volatility under certain settings. Baxter and Crucini (1995) observed lower consumption fluctuation under complete asset market arrangement. Senay (1998) found consumption smoothing benefit from higher financial integration when examining general and symmetric countries. Evans and Hnatkovska (2007) showed that moving from integration in only bond markets to integration in both bond and equity markets when there is no financial friction could result in lower consumption volatility.

found that trade induces higher output variability. Haddad, Lim, and Saborowski (2010) found negative relationship when exports are sufficiently diversified, which are the case for a majority of countries. For consumption growth volatility, Bekaert et al. (2006) show that trade increases consumption variability, Kose et al. (2003) found that trade lowers consumption volatility to output volatility ratio, and Fanta (2012) found that the impact of trade is insignificant.

The impact of financial and trade integration on the volatility of capital and investment follows a similar pattern with that of output volatility since they are closely linked. Increasing financial integration only slightly increases the volatility of domestic borrowing Z, and the impact is small compared to that of trade integration, which lowers the volatility of domestic borrowing more evidently. This result resembles that of the domestic consumption and differs notably from the pattern of foreign borrowing. This suggests that the effect of increasing foreign debt does not transfer to higher volatility of domestic borrowing possibly because they are not directly linked and the domestic borrowing is not constrained. It also has smaller impact than trade on the volatility of exports, imports, terms of trade, and exchange rate. Trade integration seems to lower down the volatility of exchange rate, but financial integration almost has no impact on the volatility of relative price between two countries. This suggests that the impact of financial integration might work through other channels. Price and exchange rate adjustment might not play much role and real variables might have to adjust instead under this RBC type of models.

Although the impacts of financial and trade integration on macroeconomic volatility are generally in opposite directions, they do not evidently offset each other. The consequences of increasing financial integration do not significantly depend on the degrees of trade and vice versa, except for entrepreneurs whose consumption volatility is slightly less affected by increasing external debts at higher trade. Interestingly, increasing financial integration, trade, or both all help make the consumption of entrepreneurs less volatile. This suggests that even though they are credit constrained internationally, they can still benefit from international integration.

The model seems able to capture the stylized fact that observed business cycles in EMEs are generally more volatile than that of the developed countries to some extent, but fails to exhibit the stylized fact that consumption in EMEs is more volatile than output.

7.2 Welfare Implication

Welfare criteria provides an alternative measure of benefit from financial integration apart from consumption volatility. Welfare result as measured by certainty-equivalent consumption relative to non-stochastic steady state is reported in Table 6 for households, entrepreneurs, and aggregate population in the home country. The computation of welfare criteria is presented in Appendix B.4. A positive value means the agents are better off in the stochastic economy than in the non-stochastic steady state, and negative values suggest welfare cost.

Table 6 Welfare result of home consumers (%)

	LTI			MTI			HTI		
	LFI	MFI	HFI	LFI	MFI	HFI	LFI	MFI	HFI
Households	0.02	0.01	0.01	0.01	0.00	-0.01	-0.01	-0.02	-0.03
Entrepreneurs	-0.43	-0.45	-0.49	-0.41	-0.43	-0.45	-0.39	-0.40	-0.41
Aggregate	-0.20	-0.22	-0.24	-0.20	-0.22	-0.23	-0.20	-0.21	-0.22

The results show that the welfare of the households is not much impacted by either types of integration. For the financial integration part, this is because home households do not have direct cross-border financial linkage as discussed in the previous section. Higher international trade partially means more exports, which affects labor supply from households. On the other hand, increasing exports mean fewer intermediate goods for domestic final goods production, and increasing imports cannot fully compensate this. As a result, there are less final goods for domestic consumption and investment in this model. These could lead to lower welfare of the households since their utility depends on both consumption and labor according to equation (1). However, they are influenced more through the domestic channels rather than trade linkage, so the welfare effect is very small. This welfare result differs from the consumption volatility of home households because their utility and hence welfare depends not only on the consumption, but also on the labor supply.

For the home entrepreneurs, higher financial integration seems to undermine welfare slightly. This welfare result is opposite to the consumption smoothing benefit. Higher financial integration leads to lower consumption fluctuation likely due to better risk-sharing and less capital scarcity, but is associated with welfare loss mainly because higher external debt means higher interest payment, which could result in less consumption and lower welfare. This finding of contrasting consumption smoothing benefit and welfare lost is similar to Evans and Hnatkovska (2007). In contrast, higher trade seems to be better for entrepreneur’s welfare in line with the result on consumption volatility. This is possible since their utility chiefly depends on consumption. Trade linkage could help dissipate and transmits the productivity shocks as already discussed. Higher trade is also associated with less production due to more imports, and consequently less borrowing. These could result in less interest payment and better welfare. At the aggregate level, higher financial integration is associated with welfare costs because the aggregate welfare seems to be dominated by the entrepreneurs’ welfare. However, the differences among all cases are small.

Combining the findings from this study and earlier studies, there are two possible common reasons for welfare loss. First, it might be because of the bond economy. Devereux and Sutherland (2011) found that the bond economy leads to welfare loss, whereas integration in both bond and equity markets results in welfare gain. Second, welfare loss might be related to frictions. Faia (2011) and Devereux and Sutherland (2011) found that agents with frictions incur welfare loss from increased financial integration, and Evans and Hatnovska (2007) and Leblebicioğlu (2009) found that agents without friction tend to have welfare gain.

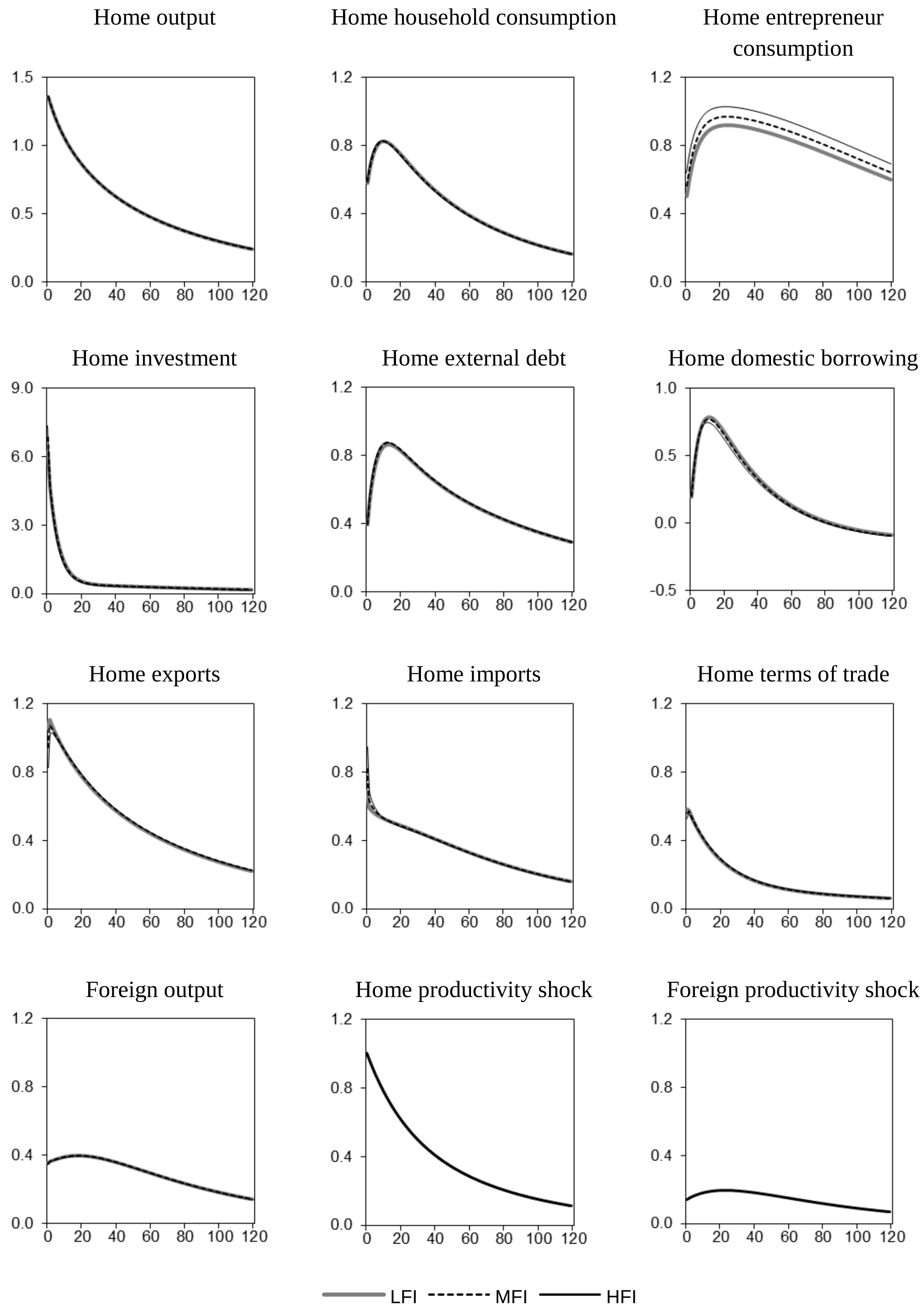
7.3 Impulse Response to Shocks

Selections of simulated impulse responses are presented in Figure 6 to 8. The IRFs shown are percentage deviation from steady state for one percentage productivity shock. Only main variables and some cases are shown due to a large amount of IRF results. The underlying shock processes are the same for all cases.

Figure 6 shows the IRF from three levels of financial integration under the case of MTI, and Figure 7 shows the IRF from three levels of trade integration under the case of MFI. One percentage of positive home productivity shock leads to more than one percentage increase in home output. The differences in home output response are small in all cases possibly because the shock directly hits the production sector and output, so this direct impact might be more pronounced and overshadow the repercussion from international financial and trade channel.

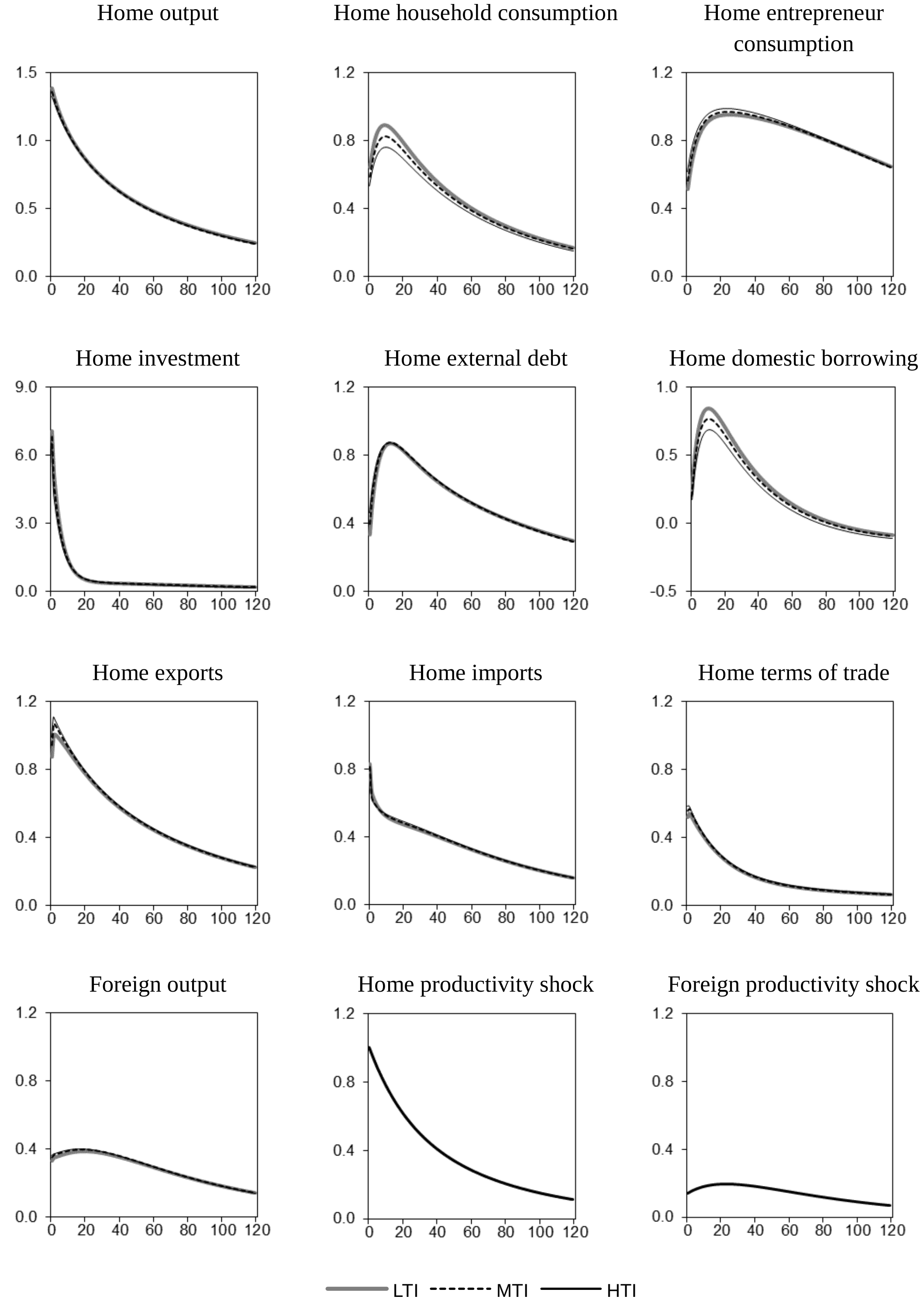
The responses of domestic consumption to shock differ between two types of consumers. First, home entrepreneur’s consumption is more affected than households because they own the production firm and directly benefit from higher output. Second, the responses of household consumption to shock vary by different level of trade, but are almost the same for different levels of financial integration. This results confirm the findings from both macroeconomic volatility and welfare implication that households are largely unaffected by entrepreneurs’ foreign debt. Their consumption responds less to shock under higher trade, in line with the consumption volatility result. These suggest that higher trade tends to stabilize the consumption fluctuation of households. In contrast, the consumption of home entrepreneurs responds more to shock under higher financial integration, but has similar response for varying degrees of trade intensity. Foreign borrowing does not only serve as a financial linkage across countries, but it also connects the production sector to the consumption of entrepreneurs through the use of physical capital as collateral in the borrowing constraint and interdependence of consumption and borrowing in the budget constraint. Given that the technology shock to production sector is the same, and hence similar response of output to shock, larger foreign borrowing implies a larger channel to transmit the impact from production sector to the entrepreneurs. As a result, these could contribute to higher response of entrepreneur’s consumption to shock under higher financial integration. Note that the response of foreign borrowing itself to shocks may look the same, but this is a percentage deviation from the steady state, so it is relative to various sizes of foreign borrowing.

Figure 6 Impulse response of main variables to domestic productivity shock for the case of MTI



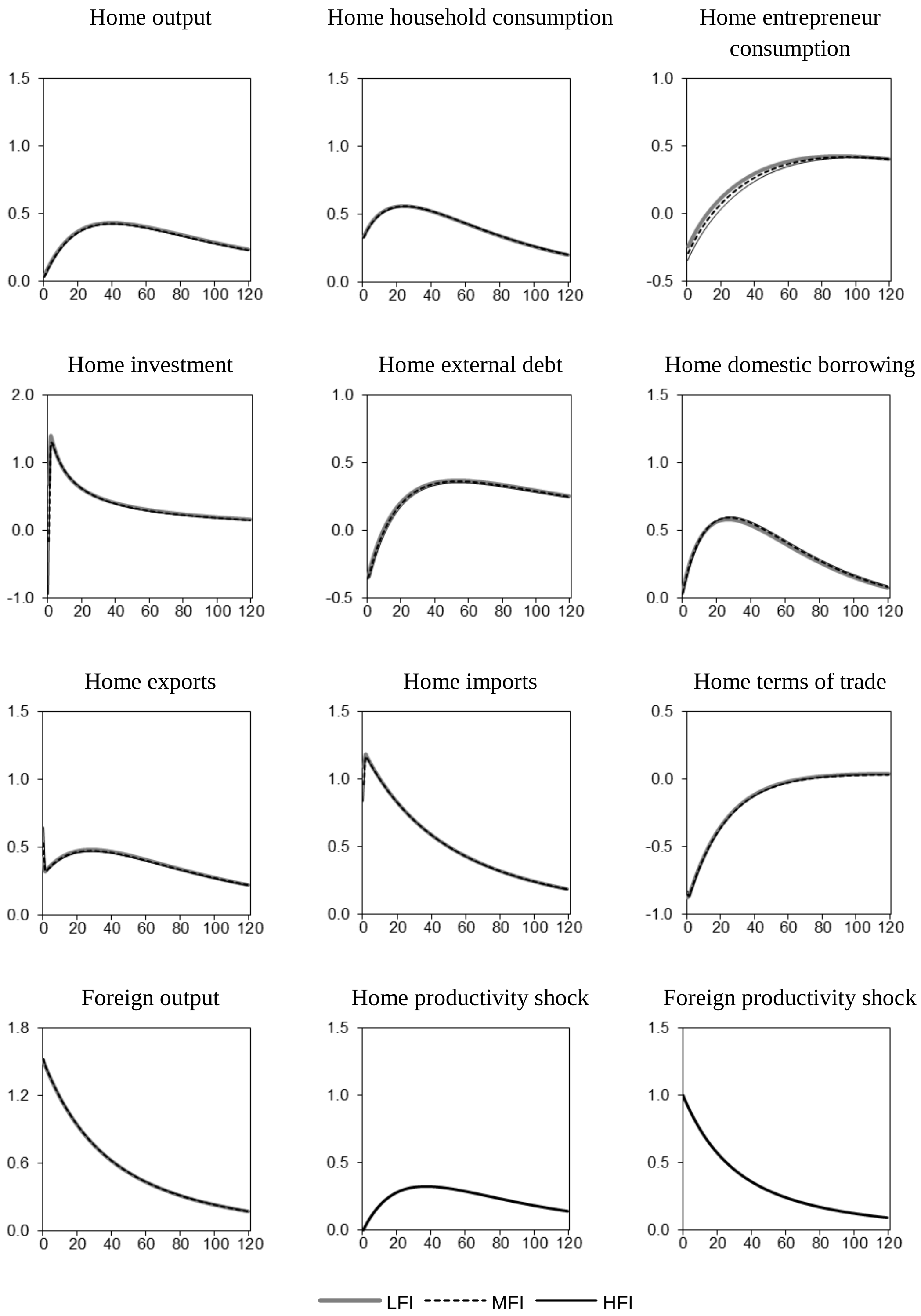
Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter.

Figure 7 Impulse response of main variables to domestic productivity shock for the case of MFI



Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter.

Figure 8 Impulse response of main variables to foreign productivity shock for the case of MTI



Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the foreign country; one period = one quarter.

Other variables exhibit little differences in response to shocks among varying levels of financial and trade integration. Home domestic borrowing is slightly more responsive to shock under low financial integration, suggesting that the entrepreneurs might need to adjust domestic debt more when the foreign borrowing is more constrained. Home domestic borrowing is also more responsive to shock at lower trade, similar to the pattern observed in household consumption.

Figure 8 shows the impulse response for one-percentage positive shocks from the foreign country. The impulse responses of home variables to foreign shocks also do not differ much among different levels of integration. Most of the home variables respond positively to positive foreign shock though to a lesser degree than home shocks. Exception is the IRF of terms of trade, which is opposite to when productivity shock is from the home country. All variables and all cases exhibit persistent responses because the shocks themselves are persistent and can spillover across countries. The impulse responses to one-percentage negative shocks would be symmetric reflections of the ones shown here.

7.4 Pareto Improvement

This section analyzes the Pareto improvement regarding the choices of financial and trade integration. Pareto improvement in this context is referred to an increase or decrease of foreign external debt, trade, or both that lowers at least one volatility considered while not increases other volatilities. Three volatilities considered are output, the household's consumption, and the entrepreneur's consumption. Table 7 summarizes which changes in the degree of integration moving from the left column to the top row constitute Pareto improvement. P denotes Pareto improving.

Table 7 Pareto improvement from changes in the level of integration

	To	LTI			MTI			HTI		
From		LFI	MFI	HFI	LFI	MFI	HFI	LFI	MFI	HFI
LTI	LFI		-	-	P	P	P	P	P	P
	MFI	-		-	P	P	P	P	P	P
	HFI	-	-		P	P	P	P	P	P
MTI	LFI	-	-	-		-	-	P	P	P
	MFI	-	-	-	-		-	P	P	P
	HFI	-	-	-	-	-		-	P	P
HTI	LFI	-	-	-	-	-	-		-	-
	MFI	-	-	-	-	-	-	-		-
	HFI	-	-	-	-	-	-	-	-	

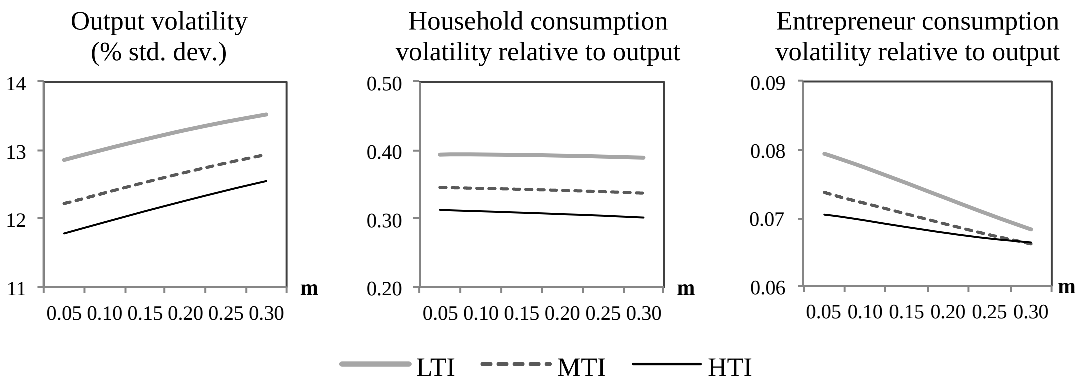
Note: P = Pareto improving; - = not Pareto improving; the grey cell means no change in the degree of integration.

To achieve lower aggregate fluctuation, the Pareto improvement is mostly to increase only trade or both types of integration at the same time. Lowering trade is never Pareto improving because trade lowers all three volatilities considered. Interestingly, neither increasing nor decreasing financial integration for a given level of trade is Pareto improving. This is because there is a benefit-cost trade-off in the effect of private external debts on macroeconomic volatility. Although no move is considered as Pareto improving under the case of high trade, it does not mean that these combinations constitute Pareto optimum because the degrees of integration are, at least ideally, not bounded by strict resource constraints. The country can always integrate deeper if there is a right balance between two types of integration that benefits the country.

7.5 Sensitivity Analysis

To test the robustness of the main findings, this section examines the sensitivity of the results to the choices of two parameters. Firstly, the values of parameter m are extended to 0.20, 0.25, and 0.30 from the main cases.[29] Figure 9 depicts the volatility of home output and consumption relative to output when m equals to 0.05 to 0.30 inclusive of the main scenarios. Higher values of m correspond to larger sizes of cross-border borrowing. The results continue from the main cases, with the volatility of entrepreneurs' consumption to output somewhat converges to around 0.067 as m increases. This emphasizes the observation that at lower trade, the entrepreneurs' consumption decreases more as financial integration increases.

Figure 9 The volatility of home variables from varying levels of leverage constraint parameter, m



[29] The values of m greater than 0.3 can result in negative consumption in some simulations, so only the values of m up to 0.3 are included. However, the size of the parameter m only covers private external debt, but not domestic debt that the entrepreneurs can borrow unlimitedly. Thus, the size of m could be small and total debts of the entrepreneurs could be higher. The value of 0.3 gives corresponding foreign debt of about 160 percent of GDP.

Secondly, the elasticity of substitution between domestic and foreign goods or σ in the Armington aggregator is changed from 1.5 in the benchmark parameter to 0.9. The value of 0.9 is chosen based on Heathcote and Perri (2002). Lower elasticity means the domestic and foreign goods are more complements, and higher elasticity means the goods are more substitutions (Kose & Yi, 2006). Other parameters are kept at their benchmark values, except for the home Armington weights that have been recomputed according to the value of σ = 0.9. The new weights for home country for the case of LTI, MTI, and HTI are 0.24, 0.36, and 0.40 respectively. The LTI and MTI cases are based on ASEAN and other emerging markets data respectively. The value 0.40 is arbitrary. The new weight for foreign country is 0.35.

Table 8 shows the volatility of key variables and welfare criteria for the main nine cases. Overall, the main findings are preserved. Increasing foreign borrowing raises home output volatility, lowers entrepreneur consumption fluctuation, and has very small impacts on home households in terms of both consumption smoothing and welfare. Trade, on the other hand, tends to be favorable for all volatility of home variables and does not play a significant role on how financial integration impacts volatility and welfare.

Table 8 Volatility and welfare results when σ = 0.9

	LTI			MTI			HTI		
	LFI	MFI	HFI	LFI	MFI	HFI	LFI	MFI	HFI
Volatility (%SD)									
Home output (Y_1)	13.42	13.56	13.69	12.50	12.65	12.80	12.26	12.41	12.56
Foreign output (Y_2)	11.31	11.27	11.21	12.00	11.98	11.95	12.18	12.17	12.15
Home household consumption (C_1^h)	5.60	5.64	5.68	4.33	4.36	4.38	4.03	4.05	4.07
Home entrepreneur consumption (C_1^o)	1.21	1.19	1.17	1.02	1.01	1.01	0.97	0.97	0.97
Home aggregate consumption (C_1)	6.65	6.67	6.67	5.20	5.21	5.22	4.85	4.86	4.87
Home consumption volatility relative to output (%SD/%SD of Y)									
Households	0.42	0.42	0.41	0.35	0.34	0.34	0.33	0.33	0.32
Entrepreneurs	0.090	0.088	0.086	0.082	0.080	0.079	0.080	0.078	0.077
Aggregate	0.50	0.49	0.49	0.42	0.41	0.41	0.40	0.39	0.39
Welfare criteria for home consumers (%)									
Households	-0.01	-0.02	-0.03	-0.04	-0.05	-0.07	-0.05	-0.07	-0.08
Entrepreneurs	-0.48	-0.51	-0.55	-0.44	-0.45	-0.47	-0.42	-0.43	-0.43
Aggregate	-0.25	-0.26	-0.29	-0.24	-0.25	-0.27	-0.24	-0.25	-0.26

Note: The statistics are the averages of 500 simulations, each 400 periods long; Y = output; SD = standard deviation.

7.6 The Combined Effect of Financial and Trade Integration

The separate impacts of financial and trade integration on macroeconomic volatility and welfare generally go in opposite directions. There is no strong evidence of lower fluctuation benefit and welfare gain from higher financial integration that takes the form of private external debt, whereas higher trade is generally favorable for output volatility, consumption smoothing, and welfare.

Considering their joint effect together, the consequences of financial and trade integration seem to be largely independent. The consequence from increasing one integration does not significantly depend on the degree of integration in the other market. Higher trade could not help mitigate the negative impact of financial integration, and higher financial integration does not enhance the benefits of international trade. This may be partly because the effect of external debt is small while the effect of trade is large. Home households are not much related to and not affected by increasing external debt, and the production sectors are not critically contingent on the external debt since unconstrained domestic borrowing is available. As a result, the link between two types of integration might not be apparent. Only one exception is that trade slightly weakens the impact of financial integration on the entrepreneur's consumption volatility.

This finding does not support the sequencing of liberalization**,** which conjectures that trade liberalization might be a prerequisite for a country to achieve gains from financial liberalization (see Edwards and Van Wijnbergen, 1986, Arteta et al., 2001, and Ito, 2001). However, it is in line with the empirical evidences of threshold effect literature that mostly finds no significant role of trade intensity on the relationship between financial integration and economic growth, suggesting that the impact does not depend on the degree of trade.[30] There is another type of threshold effect studies that employs the degree of financial integration itself as a threshold and argues that financial integration might become beneficial when financial markets are sufficiently integrated. See Kose et al. (2003) for example of empirical studies. However, it might be impossible to find this kind of threshold point or other nonlinear relationships under the setting of this model because the relationship between integration and volatility seems to be monotonic. To study a non-linear relationship, other settings are needed.[31]

Comparing with other DSGE studies, the finding of individual consequences of financial and trade integration in emerging market setting resembles some papers that examine general or advanced economies but with market imperfection. Senay (1998) investigated general and symmetric countries with adjustment cost in foreign asset trading and found that the impacts of financial and goods market integration on macroeconomic volatility are broadly independent. Kose and Yi (2006) explored the impact of transportation cost and different asset market structures on business cycle

[30] Arteta et al. (2001), Friedrich, Schnabel, and Zettelmeyer (2013), and Chen and Quang (2014) found that the threshold effect of trade openness on the relationship between financial integration and growth is insignificant. Kose, Prasad, and Taylor (2011) found the threshold effect but it is not robust.

[31] For instance, Evans and Hnatkovska (2007) found the hump-shaped relationship between financial integration and consumption volatility when equity market integration is included in addition to the bond economy.

synchronization in OECD countries. They concluded that the effect of international trade is similar regardless of the types of international financial arrangement.

However, this independent effect contrasts the finding from Ratanavararak (in press), which suggests that the impact of financial integration on business cycles is weakened under higher trade and the effect of trade openness on output volatility varies with differing degrees of financial integration. Two kinds of integration are similarly found to affect aggregate fluctuation in opposite directions, but they likely offset each other. Three differences that could explain the contrasting results are that that paper studies outward portfolio investment instead of private external debts, incorporates an endogenous linkage between financial and trade integration within the model which might lead to a more offsetting joint effect, and explores credit-constrained domestic financial market. These suggest that the direction of financial flows and the presence of frictionless domestic market might influence the relationship between international integration and business cycles. The issue of domestic market will be discussed next.

7.7 Asymmetric Financial Access, Frictions, and Domestic Financial Development

Financial accessibility and friction seem to be the factors that determine how financial integration affects heterogeneous agents. The entrepreneurs who have cross-border financial linkage are affected by increasing financial integration, while the households who can only save domestically are broadly unaffected. This finding is partly consistent with and partly different from previous literatures. Leblebicioğlu (2009) and Levchenko (2005) established that financial integration tends to benefit people with financial access, but leads to welfare loss and more volatile consumption for people with no access. The difference from those two earlier studies is that this paper assumes no other financial frictions or constraint in domestic financial markets apart from asymmetric access to foreign markets. Although home households are excluded from international risk sharing, they do not face any constrain domestically, unlike the setups of Leblebicioğlu (2009) and Levchenko (2005) that domestic imperfections exist. As for the home entrepreneurs, their constrained borrowing in foreign markets does not have much adverse impact on them possibly due to the availability of unconstrained domestic credit.

Other studies of cross-border constrained borrowing generally found that increased financial integration is associated with larger consumption volatility and welfare loss. See Pancaro (2010), Pisani (2011), and Faia (2011) for instance. However, they all omitted domestic financial markets, and people can only borrow in international markets, in which the leverage constraint applies. These suggests the importance of domestic financial development when not everyone in the economy can access foreign asset markets and those who can are internationally constrained. Domestic frictions might further undermine these restricted accessibilities, and well-developed domestic financial markets could serve as recourse for all types of market participants. This finding is in line with the literature on the relationship between financial development and international financial integration, which posits that they support each other (International Monetary Fund, 2014b; Kose et al., 2006).

8. Conclusion

This study has developed a two-country DSGE model to examine the effect of increasing financial and trade integration together on macroeconomic volatility and welfare in EMEs focusing at cross-border borrowing. The model incorporates two market imperfections, which are international leverage constraint and asymmetric access to international financial markets among domestic consumers. The degree of financial integration is determined by the reduction of leverage constraint and the size of cross-border borrowing.

The findings reveal that greater financial integration increases output fluctuation. Consumption smoothing benefit and welfare gain from higher financial integration are small and not robust, whereas higher international trade tends to be favorable for macroeconomic volatility and welfare. The impacts of financial and trade integration are found to be generally independent of each other in most cases. The results also suggest that constrained borrowing in foreign markets might not have much adverse impact on the borrowers if they have other sources of unconstrained funds. People who cannot access international market tend to be largely unaffected by increasing financial integration when they have frictionless domestic market to turn to. The robustness of the results is examined using extended and alternative parameter values. Overall, the main findings are preserved.

With imperfect financial access and international leverage constraint in place, it might be difficult for EMEs to achieve evident gains from foreign borrowing even with high trade intensity. Given a trade-off among various impacts of financial integration, enhancing it together with trade seems more favorable to aggregate fluctuation than increasing cross-border financial flows alone. A sound domestic financial market is important as a support when financial integration is imperfect, and improvement of financial accessibility and frictions might help emerging markets to better reap gains from financial integration. Additionally, different groups of people tend to be affected differently. All these factors should be taken into account for international integration policies.

The shortcomings of this study are that it only examines certain aspects of financial integration, which is the impact of constrained cross-border borrowing with imperfect access on macroeconomic volatility and welfare, and the results are contingent on the model setup and assumptions. For instance, the impact of financial integration is small in this study possibly due to the incorporation of unconstrained domestic credit, which in turn leads to the suggestion that domestic market is important. The results might differ when domestic market has frictions or unavailable. Hence, the findings of this study cannot be taken as a decisive conclusion for the impact of financial integration as a whole, and the interpretation of the findings must be applied in the light of the underlying assumptions. Furthermore, this paper only focuses at the real consequences of financial integration while neglecting monetary facets. Financial shocks are not investigated, and exchange rate has a limited role under the RBC models.

These suggest extensions from this study to incorporate monetary variables or modify the model into New Keynesian type. Financial shocks to credit market implemented through the leverage constraint could be added.[32] Exchange rate and different exchange rate policy regimes can be explored in more depth. Moreover, the external finance premium arising when borrowing funds from two different countries can be investigated,[33] and the leverage constraint could be imposed on the domestic credit in addition to the cross-border loans, either with a less degree of severity or in a different feature. Other possible extensions include applying the model to a specific country, estimating parameters from data instead of calibration, and studying other types of financial integration and frictions such as integration in equity markets and trade friction.

[32] See Devereux and Sutherland (2011) for an example of implementing shocks to the financial sector by modeling the leverage constraint coefficient as a random variable instead of a parameter. See Jermann and Quadrini (2012) and Perri and Quadrini (2011) for extensive investigation of negative financial shocks and credit tightening.

[33] See Ueda (2011) for example.

Reference

Adjemian, S., Bastani, H., Juillard, M., Mihoubi, F., Perendia, G., Ratto, M., & Villemot, S. (2011). Dynare: Reference manual, version 4: Dynare Working Papers 1, CEPREMAP.

Agénor, P.-R., McDermott, C. J., & Prasad, E. S. (2000). Macroeconomic fluctuations in developing countries: some stylized facts. *The World Bank Economic Review, 14*(2), 251-285.

Aguiar, M., & Gopinath, G. (2007). Emerging market business cycles: The cycle is the trend. *Journal of political economy, 115*(1), 69-102.

Aizenman, J. (2008). On the hidden links between financial and trade opening. *Journal of International Money and Finance, 27*(3), 372-386.

Aizenman, J., Jinjarak, Y., & Park, D. (2013). Capital flows and economic growth in the era of financial integration and crisis, 1990–2010. *Open Economies Review, 24*(3), 371-396.

Aizenman, J., & Noy, I. (2009). Endogenous financial and trade openness. *Review of Development Economics, 13*(2), 175-189.

Almekinders, G., Mourmouras, A., Zhou, J.-P., & Fukuda, S. (2015). ASEAN Financial Integration: International Monetary Fund.

Araujo, J. D. (2008). Financial Integration with Heterogeneous Home Financial Market Access.

Armington, P. S. (1969). A Theory of Demand for Products Distinguished by Place of Production. *IMF Staff Papers*, 159-178.

Arteta, C., Eichengreen, B., & Wyplosz, C. (2001). When does capital account liberalization help more than it hurts? *NBER Working Paper*.

Auster, A., & Foo, M. (2015). Financial Integration in the Asia-Pacific: Fact and Fiction.

Aviat, A., & Coeurdacier, N. (2007). The geography of trade in goods and asset holdings. *Journal of International Economics, 71*(1), 22-51.

Bacchetta, P., & Van Wincoop, E. (2013). The great recession: a self-fulfilling global panic: National Bureau of Economic Research.

Backus, D. K., Kehoe, P. J., & Kydland, F. E. (1994). Dynamics of the Trade Balance and the Terms of Trade: The J-Curve? *The American Economic Review, 84*(1), 84-103.

Baele, L., Ferrando, A., Hördahl, P., Krylova, E., & Monnet, C. (2004). Measuring financial integration in the euro area: European Central Bank.

Baxter, M., & Crucini, M. J. (1995). Business Cycles and the Asset Structure of Foreign Trade. *International Economic Review, 36*(4), 821-854.

Bekaert, G., Harvey, C. R., & Lundblad, C. (2006). Growth volatility and financial liberalization. *Journal of International Money and Finance, 25*(3), 370-403.

Benczúr, P., & Rátfai, A. (2014). Business Cycles Around the Globe: Some Key Facts. *Emerging Markets Finance and Trade, 50*(2), 102-109.

Benhamou, Z. A. (2016). Fluctuations in Emerging Economies: Regional and Global Factors: OCP Policy Center.

Bhattacharya, R., & Patnaik, I. (2013). Credit Constraints, Productivity Shocks and Consumption Volatility in Emerging Economies: International Monetary Fund.

Borensztein, E., & Loungani, P. (2011). Asian Financial Integration: Trends and Interruptions. *SSRN Working Paper Series*.

Brázdik, F., Hlaváček, M., & Marsal, A. (2012). Survey of Research on Financial Sector Modeling within DSGE Models: What Central Banks Can Learn from It. *Czech Journal of Economics and Finance, 62*(3), 252-277.

Brunnermeier, M. K., Eisenbach, T. M., & Sannikov, Y. (2012). Macroeconomics with financial frictions: A survey: National Bureau of Economic Research.

Caballero, R. J., & Krishnamurthy, A. (2001). International and domestic collateral constraints in a model of emerging market crises. *Journal of Monetary Economics, 48*(3), 513-548.

Calderon, C., Chong, A., & Stein, E. (2007). Trade intensity and business cycle synchronization: Are developing countries any different? *Journal of International Economics, 71*(1), 2-21.

Calderon, C., & Fuentes, R. (2010). Characterizing the business cycles of emerging economies: The World Bank.

Chang, R., & Fernández, A. (2013). On the sources of aggregate fluctuations in emerging economies. *International Economic Review, 54*(4), 1265-1293.

Chen, J., & Quang, T. (2014). The impact of international financial integration on economic growth: New evidence on threshold effects. *Economic Modelling, 42*, 475-489.

Chinn, M. D., & Ito, H. (2006). What matters for financial development? Capital controls, institutions, and interactions. *Journal of development Economics, 81*, 163-192.

Chinn, M. D., & Ito, H. (2008). A New Measure of Financial Openness. *Journal of Comparative Policy Analysis, 10*(3), 309-322.

Collard, F., & Juillard, M. (2001). Accuracy of stochastic perturbation methods: The case of asset pricing models. *Journal of Economic Dynamics and Control, 25*(6), 979-999.

Committee on the Global Financial System. (2014). EME banking systems and regional financial integration *CGFS Papers*: Bank for International Settlements.

Dabla-Norris, E., & Srivisal, N. (2013). Revisiting the Link Between Finance and Macroeconomic Volatility: International Monetary Fund.

Dées, S., & Zorell, N. (2012). Business cycle synchronisation: Disentangling trade and financial linkages. *Open Economies Review, 23*(4), 623-643.

Devereux, M. B., & Sutherland, A. (2011). Evaluating international financial integration under leverage constraints. *European Economic Review, 55*(3), 427-442.

Duval, R., Cheng, K. C., Oh, K. H., Saraf, R., & Seneviratne, D. (2014). Trade Integration and Business Cycle Synchronization: A Reappraisal with Focus on Asia: International Monetary Fund.

Edwards, S., & Van Wijnbergen, S. (1986). The welfare effects of trade and capital market liberalization. *International Economic Review*, 141-148.

European Central Bank. (2015). Financial Integration in Europe: European Central Bank.

Evans, M. D., & Hnatkovska, V. V. (2007). International financial integration and the real economy. *IMF Staff Papers, 54*(2), 220-269.

Faia, E. (2007). Finance and international business cycles. *Journal of Monetary Economics, 54*(4), 1018-1034.

Faia, E. (2011). Macroeconomic and welfare implications of financial globalization. *Journal of Applied Economics, 14*(1), 119-144.

Fanta, F. (2012). Financial liberalization and consumption volatility: explaining heterogeneity across countries. *Macroeconomics and Finance in Emerging Market Economies, 5*(2), 197-212.

Friedrich, C., Schnabel, I., & Zettelmeyer, J. (2013). Financial integration and growth—Why is Emerging Europe different? *Journal of International Economics, 89*(2), 522-538.

Haddad, M., Lim, J. J., & Saborowski, C. (2010). Trade openness reduces growth volatility when countries are well diversified. *World Bank Policy Research Working Paper Series*.

Heathcote, J., & Perri, F. (2002). Financial autarky and international business cycles. *Journal of Monetary Economics, 49*(3), 601-627.

Iacoviello, M., & Minetti, R. (2006). International business cycles with domestic and foreign lenders. *Journal of Monetary Economics, 53*(8), 2267-2282.

Imbs, J. (2006). The real effects of financial integration. *Journal of International Economics, 68*(2), 296-324.

International Monetary Fund. (2010). The IMF-FSB Early Warning Exercise–Design and Methodological Toolkit: IMF Washington, DC.

International Monetary Fund. (2014a). Global Financial Stability Report—Risk Taking, Liquidity, and Shadow Banking: Curbing Excess while Promoting Growth: IMF Washington DC.

International Monetary Fund. (2014b). Global Financial Stability Report: Moving from Liquidity to Growth-Driven Markets: IMF Washington DC.

International Monetary Fund. (2014c). World Economic Outlook: Recovery Strengthens, Remains Uneven: IMF Washington DC.

International Monetary Fund. (2015a). Global Financial Stability Report—Vulnerabilities, Legacies, and Policy Challenges: Risks Rotating to Emerging Markets: IMF Washington DC.

International Monetary Fund. (2015b). World Economic Outlook: Adjusting to Lower Commodity Prices: IMF Washington DC.

Ito, T. (2001). Growth, crisis, and the future of economic recovery in East Asia. *Rethinking the East Asian Miracle, World Bank*, 55-94.

Jermann, U., & Quadrini, V. (2012). Macroeconomic effects of financial shocks. *The American Economic Review*, *102*(1), 238-271.

Kim, J., & Kim, S. H. (2003). Spurious welfare reversals in international business cycle models. *Journal of International Economics, 2*(60), 471-500.

Kiyotaki, N., & Moore, J. (1997). Credit Cycles. *The Journal of Political Economy*, *105*(2), 211-248.

Koopman, R., Wang, Z., & Wei, S.-J. (2014). Tracing value-added and double counting in gross exports. *The American Economic Review, 104*(2), 459-494.

Kose, M. A., Prasad, E., Rogoff, K. S., & Wei, S.-J. (2006). Financial Globalization: A Reappraisal: National Bureau of Economic Research.

Kose, M. A., Prasad, E. S., & Taylor, A. D. (2011). Thresholds in the process of international financial integration. *Journal of International Money and Finance, 30*(1), 147-179.

Kose, M. A., Prasad, E. S., & Terrones, M. E. (2003). Financial integration and macroeconomic volatility. *IMF Staff Papers,* 119-142.

Kose, M. A., Prasad, E. S., & Terrones, M. E. (2009). Does financial globalization promote risk sharing? *Journal of development Economics, 89*(2), 258-270.

Kose, M. A., & Yi, K.-M. (2006). Can the standard international business cycle model explain the relation between trade and comovement? *Journal of International Economics, 68*(2), 267-295.

Lane, P. R., & Milesi-Ferretti, G. M. (2007). The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004. *Journal of International Economics, 2*(73), 223-250.

Leblebicioğlu, A. (2009). Financial integration, credit market imperfections and consumption smoothing. *Journal of Economic Dynamics and Control, 33*(2), 377-393.

Levchenko, A. A. (2005). Financial Liberalization and Consumption Volatility in Developing Countries. *IMF Staff Papers, 52*(2), 237-259.

Loayza, N. V., Ranciere, R., Servén, L., & Ventura, J. (2007). Macroeconomic volatility and welfare in developing countries: An introduction. *The World Bank Economic Review, 21*(3), 343-357.

Mallikamas, R. P., Thaicharoen, Y., & Rodpengsangkaha, D. (2003). Investment Cycles, Economic Recovery and Monetary Policy. *Bank of Thailand Discussion Paper*(7).

Neumeyer, P. A., & Perri, F. (2005). Business cycles in emerging economies: the role of interest rates. *Journal of Monetary Economics, 2*(52), 345-380.

Pancaro, C. (2010). Macroeconomic volatility after trade and capital account liberalization. *World Bank Policy Research Working Paper Series*.

Park, D., & Shin, I. (2013). What Hinders Cross-Border Portfolio Investment In East Asia? *The Singapore Economic Review, 58*(02), 1350012.

Perri, F., & Quadrini, V. (2011). International recessions: National Bureau of Economic Research.

Pisani, M. (2011). Financial openness and macroeconomic instability in emerging market economies. *Open Economies Review, 22*(3), 501-532.

Pongsaparn, R., & Unteroberdoerster, O. (2011). Financial integration and rebalancing in Asia: International Monetary Fund.

Prasad, E. S., Rogoff, K., Wei, S.-J., & Kose, M. A. (2007). Financial globalization, growth and volatility in developing countries *Globalization and Poverty* (pp. 457-516): University of Chicago Press.

Quadrini, V. (2011). Financial frictions in macroeconomic fluctuations. *Economic Quarterly, 97*(3), 209-255.

Quinn, D., Schindler, M., & Toyoda, A. M. (2011). Assessing measures of financial openness and integration. *IMF Economic Review, 59*(3), 488-522.

Ratanavararak, L. (in press). The impact of financial and trade integration on business cycles in emerging markets. *International Journal of Monetary Economics and Finance*.

Ravn, M. O., & Mazzenga, E. (2004). International business cycles: the quantitative role of transportation costs. *Journal of International Money and Finance, 23*(4), 645-671.

Rose, A. K., & Spiegel, M. M. (2002). A Gravity Model of International Lending: Trade, Default and Credit: CEPR Discussion Papers.

Sarel, M. (1997). Growth and Productivity in ASEAN Countries: International Monetary Fund.

Schmitt-Grohé, S., & Uribe, M. (2003). Closing small open economy models. *Journal of International Economics, 61*(1), 163-185.

Schmitt-Grohé, S., & Uribe, M. (2004). Solving dynamic general equilibrium models using a second-order approximation to the policy function. *Journal of Economic Dynamics and Control, 28*(4), 755-775.

Senay, O. (1998). The effects of goods and financial market integration on macroeconomic volatility. *The Manchester School, 66*(s), 39-61.

Stavarek, D., Repkova, I., & Gajdosova, K. (2011). Theory of financial integration and achievements in the European Union: University Library of Munich, Germany.

Ueda, K. (2012). Banking globalization and international business cycles: Cross-border chained credit contracts and financial accelerators. *Journal of International Economics, 86*(1), 1-16.

Uribe, M., & Yue, V. Z. (2006). Country spreads and emerging countries: Who drives whom? *Journal of International Economics, 1*(69), 6-36.

World Bank. (2015). Global Financial Development Report 2015/2016: Long-Term Finance. Washington, DC: World Bank.

Appendix A: List of Countries and Data Description

Table A.1 List of countries and grouping[34]

Country groups	Countries
Advanced economies:	Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Singapore, Slovak Republic, Slovenia, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States
Emerging market economies:	*East Asia:* China, Indonesia, Malaysia, Philippines, Thailand
	Europe and Central Asia: Bulgaria, Croatia, Hungary, Poland, Romania, Russia, Serbia, Turkey, Ukraine
	Latin America: Argentina, Brazil, Chile, Colombia, Mexico, Peru, Venezuela
	Middle East and North Africa (MENA): Egypt, Jordan, Lebanon, Morocco, Saudi Arabia
	South Asia: India, Pakistan, Sri Lanka
	Sub-Saharan Africa: South Africa

Table A.2 Definitions and data sources of variables

Variable	Definition	Source
Chinn-Ito capital account openness (KAOPEN)	A de jure measure of capital account openness based on the data from IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The index is normalized to range between zero and one. A higher value of the score indicates higher degree of capital account openness.	Chinn and Ito (2006, 2008) http://web.pdx.edu/~ito/Chinn-Ito_website.htm
Foreign assets and liabilities	Foreign assets are stock amounts of portfolio equity, FDI, debt, financial derivatives and foreign exchange reserves minus gold. Foreign liabilities are stock amounts of portfolio equity liabilities, FDI, debt, and financial derivatives.	Lane and Milesi-Ferretti's (2007) The External Wealth of Nations Mark II database 2011 http://www.philiplane.org/EWN.html
Foreign direct investment (FDI)	The sum of inward and outward amounts of FDI stock.	United Nations Conference on Trade and Development (UNCTAD)
Foreign portfolio investment (FPI)	The sum of reported portfolio investment assets and derived portfolio investment liabilities in amounts outstanding at end-of-period. Portfolio investment includes debt securities, equity and investment fund shares.	Coordinated Portfolio Investment Survey (CPIS), IMF
International bank claim	Amounts outstanding of international consolidated bank claims on an immediate borrower basis, calculated as a sum of cross-border bank claims and local claims of foreign affiliates in foreign currency. The series are discontinued in middle 2015.	Bank for International Settlements (BIS)

[34] The grouping of advanced and emerging economies is based on IMF (2010, 2015a, 2015b).

Variable	Definition	Source
Private external debt	Gross external debt positions to the other sectors, which exclude government, central bank, deposit-taking corporations, and intercompany lending. External debts include short-term and long-term currency and deposits, debt securities, loans, trade credit and advances and other debt liabilities.	Quarterly External Debt Statistics (QEDS), World Bank
Trade	The ratio of the sum of export and import of goods and services to GDP	World Development Indicators (WDI), World Bank

Appendix B: Technical Appendix

B.1 Derivation of Relationship between Financial Integration and m

From the international leverage constraint in equation (7) in the non-stochastic steady state, divide both sides with GDP = $\overline{q_1^a}\overline{Y_1}$. The variables with bar means their corresponding state steady values. This yields

$$\frac{\overline{q_1^a}\bar{B}}{\overline{q_1^a}\overline{Y_1}} = m\frac{\overline{P_1}\overline{K_1}}{\overline{q_1^a}\overline{Y_1}} \tag{B-1}$$

The ratio on the right hand side can be substituted by the parameters as follow. First, from the first order conditions (FOCs) of home and foreign households in equation (4) and (23), it can be deduced that in the steady state, $\overline{Q^Z} = \beta_1$ and $\overline{Q^B} = \beta_2$. Obtaining the leverage constraint Lagrange multiplier $\bar{\lambda} = (\beta_2 - \beta_1)/\overline{P_1}\overline{C_1^o}$ from home entrepreneurs' FOC in equation (13) and put this in FOC equation (11) yields;

$$\frac{1}{\overline{C_1^o}} = \beta_1\frac{1}{\overline{C_1^o}}\left[\frac{\alpha_1\overline{q_1^a}\overline{Y_1}}{\overline{P_1}\overline{K_1}} + (1-\delta)\right] + m\frac{(\beta_2-\beta_1)}{\overline{C_1^o}} \tag{B-2}$$

Rearrange to get

$$\frac{\overline{P_1}\overline{K_1}}{\overline{q_1^a}\overline{Y_1}} = \frac{\alpha_1\beta_1}{1 - m(\beta_2-\beta_1) - \beta_1(1-\delta)} \tag{B-3}$$

Put back in equation (B-1) and let $FI_1 = \overline{q_1^a}\bar{B}\big/\overline{q_1^a}\overline{Y_1}$.

$$FI_1 = \frac{\overline{q_1^a}\bar{B}}{\overline{q_1^a}\overline{Y_1}} = m\left[\frac{\alpha_1\beta_1}{1-(\beta_2-\beta_1)-\beta_1(1-\delta)}\right] \tag{B-4}$$

This is equal to equation (39).

B.2 Derivation of Relationship between Trade Integration and $\boldsymbol{\omega}$

From the FOCs of home final goods firms in the non-stochastic steady state as follow;

$$\left(\overline{q_1^a}\right)^{\sigma}\overline{a_1} = (1-\omega_1)^{\sigma}\overline{P_1^{\sigma}G_1} \tag{16}$$

$$\left(\overline{q_1^b}\right)^{\sigma}\overline{b_1} = \omega_1^{\sigma}\overline{P_1^{\sigma}G_1} \tag{17}$$

Divide (16) with (17)

$$\left(\frac{\overline{q_1^a}}{\overline{q_1^b}}\right)^{\sigma}\frac{\overline{a_1}}{\overline{b_1}} = \frac{(1-\omega_1)^{\sigma}}{\omega_1^{\sigma}} \tag{B-5}$$

Rearrange to obtain;

$$\overline{q_1^a}\overline{a_1} = \left(\frac{1-\omega_1}{\omega_1}\right)^{\sigma}\left(\frac{\overline{q_1^b}}{\overline{q_1^a}}\right)^{\sigma-1}\overline{q_1^b}\overline{b_1} \tag{B-6}$$

From the market clearing condition in equation (32), multiply both sides with the price $\overline{q_1^a}$.

$$\overline{q_1^a}\overline{Y_1} = \overline{q_1^a}\overline{a_1} + \overline{q_1^a}\overline{a_2} \tag{B-7}$$

Substitute $\overline{q_1^a}\overline{a_1}$ using (B-6)

$$\overline{q_1^a}\overline{Y_1} = \left(\frac{1-\omega_1}{\omega_1}\right)^{\sigma}\left(\frac{\overline{q_1^b}}{\overline{q_1^a}}\right)^{\sigma-1}\overline{q_1^b}\overline{b_1} + \overline{q_1^a}\overline{a_2} \tag{B-8}$$

Divide both sides by $\overline{q_1^a}\overline{Y_1}$ to obtain the ratio to GDP.

$$1 = \left(\frac{1-\omega_1}{\omega_1}\right)^{\sigma}\left(\frac{\overline{q_1^b}}{\overline{q_1^a}}\right)^{\sigma-1}\frac{\overline{q_1^b}\overline{b_1}}{\overline{q_1^a}\overline{Y_1}} + \frac{\overline{q_1^a}\overline{a_2}}{\overline{q_1^a}\overline{Y_1}} \tag{B-9}$$

Denote $\overline{q_1^b}/\overline{q_1^a} = TOT_1$, the home import share $MS_1 = \overline{q_1^b}\overline{b_1}/\overline{q_1^a}\overline{Y_1}$, and the home export share $XS_1 = \overline{q_1^a}\overline{a_2}/\overline{q_1^a}\overline{Y_1}$, the above equation becomes

$$1 = \left(\frac{1-\omega_1}{\omega_1}\right)^{\sigma}(TOT_1)^{\sigma-1}MS_1 + XS_1 \tag{B-10}$$

This equation can be rearranged to yield equation (42) to (44).

B.3 Computation of Adjusted Trade

Trade data used to derive the Armington weight parameters are from WDI and TiVA database. Table B.1 summarizes the data series used to calculate adjusted trade for parameter calibration. The computation is as follows;

1.) Compute import and export percentage adjustment from the TiVA data for each country as follows;

$$\text{Imports adjustment (\% of gross imports)} = 1 - \frac{\text{Foreign value added content of exports}}{\text{Gross imports}}$$

$$\text{Exports adjustment (\% of gross exports)} = \text{Domestic value-added share of gross exports}$$

2.) Calculate the adjusted imports and exports by multiplying the percentage adjustment from 1.) with the 2000-2013 average of raw gross imports and exports values from WDI at the country level as the following.

$$\text{Adjusted imports (\% of GDP)} = [\text{Raw imports from WDI (\% of GDP)}] \times (\text{Imports adjustment})$$

$$\text{Adjusted exports (\% of GDP)} = [\text{Raw exports from WDI (\% of GDP)}] \times (\text{Exports adjustment})$$

However, TiVA database only covers 55 countries out of 65 emerging market and advanced countries used in this study. For the ten countries with missing values, the region group's average of imports and exports percentage adjustment would be used instead to adjust the raw trade downward. After adjustment, the adjusted imports and exports all fall below 100 percent of GDP, unlike the raw series that exceed 100 percent of GDP for some countries.

3.) Average the adjusted imports and exports by country group; emerging ASEAN, other EMEs, and advanced economies.

Table B.1 Summary of trade data for parameter calibration

Series	Unit	Source	Data period	Number of countries
Foreign value added content of gross exports	Value	TiVA	2011	55
Gross imports	Value	TiVA	2011	55
Domestic value added share of gross exports	% of gross exports	TiVA	2011	55
Imports of goods and services	% of GDP	WDI	2000-2013 average	65
Exports of goods and services	% of GDP	WDI	2000-2013 average	65

B.4 Computation of Welfare Criteria

The measure of welfare criteria is computed as a percentage permanent increase in non-stochastic steady-state consumption to the level of certainty-equivalent consumption implied by the stochastic equilibrium. This measure is taken from Devereux and Sutherland (2011). It is a relative measure to the steady state and not dominated by the size of the steady-state consumption. The computation of the home household's welfare as an example is as follows;

1.) Compute unconditional expected lifetime utility EU_1^h using the simulated variables from a second order approximation of the model

2.) From the utility function of the home household; $U_{1t}^h = E_t \sum_{t=0}^{\infty} \beta_1^t \left[ln\left(C_{1t}^h\right) - \kappa L_{1t}\right]$, use the property of geometric power series to write the steady state value of expected lifetime utility $\overline{U_1^h}$ as

$$\overline{U_1^h} = E_t \sum_{t=0}^{\infty} \beta_1^t \left[ln\overline{C_1^h} - \kappa\overline{L_1}\right] = \frac{ln\overline{C_1^h} - \kappa\overline{L_1}}{1-\beta_1} \tag{B-11}$$

where $\overline{C_1^h}$ and $\overline{L_1}$ denote the steady-state values of consumption and labor.

3.) Find the level of certainty-equivalent consumption associated with the stochastic equilibrium utility EU_1^h relative to the non-stochastic steady stead by equating

$$EU_1^h = \frac{ln\left[(1+g_1^h)\overline{C_1^h}\right] - \kappa\overline{L_1}}{1-\beta_1} \tag{B-12}$$

and solve for the value of g_1^h implied by the above equation, which yields

$$g_1^h = \frac{exp\left[(1-\beta_1)EU_1^h + \kappa\overline{L_1}\right]}{\overline{C_1^h}} - 1 \tag{B-13}$$

where g_1^h denotes a shift in the level of steady-state consumption required to make the household as well off as in the stochastic equilibrium. A positive value of g_1^h means the households are better off in the stochastic economy than in the non-stochastic steady state. A negative value, -1% for instance, means the consumer would have to give up 1% of consumption in the particular scenario as compared to the steady state (Devereux & Sutherland, 2011). Thus, the higher value, the better, and negative values suggest welfare cost.

The welfare criteria for the home entrepreneurs g_1^o and the aggregate domestic consumers g_1 can be computed similarly as;

$$g_1^o = \frac{\exp\left[(1-\beta_1)EU_1^o\right]}{\overline{C_1^o}} - 1 \tag{B-14}$$

$$g_1 = \frac{\exp\left[(1-\beta_1)EU_1 + \kappa\overline{L_1}\right]}{\overline{C_1^o}\,\overline{C_1^h}} - 1 \tag{B-15}$$