FINANCIAL AND TRADE INTEGRATIONS
ON INTERNATIONAL BUSINESS CYCLE
UNDER MARKET IMPERFECTION AND HETEROGENEOUS AGENTS

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ผลกระทบของความเชื่อมโยงทางการเงินและการค้าระหว่างประเทศต่อวัฏจักรเศรษฐกิจ ภายใต้ความไม่สมบูรณ์ของตลาดและหน่วยเศรษฐกิจที่มีความแตกต่างกัน

นางสาวลัทธพร รัตนวรารักษ์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาเศรษฐศาสตรดุษฎีบัณฑิต
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ลัทธพร รัตนวรารักษ์ : ผลกระทบของความเชื่อมโยงทางการเงินและการค้าระหว่างประเทศต่อวัฏจักรเศรษฐกิจภายใต้ความไม่สมบูรณ์ของตลาดและหน่วยเศรษฐกิจที่มีความแตกต่างกัน (FINANCIAL AND TRADE INTEGRATIONS ON INTERNATIONAL BUSINESS CYCLE UNDER MARKET IMPERFECTION AND HETEROGENEOUS AGENTS) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร. สมประวิณ มันประเสริฐ, 297 หน้า.

วิทยานิพนธ์นี้ศึกษาผลกระทบของความเชื่อมโยงทางการเงิน (Financial integration; FI) และความเชื่อมโยงทางการค้าระหว่างประเทศ (Trade integration; TI) ต่อวัฏจักรเศรษฐกิจและคนในเศรษฐกิจตลาดเกิดใหม่ที่มีข้อจำกัดทางการเงินและการเข้าถึงทางการเงินที่ไม่สมบูรณ์ การศึกษาใช้วิธีดุลยภาพทั่วไปเชิงสุ่มแบบพลวัต (dynamic stochastic general equilibrium; DSGE) และได้สร้างแบบจำลองวัฏจักรเศรษฐกิจจริง (real business cycle; RBC) เพื่อศึกษา FI จากหลายแง่มุม

ผลจากการศึกษาในสามหัวข้อย่อยพบว่าผลกระทบของ FI ต่อความผันผวนของตัวแปรเศรษฐกิจมหภาคและสหสัมพันธ์ของวัฏจักรเศรษฐกิจนั้นให้ผลแตกต่างกันไป โดยขึ้นอยู่กับระดับการค้าระหว่างประเทศ ประเภทของ FI ความรุนแรงของข้อจำกัดทางการเงิน และการเข้าถึงทางการเงิน โดย FI ช่วยลดความผันผวนของระดับการบริโภค และส่งเสริมสวัสดิการของแต่ละคนได้ค่อนข้างน้อยหรือไม่ได้เมื่อมีความไม่สมบูรณ์ของตลาด กลุ่มคนที่มีข้อจำกัดทางการเงินระหว่างประเทศมากกว่าและไม่สามารถหันมาใช้ตลาดในประเทศทดแทนได้เต็มที่มีแนวโน้มที่จะได้รับผลกระทบทางลบจาก FI มากกว่า ในขณะที่ TI นั้นส่วนใหญ่แล้วพบว่าช่วยลดความผันผวนของผลผลิตและการบริโภค เพิ่มสหสัมพันธ์ของวัฏจักรเศรษฐกิจระหว่างสองประเทศ และช่วยส่งเสริมสวัสดิการของคนในสังคมเล็กน้อย ผลการศึกษายังพบว่า FI อาจจะส่งผลกระทบน้อยลงเมื่อมีการค้าระหว่างประเทศสูง เนื่องจาก FI และ TI นั้นส่วนมากส่งผลต่อวัฏจักรเศรษฐกิจในทางตรงกันข้ามและผลอาจจะหักลบกัน โดยรวมพบว่าผลของ FI มีทั้งเชิงบวกและเชิงลบ ดังนั้น การเพิ่มระดับ FI ให้สูงขึ้นเมื่อยังมีความไม่สมบูรณ์ของตลาดอยู่อาจไม่ส่งผลดีเสมอไป และระดับ FI ที่ไม่มากหรือน้อยเกินไปประกอบกับ TI ที่สูงน่าจะส่งผลต่อวัฏจักรเศรษฐกิจในทางที่ดีกว่า

ผลการศึกษาเสนอว่า นโยบายที่เกี่ยวกับความเชื่อมโยงทางการเงินระหว่างประเทศควรจะได้รับการพิจารณาแบบบูรณาการ ร่วมกับการสนับสนุน TI การลดข้อจำกัดทางการเงิน การส่งเสริมการเข้าถึงทางการเงิน และการพัฒนาระบบการเงินในประเทศควบคู่กัน การสนับสนุนความเชื่อมโยงระหว่างประเทศในทั้งสองตลาดควบคู่กันนั้นน่าจะส่งผลดีต่อเสถียรภาพของระบบเศรษฐกิจมากกว่าการให้ความสำคัญเฉพาะ FI และควรสนับสนุนให้ทุกคนสามารถเข้าถึงและใช้ประโยชน์จากผลิตภัณฑ์และบริการทางการเงินได้ทุกประเภทอย่างทั่วถึง นอกจากนี้ตลาดการเงินในประเทศเป็นอีกปัจจัยหนึ่งที่จะช่วยสนับสนุนเศรษฐกิจตลาดเกิดใหม่ที่ยังมีความเชื่อมโยงทางการเงินกับประเทศอื่นไม่สมบูรณ์

สาขาวิชา เศรษฐศาสตร์	ลายมือชื่อนิสิต ....
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5685903729 : MAJOR ECONOMICS
KEYWORDS: FINANCIAL INTEGRATION; TRADE INTEGRATION; EMERGING MARKET ECONOMIES; MACROECONOMIC VOLATILITY; BUSINESS CYCLE SYNCHRONIZATION; REAL BUSINESS CYCLE MODEL; CONSUMPTION SMOOTHING

LATHAPORN RATANAVARARAK: FINANCIAL AND TRADE INTEGRATIONS ON INTERNATIONAL BUSINESS CYCLE UNDER MARKET IMPERFECTION AND HETEROGENEOUS AGENTS. ADVISOR: ASSOC. PROF. SOMPRAWIN MANPRASERT, Ph.D., 297 pp.

This thesis studies the effect of financial integration (FI) together with trade integration (TI) on international business cycles and different types of market participants in emerging markets under the presence of financial frictions and imperfect access to finance. The study adopted dynamic stochastic general equilibrium (DSGE) framework and developed three international real business cycle (RBC) models to examine FI from various aspects.

The simulation results show that the effect of FI on macroeconomic volatility and business cycle synchronization is mixed likely depending on TI, types of financial flow, severity of market frictions, and financial accessibility. Consumption smoothing benefit and welfare gain from higher FI are small or absent when market imperfection exists. People with more financial restrictions and no unconstrained domestic markets to rely on tend to be more negatively affected by increasing FI. TI generally lowers output and consumption fluctuation, increases business cycle synchronization, and slightly enhances welfare. Some evidences suggest that the impact of FI is weakened under higher trade possibly because FI and TI affect business cycles in opposite directions and their impacts might offset each other. Overall, there is a trade-off among diverse impacts of FI and greater FI is not entirely beneficial. Medium amount of FI combined with high trade tends to yield more desirable outcomes.

The implication is that integrated policies are preferable. FI should be considered together with enhancing TI, reducing asymmetric frictions, improving unequal financial access, and advancing financial development. Deepening integration in both markets may be more favorable to business cycles than focusing at only FI. Everyone should be able to access and utilize saving, investment and borrowing opportunities. Moreover, a sound domestic financial market is an important support when FI is imperfect.

Field of Study: Economics	Student's Signature ....
Academic Year: 2016	Advisor's Signature ....

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AEs	Advanced economies
AREAER	Annual Report on Exchange Arrangements and Exchange Restrictions
ASEAN	Association of Southeast Asian Nations
BCS	Business cycle synchronization
BIS	Bank for International Settlements
CES	Constant elasticity of substitution
CGE	Computable general equilibrium
CPI	Consumer price index
CPIS	Coordinated Portfolio Investment Survey
DSGE	Dynamic stochastic general equilibrium
ECB	European Central Bank
EMEs	Emerging market economies
FDI	Foreign direct investment
FI	Financial integration
FOC	First order condition
FPI	Foreign portfolio investment
GDP	Gross domestic product
GFDD	Global Financial Development Database
HFI	High financial integration
HP	Hodrick-Prescott
HTI	High trade integration
IMF	International Monetary Fund
IRBC	International real business cycle
IRF	Impulse response function
KAOPEN	Chinn-Ito Index of capital account openness
LFI	Low financial integration
LTI	Low trade integration
LTV	Loan-to-value
MENA	Middle East and North Africa
MFI	Medium financial integration
MTI	Medium trade integration
NBFI	Non-bank financial institutions
NFA	Net foreign asset
NK	New Keynesian
OECD	Organisation for Economic Co-operation and Development
OLG	Overlapping generations model
QEDS	Quarterly External Debt Statistics
RBC	Real business cycle

ROA	Return on Assets
SD	Standard deviation
TI	Trade integration
TiVA	Trade in Value Added
TOT	Terms of trade
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WEF	World Economic Forum
WTO	World Trade Organization

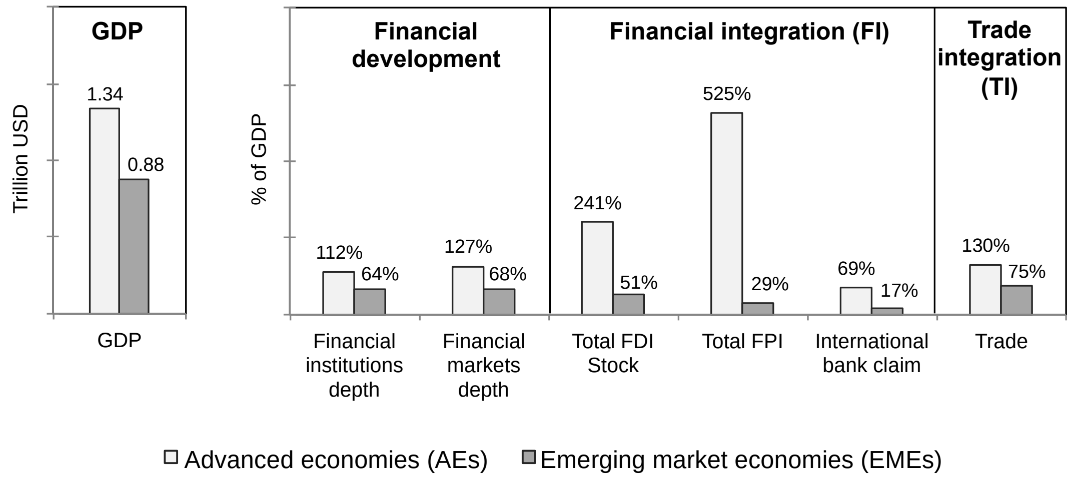
Chapter 1
Introduction

1.1. Background and Significance of the Problem

The world economy nowadays is considerably integrated in both goods and financial markets. This is manifested by more openness to international trade, greater trade and financial linkages, risen cross-border financial flows and foreign asset holdings, and fewer restrictions on international asset trading. Increasing international integration is also observed in emerging market economies, but their progress still lags far behind the advanced economies in the area of financial integration (Aizenman, Jinjarak, & Park, 2013; Borensztein & Loungani, 2011; Eichengreen & Park, 2003).

Overall, emerging market economies have lower level of financial development than advanced economies. Their financial depth as measured from the size of domestic private credit and the size of stock market capitalization plus debt securities in 2014 are 64 and 68 percent of GDP respectively, roughly half the size of financial depth in developed countries (Figure 1.1). The degree of financial integration in emerging markets is even lower. The sizes of foreign direct investment (FDI), foreign portfolio investment (FPI), and international bank claim are only 51, 29, and 17 percent of GDP respectively, which are smaller than one fourth of the numbers in industrial economies. Possible causes of low financial integration are capital flow restriction, information costs, and transaction costs (Auster & Foo, 2015; Ma, 2016; D. Park & Shin, 2013; Pongsaparn & Unteroberdoerster, 2011). The level of financial openness in emerging markets does not match their higher level of trade intensity, which is 75 percent of GDP in 2014, especially for East Asian countries (Pongsaparn & Unteroberdoerster, 2011). This figure is also lower than developed countries, but the trade integration gap between two groups of countries is much narrower than that of financial integration.

Figure 1.1 Average gross domestic product (GDP), financial, and trade variables in emerging markets and advanced economies 2014



Source: author's calculation.

Note: The figures are averages by country within the group. AEs comprise of 35 advanced economies; EMEs comprise of 30 emerging economies; financial institutions depth is measured by the size of domestic credit to private sector; financial market depth is measured by the sum of stock market capitalization and domestic private debt securities; FDI = foreign direct investment; FPI = foreign portfolio investment; data source, description, and country grouping are described in Appendix A.

Financial integration has been an important issue for emerging market economies. There are initiatives to integrate deeper into regional and global financial markets as well as debates whether it benefits emerging markets or not. There is no straightforward answer given that financial integration has a trade-off between benefits and costs. International 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. Moreover, emerging economies have less developed financial markets, lower institutional quality and possibly more market imperfection, so they might not be able to reap the gains from financial integration like the developed countries, while the downside has been witnessed through a number of crises.

A large amount of empirical literatures attempt to measure the gains from financial integration on economic growth, but fail to provide strong evidences of positive relation between the two. The level of country's development and the type of cross-border financial flow might matter. It might be more difficult for developing countries that are more prone to crisis to obtain growth benefit (Arteta, Eichengreen, & Wyplosz, 2001; Obstfeld, 2009). FDI is widely accepted to be beneficial while the results on other types of financial flows are less conclusive (Aizenman et al., 2013; Arteta et al., 2001).

There is a conjecture that an economy could achieve gain from financial liberalization when domestic financial reform and trade liberalization are put in place first (Ito, 2001; Kose, Prasad, Rogoff, & Wei, 2006). Trade integration is viewed as closely related and complementary to financial integration (Aizenman & Noy, 2009; Aviat & Coeurdacier, 2007; Borensztein & Loungani, 2011). Trade could enhance economic growth and mitigate the crisis associated with financial integration (Arteta et al., 2001; Kose, Prasad, Rogoff, et al., 2006). As a result, empirical studies usually explore financial integration together with international trade. However, a robust evidence has not yet been found that trade integration plays a role in determining how financial integration affects growth despite of its direct one-to-one relations with both financial integration and growth.

The impact of financial integration on macroeconomic volatility and business cycle synchronization is also widely studied. Macroeconomic volatility is undesirable and negatively associated with economic growth (Ramey & Ramey, 1995). Business cycle synchronization is concerned with comovement, international risk diversification, and dependency between countries. Empirical papers studying business cycles usually include trade integration, same as growth literature. The two types of integration are empirically found to 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. Only one robust finding is that international trade enhances business cycle synchronization (see Calderon, Chong, and Stein (2007), Dées and Zorell (2012), and Duval, Cheng, Oh, Saraf, and Seneviratne (2014) for example).

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 and 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 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 financial and trade integration.

These quantitative researches on financial and trade integration usually incorporate financial frictions as they could help explain business cycles and shock transmission (Brunnermeier, Eisenbach, & Sannikov, 2012; Doepke, Lehnert, & Sellgren, 1999; 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, likely more institutional and market imperfection, and not everyone has access to international finance (Calderon & Fuentes, 2010; Levchenko, 2005).

There are papers that study emerging market economies with financial frictions and imperfect access to international financial 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 access more than people without access in terms of consumption smoothing and welfare gain.

Motivated by the above observations, this thesis aims to investigate the effect of financial and trade integration together on international business cycles in emerging markets under the presence of financial frictions and imperfect access implemented through heterogeneous agent setting. The research questions are whether financial integration could help lower aggregate fluctuation, influence business cycle comovement, and enhance welfare when asymmetric market imperfections exist; whether the effect of financial integration depends on the level of trade intensity as still questionable in the literature; how different types of market participants are affected by international integration, financial frictions, and accessibility; and how accessibility to international markets and domestic financial market play roles when financial integration is imperfect. It additionally attempts to find out if there is any revealing combination of the two types of integration that would benefit emerging market economies and whether the country should enhance FI given certain level of trade.

The study builds upon previous researches by largely combining two strands of existing literature – researches examining the impact of financial and trade integration on business cycle and researches investigating the impact of financial integration in emerging markets with asymmetric financial frictions and access. Incorporating trade integration and market imperfection together might help explaining the inconclusive effect of financial integration on business cycles found in the current literature. The specific focus on emerging markets that have distinct characteristics could help extend earlier studies that are more generalized or pay more attention to developed countries. The study employs quantitative general equilibrium framework, which could complement the findings from empirical researches that rely on historical data and might offer alternative views on the issue.

This study explores aspects of financial integration that are related to trade and international business cycles. It constitutes a part of overall international integration and the financial systems. A better understanding regarding the implication of international integration on business cycles is important for policymakers to implement appropriate macroeconomic stability policies (International Monetary Fund, 2014a; Quinn, Schindler, & Toyoda, 2011). It could also provide useful recommendation in managing international integration to obtain benefits from financial openness while maintaining a low level of risk associated with it.

1.2. Objectives of the Study

The central objective of this thesis is to examine the impact of financial and trade integration together on international business cycles, the economy, and different types of market participants with unequal access to finance when financial frictions are present. The study will be carried out in the context of emerging market economies.

The research consists of three studies with three corresponding sub-objectives as follow.

1.) To investigate the effect of increased cross-border borrowing together with trade integration on macroeconomic volatility and welfare of different market participants in emerging market economies.
2.) To examine the impact of higher foreign asset investment together with trade integration on macroeconomic volatility, business cycle synchronization and different types of market participants in emerging market economies.
3.) To explore agent heterogeneity and the implication of different types of accessibility to international financial markets on business cycles in emerging markets under varying degrees of trade integration.

1.3. Expected Benefits of the Study

This study hopes to fill the research gap in the literature that there is a lack of studies investigating the implication of FI and TI together on business cycles under the emerging market setting. In this regards, it broadly combines two kinds of researches.

On the one hand, it can be viewed as expanding the general equilibrium literature investigating the effect of financial and trade integration on business cycles to study emerging economies by incorporating asymmetric frictions across countries and heterogeneity within the economy. It attempts to extend papers such as Senay (1998) and Kose and Yi (2006) that examine general or developed countries to cover emerging markets that have more market frictions and lower financial development. This study also incorporates heterogeneity within the country to investigate asymmetric financial access among domestic residents and domestic financial markets with both savers and borrowers, which are neglected by earlier papers, for instance, Senay (1998), Kose and Yi (2006), Heathcote and Perri (2002), and Pancaro (2010).

On the other hand, it can be considered as extending the literature exploring the impact of imperfect financial integration in emerging markets such as the paper by Leblebicioğlu (2009) to include trade integration.

The second key contribution of this research is the construction of three real business cycle (RBC) models to examine different aspects of imperfect financial integration in emerging markets. The three models attempt to describe the integration between two economies and the interaction among agents within the same country. They are built upon many existing models to incorporate financial integration, international trade, asymmetric financial frictions, imperfect access to international finance, heterogeneous agents, and domestic financial market altogether.

Another expected benefit is that this study hopes to provide a comprehensive perspective of financial integration in addition to previously studied aspects. The aspects covered in this study are inward and outward financial flows, investor's and borrower's problems, two main kinds of financial frictions, imperfect access when some people are restricted from foreign asset trading, intermediate levels of integration between autarky and complete which suit current situation more, and the role of domestic financial markets. These reflect a broader view that financial integration does not only refer to cross-border financial flows, but also relates to equal financial access and reduction of asymmetric frictions.[1] This could expand earlier studies that usually explore financial integration in the aspect of different asset market structures[2] like Heathcote and Perri (2002) and Devereux and Sutherland (2011b) and extreme cases of complete-or-none integration like Kose and Yi (2006) and Leblebicioğlu (2009).[3]

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

[2] 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.

[3] Comparison of these papers and the present thesis is further illustrated in Appendix B.

Additionally, this study adopts a quantitative general equilibrium approach that could analyze hypothetical scenarios and complement the empirical evidences that rely on historical data. The methodology employs recent financial and trade data from emerging markets.

Lastly, this research expects to widen the understanding of the relationship between two types of international integration and business cycles when market imperfections are present. The results might offer explanation to the inconclusive findings on the relationship. Understanding the consequences of international integration is important for policymakers in emerging markets. The findings from this study are hoped to provide useful suggestion for the policy design and possibly the debate on the benefits of financial integration.

1.4. Key Terms and Definitions

For the purpose of this study, *financial integration* refers to the access to foreign and global financial markets; the ability to borrow, lend, save, and invest across countries; the ease of cross-border financial transactions; and the amount of cross-border financial flows and foreign assets and liabilities. The term is used interchangeably with *financial openness* and *integration of financial markets*. The term is related to financial globalization and financial liberalization, but they are not the same things. The term financial integration is mainly employed in this study (abbreviated as *FI* hereafter), while other alternatives could be present.

The definition of *trade integration* is typical. It refers to the amount of cross-border goods trade. The term is used interchangeably with *trade intensity, trade openness, international trade*, and *integration in goods market*. It relates to the concept of free trade, but they are not the same things.[4] The term trade integration is mainly used in this study (abbreviated as *TI* hereafter), while other alternatives could be present.

The definitions of financial and trade integration are discussed in the next chapter.

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[4] To distinguish the terms in the present thesis, trade integration represents the actual amount of international goods trade occurred, while free trade refers to the ability to trade freely across countries with no barriers and the law of one price and purchasing power parity hold.

1.5. Outline of the Thesis

The structure of this study is as follows.

Chapter 2 provides an overview of financial development, financial integration (FI), trade integration (TI), and other related financial concepts on the definitions, empirical measures, their relations, and benefits and costs. It also presents the level of financial development, FI, and TI in emerging market economies (EMEs) as compared to advanced economies (AEs). The last section of this chapter reviews stylized facts of business cycles focusing primarily on emerging markets.

Chapter 3 reviews the existing literatures. The first half of the chapter focuses on the relationship between FI, TI, economic growth, and international business cycles. The review includes both studies adopting empirical approaches and quantitative general equilibrium models. The second half reviews the methodology used in this thesis, which are the dynamic stochastic general equilibrium (DSGE) framework and international real business cycle (IRBC) model.

Chapter 4 described the overall methodology including the rationales behind the choices of model and assumptions and the tools used to perform the simulation.

The three studies under this thesis are presented in Chapter 5, 6, and 7. They investigate sub-objective 1, 2, and 3 respectively. Each chapter begins with a summary of the chapter, and then presents and discusses the model. There are three main models – one studied under each chapter. The simulation results on macroeconomic volatility, business cycle comovement, response to shocks, and welfare are presented and discussed, depending on the chapter.

Chapter 8 compares the features of and the results from the three studies in Chapter 5 to 7. It discusses and summarizes the findings regarding both similarities and dissimilarities.

Lastly, Chapter 9 concludes the findings and summarizes the contribution of this thesis. The last part discusses limitation of the study and provides suggestion for future researches.

Chapter 2
Financial Development, Financial Integration, Trade Integration, and Business Cycle Stylized Facts

This chapter provides an overview of financial development, financial integration, trade integration, and other related financial concepts on how they are defined and measured, and the current trend in emerging market and advanced economies. The last part reviews stylized facts of business cycles focusing primarily on emerging markets. These altogether depict a broad picture of issues that are related to this thesis, which connects financial integration to aggregate fluctuation and constitutes one part of a larger financial system and the economy.

2.1. Financial Development

2.1.1. Definition of Financial Development

Financial development is a broad and multi-dimensional concept. It can be defined as a process of improving the quality of financial system, financial sector functions, and financial services (World Bank, 2012). It can also be defined as a process of mitigating market imperfections such as imperfect information, transaction cost, and contract enforceability (World Bank, 2012, 2015). The desirable outcomes of financial development are, for instance, effective and efficient financial services provision, financial markets that meet the needs of economic agents, and a sound financial system that supports economic growth (World Bank/International Monetary Fund, 2005; World Economic Forum, 2012).

2.1.2. Measures of Financial Development

Since financial development can be characterized by many factors, measuring it empirically is challenging (World Bank, 2015). Different organizations have different ways to measure the level of financial development and compare it among countries. For example, the World Bank adopts the "4x2 framework" introduced in 2013 (World Bank, 2012). The framework analyzes four characteristics of financial development; namely, depth, access, efficiency, and stability, of two sectors of financial services; financial institutions and financial markets. The 4x2 matrix shown in Figure 2.1 is directly taken from World Bank with examples of variables in each category. Another example is the World Economic Forum (WEF) that develops the "Financial Development Index". The index consists of seven pillars that together measure the financial development illustrated in Figure 2.2 (World Economic Forum, 2012).

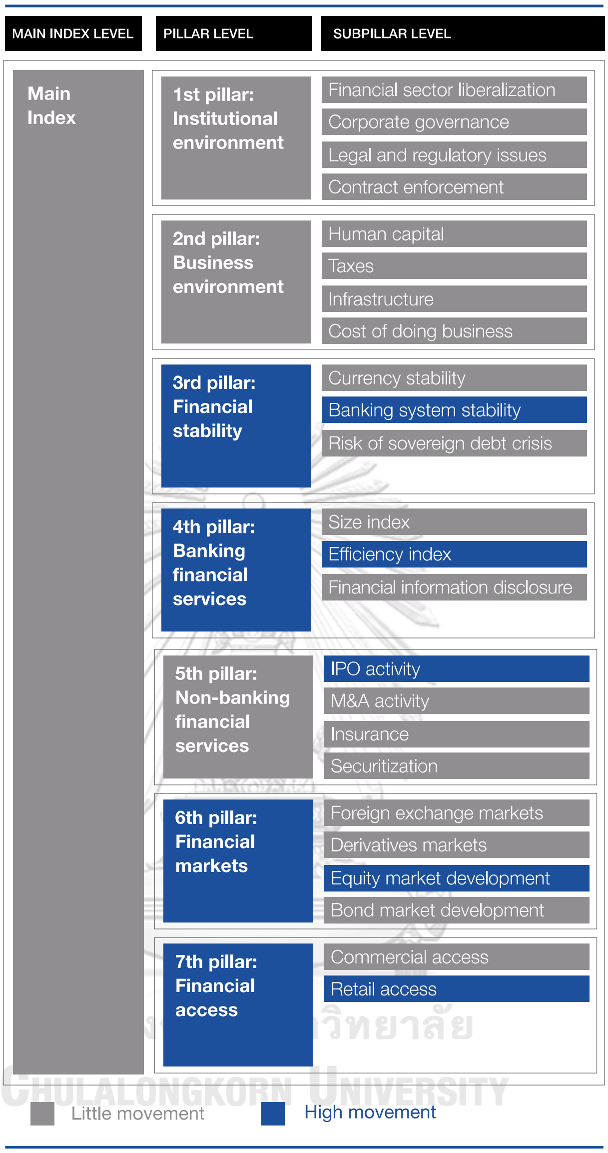
Figure 2.1 World Bank's 4x2 matrix of financial system characteristics

	Financial Institutions	Financial Markets
DEPTH	**Private sector credit to GDP** Financial institutions' assets to GDP Money (M2 aggregate) to GDP Deposits to GDP Value-added of the financial sector to GDP	**Stock market capitalization plus outstanding domestic private debt securities to GDP** Private debt securities to GDP Public debt securities to GDP International debt securities to GDP Stock market capitalization to GDP Stocks traded to GDP
ACCESS	**Accounts per thousand adults** (commercial banks) Branches per 100,000 adults (commercial banks) Percent of people with a bank account (from user survey) Percent of firms with line of credit (all firms) Percent of firms with line of credit (small firms)	**Percent of market capitalization outside of top 10 largest companies** Percent of value traded outside of top 10 traded companies Government bond yields (3 month and 10 year) Ratio of domestic to total debt securities Ratio of private to total debt securities (domestic) Ratio of new corporate bond issues to GDP
EFFICIENCY	**Net interest margin** Lending-deposits spread Noninterest income to total income Overhead costs (percent of total assets) Profitability (return on assets, return on equity) Boone indicator (Herfindahl, or H-statistic)	**Turnover ratio** (turnover/capitalization) for stock market Price synchronicity (co-movement) Price impact Liquidity/transaction costs Quoted bid-ask spread for government bonds Turnover of bonds (private, public) on securities exchange Settlement efficiency
STABILITY	**z-score** (or distance to default) Capital adequacy ratios Asset quality ratios Liquidity ratios Other (net foreign exchange position to capital, etc.)	**Volatility** (standard deviation/average) of stock price index, sovereign bond index Skewness of the index (stock price, sovereign bond) Price/earnings (P/E) ratio Duration Ratio of short-term to total bonds (domestic, international) Correlation with major bond returns (German, United States)

Source: World Bank (2012)

Note: The variables in bold are those suggested for the benchmarking.

Figure 2.2 Seven pillars of WEF's Financial Development Index



Source: World Economic Forum (2012)

The aspects of financial development and their proxy measures can be categorized as follows.[5]

a.) <u>Institutions, policies, and environment</u>

a.1) *Institutional environment* – covers the supervision of the financial systems, financial sector liberalization, and laws and regulations. Examples of proxy variables

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[5] This is summarized from Sahay et al. (2015), World Bank (2012), and World Economic Forum (2012).

are capital account liberalization, reporting and auditing standards, regulation of financial institutions and securities and exchanges, and time and cost to enforce contracts.

a.2) *Business environment* – considers the infrastructure available, cost of doing business, and the human capitals involved. Examples of proxy variables are time and cost to start a business, staff training, and net international investment position to GDP.

a.3) *Economy-wide financial stability* – refers to the systematic risks in the financial sectors, currency crises, and the risk associated with sovereign debt. Examples of proxy variables are frequency of banking crises, measures of real estate bubbles, and manageability of public debt.

b.) Bank financial institutions

b.1) *Depth* – measures the size of financial institutions. Examples of proxy variables are private sector credit to GDP, financial institutions' assets to GDP, bank deposits to GDP, and money (aggregate M2) to GDP.

b.2) *Access* – evaluates the extent that individuals and businesses can access and actually use financial institutions. Examples of proxy variables are number of commercial bank accounts per thousand adults, commercial banks' branches per 100,000 adults, and percent of firms with line of credit.

b.3) *Efficiency* – captures how financial institutions efficiently provide financial services. Examples of proxy variables are net interest margin, lending-deposits spread, bank overhead costs to total assets, financial ratios indicating profitability, and banks' non-performing loans to total loans.

b.4) *Stability* – measures the stability of banks. Examples of proxy variables are the z-score or distance to default, capital adequacy ratios, and liquidity ratios.

b.5) *Disclosure* – assesses the disclosure of financial information. Examples of proxy variables are credit bureau coverage.

c.) Non-bank financial institutions (NBFI) include agents such as broker-dealers, asset management fund, and insurance companies, and activities such as insurance, securitization, and initial public offering (IPO). Examples of proxy variables for financial development regarding NBFI are the size of pension fund assets to GDP, the size of mutual fund assets to GDP, insurance premiums, transaction value of merger and acquisition (M&A) to GDP, IPO market share, and securitization to GDP.

d.) Financial markets – refer to equity markets, bond markets, foreign exchange markets, and derivatives markets.

d.1) *Depth* – Examples of proxy variables are stock market capitalization to GDP, and private, public, and international debt securities to GDP.

d.2) *Access* – Examples of proxy variables are percent of stock market capitalization omitting top ten largest companies, and ratio of domestic to total debt securities.

d.3) *Efficiency* – Examples of proxy variables are stock market turnover ratio (stock traded to capitalization), transaction costs, government bonds' quoted bid-ask spread, derivatives turnover, and settlement efficiency.

d.4) *Stability* – Examples of proxy variables are stock price index's volatility and skewness, sovereign bond index volatility, and ratio of price to earnings (P/E).

Although the concept of financial development is not exclusively restricted to domestic financial systems, most of the representative indicators are those describing the domestic markets. Only few proxies are directly related to cross-border financial investment and asset trade such as international debt securities to GDP, risk of sovereign debt crisis, and capital account liberalization. As a result, the term financial development is broadly used as referring to domestic financial development and empirical studies exploring the implication of financial development mostly focus on variables relating to domestic markets.

Despite various proxies of financial development, the empirical literature usually measures the overall level of financial development using the depth of banking sector (World Bank, 2012), and in particular, the ratio of domestic private credit to GDP.[6] The relationship between depth of financial systems and economic growth has also been the most explored in the finance-growth nexus literatures (Pasali, 2013) as will be illustrated in the next sub-section. Using the size of financial intermediaries to indicate the development of financial system is supported by the views that it directly measures the amount of funds the private sector receives and the size of financial services provided by financial institutions, which relate to the amount of investment and ultimately economic growth (De Gregorio & Guidotti, 1995; King & Levine, 1993). However, the financial depth might not be a good measure when there is a large amount of financial transactions outside the banking system (De Gregorio & Guidotti, 1995) since the banking sector only represents one part of larger financial systems. Moreover, other aspects such as efficiency, stability, or accessibility might be neglected (World Bank, 2013). Examples of other measures adopted in the empirical literature are stock

[6] Examples of papers that focus on the financial depth of banking sectors are King and Levine (1993), De Gregorio and Guidotti (1995), Cecchetti and Kharroubi (2012), Arcand, Berkes, and Panizza (2012), and Dabla-Norris and Srivisal (2013).

market capitalization (Rajan & Zingales, 1998), the relative domestic assets of deposit banks to the central bank (King & Levine, 1993) and employment in financial sector (Cecchetti & Kharroubi, 2012). At the other end, the indicators regarding financial sector efficiency and access to finance are limitedly studied, partly because the data are not available especially for the developing countries (Pasali, 2013). Nevertheless, each indicator has its own advantages and flaws. Using a broad array of financial development measures likely provides a comprehensive view of financial development than considering only one particular measure (King & Levine, 1993).

2.1.3. Financial Development and Economic Growth

Financial development is important to economic growth. When the financial system functions well, the financial intermediaries efficiently allocate the savings to the best possible investments through project evaluation, risk management, monitoring, and other financial facilitation, fostering technological innovation and stimulating economic growth (De Gregorio & Guidotti, 1995; King & Levine, 1993). These help alleviating moral hazard and adverse selection problems and lessening the firms' cost of external finance (Rajan & Zingales, 1998). A well-developed financial system also enhances competition and reduces frictions and transaction costs, all contributing to economic growth (Cecchetti & Kharroubi, 2012; World Bank, 2012). On the other hand, when the financial system malfunctions, it can cut back investment opportunities, hinder economic growth, and destabilize the economy (World Bank, 2012).

There is an extensive amount of empirical literature studying the relationship between financial development and growth.[7] The most researched area is the financial sector depth. Overall, financial development is found to have a statistically significant and positive association with economic growth (Pasali, 2013). However, this positive impact is subject to some qualifications and may vary depending on the periods and regions (Pasali, 2013).

Early researches in the 1990s generally examined the linear regression of the growth rate on variables representing financial sector development. For instance, King and Levine (1993) adopted four measures of financial development; namely, the ratio of liquid liabilities to GDP, the relative domestic assets of deposit banks to the central bank, and the ratios of credit to nonfinancial private firms divided by total domestic credit and divided by GDP. Their paper is a cross-country study using data from 80 countries during 1960-1989. They found that their measures of financial sector

[7] The review here only briefly depicts the overall picture of financial development implication on economic growth. It does not thoroughly review the existing knowledge in this strand of literature. See Pasali (2013) for example of a comprehensive review of literature on the relationship between financial development and economic growth focusing on developing countries. The author also discusses determinants of financial development and its impact on employment.

development are positively related with real GDP growth, the accumulation rate of physical capital, and efficiency improvements of physical capital allocation, suggesting that the latter two are possibly the channels that financial development influences growth. Another example is De Gregorio and Guidotti (1995), who found a positive relationship between financial development, which is represented by the ratio of domestic private credit to GDP, and long-run growth. However, the finding of positive finance-growth relationship is subject to causality problem and that financial development and economic growth might be driven by the same underlying factors (Rajan & Zingales, 1998).

More recent researches have turned to the issues of non-monotonic relationship between financial development and growth. Nonlinearities are evidenced such that the impact of financial development on growth could become insignificant or even negative after reaching certain thresholds, and heterogeneities are found across periods and regions (Pasali, 2013). For example, Arcand et al. (2012) estimated that the impact of finance on economic growth starts to turn negative when the domestic credit to the private sector reaches about 80 to 100 percent of GDP. The result is robust across different estimators and data. The positive and robust relationship between finance and growth is found in countries that have small to medium financial sectors. The inverted U-shaped impact of financial development is also found by Cecchetti and Kharroubi (2012). Increasing the size of financial sector has a positive impact only up to a point, but it becomes negative and lowers productivity growth when financial institution depth exceeds GDP or employment in the financial sector exceeds 3.5 percent of total employment. Too large financial industry could be detrimental as it competes with other parts of the economy for resources including physical capital and skilled workers, resulting in misallocation of resources (Arcand et al., 2012; Cecchetti & Kharroubi, 2012). Rapid growth of financial sectors could also lead to macroeconomic instability, and possibly financial crises, especially in countries with inadequate regulatory infrastructure (Arcand et al., 2012). In addition, the negative effect may be caused by the ill use of finance such as unproductive lending to households' consumption and speculation (Arcand et al., 2012). Examples of studies that found heterogeneities in the relationship are Rousseau and Wachtel (2011) who demonstrated that finance only exerts positive impact on growth during 1960-89, but not during 1990-2004; and Barajas, Chami, and Yousefi (2013) who observed smaller impact of financial development in the Middle East and North Africa.

Apart from the impact on economic growth, financial development as proxied by financial depth is also associated with lower volatility of growth, and hence could help stabilize the economy (Pasali, 2013). See the papers by Beck, Degryse, and Kneer (2014), Dabla-Norris and Srivisal (2013), and Denizer, Iyigun, and Owen (2002) for examples.

2.1.4. Financial Development in Advanced and Emerging Economies

This section illustrates the level of financial development in emerging markets and advanced economies. Table 2.1 shows the variables describing the characteristics of financial development based on the 4x2 framework of World Bank. The candidate variables in bold from Figure 2.1 are chosen to represent each category. Since all eight measures are related to the domestic financial system, it could be said that they together represent the level of domestic financial development rather than the broader concept of overall financial development. The countries are grouped into 30 advanced economies, 35 emerging market economies, and four emerging ASEAN economies sub-group.[8] Table A.1 in Appendix A lists the countries in each group and Table A.2 provides data description and sources. The data is latest available from World Bank's Global Financial Development Database (GFDD). Each indicator is averaged from all countries within the group based on the data available. The variables indicating financial depth and stability are generally available for most countries, whereas the financial access measures are scarcely available for both advanced and emerging economies.

The 4x2 indicators representing the level of financial development do not necessarily point towards the same direction. The advanced economies in general have more developed financial systems than the emerging countries in almost all categories. Their depth of financial system is significantly greater averaging over 100 percent of GDP. More people in developed countries seem to have access to financial institutions, but this figure might not be representative since only six advanced economies have records of this measure. The access to financial markets, on the other hand, does not differ considerably, but the developed countries still have higher level of access. The efficiency of financial institutions is the only category that emerging markets outperform. The stability of financial institutions as measured by bank Z-score[9] is very similar across two groups of economies. Lastly, stock prices in emerging markets are more volatile than the industrial economies, suggesting less stability of financial markets. The last column shows the emerging market sub-group of four ASEAN economies. They have considerably greater financial depth than other emerging countries, but largely do not differ much in other categories.

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[8] The Association of Southeast Asian Nations or ASEAN comprises of 10 member states – Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. Only four countries considered as emerging markets are Indonesia, Malaysia, Philippines, and Thailand. Singapore is considered as advanced economies according to country classification by International Monetary Fund (2014d).

[9] Bank Z-score in World Bank's GFDD is estimated as the ratio of the sum of Return on Assets (ROA) and equity capital to assets over the standard deviation of ROA; thus, the higher score, the lower probability of insolvency.

Table 2.1 Measures of financial development in advanced and emerging market economies 2014

Financial development measure		Advanced economies		EMEs		Emerging ASEAN	
Aspect	**Variable**	**Avg.**	**Obs.**	**Avg.**	**Obs.**	**Avg.**	**Obs.**
Depth - Financial institutions	Domestic credit to private sector (% of GDP)	112.00	31	64.19	29	85.76	4
Depth - Financial markets	Stock market cap plus domestic private debt securities to GDP (%)	126.98	35	68.39	30	115.74	4
Access - Financial institutions	Bank accounts per 1,000 adults	1,457	6	873	16	824	2
Access - Financial markets	Market cap excluding top 10 companies to total market cap (%)	57.54	14	50.02	19	60.33	4
Efficiency - Financial institutions	Bank net interest margin (%)	1.40	28	3.40	29	3.08	4
Efficiency - Financial markets	Stock market turnover ratio (%)	62.51	24	49.38	22	38.49	4
Stability - Financial institutions	Bank Z-score	11.81	34	11.58	30	9.01	4
Stability - Financial markets	Stock price volatility	14.84	35	16.41	30	16.76	4

Source: author’s calculation using data from World Bank’s Global Financial Development Database (GFDD).

Note: EMEs = emerging market economies; Avg. = average; Obs. = number of countries with available data and used in calculation; market cap = market capitalization; the latest data available is from 2014.

Table 2.2 Financial Development Index of advanced and emerging economies 2012

Financial development measure	Advanced economies		EMEs		Emerging ASEAN	
	Average	Obs.	Average	Obs.	Average	Obs.
WEF Financial Development Index	4.41	26	3.25	25	3.47	4

Source: author's calculation using data from World Economic Forum (WEF).

Note: EMEs = emerging market economies; Obs. = number of countries with available data and used in calculation. The latest data available is from 2012. The index score is from 1 and 7, the higher the better.

The WEF's Financial Development Index for the year 2012 is reported in Table 2.2. Again, advanced economies have higher average score of 4.41, suggesting that they are more financially developed than emerging markets. The average score of emerging ASEAN countries is slightly higher that other EMEs, but still about one point lower than that of industrial countries.

2.2. Financial Integration (FI)

2.2.1. Definition of FI

Despite a large literature studying financial integration, its concept is multi-dimensional and the term has no universal and widely accepted definition (Auster & Foo, 2015; Ceballos, Didier, & Schmukler, 2012; Pongsaparn & Unteroberdoerster, 2011). Various definitions are adopted in the literature. Starting from the narrow one, financial integration refers to the country-level gross foreign assets and liabilities, inclusive of total capital flows, foreign direct investment (FDI) and foreign portfolio investment (FPI), typically expressed as the ratio to GDP (Ceballos et al., 2012; International Monetary Fund, 2002). This definition largely comes from the analogous comparison with the term trade integration or trade openness, which is commonly defined as the sum of exports and imports to GDP (International Monetary Fund, 2002). It is closely linked to the term financial openness. It implies that financial integration is related to domestic residents participating in foreign asset markets as well as foreigners participating in domestic financial markets, although it represents more the quantity aspect of FI rather than the prices involved (Ceballos et al., 2012). Another group of researchers connects FI with the convergence of prices and returns across markets. When financial markets are integrated, the price and the return of the assets with identical risk in different countries should be equal (Bekaert & Harvey, 2003; De

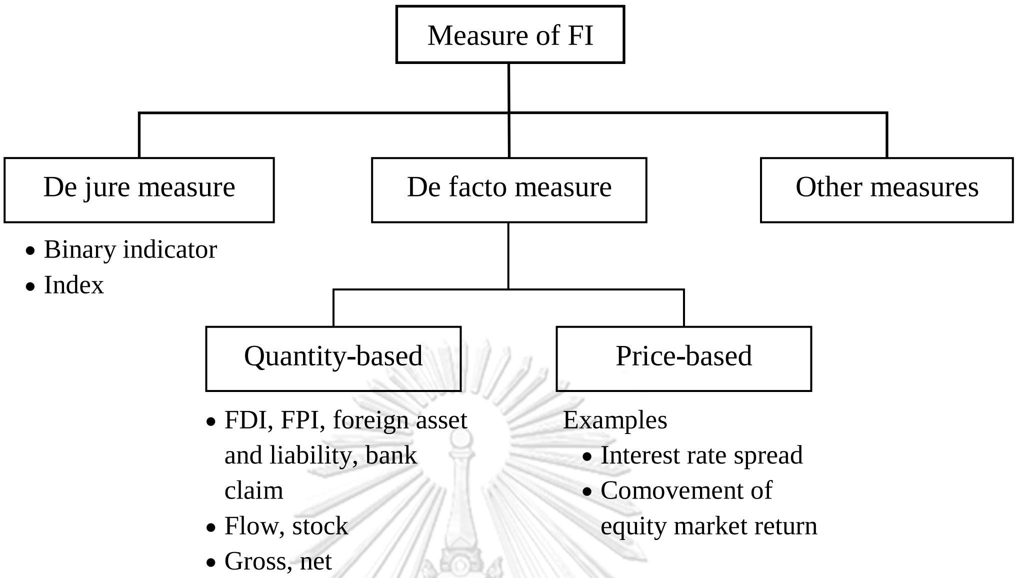
Brouwer, 2005). This relates to the concept of no arbitrage, the law of one price, and theory of purchasing power parity.

There is also a broader definition of FI, of which this thesis inclines to. Firstly, the definition of FI adopted by European Central Bank (ECB) broadly deals with equality and symmetry. For the ECB, the financial markets are fully integrated when all participants are under same set of rules, have equal access to financial services and instruments, and face symmetric frictions regardless of their domiciles (Baele, Ferrando, Hördahl, Krylova, & Monnet, 2004; European Central Bank, 2015). Implications from this definition are that the financial market structures in different locations need not be identical and frictions need not be entirely eliminated (Baele et al., 2004). The important things are that there is no discrimination and existing frictions are not asymmetric among all market participants, be it the households, the firms, or the investors. Secondly, FI is considered as the process in which the countries open up more financially, allowing domestic residents to invest abroad and foreign investors to enter local markets (García-Herrero & Wooldridge, 2007). This concept can be translated into actions of removing restriction and frictions that obstruct cross-border financial flow and services (García-Herrero & Wooldridge, 2007; Ho, 2009), and is related to the term financial liberalization and globalization. Lastly, the term financial integration may encompass many concepts altogether. It could comprise of financial openness, financial connectedness, borderless trade in financial services, and free flow of capital across countries (Auster & Foo, 2015; Pongsaparn & Unteroberdoerster, 2011). These processes would consequently lead to larger cross-border capital flows and less differentiated prices and returns among different market locations (Auster & Foo, 2015), which are the two narrow definitions of FI.

2.2.2. Measures of FI

Since FI is a multifaceted concept, measuring its level is not straightforward and no single measure can entirely captures all the extents of FI (García-Herrero & Wooldridge, 2007; Quinn et al., 2011). In empirical studies, FI can be measured by a broad range of variables that indicate various aspects of FI as well as overlap with each other. Each indicator has its own advantages and disadvantages. The choice of measures essentially depends on the research objective and how FI is defined (Pongsaparn & Unteroberdoerster, 2011). This section compiles different types of FI measures that are typically adopted in the empirical literature. They are summarized in Figure 2.3. See Quinn et al. (2011) for a review and assessment of FI measures. Kose, Prasad, Rogoff, et al. (2006), Baele et al. (2004), Pongsaparn and Unteroberdoerster (2011), European Central Bank (2015), and Stavarek, Repkova, and Gajdosova (2011) also discuss different types of FI measures. The review here focuses at quantity-based measures of FI because they are more common in empirical analysis and resemble most to the measures of FI mainly employed in this thesis.

Figure 2.3 Empirical measures of FI



Source: author's compilation.

a.) <u>De jure measure</u>

De jure measure of FI generally indicates the liberalization or the removal of controls on capital account transaction. This type of measures considers rules, regulations, legal restrictions and controls regarding the capital transactions, current accounts, payments and receipts, and exchange rate structures. Most de jure measures are derived based on IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) (Kose, Prasad, & Taylor, 2011; Quinn et al., 2011). AREAER provides many binary indicators that capture different kinds of controls such as whether there exist restrictions to current and capital account transaction or not (Kose, Prasad, Rogoff, et al., 2006). The information on capital controls and other regulations provided by AREAER is used to construct a variation of de jure measures. For example, Chinn and Ito (2008), Abiad and Mody (2005), and Mody and Murshid (2005) combine several variables reported by AREAER to form an index or a score that captures the level of financial liberalization. However, these composite indices mostly convey similar information since they come from the same source of AREAER (Kose, Prasad, Rogoff, et al., 2006).

The shortcomings of de jure measures based on AREAER are that there is a structural break during 1995-1996, the switch from financially closed to open is not clearly defined, and the data are point-in-time reported only at year-end (Quinn et al., 2011). The limitation of de jure measures in general is that they indicate only whether there is a restriction on capital transaction or not. The existing restrictions might not be enforced in the first place and countries can still be highly financially integrated even with strict capital controls (García-Herrero & Wooldridge, 2007; Kose, Prasad, Rogoff, et al., 2006; Quinn et al., 2011). Furthermore, once a country is liberalized, de jure indicators cannot fully assess the magnitude of FI beyond that. Thus, de jure measures might not be reflective of the practical situation. Examples of studies that employ de jure measures of FI are provided in Table 2.3.

Table 2.3 Examples of FI measures used in empirical studies

FI Measures	Examples of empirical studies
De jure measures	Bekaert, Harvey, and Lundblad (2006); Dées and Zorell (2012); Kose, Prasad, and Terrones (2003); Prasad, Rogoff, Wei, and Kose (2007)
Foreign direct investment (FDI) - stock and flow, inward and outward	Aizenman et al. (2013); Kose et al. (2011); Dées and Zorell (2012); Quinn et al. (2011)
Foreign portfolio investment (FPI) - assets and liabilities	Aizenman et al. (2013); Borensztein and Loungani (2011); Cowen, Shah, Salgado, Teo, and Zanello (2006); Imbs (2006); Shin and Yang (2006)
International or foreign bank claim	Cowen et al. (2006); Eichengreen and Park (2003); Shin and Yang (2006)
Foreign assets and liabilities - stock	Chen and Quang (2014); Kose et al. (2011); Prasad et al. (2007)
Gross capital flow - inflow and outflow	Kose et al. (2003); Kose, Prasad, and Terrones (2006); Kose et al. (2011)
Price-based measures	Borensztein and Loungani (2011)

b.) De facto measure

De facto measures of FI assess the actual international financial activities, cross-border capital flows, positions of foreign assets and liabilities, and prices and returns in the market (Auster & Foo, 2015). They are distinct from de jure measures and convey different information. Due to their practicality and relevance, de facto measures are more widely used in the empirical literatures than de jure measures. But since they heavily rely on data, de facto measures could be sensitive to data inconsistency across different times and countries (Quinn et al., 2011). There are two major types of de facto measures – quantity-based and price-based. They will be discussed subsequently.

b.1) Quantity-based measure

Quantity-based measures of FI are continuous indicators that quantify the exposure of international financial activities such as foreign direct investment, portfolio holding, and cross-border bank transactions. They are typically measured at the country level and in the form of ratios to GDP such as the ratio of gross foreign assets and liabilities over GDP and total cross-border capital flow over GDP. Various aggregate variables are employed in the literature as proxies for the degree of FI. They can be categorized into foreign direct investment (FDI), foreign portfolio investment (FPI), foreign assets and liabilities, and cross-border bank claim, which will be discussed next. They can also be differentiated by whether they are flows versus stocks or gross versus net amounts. Table 2.3 shows the examples of papers that employ different quantity-based measures of FI.

The advantages of quantity-based indicators are that they reflect the real volume of a country's foreign asset positions and can vary through time, overcoming the limitation of de jure measures and making them more intuitive and meaningful (García-Herrero & Wooldridge, 2007; Pongsaparn & Unteroberdoerster, 2011). However, they are subject to data availability and consistency across times and countries and possible impact of portfolio re-valuation from year to year (Ceballos et al., 2012; Pongsaparn & Unteroberdoerster, 2011).

i) *Flows versus stocks*

Both flows and stocks are used in the literature. Flows represent the flow of capital across countries during certain period and can be separated into inflows, which are liabilities, and outflows, which are considered assets. Examples of flow measures of FI are the ratio of FDI and capital flows to GDP. Stocks represent the total asset positions and amounts outstanding. They are essentially an accumulation of corresponding flows (Kose, Prasad, Rogoff, et al., 2006). Examples of stock measures of FI are total foreign assets and liabilities to GDP and stocks of cross-border portfolio investment.

The flow measures can be greatly influenced by short-term fluctuation in the markets and hence are noisier and more volatile between periods than the stock measures (García-Herrero & Wooldridge, 2007; Quinn et al., 2011). The flow measures are also more subject to measurement error (Prasad et al., 2007). However, the stock measures largely cannot distinguish changes in the amounts outstanding whether they are due to capital flows or valuation effects (Pongsaparn & Unteroberdoerster, 2011). In addition, the stock measures exhibit non-stationarity behavior, which might be undesirable under some studies (Chen & Quang, 2014).

ii) *Gross amount, net amount, and one side of the position*

The literature mostly uses the gross amounts to measure the degree of FI. These could be the sum of asset and liability positions or the sum of inflows and outflows. The advantages of using a gross amount are that it captures the two sides of the positions and provides a more practical degree of integration (Kose, Prasad, Rogoff, et al., 2006). It is also analogous with how TI is typically measured as the sum of imports and exports as a share of GDP (Kose, Prasad, Rogoff, et al., 2006). Some papers that aim to investigate specific research questions may explore only one side of financial positions or flows at a time, such as inward FDI and stocks of external liabilities. The net amounts are infrequently adopted likely because they only reflect whether the country is a net investor or borrower, but could underestimate the size of actual foreign financial assets and could be misleading (García-Herrero & Wooldridge, 2007).

iii) *Foreign direct investment (FDI)*

Foreign direct investment or FDI is cross-border investment by a resident in one country in an enterprise in another country, which involves significance influence on the management of that business or some forms of ownership (Auster & Foo, 2015). The relationship is long-term and the investors aim to obtain a lasting interest in management (Aizenman et al., 2013; Auster & Foo, 2015). FDI includes equity capital, reinvestment of earnings, and other short-term capital. It can be disaggregated into outward and inward directions, and stocks or flows.

iv) *Foreign portfolio investment (FPI)*

Foreign portfolio investment or FPI is cross-border transactions, asset holdings, and positions of debt securities, equity securities and investment fund shares that are not included in FDI and reserve assets (Auster & Foo, 2015). FPI is an investment that does not involves controlling stake; hence, FDI and FPI are two distinct types of FI and do not overlap. Exposure of portfolio investment in equity and bond securities could indicate the degree of equity market integration and bond market integration respectively.

v) *Foreign assets and liabilities*

Foreign assets and liabilities are a very broad term that describes all exposure amounts of foreign assets and liabilities, encompassing FDI, FPI, financial derivatives, and foreign exchange reserves. The most widely used is a database of Lane and Milesi-Ferretti (2007), which compiles stocks data on foreign assets and liabilities for 189 economies. Relevant valuation and cross-country adjustments are also made accordingly. Many FI measures can be constructed based on this database, such as the ratio of gross aggregate amount of assets plus liabilities and the ratio of cross-border capital flow to GDP.

vi) *Cross-border bank claim*

Cross-border bank claim is amounts outstanding of international or foreign consolidated bank claims, which capture assets and liabilities in the banking sector and indicate the degree of banking integration. The claims include deposits, loans, and other financial instruments. It is less often adopted in the literature than abovementioned measures likely because they only measure the integration in banking sector. It is typically used when the research questions focus at financial institutions.

b.2) <u>Price-based measure</u>

Price-based measures capture differentials in prices or returns of the assets across different geographic location of the markets (Baele et al., 2004). This can be viewed as a test of the law of one price that assets with similar risk should have the same returns, and assets with same risks and returns should be equally priced regardless of the domiciles of market participants due to arbitrage (Auster & Foo, 2015; Baele et al., 2004; Quinn et al., 2011). The law of one price should hold under complete FI and discrepancies between foreign and domestic prices indicate incomplete FI. Price-based measures are usually applied with tradable securities such as bonds, equities, and foreign exchange, which contain rich data of price movements (Auster & Foo, 2015). Examples of price-base measures are cross-country dispersion of interest rate spreads, differentials in asset return, comovements in bond yields, interest rate, and equity market returns, and a beta convergence that measures the speed of convergence on bond yields (Almekinders, Mourmouras, Zhou, & Fukuda, 2015; Baele et al., 2004; Pongsaparn & Unteroberdoerster, 2011). See more details on price-based measures in Baele et al. (2004), Pongsaparn and Unteroberdoerster (2011), and European Central Bank (2015) for example.

The shortcoming of price-based measure is that it is not easy to apply in practice. It relies on a strong hypothesis of the law of one price that only works if there are comparable assets with similar risk and return profiles across countries (Pongsaparn & Unteroberdoerster, 2011). Consequently, price-based indicators comparing developing to advanced economies might be difficult to construct since financial instruments in developing countries tend to be less sophisticated and quality data are scarcer. Moreover, differential in prices from inefficient arbitrage might stem from domestic market frictions that are difficult to distinguish, rather than reflect imperfect international integration of financial markets (Kose, Prasad, Rogoff, et al., 2006; Quinn et al., 2011). These limitations might obstruct the use of price-based measures in FI literature, as this type of measures are much less employed than de jure measures and quantity-based measures.

c.) Other alternative measures

Apart from the mainstream measures of FI, there are other alternative measures. The first one is a composite index that combines more than one indicators of FI. The example is ECB's *Price-based and Quantity-based Financial Integration Composites (FINTECs),* which aggregate ten and five indicators respectively. The FINTEC has the value from zero to one. A higher value of FINTEC indicates higher FI and the value of one indicates full integration.[10] Another one is *news-based measure* of FI, which differentiates the information effects from those that result from barriers or frictions (Baele et al., 2004; Stavarek et al., 2011). To illustrate, if the financial markets are highly integrated, the local news should have little influences on prices, while global news should have larger impacts, suggesting that the systematic risk is similar across different countries (Baele et al., 2004; Stavarek et al., 2011). Lastly, measures of FI can be divided in the aspects of trading partners – bilateral, regional, and global. *Bilateral measures* only capture the financial transactions taking place between a pair of countries. *Regional measures* focus on the integration within the region where the country is located. *Global measures* focus on the financial linkages with major financial center countries such as the United State and Eurozone. Global FI tends to support international risk-sharing more than regional FI since economies within the same region tend to be highly correlated, while regional integration could bring benefits in the form of institution corporation and competition (García-Herrero & Wooldridge, 2007).

2.2.3. FI and Financial Development

Financial integration and financial development are two different but related aspects of financial markets. While financial development and domestic financial development in particular are concerned with the development of overall financial systems of one country, FI refers to the connectedness of one economy's financial systems with another country or the rest of the world. The development and integration of financial markets often occurred together and their relationship seems to be bi-directional. (International Monetary Fund, 2014b; Kose, Prasad, Rogoff, et al., 2006). Lower degree of FI could reflect overall lesser development of financial systems, and more advanced domestic financial markets could stimulate greater international FI. They both are associated with easing of frictions and barriers, more efficient capital allocation, and potentially enhancing economic growth (Baele et al., 2004).

[10] See European Central Bank (2015) for more detail.

Financial integration can contribute to domestic financial development.[11] FI could boost more competition and efficiency in domestic markets from foreign entrants, provide broader and more advanced financial instruments, ensure against domestic shocks, generate more liquidity, and promote better macroeconomic policies (Kose, Prasad, Rogoff, et al., 2006; Ma, 2016; Pongsaparn & Unteroberdoerster, 2011). Financial openness is also empirically found to be associated with more developed and active domestic financial markets such as larger private credit to GDP and higher growth rate of stock market development (Bonfiglioli & Mendicino, 2004; Chinn & Ito, 2002; Pasali, 2013). However, the association tends to be stronger for economies that have better institutions (Pasali, 2013). On the other hand, under-regulated financial liberalization could also hamper the domestic financial markets and overall economic growth, as seen from a number of crises.

Well-developed domestic financial markets could foster international financial integration and help the economy to better achieve benefit from FI (Kose, Prasad, Rogoff, et al., 2006). Sound domestic financial markets such as large sophisticated domestic investor base, market liquidity, and improved institution quality could help allocate foreign capital flows efficiently, mitigate the effect of external shocks, and make the country more resilient to vulnerability caused by international financial linkages (Gelos & Oura, 2014; International Monetary Fund, 2014b; Kose, Prasad, Rogoff, et al., 2006).

2.2.4. Benefits and Costs of FI

There has been a long intense debate on the benefits and costs of FI (Kose, Prasad, Rogoff, et al., 2006). In theory, FI benefits through two main channels. First, it facilitates consumption smoothing and improves international risk sharing (Kose et al., 2011). With access to world financial markets, countries can use a wider array of financial instruments to diversify the risks and better insure themselves against fluctuations in income and country-specific shocks. More advanced foreign markets could provide greater liquidity and financial depth especially for developing countries with less developed financial markets (Ceballos et al., 2012). More saving and borrowing opportunities also play a stabilizing role in providing the consumers with intertemporal smoothing of consumption (Senay, 1998). Opening to foreign capital flows can increase the stability of investment participants. As theories predicted, these aspects of higher FI should lead to lower consumption volatility, higher consumption correlation and lower output correlation among countries (Backus, Kehoe, & Kydland, 1994; Obstfeld, 2009).

[11] This view that financial integration promotes the development of domestic financial systems is shared by many papers. See International Monetary Fund (2014b), Kose, Prasad, Rogoff, et al. (2006), Pongsaparn and Unteroberdoerster (2011), Ma (2016), and Pasali (2013) for example.

Secondly, openness to foreign financial flows can alleviate the problem of capital scarcity and limited domestic saving (Kose, Prasad, Rogoff, et al., 2006; Obstfeld, 2009). This especially benefits developing countries whose problem is more prevalent (Kose et al., 2011). Access to foreign capital, a bigger pool of savers, and factors of production can reduce the cost of capital, promote more efficient allocation of capital across time and border, and enable more investment opportunities (Aizenman et al., 2013; Kose et al., 2011; Obstfeld, 2009). Greater domestic specialization in production can also be promoted by the accessibility to international capital markets, and in turn boosts productivity (Evans & Hnatkovska, 2007a; Kose, Prasad, Rogoff, et al., 2006). Foreign direct investment inflow potentially comes with foreign knowledge and knowhow creating technology and managerial transfer (Kose, Prasad, Rogoff, et al., 2006). Through direct and indirect channels of enhancing risk sharing, improving efficient capital allocation, along with supporting domestic financial development as discussed in the previous section, FI should ultimately enhance economic growth as illustrated in Figure 2.4 (Kose, Prasad, Rogoff, et al., 2006; Stavarek et al., 2011). The empirical evidences on the relationship between FI and economic growth are presented in Section 3.1 in the next chapter.

Figure 2.4 Benefits of FI

Source: Stavarek et al. (2011).

However, global financial crisis can undermine the benefits of FI. FI may help reducing risks from asset diversification, but it comes with a cost of increasing risks through financial linkages. Unfettered financial globalization can expose a country to global financial fluctuations, vulnerability, risks of sudden capital reversal, and financial crisis contagion. As manifested by a number of events, financial linkages are not only considered as one critical channel for the crisis propagation among countries, but they can also magnify the spillover effect (Devereux & Sutherland, 2011b; International Monetary Fund, 2014c). These could post challenges regarding supervision of capital flow and lead to higher volatility of output and consumption rather than lower as FI is supposed to increase risk-sharing (Auster & Foo, 2015; García-Herrero & Wooldridge, 2007; Stavarek et al., 2011). The impact tends to be more severe for countries with distortions and weak institutions (Ho, 2009; Stavarek et al., 2011). In the views of financial globalization critics, the downside of financial globalization has already been witnessed and its impact is large, while its predicted benefit is still controversial with yet no robust evidence (Obstfeld, 2009). See Kose, Prasad, Rogoff, et al. (2006) and Stavarek et al. (2011) for more discussion on benefits and costs of FI.

Given the trade-off between the benefits and costs, it is important to maintain appropriate level and type of FI given a country's circumstance, in order to attain the most-possible benefit from financial openness while keeping potential risks low. This is especially challenging for less-developed countries where the FI level is still relatively small and the economy seems to be more susceptible to international financial crisis than advanced economies (Kose, Prasad, Rogoff, et al., 2006; Pancaro, 2010).

2.2.5. FI in Advanced and Emerging Economies

This section gives an overview of FI in EMEs compared to advanced economies. The advanced economies began the process of financial integration much earlier than emerging markets. Just in early 1990s that large emerging economies began putting fewer restrictions on capital accounts and joined the move towards financial integration, although within a higher controlled environment than advanced economies (Aizenman et al., 2013). There has been an observable rise in emerging economies' financial integration, but there is still room to grow. This leads to different experiences of FI between the developed and developing worlds.

Eight measures that depict various aspects of FI during the period of 2000 to 2015 for advanced and emerging market economies are reported in Table 2.4. The analysis focuses on the quantity-based measures as this thesis explores the facets of FI that fall into this type of measures more than the price-based ones. Additionally, the quantity-based measures are more typically used in the literatures to capture the degree of FI. One example of de jure measure is also included, which is Chinn-Ito Index of capital account openness or KAOPEN. It is a composite index that measures the capital account openness based on the data from IMF's AREAER. The calculation is based on Chinn and Ito (2006, 2008). The chosen index is normalized to range between zero and one. A higher value of the score indicates higher degree of capital account openness.

Table 2.4 Measures of FI in advanced and emerging economies 2000-2015

Financial integration measure	Advanced economies		EMEs		Year coverage
	Avg.	**Obs.**	**Avg.**	**Obs.**	
Capital account openness (Chinn-Ito Index; 0-1 score)	0.92	34	0.49	29	2000-2014
Total FDI flow (% of GDP)	17%	35	4%	30	2000-2015
Total FDI stock (% of GDP)	179%	35	42%	30	2000-2015
Total FPI (% of GDP)	436%	35	22%	24	2001-2015
Total foreign assets and liabilities (% of GDP)	1098%	35	145%	30	2000-2011
Net foreign asset (NFA) (% of GDP)	-7%	35	-31%	30	2000-2011
International bank claim (% of GDP)	85%	35	17%	30	2000-2014
Private external debt (% of GDP)	100%	35	15%	26	2000-2015

Source: author's calculation.

Note: EMEs = emerging market economies; Avg. = average; Obs. = number of countries with available data and used in calculation; the year coverage depends on the availability of data from the sources; data sources and description are presented in Table A.2 in Appendix A.

The rest of the indicators are quantity-based and represented in ratios as a share of GDP. Total FDI sums the inward and outward amounts of FDI taken from UNCTAD database. The FDI stock is larger than yearly FDI flow. Total foreign portfolio investment (FPI) includes the assets and liabilities regarding debt securities, equity, and investment fund shares, as reported in CPIS database from IMF. Total foreign assets and liabilities and respectively net foreign asset (NFA) are taken from Lane and Milesi-Ferretti's database of "The External Wealth of Nations Mark II", which is a widely-used dataset based on their 2007 paper. These include all types of foreign amounts outstanding such as FDI, FPI, and foreign exchange reserves, making them very broad measures of FI. International bank claim taken from BIS database represents the amounts outstanding of international consolidated bank claims. It is used in the literature broadly to represent banking integration. Lastly, private external debt is the gross external debt positions of the private sectors taken from World Bank's QEDS database. Private external debt is not a typical indicator of FI but included as it relates to the study in Chapter 5 of this thesis.

Most of the quantity-based variables are stocks in gross amounts. Total FDI flow is the only financial flow variable. NFA is the only variable describing the net amount of assets minus liabilities. All of the FI measures are averaged roughly over the

2000-2015 period depending on the availability of data from each source and across two groups of advanced and emerging economies. Data description and sources are presented in Appendix A.

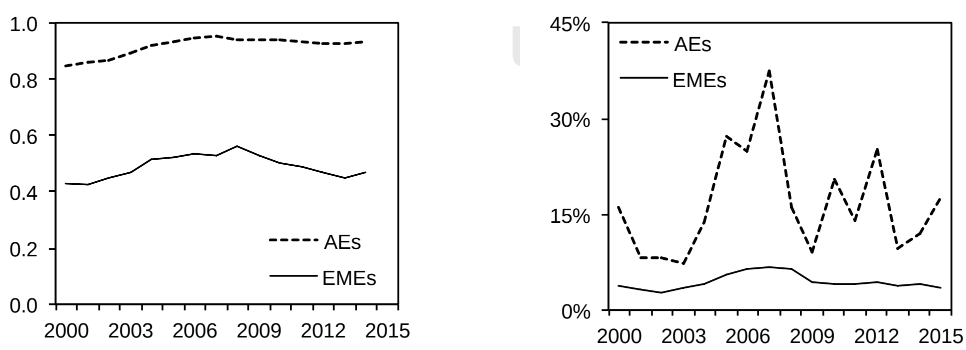
All measures of FI in advanced economies are larger than those in EMEs, suggesting that they are more financially integrated, except for the NFA that the figure of EMEs is larger in negative sign, implying that they are generally more indebted. The capital account openness index of AEs group is significantly larger than that of EMEs and almost reaches one, which is the maximum score. Although not perfectly comparable, the figures suggest that FDI is a large component of FI in EMEs, averaging around 42 percent of GDP, higher than FPI, international bank claim, and external debt of the private sectors. On the other hand, developed countries have significantly higher FPI than FDI. The figures of total foreign assets and liabilities are very large for both groups of countries since they include a wide range of foreign financial components.

One caveat is that the measures of FI in EMEs should be taken with more caution than AEs since looking at the number of observations, the FI variables are available for almost all advanced economies in the sample (totaling 35 countries), but less so in EMEs (totaling 30 countries). This means that not all emerging countries report the data and there is possibly that those who do might underreport.

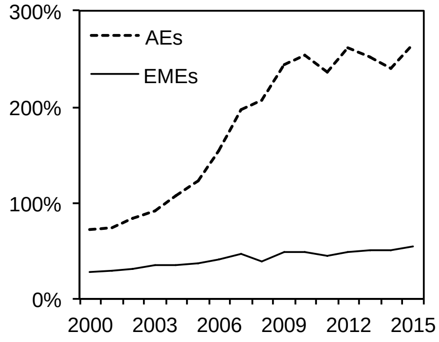
Figure 2.5 Trend of FI in advanced and emerging market economies 2000-2015

a. Chinn-Ito index of capital account openness

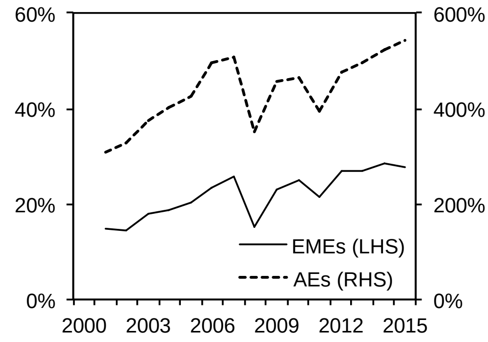
b. Total FDI flow (% of GDP)



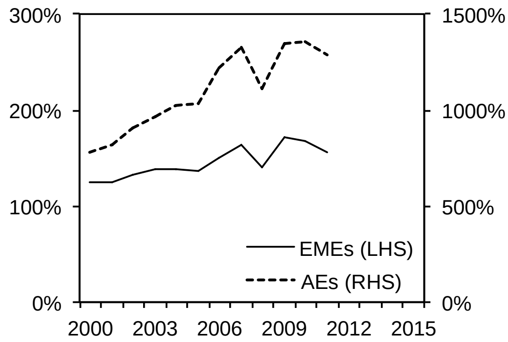
c. Total FDI stock (% of GDP)



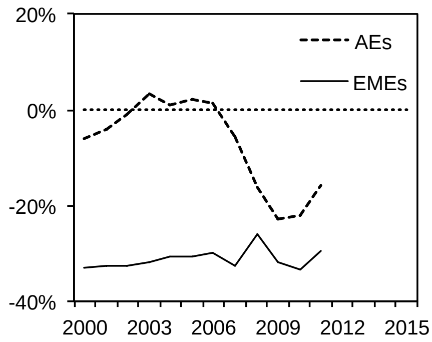
d. Total FPI (% of GDP)



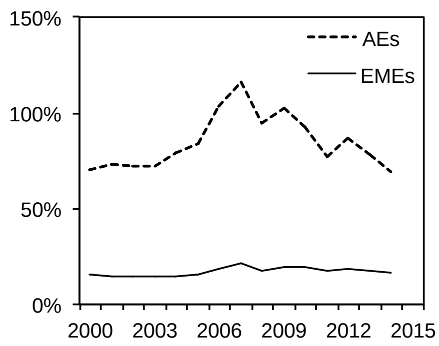
e. Total foreign assets and liabilities
(% of GDP)



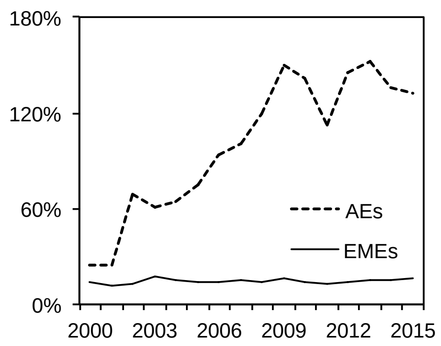
f. NFA (% of GDP)



g. International bank claim (% of GDP)



h. Private external debt (% of GDP)



Source: author's calculation.

Note: AEs = advanced economies; EMEs = emerging market economies; LHS = left hand side; RHS = right hand side. The year coverage depends on the availability of data from the sources. Data sources and description are presented in Appendix A. The series used to construct the trend lines are presented in Table A.3 and A.4.

The trend lines of these eight FI measures are illustrated in Figure 2.5. It compares advanced and emerging market economies between 2000-2015. The level of FI in all measures is small for EMEs as compared to AEs. The de jure measure of capital account openness (figure a.) in EMEs is about half the size of AEs. Furthermore, the average openness in EMEs initially increased but then declined. This is because many emerging economies in the sample have been less open concerning their capital accounts during this period. The notable decline is seen in Argentina, Egypt, and Venezuela.

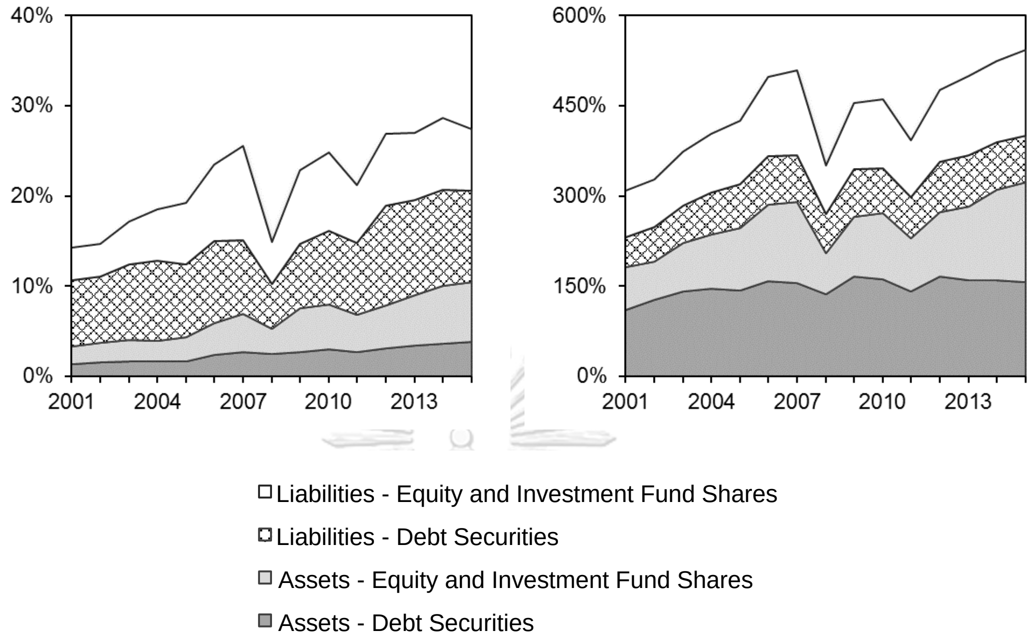
The FDI flow (figure b.) seems to be more volatile than the FDI stocks and likely depends on the business cycle. FDI stock of AEs shows an upward trend, while FDI of EMEs increased slightly during this period (figure c.). The size of FPI relative to GDP in AEs (figure d., right axis) is more than ten times larger than that of the EMEs (left axis). Overall, the upward trend is observed for both groups of economies, with apparent drops during the 2007-2008 and 2011 financial crises. This contrasts with the level of FDI, which are relatively more stable and less susceptible to crises likely owing to its long-term nature. Nevertheless, overall portfolio investment landscape in EMEs has progressed during this period, with more globalized markets and broader ranges of asset classes (International Monetary Fund, 2014b).

EMEs have considerably smaller amounts outstanding of foreign assets and liabilities than AEs (figure e.), but they seem to be more indebted as their NFA is more negative (figure f.). The cross-border bank claims of EMEs (figure g.) 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 117 percent before the 2007-2008 global financial crisis. The level of private external debt shows similar pattern with FDI stock (figure h.). The private external debt of AEs increased drastically from 2000 to 2015, whereas that of EMEs is much smaller and does not show any upward trend.

Possible reasons that EMEs have evidently lower level of international FI are capital flow restriction and cross-border regulation that are still in place for some economies (Pongsaparn & Unteroberdoerster, 2011), information cost associated with investing in foreign markets (Auster & Foo, 2015), and transaction costs due to inefficient trading infrastructure (Auster & Foo, 2015; Ma, 2016; D. Park & Shin, 2013). These could reflect overall less-developed financial systems in EMEs.

Figure 2.6 FPI composition by asset types 2001-2015 (in percent of GDP)

a. Emerging markets b. Advanced economies



Source: author's calculation using data from CPIS.

Note: Data source and description are presented in Appendix A. The series used to construct the figures are presented in Table A.5 in Appendix A.

The composition breakdown of FPI illustrated in Figure 2.6 also contrasts EMEs and AEs. The majority of FPI in the emerging markets is the portfolio liabilities with debt securities being the largest (panel a). This is in line with the negative NFA figure of EMEs. 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, the AEs have more portfolio assets than liabilities and 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). The implication is that portfolio assets tend to be a result of domestic residents' decision to invest, while large portfolio liabilities in EMEs tend to be associated with investment decision of foreign investors, which could be subject to sudden capital reverse such as in the events of market turmoil (Ghosh & Qureshi, 2012). These motivate the question whether the emerging markets should now advance their own outward portfolio investment or not.

2.3. Trade Integration (TI)

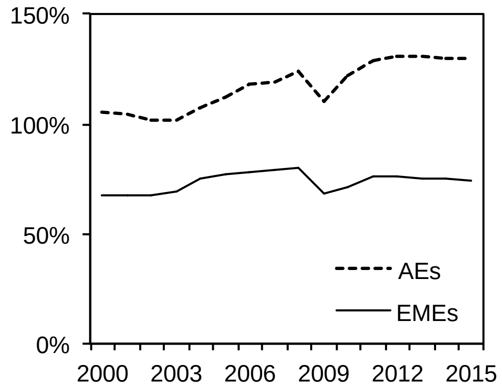
Unlike financial integration, trade integration has a more standard definition as the sum of exports and imports of both goods and services as a share of GDP, and the term is largely used interchangeably with trade intensity, trade openness, and goods market integration. This definition is a counterpart of a quantity-based gross stock measure of FI. Variations apply in practice. Firstly, TI can be measured as trade with the rest of the world or bilateral trade. Trade with the rest of the world refers to the total sum of exports and imports of an economy with all other countries in the world, expressed as a ratio to that country's GDP. This kind of measure is used by authors such as Cowen et al. (2006), Kose et al. (2011), and Kose, Prasad, and Terrones (2006). Bilateral trade measure refers to the exports and imports that only occur between a pair of countries. This can be computed as the bilateral exports and imports divided by the total world trade, the bilateral exports and imports as a ratio to the sum of GDP of the two countries, or other alternative method. For instance, Duval et al. (2014) and Shin and Sohn (2006) measure TI on a bilateral basis.

Secondly, trade can be measured as a conventional gross value or a value-added term that has recently become more adopted. The total trade amount captures all the exports and imports of a country. Trade in value-added deals with the origination of the value-added and breaks down gross exports and imports into various components such as domestic value-added content of exports and imported foreign value-added embodied in exports. The widely-used database is OECD-WTO Trade in Value Added (TiVA), which covers a broad range of countries and provides fairly updated data. A recent database constructed by Koopman, Wang, and Wei (2014) also reports trade in value added using a sophisticated calculation based on their 2014 paper, but covers fewer countries and only provides data up to 2009.[12]

Figure 2.7 compares the trend of trade intensity on a gross value basis between EMEs and AEs during 2000-2015. Similar to FI in Figure 2.5, the EMEs also have lower degree of TI than the AEs, but the gap is considerably smaller than that of FI. The degree of TI in AEs shows somewhat upward trend during the period, overall averaging to 117 percent of GDP. The level of TI in EMEs increases only slightly from around 68 percent in 2000 to 74 percent in 2015, with ups and downs in-between.

[12] The dataset is available at http://dx.doi.org/10.1257/aer.104.2.459.

Figure 2.7 Trend of TI in advanced and emerging market economies 2000-2015 (in percent of GDP)



Source: author’s calculation using data from World Bank’s WDI.

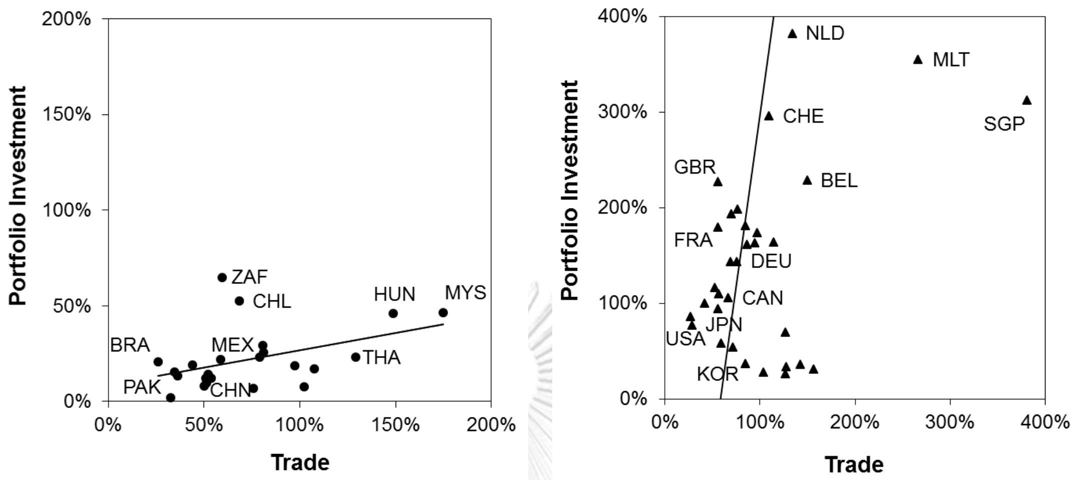
Note: Data source and description are presented in Appendix A. The series used to construct the trend lines are presented in Table A.4 in Appendix A.

2.4. Financial and Trade Integration in Advanced and Emerging Economies

This section further explores the levels of financial and trade integration together and differences among emerging markets across region during the period of 2001-2015. Firstly, Figure 2.8 plots the size of FPI on the vertical axis against the degree of TI on the horizontal axis for each economy under EMEs and AEs groups. FPI is chosen as a representative since it is one of FI measures that are mainly examined in this thesis. The figures clearly show different integration mixes between EMEs and AEs. The emerging markets greatly incline towards higher trade with little presence in international finance (panel a). The unmatched levels of higher international trade but much less advanced FI in EMEs have also been pointed out by Committee on the Global Financial System (2014), Pongsaparn and Unteroberdoerster (2011), and Lee, Huh, and Park (2013). In contrast, the AEs 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 intensity ranges from low levels in Brazil (BRA) and Pakistan (PAK), to very high levels in Malaysia (MYS), Hungary (HUN), and Thailand (THA).

Figure 2.8 FPI and TI in emerging markets and advanced economies (2001-2015 average, in percent of GDP)

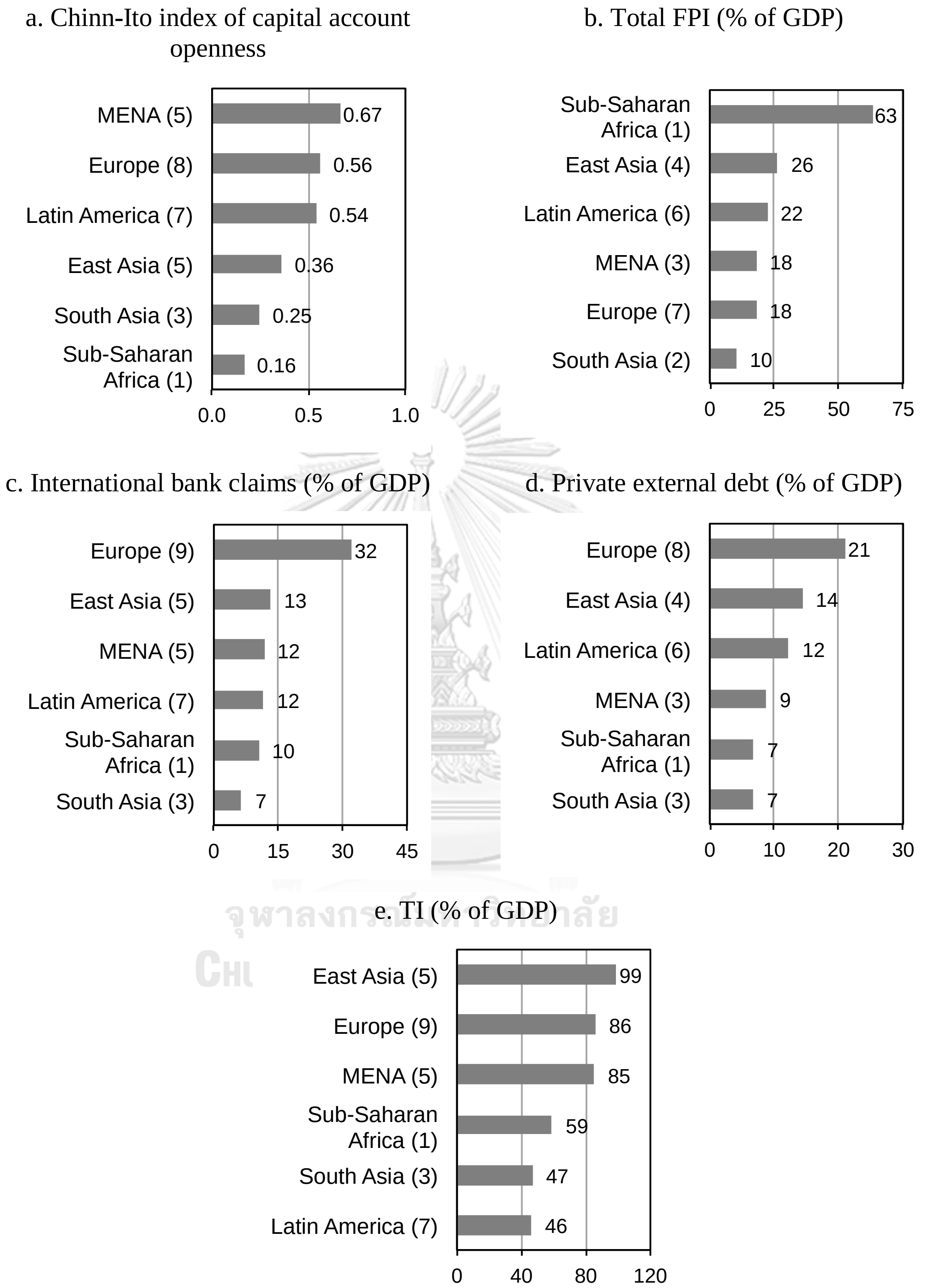
a. Emerging markets b. Advanced economies



Source: author’s calculation.

Note: The scatter plots include only the economies with data from the two sources. The period 2001-2015 is chosen as the common period available from two data sources. The data used to construct the scatter plots are presented in Table A.6 in Appendix A. 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.

Figure 2.9 Financial and trade integration of EMEs by region (2001-2014 average)



Source: author's calculation.

Note: 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 and the periods used. The period 2001-2014 is chosen because there are available data from all four sources. MENA = Middle East and North Africa. The list of countries is presented in Table A.1 in Appendix A.

The differing degrees of integration is further explored in Figure 2.9, which depicts four measures of FI and one measure of TI for six regions of EMEs. The regions are based on World Bank's WDI and the measures are the same as explored in Section 2.2.5 and 2.3. Degrees of integration vary across emerging market regions and different measures of FI do not necessarily yield the same conclusion.

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.). Interestingly, South Africa, the only country in the Sub-Saharan Africa group, has the lowest average score on capital account openness index, but has the largest size of cross-border portfolio investment among the EMEs (panel b.). On the other hand, MENA region with the highest score on de jure index does not have correspondingly higher degree of FI based on the other three quantity-based measures. These show that countries that are more liberalized on paper need not have larger amounts of foreign asset positions, and countries that are relatively less open with their capital accounts could have larger cross-border financial flows.[13]

Emerging Europe has the highest levels of FI in two measures, namely 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 FI in all three quantity-based measures. Other emerging market regions cluster around the low scales of these FI variables.

For trade intensity (panel d.), the data highlights two levels of trade in EMEs. Emerging East Asia has the highest degree of trade averaging almost 100 percent of GDP. This is heavily influenced by the four ASEAN countries. 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.

2.5. Other Related Financial Concepts

This section discusses five terms related to financial integration. The first three terms – financial globalization, liberalization, and openness – are closely related and often used interchangeably in the literature with the term financial integration although in principle, they convey different facets. The last two terms – access to finance and financial inclusion – describe different issues and are discussed together.

[13] This view is also pointed out by Kose, Prasad, Rogoff, et al. (2006).

Financial globalization

Financial globalization is a closely related concept with international financial integration, but is more aggregate in the sense that it depicts overall global linkages through financial connectedness (Prasad et al., 2007). On the other hand, financial integration largely reflects a smaller part such as one individual economy's financial linkages with another country or with the rest of the world (Prasad et al., 2007). In this regards, the rises of financial globalization and financial integration generally go hand in hand.

Financial liberalization

Financial liberalization is concerned with the removal of restriction and impediments in financial asset trade, of which mostly legal and administrative. The term has two senses. One deals with the liberalization of domestic financial markets such as reforms of the banking sector. The other deals with the liberalization of cross-border financial flows and investment such as reducing restrictions on domestic investors trading foreign securities and foreign ownership of domestic assets (Bekaert & Harvey, 2003). The complete financial liberalization should consist of capital account liberalization, equity market liberalization, banking sector reforms, and possibly even privatizations (Bekaert & Harvey, 2003; Pasali, 2013).

Financial integration is related more with international financial liberalization, which typically goes together with the increase in financial openness and cross-border capital flows (Bekaert & Harvey, 2003; Ma, 2016). However, financial liberalization does not necessarily lead to full integration of financial markets (Bekaert & Harvey, 2003). Financial liberalization most resembles the de jure measures of FI.

Financial openness

Financial openness is considered comparable to the quantity-based measure of FI, referring to size of foreign assets and liabilities and cross-border capital flows (International Monetary Fund, 2002; Pongsaparn & Unteroberdoerster, 2011). In this sense, financial openness is deemed a part of financial integration. This definition is analogous to the term trade openness.

Access to finance and financial inclusion

Access to finance and financial inclusion are two related but different concepts. The former one refers to the ability of individuals to participate in financial markets and use financial services. The latter one concerns with the actual use of financial intermediaries and services and is typically measured by the proportion of individuals that use the services (World Bank, 2015). People may have access to financial services, but do not use them due to reasons such as cash is preferred or firms currently have no promising projects (World Bank, 2014). This absence of use is reflected in financial inclusion and does not necessarily suggest the absence of financial access, while the lack of access such as from unavailability, barrier to entry, or unaffordable prices could lead to lower financial inclusion (World Bank, 2014).

Although conceptually different, it is empirically difficult to clearly separate them. The two concepts are usually associated with access and inclusion in domestic financial markets rather than referring to international context. Example proxies of access to finance and financial inclusion are surveys on firms' financial constraint, banks' penetration, and number of ATM machines and bank accounts (Pasali, 2013).

Financial access and inclusion both contribute to economic growth. Access to finance is important for firms to create innovation and growth, especially new and small ones in developing countries whose main obstacle is the lack of access (World Bank, 2014). Financial access is empirically found to be a robust determinant of firms' growth (Pasali, 2013)[14]. It also plays an important role in lessening severe poverty and enhancing inclusive development (World Bank, 2014).

2.6. Stylized Facts of Business Cycles in Emerging Markets

This last section digresses slightly to explore the stylized facts of business cycles since the impact of FI and TI on business cycles is the research objective of this thesis. The business cycles are repeated fluctuation over time, mostly in real GDP, and caused by underlying driving forces like shocks and disturbances (Doepke et al., 1999). This section summarizes key characteristics of business cycles in EMEs comparing with advanced economies from four papers selected based on the criteria of being relatively recent, including a broad range of countries from both advanced and emerging economies, and not focusing at any specific region. The review focuses at output and consumption volatility, as they are the key indicators of aggregate fluctuation (Benhamou, 2016). The papers are reviewed in chronological order. The last part concludes and discusses issues regarding possible reasons for different characteristics of business cycles in EMEs and how to model them in general equilibrium framework.

[14] See Pasali (2013) for a review of studies on the effect of financial inclusion on growth and its determinants.

First study is by Aguiar and Gopinath (2007). They investigate the business cycles of two groups of economies – 13 emerging economies and 13 developed countries. The data is quarterly around the period of 1980-2003. The exact period used varies by country. The series are Hodrick-Prescott (HP) filtered and average moments reported in Table 2.5 are computed by generalized method of moments (GMM).

Table 2.5 Average macroeconomic volatility and correlation in developed and emerging markets from a study of Aguiar and Gopinath (2007)

	$\sigma(Y)$	$\sigma(C)/\sigma(Y)$	$\rho(Y_t, Y_{t-1})$	$\rho(C, Y)$
Developed markets	1.34 (0.05)	0.94 (0.04)	0.75 (0.03)	0.66 (0.04)
Emerging markets	2.74 (0.12)	1.45 (0.02)	0.76 (0.02)	0.72 (0.04)

Source: Aguiar and Gopinath (2007), adapted by author.

Note: Data are filtered using Hodrick-Prescott method with a smoothing parameter of 1,600; σ denotes the volatility in percentage; ρ denotes the correlation; the standard errors are reported in parentheses; developed markets (13) = Australia, Austria, Belgium, Canada, Denmark, Finland, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland; EMEs (13) = Argentina, Brazil, Ecuador, Israel, Korea, Malaysia, Mexico, Peru, Philippines, Slovak Republic, South Africa, Thailand, Turkey.

On average, the business cycle of EMEs is about twice more volatile than that of AEs (2.74 versus 1.34). The volatility of filtered consumption as a ratio of output shows that consumption volatility at business cycle frequencies in emerging markets exceeds their own output volatility and is about 40 percent higher than developed countries, whose ratio is slightly below one. This indicates that consumption is highly volatile in emerging markets even after controlling for the high volatility of output (Aguiar & Gopinath, 2007). The autocorrelation of filtered output is similar across two country groups. The contemporaneous correlation between consumption and output in emerging markets is higher than AEs. Nevertheless, consumption and output are well correlated in both groups.

The second paper by Calderon and Fuentes (2010) characterizes the business cycles regarding duration and amplitude for 23 EMEs and 12 OECD economies using quarterly data from 1980 to 2006. The emerging markets are further divided into eight East Asian and Pacific countries, 12 Latin American, and three other EMEs. They adopt the classical approach of identifying the turning points in real GDP series, which indicate peaks and troughs. The duration, amplitude, and number of the contractions (peak-to-trough phases) and expansions (trough-to-peak phases) are then derived from the turning points. Table 2.6 depicts these characteristics of business cycles in advanced and emerging economies.

Table 2.6 Characteristics of business cycles in OECD and emerging economies from a study of Calderon and Fuentes (2010)

	Mean duration (quarters)		Mean amplitude (%)		Number of contractions
	Contractions	Expansions	Contractions	Expansions	
OECD	3.6 (1.2)	23.8 (10.0)	-2.2 (1.1)	20.2 (8.7)	3.3 (1.5)
EMEs	4.0 (1.5)	17.3 (14.9)	-6.6 (3.7)	27.9 (24.5)	4.1 (2.5)
Asia	4.2 (1.7)	21.3 (13.6)	-7.4 (4.1)	41.6 (31.0)	2.9 (1.7)
Latin America	3.5 (0.8)	16.0 (17.6)	-6.2 (3.8)	21.3 (19.4)	4.8 (2.8)
Other EMEs	4.8 (3.1)	17.1 (11.2)	-4.8 (2.9)	28.9 (25.2)	3.3 (1.5)

Source: Calderon and Fuentes (2010), adapted by author.

Note: The standard deviations are reported in parentheses; OECD = Australia, Canada, France, Germany, Italy, Japan, New Zealand, Portugal, Spain, Sweden, United Kingdom, United States; Asia = Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, Thailand; Latin America = Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Paraguay, Peru, Uruguay, Venezuela; Other EMEs = India, South Africa, Turkey.

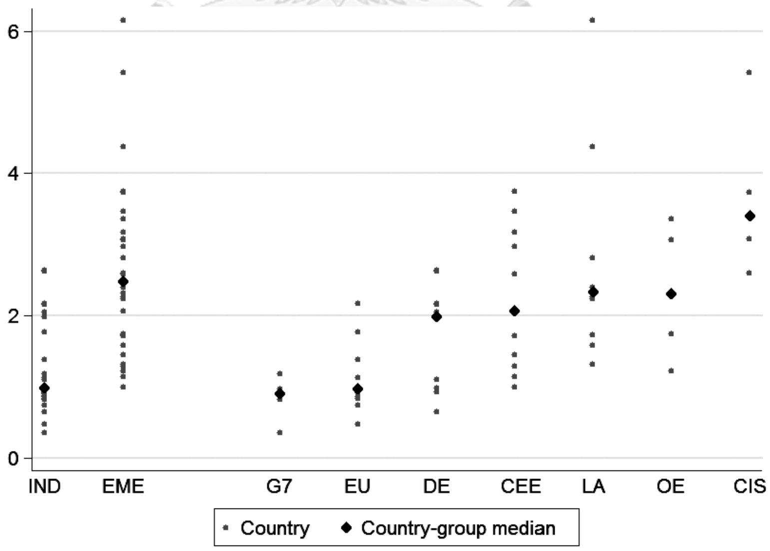
The contractions in emerging markets are longer, deeper, and more frequent than OECD countries. The recession in EMEs on average lasts about 4 quarters, with 6.6 percent in amplitude, and occurs about 4 episodes per country. The emerging market expansions are also larger (27.9 versus 20.2 percent), but shorter (17.3 quarters versus 23.8 quarters) than those of developed economies. These suggest that the business cycles in emerging markets are more volatile (Calderon & Fuentes, 2010). The long period of recession is influenced by other EMEs group, and in particular, South Africa, while the large amplitude of the recession is influenced by East Asian group, and in particular, Thailand. Asia also exhibits the longest and largest expansions among EMEs.

The third study is by Benczúr and Rátfai (2014). They examine the aggregate fluctuation in 29 industrial economies and 31 emerging countries. The AEs and EMEs are categorized into three and four subgroups respectively based on their regions. The data are quarterly from 1995 to 2008 and filtered using HP method. Their results on output and consumption volatility are presented in Figure 2.10, which plots the volatility for each country and the mean of country group.

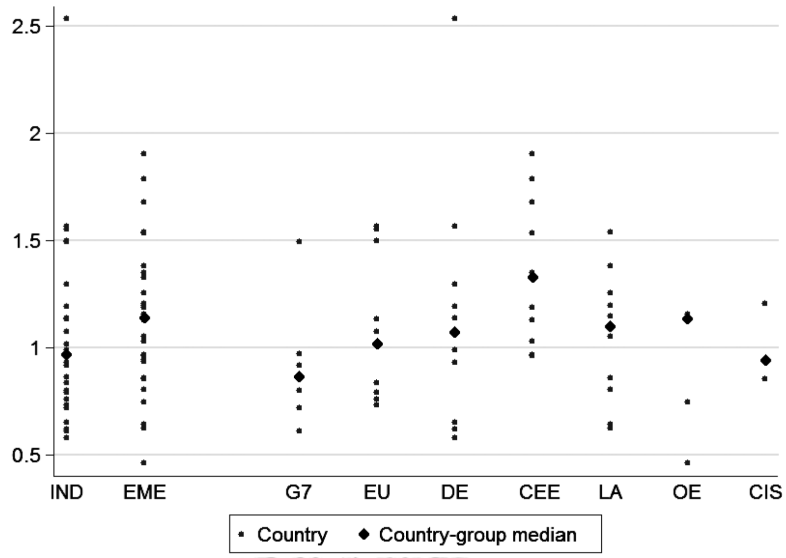
The output in EMEs is roughly twice as volatile as in AEs, similar to the findings of Aguiar and Gopinath (2007). Among EMEs, the mean is highest in former Soviet Union (CIS) and lowest in Central and Eastern Europe (CEE), but with large dispersion within the group. The output volatility in EMEs generally seems to be less homogeneous than AEs (Benczúr & Rátfai, 2014). Also similar to the evidences provided by Aguiar and Gopinath (2007), the consumption is more volatile than output in EMEs, and the ratio of consumption to output volatility in EMEs is larger than that of AEs, which is about one percent, meaning the volatilities of output and consumption are similar.

Figure 2.10 Volatility of output and consumption in advanced and emerging economies from a study of Benczúr and Rátfai (2014)

a. Output volatility



b. Consumption volatility relative to output volatility



Source: Benczúr and Rátfai (2014)

Note: IND = industrial countries comprising of G7, EU, and DE; EME = emerging market economies comprising of CEE, LA, OE, and CIS; G7 = Canada, France, Germany, Italy, Japan, United Kingdom, United States; EU = Austria, Belgium, Denmark, Finland, Greece, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden; DE (Other developed economies) = Australia, Cyprus, Hong Kong, Iceland, Israel, Malta, New Zealand, Norway, South Korea, Switzerland, Taiwan; CEE (Central and Eastern Europe) = Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia; LA (Latin America) = Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, Venezuela; OE (Other emerging markets) = Malaysia, Philippines, South Africa, Thailand, Turkey; CIS (former Soviet Union) = Georgia, Kazakhstan, Moldova, Russia, Ukraine.

Lastly, a recent paper by Benhamou (2016) explores the business cycles of 102 economies that are divided into 34 OECD countries and four other groups of developing countries based on regions. This paper does not focus only at emerging markets and includes a large sample of developing countries. The developing countries comprise of 16 Asian economies, 19 Latin American, 13 MENA countries, and 20 Sub-Saharan African. The series are from 1950 to 2013 and HP filtered. The average statistics of volatility and correlation are reproduced in Table 2.7.

Table 2.7 Average volatility and correlation in OECD and developing economies from a study of Benhamou (2016)

	$\sigma(Y)$	$\sigma(C)$	$\rho(C,Y)$	$\rho(Y,W)$	$\rho(Y,R)$
OECD (34)	2.85% (0.013)	2.40% (0.019)	0.705 (0.193)	0.731	0.576
Asia (16)	4.00% (0.019)	4.80% (0.026)	0.643 (0.200)	0.402	0.301
Latin America (19)	3.10% (0.009)	3.90% (0.015)	0.711 (0.176)	0.242	0.194
MENA (13)	6.50% (0.044)	5.10% (0.022)	0.426 (0.406)	0.342	0.398
Sub-Sahara Africa (20)	5.30% (0.029)	7.90% (0.069)	0.581 (0.301)	0.429	0.286

Source: Benhamou (2016), adapted by author

Note: σ denotes the volatility in percentage; ρ denotes the correlation; W = global cycle; R = regional cycle; the standard errors are reported in parentheses under the figure where available from the source; the numbers of countries are reported in parentheses after the grouping name. Refer to Benhamou (2016) for a list of countries in each group.

Standard deviation of de-trended output shows that all four developing regions have larger output fluctuation than OECD economies. MENA region has the highest output volatility, about double size of OECD's. The consumption volatility in EMEs is also higher than OECD and higher than their corresponding output volatility except for MENA. The contemporaneous correlation between output and consumption, on the other hand, does not differ much among five country groups, all suggesting that output and consumption are well correlated (Benhamou, 2016). Average business cycle correlations of individual economy with the world and with other countries in the region are reported in column 5 and 6. The business cycle synchronization of OECD with the global economy is significantly higher than other groups, but this might be owing to their worldwide prominence (Benhamou, 2016). OECD is also relatively highly correlated within their group. For four developing groups, the regional and global correlations are not much different, and both are significantly lower than business cycle synchronization of OECD. A further examination of Benhamou (2016) using variance decomposition suggests that developing countries are more susceptible to country-specific shocks than OECD, which is more driven by global and regional cycles.

In summary, the differences of business cycles between emerging market and advanced economies are widely documented. Common stylized facts can be drawn from a number of studies although they use different data period, country group, and methodology. The most prominent stylized fact is that the output in EMEs is more volatile than that of advanced economies. This is a well-recognized fact and has been confirmed by many other authors apart from the abovementioned. See Agénor, McDermott, and Prasad (2000) and S. H. Kim, Kose, and Plummer (2003) for example. Secondly, consumption in EMEs is found to exhibit higher fluctuation than their output, leading to a ratio of consumption to output volatility greater than one, which is larger than that of industrial countries. 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).

The discrepancies in business cycles among countries could be due to many 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 et al., 2000; Aguiar & Gopinath, 2007).

Other findings apart from those presented above are as follow. The output fluctuations in EMEs and advanced economies are positively correlated, suggesting that activities in industrial countries could influence EMEs (Agénor et al., 2000). Emerging markets largely have more countercyclical and volatile net exports than developed countries (Aguiar & Gopinath, 2007; Benczúr & Rátfai, 2014). Their real interest rates are also countercyclical and very volatile (Calderon & Fuentes, 2010). Regarding the persistence, the results 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 real business cycle (RBC) framework that usually applies to developed countries may not be able to capture the stylized facts (Agénor et al., 2000). Many modifications are suggested. Aguiar and Gopinath (2007) advocate adding shocks to trend growth in standard RBC and dynamic stochastic general equilibrium (DSGE) models.[15] They argue that these shocks could help replicate the fluctuations in 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

[15] RBC and DSGE models will be discussed in the next chapter.

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).

2.7. Conclusion

This chapter has summarized the definition and measures of financial development, financial integration (FI), and trade integration (TI). Financial development is a very broad concept that covers development in many parts of the financial systems and in diverse aspects. FI is a multifaceted term and does not have a single definition. In a narrow sense, it can represent the size of cross-border financial flows. In a broader sense, it relates to symmetric frictions and equal financial access. FI can be measured by various indicators. In contrast, TI is a well-defined term that generally means the exports and imports relative to GDP.

Financial development and FI are related and they tend to positively support each other. While financial development is generally advantageous to the economy, FI has both benefits and costs. FI should provide diversification, smooth consumption, and alleviate capital scarcity, but there is a risk of financial crisis contagion. The concept of FI is related to financial globalization, financial liberalization, financial openness, and access to finance.

The chapter also presents the level of financial development, FI, and TI in emerging market economies (EMEs) as compared to advanced economies (AEs). The EMEs largely have lower level of financial development than AEs. Their FI levels in all measures are relatively low and lag far behind the AEs. These are possibly due to many factors such as market imperfections, more restriction, and lower institutional quality, which in turn could hinder EMEs from achieving presumed gains from FI. EMEs also have lower degree of TI than AEs, but the difference is much smaller than that of FI. Moreover, their integration mixes differ. The AEs incline towards higher FI more than TI, but it is the opposite for EMEs.

Lastly, the investigation of business cycles depicts some stylized facts that the business cycle in EMEs is more volatile than AEs, and their consumption fluctuates more than output. This highlights the importance of including financial frictions in macroeconomic general equilibrium models to account for their larger aggregate fluctuations.

Chapter 3
Literature Review

This chapter reviews the existing literatures regarding financial integration (FI), trade integration (TI), real business cycle (RBC) model, and other related issues. The first half of this chapter covering Section 3.1 to 3.5 mainly discuss the relationship between FI and TI, and their impacts on economic growth, macroeconomic volatility, business cycle synchronization, and welfare. Section 3.1 to 3.3 summarize FI's relationship with growth and TI. The impact of FI and TI on business cycles is reviewed in Section 3.4 and 3.5, which include the findings from both empirical studies and quantitative general equilibrium models. This thesis largely combines two strands of general equilibrium literatures, which are the studies of imperfect FI in emerging markets and the studies on the effect of financial and trade integration together on business cycles. These are reviewed in Section 3.4.1 and 3.5.2 respectively.

The second half starting from Section 3.6 reviews the methodology used in this thesis, which are the dynamic stochastic general equilibrium (DSGE) framework and international real business cycle (IRBC) model. DSGE modeling is introduced in Section 3.6. Section 3.7 examines various components of the model economy. How FI and TI can be modeled within general equilibrium models are discussed in Section 3.8 and 3.9. Section 3.10 reviews various solution techniques relevant to solving these kinds of models in different settings. Lastly, Section 3.11 concludes.

3.1. Financial Integration and Economic Growth

There have been a large amount of empirical studies investigating the impact of FI on economic growth. The findings from these studies, however, cannot provide robust evidence that FI promotes growth (Aizenman et al., 2013; Kose, Prasad, & Terrones, 2006). The results are mixed depending on the data, country grouping, measures of FI, types of international financial flows, and the estimation method employed.

Among many approaches, the most popular one is an empirical cross-country analysis that builds on the standard growth regression. This strand of research studies a long-term average of growth regression on financial openness measures and other growth-related variables. The regression analysis mostly uses the data samples that include as many countries as possible for cross-sectional or panel data analysis. Variables entering the regression are usually a non-overlapping five-year average for each country since this type of growth study focuses on medium- to long-run trend rather than short-run fluctuation. Countries are often categorized into industrial countries versus emerging and developing countries. Other methods of categorizing the countries are infrequent. It is interesting to examine other ways to divide countries into groups, such as dividing into countries with net positive outflow and net negative outflow because there may be some asymmetric nature of flow direction.

The adopted growth regression equation in its most basic form is given by

$$\Delta y_{it} = \alpha + X_{it}'\beta + \gamma FI_{it} + \varepsilon_{it} \tag{3-1}$$

where y_{it} is GDP per capita in country i, Δy_{it} is the five-year average growth of GDP per capita, α is a constant term, X_{it} is a vector of standard control variables for growth regression such as population growth, government spending, and inflation, β is a vector of coefficients on growth control variables, FI_{it} is a measure of financial integration, and ε_{it} is an error term. Country and time period specific effect can be added instead of a plain constant term α. Other possible variations are quadratic terms of financial openness measures and interaction terms describing by the product of FI measure and other variables of interest such as exchange rate stability (see Aizenman et al., 2013).

The results from these regression studies are mixed and inconclusive. Some papers found a negative coefficient on FI, suggesting that it is harmful to economic growth. Some papers found no robust correlation between the two (Kose, Prasad, & Terrones, 2006; Rodrik, 1998). Overall, evidences are not in favor of either supportive or adverse relationship between FI and growth (Aizenman et al., 2013).

One argument claims that FI tends to benefit high-income countries more than low-income countries that are more in need of financial globalization than stable industrial countries (Arteta et al., 2001; Obstfeld, 2009). However, Arteta et al. (2001) empirically tested this statement and found that this conjecture was weak and had little support from data.

Different measure of FI also matters. De facto and finer de jure measures are more likely to yield positive growth effect than coarse binary de jure measures because they are more informative (Kose, Prasad, Rogoff, et al., 2006). For instance, Rodrik (1998) who employed a binary indicator of capital account liberalization found no significant growth effect, while Quinn (1997) who use a finer openness measure found positive impact of capital account liberalization on growth. In addition, using data over longer period of times tend to provide positive impact of FI on growth.

Some studies distinguish the financial flows into different types. It is largely accepted based on empirical evidences that FDI brings along with it the technology and knowledge that can enhance productivity and faster economic growth (Arteta et al., 2001). It is argued to be less volatile than other types of flows owing to its longer-term commitment that are less subject to sudden stops (Kose, Prasad, Rogoff, et al., 2006). Evidences also suggest that equity market liberalization positively impacts growth[16] possibly through investment and total factor productivity channels, but this could just be because equity market liberalization likely occurs together with other reforms (Kose, Prasad, Rogoff, et al., 2006). The type of financial integration that deems to post greatest risks are debts flows such as bond and commercial bank loans because they could result in poor domestic bank supervision and inefficient capital allocation (Kose, Prasad, Rogoff, et al., 2006). For instance, a recent work by Aizenman et al. (2013) studied financial openness-growth relationship by focusing on international capital flow and its heterogeneous nature among different kinds of flows. They distinguished the flows into FDI outflow, FDI inflow, investment in equity and short-term debt. The result suggests that the relationship indeed depends on the types of flows. Both FDI inflows and outflows were found to exhibit robust positive impact on growth. Equity flow's impact was insignificant and short-term debt's effect was negative during the late 2000's crisis. The finding supported the view that short-term foreign debt can harm growth, as it is a liability and must be repaid. Comparing all kinds of financial flow, FDI is confirmed to be more beneficial than the others.

There have also been suppositions along with some evidences that a country can reap the full benefit of FI only when certain preconditions are met first. This suggests the sequencing of development a country should follow. Examples of prerequisites are developed domestic financial markets, sound institutional quality and supervision, the right exchange rate regime, and openness to trade (Aizenman, 2008; Arteta et al., 2001; Obstfeld, 2009). With these conditions in place, capital can be allocated efficiently and contracts can be well implemented. Then, financial globalization can play a supporting role on growth.

Apart from inconclusive results, the cross-sectional empirical approach also faces criticism. Examples are that it lacks an underlying theoretical framework on how openness can affect growth and financial openness usually comes in a bundle together with other structural reforms that can also help promote growth, which raise questions about endogeneity (Obstfeld, 2009). For example, a number of EMEs liberalized their equity markets at a similar time with other structural reforms (Kose, Prasad, Rogoff, et al., 2006).

Other alternative methods beside the mainstream are the case study of specific financial liberalization events that have actually taken place, and time-series analysis of a single country employing econometric concepts like cointegration. See Adam (2011) for example.

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[16] See Bekaert, Harvey, and Lundblad (2005) for example.

3.2. Financial and Trade Integration

Trade integration is viewed as closely related to financial integration. The relationships are mostly found to be that TI encourages higher FI (Aizenman, 2008; Borensztein & Loungani, 2011; Rose & Spiegel, 2002), or that the two types of integration are complimentary to each other (Aizenman & Noy, 2009; Aviat & Coeurdacier, 2007; Feeney, 1994; International Monetary Fund, 2002; Shin & Yang, 2006).

Many channels are possible in which TI can induce greater FI particularly in cross-border bank lending. Rose and Spiegel (2002) suggested that sovereign creditors are likely to prefer lending to a country that is a trade partner. Since defaulting on the debt might adversely affect the established international trade relationship, debtors are likely to be more careful. They also established that the patterns of international trade affect the patterns of the lending. Eichengreen and Park (2003) showed that an increase in trade activities is linked with an increase in bank lending transactions. One possible channel is that merchandise transactions encourage the establishment of stronger financial flows to support the trade activity. Apart from international bank lending, cross-border bilateral equity and bond holdings are also found to have positive relationship with bilateral trade (Borensztein & Loungani, 2011). For instance, International Monetary Fund (2015b) stated that a ten percent increase in bilateral goods trade leads to four to seven percent higher bilateral portfolio holding.

Financial and trade integration are also found to be complementary. Feeney (1994) concluded that international goods and asset trades are complement, rather than substitutes. Trade openness encourages a comparative advantage and specialization in production. Risk diversification realized from international financial asset trading helps facilitate allocation of labor and promote more specialization and hence, trade to other countries. Shin and Yang (2006) and Aviat and Coeurdacier (2007) investigated two-way effects between bilateral trades in goods and trades in financial assets adopting a gravity model. They found that the effects go both directions suggesting the complementarity between the two types of integration. However, the effect from trade to financial transaction is stronger than the opposite direction. Additionally, Shin and Yang (2006) found that physical distance is more influential to bilateral trade whereas common languages are more influential to financial assets trade. The finding implies that communication is important for cross-border financial transactions. Portes and Rey (2005) linked financial and trade integration through lower information cost and higher bilateral flows of information. They showed that both types of integration are driven by common information factors. International Monetary Fund (2002) surveyed the literatures on trade and financial openness. They concluded that increasing TI could lessen the risk of financial crisis for countries with high FI. With trade openness in place, the associated risks with financial openness can be partly mitigated. A country likely becomes less vulnerable to potential shocks in financial flows through various channels such as real exchange rate adjustment mechanism (Kose et al., 2011; Obstfeld, 2009). On the other hand, increasing FI could help manage output volatility for countries with high TI. In addition, FI could complement international trade by lowering information asymmetry and transaction costs (International Monetary Fund, 2015b).

From the findings, it leads to a conclusion that trade and financial integration are related. The policy implication is then that the two types of integration should not be managed separately (Aizenman, 2008; Aizenman & Noy, 2009).

3.3. Sequencing of Liberalization, Threshold Effect and Optimal FI

Sequencing of liberalization, threshold effect of FI on growth, and optimal level of FI are three related concepts and will be discussed subsequently in this section.

Sequencing of liberalization[17]

There is a widely accepted conjecture that sequencing of liberalization matters. Certain liberalization should precede another kind of liberalization. In a broad sense, international trade should be liberalized before financial liberalization, domestic financial reforms should be put in place before external financial liberalization, and foreign direct investment should be liberalized before portfolio and bank loan. Intuitively, capital account liberalization would be more smoothly implemented and successful when there are sound macroeconomic policies, well-functioned financial sector, good institution, and other supportive environment in place. Rapid liberalization of capital accounts without these prerequisites could lead to distortion, misallocation of resources, unfavorable capital flow structure, and vulnerability to sudden flow reversal as have been shown by many evidences such as the experiences of Indonesia, Thailand, and Korea during 1997 East Asian crisis.

In particular, trade liberalization is considered one important precondition that should precede financial liberalization. TI has a more favorable cost-benefit trade-off than FI, and it tends to mitigate the risks and costs of crises associated with FI. There are evidences that developing countries with greater trade openness could export their way out of crises and adverse growth impact better that others, likely due to larger effect of exchange rate depreciation on export revenues. Furthermore, financial liberalization

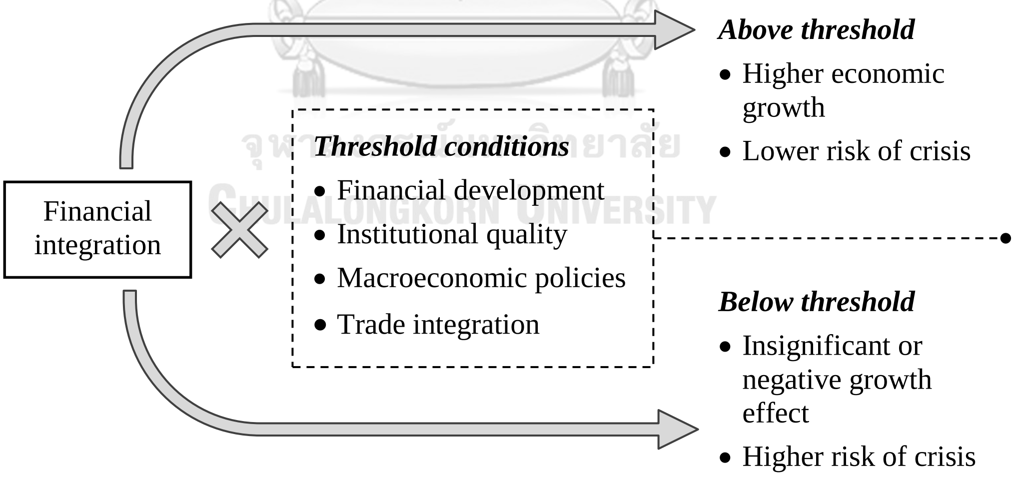
[17] This section is summarized from Ito (2001) and Kose, Prasad, Rogoff, et al. (2006).

without TI could misallocate capital flows to sectors that an economy lack comparative advantage. For the literatures on the sequencing of liberalization, see for example, Arteta et al. (2001), Edwards (2001), Edwards and Van Wijnbergen (1986), and McKinnon (1993).

Threshold effect of FI

One related empirical test of sequencing of reform conjecture is the threshold effect study. The concept of threshold effect deals with the changing effect of FI given certain level of relevant structural factors. At the threshold level of these related structural factors, the effect of FI broadly turns from negative or insignificant to positive. Above the threshold levels, FI is supportive to economic growth and less prone to crisis. But below the threshold level, FI tends to be insignificant or sometimes even harmful to the economic growth. Examples of structural factors that possibly interact how FI influences growth, volatility and crisis are domestic financial development, overall quality of institutions, and trade integration. Figure 3.1 depicts this threshold effect concept.

Figure 3.1 Threshold effect of FI



Source: Kose, Prasad, Rogoff, et al. (2006).

The ideas behind the threshold effect is that developed countries which tend to have higher domestic financial development, better institutional quality, and more stable policies are also more likely to benefit from financial globalization than less-developed countries (Kose et al., 2011). Because these structural factors seem to support the openness of financial markets in many ways, it may be the case that developing countries should put the appropriate structure in place first too. The threshold effect studies could lend explanation as to why the result of FI-growth relationship is inconclusive. It might be that the relationship is nonlinear and contingent on other precondition factors that determine the impact of FI on growth and other outcomes. However, this strand of literatures generally does not intend to pinpoint the exact threshold. Its major aim is to identify what conditions are desirable and supportive for integrating into global financial markets.

Threshold effects are usually studied using similar setting and approaches with the empirical study of FI on economic growth alone discussed in Section 3.1. The estimated equation is based on standard growth regression plus the interaction terms combining the effects of threshold variables with FI variable. The notations for y_{it}, Δy_{it}, X_{it}, and FI_{it} are the same with Section 3.1. With added variable TH_{it} denoting the threshold variable in interest, the typical regression equation is

$$\Delta y_{it} = \alpha + X_{it}'\beta_X + \beta_{FI}FI_{it} + \beta_{TH}TH_{it} + f(FI_{it}, TH_{it}) + \varepsilon_{it} \quad (3\text{-}2)$$

where $f(FI_{it}, TH_{it})$ is an interaction function describing the relationship between FI measure and the threshold variable. The interaction function can generally take three forms (Kose et al., 2011). The first form is a linear interaction. This is a multiplication of FI variable and threshold variable. The second form is a quadratic interaction. It includes a non-linear terms of the threshold variable in addition to a linear interaction. The third form is a dummy variable indicating whether FI level is high or low. To illustrate, the dummy variable takes a value of one when the country's threshold variable is above the sample median, and zero otherwise. Although the main dependent variable explored is mostly economic growth, other dependent variables are also present such as macroeconomic volatilities and crisis likelihood.

From the linkage between financial and trade integration discussed in Section 3.2 and the agreement that trade openness enhances economic growth (Arteta et al., 2001; International Monetary Fund, 2002; Kose, Prasad, & Terrones, 2006; Pancaro, 2010), TI is usually included in the threshold studies. However, the literatures fail to robustly detect the threshold effect of TI in determining the impact of FI on growth. 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 FI and growth is insignificant. Kose et al. (2011) found threshold effect of trade on FI but it is not robust. There is one case that the trade threshold level is too high that few countries achieve it.

Apart from trade, studies under different settings, datasets, and methods arrive at a similar conclusion that there exist threshold effects in other structural factors. The thresholds are documented for the depth of domestic financial market and institutional quality by Kose et al. (2011) and Chen and Quang (2014). Arteta et al. (2001) found promising results for rules of laws and elimination of domestic macro imbalance focusing on exchange rate regime. Friedrich et al. (2013) observed that emerging European countries attain more benefit from FI as compared to other developing countries due to their political integration with stronger European countries. The threshold effect literature is large, but it is not a main focus of this dissertation. See Kose et al. (2011) for a lengthier list of literature studying threshold effects of other variables (apart from trade) on the FI-growth relationship.

Optimal level of FI

A related finding to the threshold effect is the optimal level of financial integration. The optimal FI can be thought of as an inverse of the threshold effect. The threshold level turns the effect of FI from negative to positive, whereas the optimal level turns the effect of FI from positive to negative. However, unlike the large threshold literature, very few papers studied or found the optimal level of FI. Kose et al. (2011) discovered that the relationship of FI and domestic financial depth on growth is hump-shaped. At low and high levels of domestic financial depth, FI is bad for growth. But at medium level of domestic financial depth, FI is good for growth.

This might be comparable with an inverted U-shaped relationship between financial development and growth found in recent literature, which has been discussed in Section 2.1.3. Financial development seems to be positive up to a certain point, but too much finance could be adverse. However, the size of domestic financial markets has become very large in many economies and its optimal level has been in debates, but the degree of FI is still relatively low for many countries especially the developing ones. Thus, the question has not reached the state of too much of FI yet, but rather how much FI is sufficient to gain benefits.

Overall, the threshold evidence is robust for many structural factors with the exception of TI. There seems to be some thresholds or prerequisite conditions that a country should surpass first in order to gain benefits from FI. However, it is unlikely to have one universal approach of liberalization that works well for every economy (Kose, Prasad, Rogoff, et al., 2006). In contrast, the research on optimal FI has received much less attention and the evidences maybe insufficient to arrive at a conclusion that there is an optimal level of FI. Main papers discussed in this section are summarized and compared in Table 3.1.

Table 3.1 Studies of threshold effect and optimal FI

Author	Main relationship examined	Include TI	Finding on TI threshold effect	Finding on optimal FI	Other related findings
Arteta, Eichengreen, and Wyplosz (2001)	FI and growth	Yes	TI threshold effect is insignificant	-	Found significant threshold effect of rule of law and exchange rate regime
Kose, Prasad, and Taylor (2011)	FI and growth	Yes	TI threshold is found in some cases but not strong. In one case, the TI threshold level is too high that few countries achieve it.	Found optimal FI contingent on domestic financial depth. At low and high domestic financial depth, FI is bad for growth. At medium domestic financial depth, FI is good for growth.	Found threshold effect in institutional quality and domestic financial depth
Friedrich, Schnabel, and Zettelmeyer (2013)	FI and growth	Yes	TI threshold effect is insignificant	-	Found that political integration plays positive role in enhancing FI-growth relationship
Chen and Quang (2014)	FI and growth	Yes	TI threshold effect is insignificant	-	Found threshold effect in income, institutional quality, and domestic financial depth

3.4. Financial Integration on Business Cycles and Welfare

Apart from economic growth, the effect of FI on business cycle synchronization, macroeconomic volatility, and welfare is also usually explored. These three concepts are partly related and often studied together. Focusing on which consequences generally depends on the author's interest.

Business cycle synchronization (shortened as BCS hereafter) is mainly concerned with cross-country comovement and international risk sharing. In particular, output and consumption correlation are most studied. On the positive side, financially integrated markets bring about risk diversification. People consequently tend to consume out of a fairly common international diversified portfolio (Imbs, 2006). This can result in increased correlation between the countries. The increase in correlation of aggregate consumption can then be interpreted as increase in international risk sharing. On the negative side, business cycle comovement may mean tight dependency among countries, which can be adverse in the event of crisis spillover. Therefore, knowing the characteristics of business cycle comovement is important for policy making. For example, strong synchronization may requires more policy coordination among countries, and domestic stabilization policy may have less influence when external factors are also the main drivers of the country's business cycle (García-Herrero & Ruiz, 2008).

For the effect of FI on macroeconomic volatility, the importance is threefold. Firstly, the volatility itself is not desirable. Secondly, it also has negative relationship with economic growth (Ramey & Ramey, 1995). Thirdly, it is associated with the concept of consumption smoothing or the ability of a country to smooth domestic shocks. Financial openness provides the consumer with more borrowing and saving choices. Thus, it can help the consumers to smooth consumption through time and insure themselves against country-specific shocks (Kose, Prasad, Rogoff, et al., 2006; Leblebicioğlu, 2009). In aggregate, increased consumption smoothing is observed from lower volatility of consumption growth in relative to output (Bekaert et al., 2006; Leblebicioğlu, 2009). However, the direction of FI's impact on output volatility is less clear in the literature.

Lastly, the welfare of the economy seems to be the ultimate goal for every country. Welfare gain or loss can be directly measured as changes in household's expected lifetime utility, which is in turn primarily derived from consumption. Sometimes welfare is approximated by other obvious measures easier to observe such as macroeconomic volatility (Sutherland, 1996), but the level of utility-based measure still provides a more appropriate measure. Welfare study is usually studied within theoretical framework.

This section reviews the researches examining the effect of FI alone on macroeconomic volatility, cross-country comovement, and welfare gain. As a result, only general equilibrium framework is presented and empirical literatures that typically include TI will be taken up in the next section.

3.4.1. Quantitative General Equilibrium Models

In recent decades, the widely used framework to study relationship between FI and business cycles is *dynamic stochastic general equilibrium (DSGE)* class of models.[18] A typical setting is a two-country model consisting of two main sectors – household and production. Households can be divided into savers and borrowers, or consumers and entrepreneurs, for example. The production sector can be divided into several types of goods producing firms depending on the researcher's model setting. Financial integration is usually defined as domestic agent's accessibility to a wide range of financial assets in foreign markets (Evans & Hnatkovska, 2007a; Leblebicioğlu, 2009). The definition represents household's ability to save or borrow abroad which can partly protect them from domestic shocks. This is different from the empirical studies on FI, which usually regard it wholly as the amount of capital flows or the size of international financial asset holdings.

The general equilibrium framework usually compares at least two financial scenarios. For example, one is financial autarky where people cannot invest or borrow abroad at all, comparing to the one with domestic financial markets fully integrated into the world markets. Consequences of moving from financial autarky to financial integration are then analyzed if there is any welfare gain or risk sharing benefits from opening up a country financially. The procedure is solving the conditions for the equilibrium, and then simulating the system and analyzing a shock to the economy. Finally, the effects of interest are derived, whether it is the cross-country comovement, macroeconomic volatility, or welfare implication. Different papers have different model specifications, but the procedures and overall framework are roughly the same. The general equilibrium framework focuses more on short-run dynamic of economy in response to a shock and fluctuations of macroeconomic variables, not the long-run trend like the empirical literatures of FI and growth. The papers reviewed here are non-exhaustive and presented in chronological order to illustrate the advancement of studies in the field.

This strand of literature has started from the influential papers by Backus, Kehoe, and Kydland (1992, 1994) who pioneered *international real business cycle (IRBC)* model. They extended the closed-economy *real business cycle (RBC)* model of Kydland and Prescott (1982) to open-economy two-country setting with complete asset

[18] DSGE model is explained and discussed in further details in Section 3.6 and 3.7.

market. Several of their theoretical findings contradicted with the empirical data, such as the model's anomaly prediction that cross-country consumption correlation is higher than output correlation (Heathcote & Perri, 2002). Nevertheless, motivated by the discrepancies between data and theory from the studies of Backus et al. (1992, 1994), a number of researchers had tried to resolve the puzzles by introducing different structures of asset market and frictions.

Deviating away from the complete asset market structure, Baxter and Crucini (1995), for example, constructed the model economy with only non-contingent bond traded, or the *bond economy*. They examined the consequences of this asset trade restriction and different types of shock on international business cycle and shock transmission. They discovered that the incomplete asset market leads to different results from the complete market only when shocks to the economy are very persistent or cannot be transmitted across countries.

Heathcote and Perri (2002) proposed another asset market structure. They restricted all trades of international asset in their *financial autarky* model. They compared financial autarky with the prior two types of asset markets – complete market and the bond economy – whether which model's prediction is closest to the data. They discovered that the autarky model can generate cross-country correlation of GDP, employment and investment that are most consistent with the empirical data. Increasing integration from financial autarky is associated with higher output volatility and lower cross-country correlations. Their findings highlight the importance of financial friction and international asset trading on the business cycle.

Although the abovementioned papers do not directly investigate the impact of increased FI, they serve as a critical starting point and a base model to build upon for later FI studies. Evans and Hnatkovska (2007a, 2007b) introduced the integration in equity market to study the macroeconomic volatilities and welfare implication of increased FI. They investigated three stages of financial integration. Financial autarky is a benchmark scenario where domestic households can hold only domestic equity but cannot hold foreign assets. In low FI, households are able to hold a foreign non-contingent bond in addition to domestic equity. In high FI, the households can additionally hold the equities issued by foreign firms. Their model consists of households, a tradable goods sector, and a non-tradable goods sector. The asset market and risk sharing are incomplete even with high integration. The market is assumed to be frictionless.

Their finding suggests that the relationship between the level of FI and consumption and output volatilities is hump-shaped. Consumption and output volatilities initially increase moving from financial autarky to low integration. They then decrease as FI advances further from low to high integration. The reason behind is that the households have to trade-off between smoothing consumption over time (decline of consumption volatility) and balancing the consumption composition between tradable and non-tradable goods (increase of consumption correlation of the two goods). In this case, the latter plays more roles in the first move from autarky to low integration, and the former plays more roles in the second move from low to high integration. Hence, the hump-shaped relation is observed. Moreover, results also reveal risk-sharing gains from increasing correlations between home and foreign households' intertemporal marginal rates of substitution. However, welfare gain, which is measured by the household's expected lifetime utility, is found to be very small and inconclusive under their model specification.

Leblebicioğlu (2009) addressed the issue in a slightly different dimension, by focusing on the implication of domestic market imperfections on the relationship between FI and consumption smoothing benefit in a developing country setting. The model of Leblebicioğlu (2009) consists of households, traded good sector, and non-traded good sector. Two credit market imperfections are implemented in the smaller economy. One is the inability of the non-traded good firm's owners to borrow from international market. The other one is the domestic leverage constraint imposed on the firm owners such that they cannot borrow higher than a certain proportion of the firms' capital stock due to enforceability problem. The author compared only two scenarios of financial openness – financial autarky with no international assets trading, and complete FI, where the households can hold international assets.

The simulation results yield higher standard deviation of consumption, output, and consumption to output ratio in FI setting as compared to autarky. The finding suggests the absence of consumption smoothing gain of FI. This is consistent with some empirical evidences. The imposed frictions limit the ability of the non-traded firm owners to share the risks and insure themselves against productivity shocks. Hence, the non-traded sector prices and output are more volatile. It implies that for a small and relatively less developed country with unequal opportunities among households to borrow abroad, FI may fail to generate consumption smoothing benefit.

Leblebicioğlu (2009) also studied the welfare impact. Households who can access to international financial markets incur welfare gain with FI. In contrast, the non-traded firm owners who are excluded from international risk sharing are worse off as shown by the welfare loss. Under this model parameterization, the non-traded firm owners' welfare loss dominates the households' welfare gain. Thus, the weighted welfare sum of the whole economy turns out to be lower in FI than in financial autarky.

Lastly, Devereux and Sutherland (2011b) investigated the portfolio choice problem inclusive of the equity market integration similar to Evans and Hnatkovska (2007a, 2007b). They studied the implication of increased FI on macroeconomic volatility, cross-country comovement, and welfare gain under the presence of international leverage constraint. Three levels of asset market structures are employed. They are financial autarky, integration in bond market only, and integration in both bond and equity markets. Lower consumption and output volatility, higher comovement of business cycles, and welfare gain are observed when the world market is unified in both debt and equity. The results are opposite when the cross holding of equity is not allowed.

Table 3.2 summarizes the researches discussed above. As can be seen, modeling the degree of FI as different types of asset market structure has been extensively studied. This implies that only absolute cases of FI are considered, that is, either financial autarky or complete integration in each market. The investigation of intermediate levels of FI between the two extremes is not feasible under this approach. Other approaches of measuring FI are available and will be presented in Section 3.8.

In addition, most papers study FI in generic or advanced economies rather than developing countries, which have been shown to exhibit business cycle characteristics differently from developed countries and have lower financial development. For example, Heathcote and Perri (2002) calibrate the model to the United States and the rest of the world, while Evans and Hnatkovska (2007a, 2007b) and Devereux and Sutherland (2011b) model general symmetric countries.

Among those reviewed, Leblebicioğlu (2009) is the only paper that explores developing countries and the issue of imperfect financial access. There are other studies that examine EMEs with asymmetric access to finance, but they mostly employ one-country setting and focus only on consumption smoothing implication. For example, Levchenko (2005) and Araujo (2008) study the consumption volatility in developing countries. Levchenko (2005) found that financial liberalization potentially benefits people who have access more than people without access. Calibrated to Mexico, Araujo (2008) found that FI increases consumption volatility when access is restricted, but decreases consumption volatility when all people have access to international finance. Recent studies have paid more attention to emerging markets, but they usually investigate a specific country; thus, the results might not be applicable in other circumstances. For instance, Pisani (2011), Mendoza and Smith (2014), and Ma (2016) calibrate their model to Malaysia, Mexico, and China respectively. Pisani (2011) is the only paper among the three that includes TI.

Employing DSGE comparative approach to explore the benefits of FI has many advantageous. Firstly, the model is quite straightforward with a few sectors, yet it is sufficient to serve as a powerful tool in dealing with many issues in interest. It is also more agile than other types of general equilibrium models such as *computable general equilibrium (CGE)* model. Secondly, the definition of FI as different levels of access to international financial markets is intuitive. Furthermore, modifications like market frictions and dissimilarities between countries can be added. The possible disadvantages of DSGE are that it may be too simple to accurately replicate the real world and it does not make much use of data as compared to empirical analysis.

Table 3.2 Studies of FI impact on macroeconomic volatility and BCS

Author	Model Type	Measure of FI	Financial Friction	Related Finding
Backus, Kehoe, and Kydland (1992, 1994)	RBC	None (only complete asset market structure)	None	• Discrepancies between data and theory • Cross-country consumption correlation is higher than output correlation • Low volatility of term of trades
Baxter and Crucini (1995)	RBC	Different asset market structures (bond, complete)	Restricting asset traded to only non-contingent bond	• Incomplete asset market leads to different results from complete market only when shocks are very persistent or cannot be transmitted across countries
Heathcote and Perri (2002)	RBC	Different asset market structures (autarky, bond, complete)	Restricting all international asset trades (autarky)	• Autarky model's results are closest fit to the data as compared with other two asset market structures • FI increases output volatility and decreases cross-country comovement
Evans and Hnatkovska (2007a, 2007b)	RBC	Different asset market structures (autarky, bond, bond and equity)	None	• Relationship between FI and consumption and output volatilities is hump-shaped (initially increases, then declines) • Welfare gain is small and inconclusive
Leblebicioğlu (2009)	RBC	Different asset market structures (autarky, complete)	Domestic leverage constraint	• Under domestic market imperfection, FI increases consumption and output volatilities and can lead to welfare loss
Devereux and Sutherland (2011b)	RBC	Different asset market structures (autarky, bond, bond and equity)	International leverage constraint	• Under integration in both equity and bond markets, FI decreases macro volatility, increases comovement, and leads to welfare gain

3.5. Financial and Trade Integration on Business Cycles

In the previous section, only the literature studying FI alone is reviewed. This section in turn discusses studies that include the analysis of both financial and trade integration. It first reviews the empirical work in Section 3.5.1. Then, Section 3.5.2 concludes the first half of this chapter with the studies that are most related with this thesis before continuing with methodology review in the second half.

3.5.1. Empirical Evidences

Macroeconomic volatility

Regarding the effects on macroeconomic volatility, the widely-cited paper by Kose et al. (2003) investigates the roles of FI together with TI. Their empirical analysis used data from 76 advanced and developing countries during 1960-1999. Both de jure and de facto measures of FI are employed. The regression equation can be summarized as;

$$VOL_{it} = \alpha + \beta_{FI} FI_{it} + \beta_{FIsq} FI_{it}^2 + \beta_{Trade} TRADE_{it} + X_{it}'\beta + \varepsilon_{it} \qquad (3\text{-}3)$$

where VOL_{it} denotes the growth rate volatility of output, income, private consumption, total consumption and the ratio of total consumption volatility to income volatility. $TRADE_{it}$ is a measure of trade openness. FI_{it} is a measure of financial integration and computed by a combination of de jure measure and gross capital flows. X_{it} is a vector of standard control variables for growth regression. A quadratic term $\beta_{FIsq} FI_{ijt}^2$ is added to capture potential non-linear effect of financial openness on volatility.

The results show that there is a non-linear relationship. The threshold effect is observed between the relationship of financial openness measure and volatility. Below certain level of FI, the increase in FI corresponds to the increase in consumption volatility relative to output. The effect turns opposite when FI level surpasses the threshold, indicating risk sharing and consumption smoothing benefits of FI beyond the threshold. It can be interpreted that financial openness is more advantageous for developed countries that already have high level of FI rather than developing countries. As for output volatility, they found positive but insignificant relationship between FI and output fluctuation. For trade openness, it was found to be associated with increasing output, income, and consumption volatility. However, TI has a negative net impact on consumption volatility as a ratio relative to income volatility.

In a similar notable study, Bekaert et al. (2006) investigated the consequences of financial liberalization in equity market and capital account on consumption growth volatility. They explored two samples during 1980-2000. The first sample group consists of all 95 countries, and the other one is a sub-group of 40 countries that has liberalized their equity markets during the sample period. Most of the countries in the second group are emerging markets. They used various measures of financial openness including both de jure and de facto measures in the following growth regression model;

$$SD_{i,t+5} = \beta_{FI} FI_{it} + \beta' X_{it} + \varepsilon_{i,t+5} \quad (3\text{-}4)$$

where $SD_{i,t+5}$ denotes the five-year standard deviation of real consumption growth, FI_{it} represents measures of capital account openness or equity market liberalization, and X_{it} are control variables.

Bekaert et al. (2006) demonstrated that for a large sample of countries, financial liberalization generally leads to a decrease in output variability, consumption growth variability, and the ratio of consumption volatility to GDP volatility. Their result has been tested with a number of robustness checks and proved to be robust. However, in a smaller sample of emerging economies, the negative relationship between FI and consumption growth volatility is weaker. Trade intensity was also included in their study as a macroeconomic control variable. It was found that trade openness alone increases consumption growth volatility, but the interacting estimation of trade and financial openness together results in lower consumption volatility.

Examples of other studies are as follow. Haddad, Lim, and Saborowski (2010) investigate the impact of trade and financial openness on growth volatility whether it depends on the level of export diversification or not. Using data from 77 developed and developing countries during 1976-2005, they found a negative relationship between TI and output growth volatility when exports are sufficiently diversified, which are the case for a majority of countries in the sample. Financial openness as measured by Chinn-Ito de jure index is observed to be associated with lower output fluctuation. Fanta (2012) examine the impact of FI and TI on consumption smoothing in a sample of 26 countries over the years 1973 to 2005. They measure financial liberalization using an index from Kaminsky and Schmukler (2008) that captures many types of liberalization. Financial liberalization is found to help reduce consumption volatility, while the impact of trade on consumption volatility is insignificant. Lastly, Dabla-Norris and Srivisal (2013) mainly examines the relationship between finance and aggregate fluctuation, but includes financial and trade openness as possible explanatory variables. Gross inflows of FDI and FPI are used as an indicator of FI. Applying a dynamic panel analysis to 110 developed and developing countries during the period 1974-2008, FI and TI are found to have positive but mostly insignificant associations with output and consumption volatility, and the two kinds of integration could boost the dampening role of finance on macroeconomic volatility. Additionally, two survey papers of Prasad et al. (2007) and International Monetary Fund (2002) both suggest that FI contributes to lower output variability. Prasad et al. (2007) also provide some evidences that FI could lead to higher consumption fluctuation in more financially opened developing countries. Table 3.3 summarizes the empirical findings of these papers. The papers of Prasad et al. (2007) and International Monetary Fund (2002) are not included in the table summarizing empirical findings because they are mainly literature survey and policy papers.

Table 3.3 Empirical studies of financial and trade integration impact on macroeconomic volatility

Author	**Measure of FI**	**Finding on FI**	**Finding on TI**	**Finding on FI and TI**
Kose, Prasad, and Terrones (2003)	Gross capital flows (% of GDP) and de jure measure	• Positive but insignificant relationship with output volatility • At low FI level (developing countries), FI increases consumption volatility • At high FI level (developed countries), FI decreases consumption volatility	• TI increases output, income, and consumption volatility, but lowers consumption volatility to income volatility ratio	-
Bekaert, Harvey, and Lundblad, (2006)	De jure and de facto measures in both equity market and capital account	• FI lowers output variability • For whole sample of countries, FI lowers consumption volatility • For mainly EMEs subgroup, the relationship between FI and consumption volatility is weaker	TI increases consumption growth volatility	FI and TI together lowers consumption volatility
Haddad, Lim and Saborowski (2010)	Chinn-Ito de jure index	FI reduces output volatility	TI reduces output volatility when exports are diversified	-
Fanta (2012)	Liberaliza-tion index	FI reduces consumption volatility	Impact of TI on consumption volatility is insignificant	-

Author	Measure of FI	Finding on FI	Finding on TI	Finding on FI and TI
Dabla-Norris and Srivisal (2013)	Gross inflows of FDI and FPI	• Positive but insignificant relationship with output volatility • FI increases consumption volatility	TI increases output and consumption volatility, but mostly insignificantly	FI and TI enhance dampening role of finance on macro volatility

Business cycle synchronization

Regarding the effects on cross-country correlation, a notable paper by Imbs (2006) empirically studied the risk-sharing effect of FI on the correlations of GDP and consumption. The author used cross-sectional bilateral data of 12 core and 31 periphery economies around the years of 1960-2000. Three measures of FI are examined, which are bilateral foreign portfolio holdings, restriction index from IMF's AREAER and Quinn (1997) index of capital account openness. Simultaneous equation estimates are employed to examine both the direct effect of FI and the indirect effect through trade linkage and industry specialization. In particular, two following systems of equations are estimated.

Simultaneous equation system I:

$$\rho_{ij}^{Y} = \alpha_0 + \alpha_1 FI_{ij} + \alpha_2 TRADE_{ij} + \alpha_3 S_{ij} + \alpha_4 X_{ij} + \varepsilon_{ij}$$

$$\rho_{ij}^{C} = \eta_0 + \eta_1 FI_{ij} + \eta_2 \rho_{ij}^{Y} + \varepsilon_{ij}$$

Simultaneous equation system II:

$$\rho_{ij}^{Y} = \alpha_0 + \alpha_1 FI_{ij} + \alpha_2 TRADE_{ij} + \alpha_3 S_{ij} + \alpha_4 X_{ij} + \varepsilon_{ij}^{0}$$

$$FI_{ij} = \beta_0 + \beta_1 TRADE_{ij} + \beta_2 I_{ij}^{1} + \varepsilon_{ij}^{1}$$

$$TRADE_{ij} = \gamma_0 + \gamma_1 FI_{ij} + \gamma_2 I_{ij}^{2} + \varepsilon_{ij}^{2}$$

$$S_{ij} = \delta_0 + \delta_1 FI_{ij} + \delta_2 I_{ij}^{3} + \varepsilon_{ij}^{3}$$

where ρ_{ij}^{Y} and ρ_{ij}^{C} are the correlation of GDP cyclical components and the correlation of consumption between country i and country j respectively; FI_{ij} measures the level of bilateral financial integration; $TRADE_{ij}$ represents the level of bilateral trade linkages; S_{ij} is a specialization proxy measured from the pattern of production similarities between two countries; X_{ij} is a vector of other standard control variables such as policy and currency variables; I_{ij} is instrumental variables; and ε_{ij} is an error term.

Empirical results show that FI is associated with higher cross-country correlations in consumption. It can be interpreted as increase in international risk sharing. However, contrary to what theory suggests, the author also found that FI raises correlations of GDP as well. Possible explanations are that there may be some restriction on capital flows and the economy cannot achieve fully effective diversification of FI. As a result, consumption is relatively less correlated between countries than GDP fluctuations. Investigating the second set of simultaneous equation system, both trade and specialization are found to be associated with FI (Imbs, 2006). This provides possible indirect linkage channels from FI to GDP correlation through trade and specialization. The results differ slightly when changing the measure of financial openness used in the estimation.

Using the same empirical approach as Imbs (2006), Dées and Zorell (2012) explored the impact of FI and TI on business cycle synchronization (BCS) in a sample of 56 economies during 1993-2007. They explored two measures of FI, namely, FPI and FDI. However, they could not establish a robust direct relationship between FI and output comovement. They argue that FI likely influence BCS indirectly through the channels of boosting sectoral specialization. In contrast, TI is robustly found to be associated with higher output correlation.

A recent study by Duval et al. (2014) investigates the issue of TI along with FI as the drivers of BCS between a pair of countries. The sample includes 34 advanced economies and 29 EMEs during the period 1995 to 2012. Essentially, they adopted the following panel regression.

$$QCORR_{ijt} = \alpha_{ij} + \alpha_t + f(FI_{ijt-1}, TRADE_{ijt-1}, POLICY_{ijt-1}) + \varepsilon_{ijt} \qquad (3\text{-}5)$$

where $QCORR_{ijt}$ is the quasi-correlation between the growth rates of country i and country j, α_{ij} is a country-pair fixed effect accounting for other idiosyncratic drivers such as common language and geographic distance, and α_t is a time dummy. The drivers in interest enter the estimated equation as one-period lagged variables, where FI_{ijt-1} represents measures of banking integration, portfolio integration, and FDI integration, $TRADE_{ijt-1}$ denotes value-added trade intensity, and $POLICY_{ijt-1}$ is related policy variables. The analysis also looks at the differentiation between crisis and non-crisis periods.

FI is found to broadly reduce BCS in normal times, but the effect is small comparing to the effect of TI. However, in crisis periods, financial openness raises cross-country output comovement, in line with the financial contagion during crisis. The finding that higher FI typically lowers BCS during non-crisis periods, but increases BCS during the crisis periods is also established by International Monetary Fund (2013). For trade intensity, a significantly positive effect on BCS is found. Moreover, the impact appears to be larger during crisis periods, suggesting that trade plays a role in shocks propagation. Table 3.4 summarizes the three papers on BCS.

Table 3.4 Empirical studies of financial and trade integration impact on BCS

Author	Measure of FI	Finding on FI	Finding on TI	Finding on FI and TI
Imbs (2006)	FPI, IMF's AREAER, Quinn (1997) capital account openness index	FI increases cross-country correlation in consumption and output	TI increases BCS	Trade is related to FI Some of FI's effect work through TI
Dées and Zorell (2012)	FPI and FDI	Direct relationship between FI and BCS is inconclusive	TI increases BCS	
Duval, Cheng, Oh, Saraf, and Seneviratne (2014)	Banking, portfolio and FDI integration	FI significantly increases BCS in crisis period, but decreases comovement in non-crisis period	TI increases BCS, especially in crisis periods	-

Note: BCS = business cycle synchronization.

Overall, the empirical evidences generally show that financial and trade integration influence aggregate fluctuation and cross-country comovement. However, findings on the direction of the relationship are inconclusive, especially for the consequences of FI. Positive, negative, and insignificant relationships are all observed. Only one strong robust finding is that international trade enhances BCS. See Calderon et al. (2007), Duval, Li, Saraf, and Seneviratne (2016) and Di Giovanni and Levchenko (2010) for more examples of studies that found positive relationship between TI and BCS apart from those mentioned in this section.

There are also a number of papers investigating the issues specifically on East Asian region. See S. Kim, Kim, and Wang (2006), Shin and Sohn (2006), and Dai (2014) for example. The overall results suggest that FI affects international risk sharing and BCS to certain extent. However, the empirical findings are still far from conclusiveness given a low level of FI and a limited role of financial markets in this region (Borensztein & Loungani, 2011; S. Kim et al., 2006).

3.5.2. Quantitative General Equilibrium Models

One of the most related papers with this thesis is Senay (1998).[19] The author examined the implication of varying degrees of goods market integration (GMI) and financial market integration (FMI) on macroeconomic volatility and their stabilizing role in the event of economic disturbances. Perfect GMI is defined as when law of one price perfectly holds and the same goods do not have price differential across countries.

Perfect FMI is characterized by the absence of adjustment cost of foreign asset holding. The absence of the asset trading cost induces the same interest rate for all financial markets, or in other words, it suggests that *uncovered interest parity (UIP)* holds. Four combinations of integration were considered 1) complete integration in both markets, 2) complete FMI, but no integration in goods market, meaning prices of the same goods discriminate across countries, 3) complete GMI, but incomplete FMI, representing by high adjustment cost of asset holding; and 4) incomplete FMI and no integration in goods market.

Dynamics of macroeconomic variables are analyzed under Obstfeld and Rogoff's *new open economy model* (1995) with nominal rigidities. The results reveal that the effect of integration on macroeconomic volatility varies considerably with different kind of shocks and the variables under consideration. Increased integration in financial markets is observed to be largely associated with lower volatilities of consumption and output but higher volatility of foreign bond holding. Increased integration in goods market tends to raise volatility of consumption and output but reduce volatility of exchange rates. One intriguing finding is that the consequences of increased integration in one of the markets do not significantly depend on the integration level of another market.

However, Senay (1998) modeled a generic country that does not represent any country in particular and there is only one type of households. The implication is that all countries are identical and all consumers are implicitly assumed to have access to international finance. This setting may not be able to explain the differences among specific groups of countries such as developed versus developing countries. It is largely acknowledged that developing countries have lower level of financial development than advanced countries and not everyone in emerging economies has access to finance (Bhattacharya & Patnaik, 2013; Levchenko, 2005). Furthermore, domestic financial markets cannot be explored under homogeneous agent setting because there can be only one kind of market participants – either a saver or a borrower – but cannot be both.

The second most related study is by Pancaro (2010). The author investigated the impact of integration in goods and financial markets on consumption smoothing. Two countries investigated in the model are assumed to represent advanced and emerging

[19] The discussion order of this section starts from the most related papers with this study to the least.

economies. The asset market is incomplete with only single non-contingent bond traded. The collateral is required to borrow internationally. Both types of integration are modeled in a consistent way as a reduction of trading frictions between countries. Higher FI is modeled as the increasing amount the borrower can borrow out of the value of collateral pledged, that is, the increasing loan-to-value (LTV) ratio. TI is modeled as the elimination of quadratic iceberg transportation cost, which represents both tariffs and non-tariffs costs. Three levels each of financial liberalization (autarky, moderate and high) and trade liberalization (low, moderate, and free trade) are explored. It is found that greater financial liberalization tends to reduce consumption smoothing while trade liberalization tends to increase it.

However, Pancaro (2010) did not focus on the combined effect of the two types of integration. Two separate analyses were examined; one with varying levels of FI and the other one with varying levels of TI. Furthermore, although the author specified difference across countries in which emerging market households are leverage-constrained debtors and advanced country households are creditors, there is only one type of consumers within the country. Again, this implicitly implies that all consumers in emerging markets have access to international finance.

In a similar model economy as Pancaro (2010), Kose and Yi (2006) studied varying cross-country transportation costs within two different asset market structures – financial autarky and complete market. They focused primarily on trade linkages and aimed to establish whether business cycles are more synchronized among countries with stronger trade linkages. Two different levels of transportation costs are used; no transportation cost that implies free trade, and 35 percent transportation cost which represents low trade intensity. Their model was calibrated to represent OECD countries. They provided evidence that under both financial scenarios, a lower transportation cost that implies higher trade intensity could cause stronger comovement between outputs. The result is consistent with the empirical evidence though it does not exhibit the same magnitude (Kose & Yi, 2006).

Another two papers are worth discussing though they do not directly investigate the implication of increased integration. Faia (2007) studied the impact of different monetary policy regimes regarding inflation and exchange rate on the business cycle comovement. The degrees of trade and financial openness are included as varying factors that affect this relationship. Trade openness is measured as the proportion of foreign goods consumption of the household. Financial openness is attained by allowing agents to engage in loans in foreign currency. The finding demonstrates that trade openness increases cross-country output correlation consistent with empirical evidences, while financial openness decreases it.

Ueda (2012) examined the 2007-2008 global financial crisis to seek under what circumstances a global economic downturn is likely to occur. This is carried out by modeling the relationship between banking globalization and business cycle synchronization. The role of financial institutions is emphasized as a cross-border intermediary between investors and entrepreneurs. Banking globalization or financial openness is represented by the amount that domestic financial institutions choose to borrow from foreign investors or lend to foreign entrepreneurs. Trade openness, as measured by the amount of foreign goods consumption, enters the model as just a varying parameter. The author's main results indicate that banking globalization, the unfavorable shock to the net worth of financial institutions, and the credit constraints faced by the financial institutions all play key roles in understanding the latest financial crisis. In addition, both financial and trade openness tend to strengthen the business cycle synchronization.

Similar to the empirical evidences, the overall findings concerning the impact of FI and TI on business cycles are far from conclusive. Results depend crucially on the model setup and assumptions. There is some evidence of consumption smoothing and international risk sharing benefits from FI given certain circumstances, but the gains become more controversial when there are market frictions. Papers that examine both FI and TI mostly study their effect on business cycles separately and only few examine the effect of two integrations together, unlike empirical studies that explore the interacting consequences of FI and TI through studies such as the threshold effect literature. Moreover, the literature has paid more attention to general or advanced countries rather than developing countries, same as pointed out earlier in Section 3.4.1. The only paper discussed here that investigates the issues in emerging market context is Pancaro (2010), but the issue of asymmetric financial access and domestic financial market are neglected.

The aforementioned papers are summarized in Table 3.5. Thus far, this review has outlined the existing literature on financial and trade integration and pointed out some research gaps that motivate this paper. In the next part, the methodology will be reviewed and summarized.

Table 3.5 DSGE studies of impact of FI and TI on macroeconomic volatility and BCS

Author	Model Type	Paper Aim	Measure of FI	Measure of TI	Country studied	Related Finding
Senay (1998)	NK	Varying degrees of FI and TI on macro volatility	Reduction of adjustment cost of international asset holding	Existence of purchasing power parity (no price differential)	General	• FI lowers consumption and output volatility, TI increases it • Effect of one integration not depend on another integration
Pancaro (2010)	RBC	FI and TI on consumption smoothing	Reduction of borrowing constraint	Reduction of transportation cost	EME	• FI increases consumption volatility • TI decreases it
Kose and Yi (2006)	RBC	Varying transportation costs on comovement	Different asset market structures	Reduction of transportation cost	OECD	Under both asset market structures, TI increases output comovement
Ueda (2012)	NK	Banking globalization and recent crisis on international business cycle	Amount of bank borrowing and lending abroad	Weight on foreign goods consumption	General	Both FI and TI increases BCS
Faia (2007)	NK	Monetary policy regimes on international business cycle	Loans are in foreign currency	Weight on foreign goods consumption	OECD	• FI lowers output comovement • TI raises it

Notes: FI = financial integration; TI = trade integration; NK = New Keynesian; RBC = real business cycle; BCS = business cycle synchronization.

3.6. Dynamic Stochastic General Equilibrium (DSGE) Model

Dynamic stochastic general equilibrium (DSGE) is a macro model framework embedded with micro-foundation. It is currently a standard quantitative tool in modern macroeconomics literature to study business cycles, growth, monetary and fiscal policies, and other issues in macroeconomics and international economics (Fernández-Villaverde, 2010; Flotho, 2009; Townsend, 2010). Since the keystone paper by Kydland and Prescott (1982), DSGE framework has been increasingly widely used and accepted in many areas of macroeconomics (Fernández-Villaverde, 2010). This includes the use in FI literature.

DSGE model is a small and comprehensive model describing the whole economy based on the principles of agent's optimization and rational expectations (Fernández-Villaverde, 2010). It focuses on dynamic forward-looking behaviors and deals with the general equilibrium of the economy under some stochastic disturbances (Flotho, 2009).

The advantages of DSGE framework are the microeconomic foundation that studies behaviors of the individuals within a macro model framework. It allows separate assessment of welfare for different agents in the economy. It also facilitates richer analysis of business cycles than econometric models. Moreover, it serves as a powerful tool for policy analysis to transform questions about policy choices into assessable results.

The disadvantages of DSGE include its complex solution strategies that may cause difficulties in interpreting and communicating the results and the simplified structure of the model economy that are far from fully capturing the reality.[20]

3.7. The Model Economy

This section reviews the types and the components of *the model economy*. The model economy comprises of many agents rationally interacting with each other in the economy. It constitutes a critical starting point for DSGE frameworks.

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[20] The advantages and disadvantages of DSGE are summarized from Flotho (2009) and Brázdik, Hlaváček, and Marsal (2012). See Fernández-Villaverde (2010) and Flotho (2009) for further discussions on the issue.

The survey focuses mainly on the papers researching the effect of increased international financial and trade integration. The models reviewed typically consist of two countries with cross-country trade. The two countries can be either symmetric or asymmetric. Each country has at least one type of households and one type of firms. Related papers studying other aspects of international trade will also be mentioned where applicable.

3.7.1. Choice of Model

There are two classes of DSGE models commonly used in FI literature. First is the international real business cycle (IRBC) model. IRBC or real business cycle (RBC) model views business cycles as a natural reaction of the economy to shocks, which are mainly technology shocks (Doepke et al., 1999). The IRBC model is popular among many researchers whose research questions are concerned primarily with business cycle synchronization, productivity shock, and consumption and output volatility. It is a natural setting to study the impact of increased integration on the real economy within flexible price environment (Flotho, 2009; Kose & Yi, 2006). Following the classic work of Backus et al. (1992, 1994) and Baxter and Crucini (1995), a non-exhaustive list of papers studying FI under the IRBC framework includes Kouparitsas (1996), Heathcote and Perri (2002), Kose and Yi (2006), Evans and Hnatkovska (2007a, 2007b), Pancaro (2010) and Devereux and Yetman (2010).

The second one is the *New Keynesian (NK)* model with nominal rigidities. NK model views business cycles as a failure of market mechanism in the economy, possibly resulting from market imperfection and friction (Doepke et al., 1999). Economic fluctuation is generated by both technology and monetary shocks (Doepke et al., 1999). This kind of model is more suitable for researches involving monetary issues such as monetary policy, money supply shock, and government expenditure shock. Nominal rigidities can be implemented with sticky wages or sticky prices, which enable the effect of money on real variables (Flotho, 2009). Many specific well-known models have been adopted to study FI, such as Bernanke, Gertler and Gilchrist's (1999) *financial accelerator model* and Obstfeld and Rogoff's (1995) *new open economy model*. The former model was adopted by Faia (2007) to study different monetary policy regimes amid financial integration, and Ueda (2012) to study the relation of banking globalization and financial crisis with the monetary authority and the government playing roles. The latter model was employed by, for example, Sutherland (1996) and Senay (1998) to study implications of financial market integration with the role of money supply, tax, and the government.

While New Keynesian model has the advantage of providing a rich framework to study the role of money, government, monetary authority, and policies, the IRBC model has the advantage of its simple structure suitable for the study that is concerned with markets and real sectors. Therefore, the choice of model depends on the questions under investigation.

Apart from IRBC and NK models, alternative models are also employed though it is infrequent. For example, Farmer (2014) used the two-country *Overlapping Generations model* (OLG) to compare the situations before and after the introduction of the European Economic and Monetary Union (EMU) – the event that considered creating FI among European countries. Pisani (2011) and Faia (2011) adopted small open economy model to study implication of financial openness on macroeconomic stability.

Since IRBC model is the chosen tool adopted in this thesis, the review going forwards will mainly cover only the components of IRBC model. The public sector and nominal rigidity will be omitted from the survey.

3.7.2. Households

The country usually consists of a continuum of infinitely lived households with preference over consumption and labor. Households maximize expected lifetime utility given a budget constraint to choose the optimal allocation between consumption and leisure. The budget constraint allocates income to consumption and intertemporal saving or borrowing.

In earlier studies, there is generally only one type of households in each economy that serves as one certain kind of market participants, for instance, either a saver or a borrower. Recent papers tend towards the heterogeneity and interaction among individuals by introducing a second type of households. The first type of households is mostly assumed to be *a consumer, a worker, a saver, or a lender*. The worker type supplies labor to the production firms, consumes goods, and saves money in some kinds of financial assets or lends to the borrower. The second type is usually *an entrepreneur, an investor, or a borrower*, who borrows money to invest in firms and to finance production of goods. Incorporating two types of consumers is used to investigate the domestic market that needs two sides of domestic market participants and unequal financial access when one group of people have the access and the other does not. Studies by Iacoviello and Minetti (2006), Faia (2007), Leblebicioğlu (2009), Devereux and Sutherland (2011b) and Ueda (2012), for instance, have two types of households.

3.7.3. Production Firms

Firms employ labor, capital, or other resources to produce goods using some forms of production function and maximize profits given this production technology. The structure of firms depends on the issues investigated. Firms can produce intermediate goods for production, final goods for consumption, tradable goods that can be sold overseas, or non-tradable goods that can only be sold in domestic markets. If the paper aims to study the heterogeneous interaction among agents rather than the production side, one type of firm seems sufficient. For example, Faia (2007) divided households into a consumer and an entrepreneur, but only has one type of firm, which is a traded intermediate goods firm. Devereux and Sutherland (2011b) also divided household into a saver and an investor, with only one sector of firms producing final goods.

For the setting with two types of firms, one widely-used structure particularly in the trade literature is to have one sector as a traded intermediate goods firm and the other one is a non-traded final goods firm. The traded intermediate goods firm employs labor and capital in Cobb-Douglas production function. It supplies intermediate goods as inputs for both domestic and foreign final goods producing firms. The final goods firms normally combine intermediate inputs using Armington (1969) aggregator. This setting is employed by Heathcote and Perri (2002), Kose and Yi (2006), and Pancaro (2010), for example. The two types of firms can also be plainly just traded goods sector and non-traded goods sector, as used by Evans and Hnatkovska (2007a, 2007b) and Leblebicioğlu (2009). Moreover, to better reflect the complex structure of the real world, production sectors can be divided into several types of firms, such as firms producing wholesale goods, retail goods, and capital goods as implemented by Ueda (2012).

3.7.4. Difference between Countries

Since international integration involves more than one country, it is common to have at least two countries in the model economy. The two countries interacting with each other can be either identically symmetric or different. Differences between countries usually come in the forms of developed countries versus emerging or developing countries (see Kouparitsas, 1996, Leblebicioğlu, 2009, and Pancaro, 2010), and the United States or certain country against the rest of the world (see Heathcote and Perri, 2002, and Kose and Yi, 2006).

There are three major ways to implement country difference in FI literature. The first and simplest one is to assign different parameters for the two countries, such as the home bias parameters (Kose & Yi, 2006; Kouparitsas, 1996), the capital-labor share in production function (Farmer, 2014), and parameters in the process of productivity shock (Heathcote & Perri, 2002; Pancaro, 2010). This seems to be the easiest way to introduce country difference because a foreign country can be just a replication of a home country with identical settings and functional forms but with different values of parameters. The second one is the size of the country, which is normally defined by the numbers of households or population size in the two countries (Kose & Yi, 2006;

Leblebicioğlu, 2009). The different country size mostly plays a role in the world market clearing conditions. It is also not difficult to implement. The last way deals with the quantitative setup of the model economy. The difference is mostly in the form of different financial conditions between a less-developed country that incurs more severe financial frictions, constraints, and international market inaccessibility than a more-developed country (Faia, 2007; Leblebicioğlu, 2009; Pancaro, 2010). The different setting naturally leads to two distinctive sets of maximization problems for home and foreign countries, which causes more complexities.

3.7.5. Financial Assets

A menu of financial assets available is very crucial for many reasons. It defines the asset market structure, which in turn can decide the type and level of FI. The choice of assets also depends on the research questions under consideration. Certain structures of financial assets can complicate the solution method of the model. In general, studies of financial and trade integration deal with four main types of assets – international non-contingent bond, state-contingent securities, equity, and domestic financial assets.

International non-contingent bond

An international risk-free non-contingent bond is likely to be the simplest and most widely-used asset. The bond typically yields risk-free interest rate. In each period, agents choose the amount of bond to hold in the next period. It can be used in a study for many purposes. Evans and Hnatkovska (2007a, 2007b), Devereux and Yetman (2010) and Devereux and Sutherland (2011b) utilized international bond to particularly investigate the integration in the bond market only. Baxter and Crucini (1995) and Heathcote and Perri (2002) employed the bond economy as a way to introduce market incompleteness in an attempt to resolve some puzzles associated with the complete asset market. To study the debtor-creditor relationship, non-contingent bond was chosen by Iacovielloa and Minetti (2006) and Benigno (2009) as bonds can be regarded as loans. Lastly, it provides a simple framework to work on other issues, especially to build frictions and constraints upon, as practiced by Senay (1998) and Pancaro (2010).

However, the model economy that has bond as its only asset cannot distinguish the flow and position of foreign assets between net and gross amount (Heathcote & Perri, 2004). In addition, the use of bond entails a small complication. As Schmitt-Grohé and Uribe (2003) pointed out, an incomplete market setting with only a single bond traded can raise a problem of non-stationarity. Therefore, a stationary-inducing feature must be added to make the bond's law of motion stationary. This is further discussed in Section 3.10.

International state-contingent asset

An international state-contingent asset is normally included for the purpose of completing the market with a full array of financial assets. It provides the straightforward form of full FI and complete risk sharing.[21] Examples of state-contingent assets are state-contingent bond, state-contingent portfolio or a complete set of Arrow securities. The state-contingent asset yields a return that depends on the state of the nature. Holding this asset insures household from domestic shocks.

The structure of the typical state-contingent asset goes as follow. Let s^t be the state of the world, $B(s^t)$ denotes the market value of state-contingent securities at the end of period t after history s^t, and $Q(s^{t+1}|s^t)$ is the pricing kernel of these securities. Households choose $B(s^{t+1})$ to hold in the next period which has a value of $\sum_{s_{t+1}} Q(s^{t+1}|s^t)B(s^{t+1})$.

This type of asset is used by, for example, Heathcote and Perri (2002), Kose and Yi (2006), and Leblebicioğlu (2009) for the financial scenario with complete asset market.

Equity

Equity is usually included when the study aims to investigate the cross-country integration of equity market and the portfolio choice problem. It serves as a way to increase FI from the bond economy. There are several ways to account for this financial asset. For instance, Devereux and Yetman (2010) and Devereux and Sutherland (2011b) modeled it as a household's holding of fixed asset used in production. The holding of this asset generates a return different from the return of the bond, and mainly risky. The equity of this type may be view as monetary capital invested in a firm. Accordingly, integration in equity market means the domestic investor can hold claims on foreign firm's fixed asset. Similarly, Mendoza and Smith (2014) modeled equity as the household's claim on the capital stock. The capital stock is assumed to be in fixed amount and used by firms in production. Evans and Hnatkovska (2007a, 2007b) modeled the equity asset as a fraction of household's wealth that generates a return different from a risk-free rate and a bond yield. Although their model economy assumes that the equity is issued by firms and traded on the stock market, this characteristic is not explicitly quantified.

[21] A complete market economy can also be achieved by other means, such as exploiting the second welfare theorem that with a complete asset market, the competitive equilibrium is Pareto optimum. Hence, the optimum allocation can be obtained by maximizing the social planner's problem (Kouparitsas, 1996).

Domestic asset

While some FI literatures choose to focus only on international market and disregard the dynamic of domestic financial markets, some papers do include domestic assets in their model economies. Generally, the domestic asset is presented in the form of domestic bonds, deposits, and loans. People can choose to hold or borrow the domestic assets in addition to international financial assets. The inclusion of domestic assets serves as many purposes, such as to make the market setting more complete with both domestic and foreign markets (Devereux & Sutherland, 2011b), to examine the financial interaction among domestic agents and the imperfection in the domestic financial markets (Faia, 2007; Leblebicioğlu, 2009), and to contrast features of domestic and global financial assets (Senay, 1998).

3.7.6. Financial Frictions

Financial frictions crucially provide the framework that better reflects the market imperfection in the real world. Financial market frictions are regarded as a key driver that can explain business cycles as they can amplify and propagate shocks, serving as an important transmission channel (Brunnermeier et al., 2012; Doepke et al., 1999; Quadrini, 2011). For instance, frictions in financial sector could lead to bank failure in efficiently providing financial services that could spill over to the real economy and magnify instability in crisis times (Brunnermeier et al., 2012; Doepke et al., 1999). For these reasons, it is common to incorporate financial frictions in macroeconomic models (Quadrini, 2011). Financial frictions are also viewed to be closely related with FI and together they depict a complete financial market in EMEs (Ma, 2016). They are included in some papers to indicate the level of FI, in which a relaxation of financial frictions suggests increased integration. Two major types of financial frictions are widely used in the FI literature, namely, the borrowing constraint and the cost of portfolio adjustment.

Leverage constraint

The first celebrated type of financial frictions is the leverage constraint a la Kiyotaki and Moore (1997). The leverage constraint limits the amount of borrowing. It is often imposed on the debt financing such that the debtor cannot borrow from the creditor higher than a certain portion of the value of debtor's asset pledged as collateral. Stemming from the debt contract enforcement problems and asymmetric information between debtors and creditors (Iacoviello & Minetti, 2006; Leblebicioğlu, 2009), the underlying reasons are twofold. First, without a collateral secured, creditors do not have any power over debtors to make them repay their debts in the event of borrower's defaulting on the debt contract (Pancaro, 2010). Consequently, the borrower is required to pledge collateral. Second, upon the event of bankruptcy, liquidating the collateral pledged in order to pay back the loan incurs cost to lenders (Iacoviello & Minetti, 2006). Hence, lenders only give out loans that do not exceed the expected value of collateral pledged minus liquidation and overhead costs.

Although the credit constraint originally comes from the work by Kiyotaki and Moore (1997), there are several modifications when used in the more recent literatures. In general, the leverage constraint is typically written as the total debt B_t inclusive of interests R_t, not to be greater than a fraction $m < 1$ of the collateral value $P_{t+1}K_t$ expected in the future (Leblebicioğlu, 2009);

$$R_t B_t \leq m E_t[P_{t+1}K_t] \tag{3-6}$$

The parameter m can be thought of as the degree of contract enforceability, or the loan-to-value (LTV) ratio. High value of m indicates loose credit and low value of m indicates tight credit. Accordingly, it can be a proxy for the level of financial market development as used by Leblebicioğlu (2009), and international FI as adopted by Pancaro (2010) and Pisani (2011). The pledged collaterals K_t, can be various types of assets, such as a variable physical capital stock (Leblebicioğlu, 2009), a fixed capital stock representing as equity (Mendoza & Smith, 2014), general fixed asset (Devereux & Sutherland, 2011b), land (Kiyotaki & Moore, 1997), and real estate (Iacoviello & Minetti, 2006; Pancaro, 2010).

The borrowing constraint has been adopted by numerous literatures. It is perhaps because the leverage constraint is the prominent characteristic of borrowing-lending relationship. It is straightforward to explain and interpret. It also provides a rich framework to study many issues such as enforceability problem, market imperfection, degree of financial openness, and different technology of liquidation (see Iacoviello and Minetti, 2006 for example). The effective return wedge between lenders and borrowers resulting from the collateral constraint can provide an important channel for the repercussion of business cycle shocks (Devereux & Sutherland, 2011b). Additionally, the credit constraints are critical for low financially-developed countries which have less access to finance (Kose et al., 2011). Surveys of firms in developing economies often suggest that financing constraints are one of the main investment obstacles (Harrison, Love, & McMillan, 2004). The constraints can negatively affect financial liberalization (Kose et al., 2011) and lessening of these constraints have positive impact on capital allocation (Bekaert & Harvey, 2003).

Adjustment cost of asset holding

The adjustment cost of asset holding is the cost occurred when agents invest in financial assets. The cost can represent the transaction cost involved with cross-border asset trading, the brokerage fee paid to asset management or mutual funds, the learning costs associated with acquiring information about foreign markets, or restrictions imposed on cross-border financial transaction (Ma, 2016; Sutherland, 1996).

Sutherland (1996) suggested that the adjustment cost is approximated by a convex function of international transaction amount, instead of a one-time cost that could result in a temporary friction or a proportional linear cost whose marginal effect is deflated through linearization process (Kose & Yi, 2006). The convex functional form also provides analytical convenience (Senay, 1998; Sutherland, 1996). However, the different functional forms of adjustment cost have little effect if the cost of adjustment is large (Sutherland, 1996).

Sutherland (1996) and Senay (1998) adopted the convex adjustment cost on bond holding as a reverse measurement of FI. The cost takes the form

$$Z_t = \frac{\psi}{2} I_t^2 \tag{3-7}$$

where Z_t denotes the cost of asset holding adjustment, ψ is a parameter representing the size of the cost, and I_t denotes the amount of net fund transfer to international or foreign markets in each period. The net fund transfer is defined as the difference in value of this period bond holding, B_t, and the last period bond holding with interest $R_{t-1}^B B_{t-1}$, adjusted by exchange rate ε_t and the price index P_t;

$$I_t = \frac{\varepsilon_t}{P_t} B_t - \frac{\varepsilon_t}{P_t} R_{t-1}^B B_{t-1} \tag{3-8}$$

Similar forms of this adjustment cost are also later adopted by other authors such as Buch, Döpke, and Pierdzioch (2005) and Buch and Pierdzioch (2009). Alternatively, Mendoza and Smith (2014) applied the quadratic trading cost on equity holding as

$$\frac{\psi}{2}(\alpha_{t+1} - \alpha_t + \theta)^2$$

where, similarly, ψ is a coefficient, α_{t+1} and α_t are the share holding in the next period and this period respectively, and θ represents the recurrent cost.

There is another related type of bond adjustment cost. This is employed for the main purpose of making the equation of bond flow stationary. First established by Schmitt-Grohé and Uribe (2003), many subsequent papers follow their specification, such as Iacovielloa and Minetti (2006) and Pancaro (2010). Instead of intertemporal difference of asset holding, the adjustment cost is expressed as a function of the difference between the asset holding amount each period, d_t, and its constant long-run level $\bar{d}$;

$$\frac{\psi}{2}\left(d_t - \bar{d}\right)^2$$

The main distinction between two kinds of adjustment cost is that the first type's role still prevails in the non-stochastic steady state, whereas the second type does not.

Alternative financial frictions

Apart from above, financial frictions can also be considered as restriction on certain financial asset trade such as some asset markets are missing or some people cannot participate in particular asset trade (Brunnermeier et al., 2012; Quadrini, 2011). These lead to incomplete insurance against shocks. There could be an equity constraint that limits investors from selling off all their risky claims analogous to the debt constraint on the borrowing amount (Quadrini, 2011). See Quadrini (2011) and Brunnermeier et al. (2012) for a survey of financial frictions generally used in macroeconomic models.

3.7.7. Exogenous Shocks

Under RBC model, the shock to the economy is mostly from the production technology. It can be both positive and negative. New technology could raise productivity, while breakdown of production facilities could interrupt productivity (Doepke et al., 1999). The change in technology is usually not smooth and occurs as a shock (Doepke et al., 1999). The shock can be either uncorrelated or correlated across countries and sectors.

A study by Baxter and Crucini (1995) shows that the type of shock process plays a crucial role on the effect of asset trade restriction. They showed that when shock is trend-stationary, low persistent, and internationally transmissible, the complete asset market and incomplete asset market in which only bonds are traded yield similar results on international business cycle. In contrast, when shock is a random walk with high persistence, and cannot be transmitted across countries, complete market differs significantly from incomplete market.

An exogenous technology shock is typically captured by vector autoregressive (VAR) or simply autoregressive of order one (AR(1)) process such as

$$A_t = \rho A_{t-1} + \varepsilon_t \tag{3-9}$$

where A_t is the technology shock, $\rho < 1$ is an AR(1) coefficient indicating the persistence level, and ε_t is an independently distributed random variable.

However, other kinds of shocks can be investigated under IRBC framework. For example, Devereux and Sutherland (2011b) investigated the direct credit shock to the collateral constraint in which it affects the maximum size of the debt that can be contracted. They called this a borrower-specific shock. For model with nominal rigidities, a variety of shocks can be investigated. These include shocks to money supply, government expenditure, labor supply (see Senay, 1998, and Sutherland, 1996), shocks to monetary policy (see Faia, 2007), shocks to net worth of financial institutions (see Ueda, 2012) and shocks to interest rate (Doepke et al., 1999).

3.8. Modeling Financial Integration

In general equilibrium model framework, it is common to investigate increased integration by comparing one equilibrium or one financial scenario with another (Evans & Hnatkovska, 2007b). Constructing different equilibrium for comparison can be carried out by many approaches. This section summarizes three major ways in the literatures to quantify and measure the level of FI. The three methods are adopting different financial market structures, reducing international financial frictions, and imposing exogenous amount of international financial flows. The last part of this section discusses and compares these methods.

3.8.1. International Asset Market Structure

The first approach is defining FI as the level of market completeness. The market completeness level is represented by the asset market structure, starting from *financial autarky* with no international asset trading at all; FI in bond markets only or *the bond economy*; integration in both bond and equity markets; and finally, *complete asset markets* where the complete arrays of financial assets are available for cross-border trade. The consequences of increased integration are studied by comparing the properties of model equilibrium resulting from different asset market structures. The complete asset market economy represents the highest level of FI.

The complete asset market, especially the one studying under IRBC framework, has been criticized as inconsistent with empirical evidences (Heathcote & Perri, 2002). Nevertheless, it is a good starting point for many papers. Leblebicioğlu (2009) compared complete market economy with financial autarky. It was found that output volatility, consumption volatility and welfare differ between the two types of asset market structure under some imperfection in credit markets. Kouparitsas (1996) defined increased FI as a move from the bond economy to the complete market economy. The increased FI is shown to lower the volatility of consumption and output in the developing countries, and lower the business cycle comovement between the industrial and developing countries.

Adding the bond economy into the comparison, Heathcote and Perri (2002) found similar resulting equilibrium allocations between the bond economy and the complete market when technology shock is stationary. In contrast, the behaviors of autarky economy are notably different. This demonstrates that the essential is the existence of international markets for borrowing and lending, but not the extent of financial assets available for trading. However, financial autarky seems to fit more with the observed data than the other two asset structures under their parameterization.

Other researchers also confirm the similarities between the bond economy model and the complete asset market structure. For example, Baxter and Crucini (1995) showed that this is true for the implication on the international real business cycle when productivity shock is trend-stationary, low persistent, and can spillover to other countries. Schmitt-Grohé and Uribe (2003) also proved that the impulse response function and second moments of macroeconomic variables under the bond economy with stationary-inducing feature quantitatively resemble those of the complete asset market economy.

Moving away from the complete market structure in earlier works, recent attention has started upon the integration in equity market. The equity market integration is an alternative to the bond market integration. Evans and Hnatkovska (2007a, 2007b) and Devereux and Sutherland (2011b) studied the portfolio choice of individuals by comparing three scenarios; financial autarky, integration in the bond market only, and integration in both bond and equity markets. It was found that all three types of asset market structures exhibit different behaviors of comovement and volatility in consumption and output. In particular, bond market economy is largely associated with more volatile consumption and output than when both bond and equity markets are integrated. However, the welfare improvement of higher integration is small and the welfare results are rather mixed.

3.8.2. Reduction of Financial Frictions

The second approach models the level of FI as a reduction of financial frictions and constraints that obstruct international financial flows. Lesser frictions and constraints ease free financial flow, and hence encourage higher FI. The full FI will be the one with no transaction cost and no friction. A reduction of frictions is mostly implemented by adjusting parameters in the friction function. The frictions can take many forms, such as the cost of international portfolio adjustment used by Sutherland (1996) and Senay (1998), and the leverage constraints used by Pancaro (2010).

Sutherland (1996) compared perfect FI when there is zero cost of bond holding adjustment with imperfect financial market integration when there exists a cost of bond holding adjustment. The elimination of adjustment cost is found to be broadly associated with a decrease in short-run volatility with exceptions in some cases. Senay

(1998) found that increased integration in financial markets as modeled by the removal of international bond adjustment cost likely lowers volatility of consumption and output. Pancaro (2010) used borrowing constraints as a friction indicating international integration, and found that greater FI tends to increase consumption volatility.

3.8.3. Exogenous Portfolio Choice

The third way to quantify FI is to regard it as a portfolio appetite of an individual (Sutherland, 1996). Even in a perfect integration of financial markets, an individual may choose to mainly hold domestic assets over foreign assets. Possible reasons are home biasness and the sufficient hedge that domestic assets can offer. The exogenous portfolio choice is implemented by directly assigning a foreign asset position or flow as a parameter. The parameter explicitly indicates the level of FI. For example, Ueda (2012) measured the degree of financial openness as the exogenously determined proportion of foreign versus domestic borrowing and lending of financial institutions. The finding reveals that financial openness tends to increase the business cycle synchronization.

3.8.4. Discussion

The most straightforward way to define FI seems to be assigning exogenously specific level of asset holding. This definition explicitly represents the actual level of financial flow across country. It is consistent with the definition used in empirical studies, in which FI is measured by the amount of cross-border financial flows. However, the dynamic behavior of asset holding might be limited under this method. Moreover, it is not often used in the literatures.

The asset market structure approach has been the most popular way of modeling FI since the start of IRBC framework. It has been abundantly studied starting from complete market structure and international financial autarky in earlier studies, to the bond economy, and recently, integration in equity market. Working with different asset market structures, especially with equity markets, has some computation difficulties arising from the portfolio choice among different returns. Hence, unless the aim is to study the portfolio choice problem, there is no need to complicate the calculation with separate equity integration. This issue is further discussed in Section 3.10.

Lastly, modeling FI as a reduction of asset trading frictions and constraints offers the flexibility of portfolio adjustment according to the shock to the economy. It also provides the framework for studying the policy implication on the frictions and constraints in the financial market. In addition, it has not been much explored by the existing literatures as compared to the asset market structure approach.

3.9. Modeling Trade Integration

There are three major ways to model the level of TI in FI literature; by reducing international trade frictions, imposing amount of cross-border trade, and equating it to the existence of purchasing power parity.

The first approach is to define trade intensity as dependent on the varying degree of iceberg transportation cost associated with international goods trade. The transportation cost is considered as a representative of trade barriers. Lower level or reduction of this transportation cost accordingly enhances trade globalization (Kose & Yi, 2006; Pancaro, 2010). A zero cost then implies no trade frictions, and hence free trade.

The second way to measure TI is to specify a level of trade occurring between countries in the form of consumption share of foreign goods (see Bacchetta and Van Wincoop, 2013, Faia, 2007, and Ueda, 2012). This is captured by the weight parameter in the constant elasticity of substitution (CES) consumption index between domestic and foreign goods. In other words, TI is estimated by the inverse of home bias parameter. Trade autarky means households consume only home-produced goods. The use of one parameter to measure TI is pointed out by Bacchetta and Van Wincoop (2013) that it is adequate. Furthermore, it is consistent with empirical work where TI is quantified by the ratio of the sum of exports and imports over GDP. However, the existing literature mostly considers the trade of final goods for consumption through the use of the CES index, but not the intermediate goods for production, which are now a large part of international trades.

Alternatively, Senay (1998) defines the goods market integration as an existence of law of one price. It means there is a single world price for each goods and no price differential between domestic and foreign markets. However, this seems to be the feature of free trade, rather than the indicator of TI level.

3.10. Issues on Approximation and Solution Method

As closed-form analytical solutions to DSGE models are generally not available, numerical methods and approximation techniques are needed to solve the problems. The purpose of this section is not to review the standard well-known approaches to solve the DSGE model in general as will be described in the next chapter. Instead, this section aims to highlight some recommendation and caveats specific to modeling FI in the DSGE framework since these fundamentally depend on the choice and the setup of the model.

3.10.1. Complete Asset Market Economy

A complete asset market model without analysis on welfare is the most straightforward one. The solution can be approximated with the standard linearization, log-linearization or first-order perturbation method around a non-stochastic steady state. This method adequately provides investigation of the equilibrium and the second moments of the variables (Schmitt-Grohé & Uribe, 2004). Examples of FI studies that apply linear approximation to equilibrium with complete asset markets are Heathcote and Perri (2002) and Kose and Yi (2006).

3.10.2. Bond Economy

When only international risk-free bonds are traded, a small computation difficulty arises. As Schmitt-Grohé and Uribe (2003) elaborated, the steady state of this type of models does not depend only on model parameters, but also on the initial position of the country's net foreign asset. 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. As a result, the typical numerical solution method that only works well locally with a stationary path cannot be appropriately applied.

To solve the problem of non-stationarity, many approaches have been proposed. Schmitt-Grohé and Uribe (2003) summarized three possible ways to induce stationarity and remove the random walk element from the model. The three approaches are 1) using endogenous discount factor that depends on consumption; 2) employing interest rate which is dependent on net foreign debt of the country; and 3) adding convex costs of adjusting bond holding. They have shown that all three stationary-inducing modifications deliver similar results on business cycle dynamics as represented by impulse response function and second moments of the variables. Furthermore, these results resemble those obtained from a complete asset markets model, though with a less smooth consumption than a complete market setting. With any choice of the modifications, a standard approximation method such as log-linearization can be used to obtain the model solutions.

Studies of FI that fall into this category of models are Heathcote and Perri (2002), Iacovielloa and Minetti (2006), Benigno (2009) and Pancaro (2010). They all adopted the convex adjustment cost of asset holdings to induce stationarity in the bond market economy. Endogenous discount factor and debt-dependent interest rate are employed by, for example, Devereux and Sutherland (2011b) and Faia (2007) respectively.

3.10.3. Welfare Analysis

When welfare comparison is included in the models, the first-order linearization to the solution is no longer sufficient (J. Kim & Kim, 2003; Schmitt-Grohé & Uribe, 2004; Sutherland, 1996). As J. Kim and Kim (2003) have rationalized, second and higher moments, which are important elements regarding risk and welfare measurements, are neglected under a linear approximation. This could result in a large approximation inaccuracy that can spuriously cause welfare reversal. The welfare reversal is a situation in which financial autarky provides higher risk-sharing welfare gains than the complete market with full risk-sharing possibilities.

To accurately address the welfare analysis, second-order or higher-order approximation method applying on the policy function is more appropriate (Devereux & Sutherland, 2011a; Schmitt-Grohé & Uribe, 2004). As one possible way to derive the accurate welfare criteria, Schmitt-Grohé and Uribe (2004) have proposed using the second-order *perturbation solution method*. The perturbation method is an approach that applies a Taylor expansion to the second order on the equilibrium and market-clearing conditions around the economy’s non-stochastic steady state.

The welfare criteria can be derived by many means. Evans and Hnatkovska (2007b) used a constant level of consumption in period t that implied by the level of expected lifetime utility. J. Kim, Kim, and Levin (2003) and Devereux and Sutherland (2011b) modeled it as the shift in the steady state level of consumption required to make consumers equally well off in the steady state and in the stochastic economy being modeled. Mendoza, Quadrini, and Ríos-Rull (2009) measured it by the increase in the financial autarky level of consumption required to make agents equally well off between staying in autarky with increased consumption level and moving to financial integration world. The aggregate welfare is achieved by combining welfare measures of all households or all types of consumers in the economy. It can be the weighted average with the weights representing the proportion of each type of consumers (Benigno, 2009; Leblebicioğlu, 2009), or the equally weighted average (Evans & Hnatkovska, 2007b; Mendoza et al., 2009). This depends on the model setup. There can be cases where the aggregate welfare of the economy is dominated by the welfare of certain groups of agents. To see if there is any welfare gain or loss moving from one financial market arrangement to another, the welfare measure from different financial scenarios are compared.

3.10.4. Endogenous Portfolio Choice Model

The last issue is concerned with the dynamic endogenous portfolio choice. Agents can choose among many classes of financial assets that yield different rates of return such as between bonds and equities. The portfolio choice problem is still under the incomplete asset market because the menu of assets available does not cover a complete array of assets and is inadequate to provide perfect international risk sharing. A number of technical difficulties arise in derivation of the optimal portfolio allocation. Firstly, this kind of models involves complicated interactions of financial risk-return problems and real economy problems, and potentially requires a large set of state variables to fully capture the economy's equilibrium (Evans & Hnatkovska, 2012). More importantly, time-varying portfolio problems, which involve risky returns, do not have a unique non-stochastic steady state; thus, the standard approximation techniques cannot be employed (Devereux & Sutherland, 2010; Evans & Hnatkovska, 2012).

Researchers have proposed methods to solve models of portfolio holding, but it seems that a consensus has not been reached. For example, Devereux and Sutherland (2010) proposed a solution method that combines a third-order approximation of the equilibrium portfolio equations with a second-order approximation of other non-portfolio optimality conditions to accommodate the dynamic risk behavior of asset holdings. Their approach can be applied to the model with any number of financial assets, and with either incomplete or complete markets. Evans and Hnatkovska (2012) proposed another approximation technique. They combined the continuous-time log-approximations techniques from partial equilibrium problem in finance literature with the second-order perturbation method from general equilibrium problem in macroeconomics literature. Also, the wealth factor is added into the state variables. Their solution method encompasses all classes of models aforementioned. As they claimed, the optimal portfolio holdings can be accurately characterized and their method provides a more precise result than the one proposed by Devereux and Sutherland (2010). However, Evans and Hnatkovska's (2012) approach is far more complex to implement.

Studies of FI that fall into this category of models are Evans and Hnatkovska (2007a, 2007b) and Devereux and Sutherland (2011b).

3.11. Conclusion

The first half of the chapter has mainly reviewed the existing literature on the relationship of financial integration (FI), trade integration (TI), and business cycles in both empirical and general equilibrium modeling setting.

Empirical researches on FI usually include TI since they are closely related. The findings generally show that financial and trade integration play roles on macroeconomic volatility and business cycle synchronization, but the results on the direction of the relationship are inconclusive, especially for the impact of FI. Only one strongly robust finding is that international trade enhances business cycle synchronization.

Under general equilibrium model framework, there are some evidences of consumption smoothing and international risk sharing benefits from FI largely in models without market imperfections, but FI could be harmful and result in welfare lose when there are market frictions. Results depend on the model setup and assumptions regarding asset market structure and financial frictions. The literature usually examines FI in the aspect of different asset market structures and typically studies the individual effect of FI alone on business cycles, unlike the empirical studies. Not many studies explore the role of trade and only few investigate the combined effect of two types of integration. Furthermore, these papers mostly study FI and TI in the context of generic or advanced economies with one kind of homogeneous consumers. This implies that countries are identical and all consumers are implicitly assumed to have equal financial access. This setting may not be able to capture the characteristics of emerging markets, which have lower financial development but higher aggregate fluctuation than advanced countries. Emerging markets also likely have more market imperfection and not everyone has symmetric access to international finance.

On the other hand, there are papers that study EMEs, but they mainly focus at FI without examining the role of trade, which is important to these economies. Asymmetric access to international financial markets are also explored, but usually to study only the effect on consumption smoothing under one-country setting, which might not be able to provide a rich analysis of international business cycles. The results generally show that FI tends to benefit people with access more than people without access.

These reviews have pointed out the gap in the literature that there is a lack of studies investigating the implication of FI and TI together on business cycles under the emerging market setting. This is the research gap that motivated this thesis and that this thesis hopes to fill.

The second half of the chapter has reviewed the methodology. Dynamic stochastic general equilibrium (DSGE) model and the elements of the model economy are introduced and discussed. Measures of FI and TI in this kind of studies are outlined. The review also points out some complexities regarding computation. These discussions result in the choice of methodology adopted in this thesis as will be described in the next chapter.

Chapter 4
Methodology

This chapter provides the overview of methodology used in this study, which is the DSGE framework and two-country RBC model with market imperfections. It focuses mainly at the common characteristics of the methodology. Differences across three sub-studies in this dissertation are introduced in Section 4.3.1, but details will be discussed in each following chapter - Chapter 5, 6, and 7 – and will be summarized again in Chapter 8. This chapter also aims to provide rationales behind the choices of model and assumptions, and the tools used to perform the simulation. It additionally covers how the models in this study are different from the existing researches.

4.1. The Choice of Approach

4.1.1. DSGE Framework

DSGE framework is chosen as the main methodology for this study because it provides a rich analysis of business cycles and it can be used to study hypothetical situations, which suits the research objective of this study. It is commonly used in FI literature; hence, the results can be compared with findings from existing studies. It seems to have advantage over the empirical approach when studying emerging markets, whose long historical quality data might not be available. Other alternative approaches, such as CGE, are scarcely adopted in this field.

4.1.2. IRBC Model

The two-country discrete RBC model is chosen rather than New Keynesian model with nominal rigidities because the goal of the thesis is to explore the real effects of financial and trade integrations. It aims to investigate implications in a friction world under given policies. The thesis inclines toward the issue of financial development through easing of frictions, enhancing financial access, and promoting the use of financial services, rather than issues regarding monetary variables like money supply, inflation, interest rate, and exchange rate. Its purpose is not to answer questions regarding either fiscal or monetary policies. Thus, money can be dropped out to focus on real implications and RBC model is sufficient. One-country small open economy model is also adopted in the literature, but the two-country setting likely provides better analysis on the comovement and shock transmissions between the two economies. The use of continuous model instead of the discrete one is infrequently seen and mostly employed in papers that are more theoretical.

4.2. DSGE Modeling

DSGE modeling generally follows the steps as follow.[22]

1) Constructing *the model economy* that comprises of different kinds of agents, sectors and markets based on model assumptions and the research questions being studied. The typical sectors are public and private sectors. The private sector usually consists of households and firms. Each sector in the economy has its own separate optimization problem. Market clearing conditions and resource constraints link all the sectors in the economy together and close the model. The behaviors of all agents and the assumptions are represented by mathematical formulae with appropriate functional forms, interested variables, and relevant parameters.
2) Deriving the first order optimality conditions from the agents' optimization problem identified in step 1). For example, households maximize the expected lifetime utility subject to the budget constraint.
3) The first order conditions, resource constraints and market clearing conditions form a system of *non-linear stochastic difference equations*. For most DSGE models, this system does not have a closed-form analytical solution. Therefore, a numerical approximation is required to describe the model's equilibrium. There are many techniques available to deal with nonlinearity. The widely used one, which is also used in this study, is to approximate the system around the non-stochastic steady state; hence the next step.
4) Solving the system from step 3) for the non-stochastic steady state. Steady state values of all the variables in the model are critical inputs for the next step.
5) Approximating the non-linear system around the steady state values to obtain a system of *linear stochastic difference equations.* Examples of approximation methods are linear approximation or *linearization*, *log-linearization*, and *perturbation method* (a second- or higher-order approximation).

[22] The procedure is summarized from Fernández-Villaverde (2010), Flotho (2009) and the author's view of the DSGE framework.

6) Solving the linear rational expectations model from step 5). There are many approaches available for this purpose. Example of renowned methods are Blanchard and Kahn (1980), King and Watson (1998), Uhlig (1995), Klein (2000), and Sims (2002).

7) Calibrating or estimating the parameters of the model. For calibration, the values of the parameters are taken from early microeconomic studies that have estimated the required parameters. Otherwise, the parameters are estimated within the model using many approaches available such as *Bayesian estimation*.

8) Finally, analyzing the dynamic characteristics of the model. Simulated variance, standard error, and correlation of the endogenous variables can be obtained from the simulation of the system. *Impulse response function (IRF)* from shocks that deviate the variables away from their steady state can also be analyzed. These results from the model can be compared with empirical data to assess the model's performance whether they are good fits.

4.3. The Model Economy

The common characteristics of the model economies in this thesis are as follow. The model economy consists of two countries. The home country is always an emerging market economy with some forms of market imperfection and two types of heterogeneous consumers. The foreign country is a frictionless advanced economy. Exploring asymmetric countries when the emerging economy is less developed extends earlier researches that examine general identical countries like the papers by Senay (1998) and Devereux and Sutherland (2011b), or developed countries like the works by Heathcote and Perri (2002) and Kose and Yi (2006).

The model economies are constructed by combining desirable features from many existing papers and modifying into new models that attempt to study imperfect FI and international trade in the context of emerging markets. They are not extension of any one particular model. Appendix B compares how the models in this dissertation differ from previous researches in details.

The assumptions specified in each model economy are mostly typical assumptions, which have been previously adopted by other researchers. Nevertheless, the findings are contingent on these assumptions and may not be applicable in all circumstances. The main components of the model are discussed as follow.

4.3.1. Financial Structure and Frictions

There are three main financial structures examined in Chapter 5, 6, and 7 accordingly. They differ primarily in the aspects of FI investigated, how FI is measured, types of market imperfections in home emerging economy, the ability of domestic residents to invest and borrow, and the linkage between FI and TI within the economy.

Chapter 5 studies the cross-border borrowing, Chapter 6 investigates foreign asset investment, and Chapter 7 explores different types of accessibility to international financial markets that involve both investing and borrowing abroad.

Three major types of market imperfections adopted are the leverage constraint, the adjustment cost of foreign asset holding, and asymmetric access to international financial markets. They 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 as compared to the foreign advanced economy. Chapter 5 examines international leverage constraint. Chapter 6 investigates cross-border adjustment cost of asset holding and domestic leverage constraint. Chapter 7 includes both international leverage constraint and adjustment cost of foreign asset holding. Imperfect financial access is explored under all three studies.

In Chapter 5, FI is measured as the amount of private external debt and determined by the loan-to-value (LTV) parameter in the credit constraint. In Chapter 6, FI is measured as the size of foreign asset holding and determined by the coefficient of the adjustment cost. In Chapter 7, higher FI is viewed as greater access to global financial markets, analyzed by comparing three types of financial accessibility. This approach of measuring FI allows the investigation of intermediate levels of FI in-between two ends of financial autarky and perfect integration. The intermediate integration tends to be more consistent with the present environment that integration has proceeded from autarky, but likely not yet reached complete integration. This extends previous researches that usually study extreme cases of integration; that is, no integration at all and complete integration like studies by Senay (1998), Heathcote and Perri (2002), Kose and Yi (2006), and Leblebicioğlu (2009).

There is a separate frictionless domestic financial market in Chapter 5, while Chapter 6 incorporates constrained domestic credit market. There is no explicit domestic financial market in Chapter 7.

Apart from these, the relationship between FI and TI in the model also differs. In Chapter 5, there is no endogenous linkage between the two, meaning that higher TI does not enhance higher FI and vice versa, but in Chapter 6 and 7, FI and TI are complementary such that greater integration in one market is associated with greater integration in the other market.

The key differences across three studies are summarized in Table 4.1.

Table 4.1 Key differences across three studies

	Chapter 5	**Chapter 6**	**Chapter 7**
Aspect of FI explored	• Cross-border borrowing • Asymmetric financial access	• Cross-border investment • Asymmetric financial access	• Access to international financial markets • Cross-border saving and borrowing
Measure of FI	Size of private external debt determined by loan-to-value (LTV) ratio	Size of foreign asset investment determined by adjustment cost	Greater access to international financial markets by comparing three scenarios
Frictions and constraints	International leverage constraint	• Adjustment cost of foreign asset holding • Domestic leverage constraint	• Adjustment cost of foreign asset holding • International leverage constraint
Domestic financial markets	Separate market with no friction	Separate market with friction	Combined market with frictions
Relationship between FI and TI in the model	None	FI and TI are complementary	FI and TI are complementary

The common features are as follow. Financial transactions are assumed to be facilitated by financial intermediaries that are not present in the model. 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 et al., 2012). Since those are not the research purposes of this study, the explicit financial intermediaries are omitted.

The financial assets traded are modeled by a risk-free non-contingent bond as a proxy for deposits and loans. The study focuses on agent's overall accessibility to international asset markets rather than to distinguish the access among different classes of financial assets such as bonds and equities or investigate equity market integration and portfolio choice.[23] Thus, the bond economy is adequate. Furthermore, this could be

[23] There are already a number of existing literatures investigating different asset market structures. For example, Heathcote and Perri (2002) compare the international financial autarky, the bond economy, and the complete asset market. Devereux and Sutherland (2011b) and Evans and Hnatkovska (2007a, 2007b) study the portfolio choices between bond and equity.

viewed as imperfect FI in the sense that certain financial assets cannot be traded, which likely suits emerging markets more than perfect FI.

4.3.2. Production Firms and International Trade Structure

There are two production firms. One is a tradable intermediate goods producing firm that adopts the Cobb-Douglas technology to produce intermediate goods. The other one is a non-traded final goods producing firm that combines intermediate goods from domestic and foreign countries using Armington (1969) aggregator. 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.

All goods are differentiated and can be traded freely across countries without any trade friction. Trade frictions such as transportation cost are omitted to focus more on financial frictions and to avoid unnecessarily complicating the model. Including many frictions may make the model difficult to operate and the interaction among frictions might lead to difficulties in interpreting the results. The structure of firms and cross-border trade closely follows Heathcote and Perri (2002).

Trade integration is measured from the amount of cross-border goods trade and is determined by the Armington weight that represents relative preference or technology in favor of foreign goods. This approach is adapted from Faia (2007) and Ueda (2012). It is one contribution of the present thesis that deviates from existing literature, which usually models the level of TI from a reduction of transportation cost like Kose and Yi (2006) and Pancaro (2010) or the validity of purchasing power parity across countries like Senay (1998). The trade structure and how TI is implemented are the same across three studies in Chapter 5, 6, and 7.

4.3.3. Heterogeneous Households, Domestic Financial Market, and Asymmetric Access

Home emerging country has two kinds of heterogeneous households. This has two important implications. Firstly, when heterogeneous consumers act as different kinds of market participants, it enables the investigation of domestic financial markets since there exists both domestic savers and borrowers. This is not possible if there is only one type of homogeneous consumers. Secondly, not everyone in emerging markets might have access to international financial markets. Having two groups of agents can provide the analysis when only some people have access, and some do not.

Incorporating heterogeneity within the economy expands earlier papers such as by 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.

4.4. Quantitative Analysis

4.4.1. Solution Method and Simulation

The solutions of the model are obtained by the second-order perturbation method, which applies a second-order Taylor approximation around the non-stochastic steady state. The second-order approximation is employed because linear approximation can lead to large inaccuracy that can spuriously cause welfare reversal when comparing different financial arrangements (J. Kim & Kim, 2003; Schmitt-Grohé & Uribe, 2004). A system of linear stochastic difference equations is solved using the calibrated parameters that will be discussed in the following sub-section.

The model solutions and simulations are computed using Dynare software and MATLAB. Dynare is a user-friendly free software for simulating and estimating economic models such as DSGE and OLG models. It provides many check points to assure the correctness of the model and the results, such as steady state values check, check of Blanchard-Kahn conditions regarding the number of eigenvalues greater than one and the number of non-predetermined variables, and check of Walras' law concerning the numbers of market clearing conditions. 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). The program and resources are available online at http://www.dynare.org. The Dynare works on Matlab and simulation results are generated in Matlab. Second moments are calculated as the averages of 500 simulations, each 400 period long.[24]

4.4.2. Parameter Calibration

The model is calibrated to the benchmark parameters. Most of financial and trade parameters are computed from data of emerging and advanced economies. The rest of the parameters are taken from RBC literature. They are standard and have been used in both emerging market and advanced economy studies.

[24] Other papers use averages of 100-1000 simulations and 100-400 period long (Evans & Hnatkovska, 2007b; Heathcote & Perri, 2002; Pisani, 2011; Ravn & Mazzenga, 2004).

The parameter calibration is chosen instead of parameter estimation within the model due to the following reasons. First, the main parameters in this study, which concerns financial markets and international trade, can be derived straightforwardly from the data using the steady-state relationship without the need of estimation. Secondly, parameter estimation requires a large set of data from many emerging markets, which might not be consistently available across different countries. Thirdly, the study examines a large group of countries and does not particularly calibrate the model to one specific country, so borrowing parameters from the existing literature that studies general countries would be applicable.

The data used to derive financial and trade parameters come from many sources, which will be described in each chapter. All data sources are from international organizations that provide data covering a wide range of both emerging market and advanced economies to assure consistency. The data are annual averages over the year 2000 to 2013. The period of 2000 to 2013 is chosen based on the common data availability across different series from different data sources. The 2013 data is the latest available at the time this study was conducted. This choice of data period covers crisis period in some countries in the sample such as 2007-2008 global financial crisis and economic crisis in Argentina that lasted up to about 2002. However, the variables used are long-term averages of many countries within each group; hence, spikes in some series or a few more year of updated data should not have much influence.

The period in the model is quarterly, but the data used to compute the parameters are yearly because of the following reasons. Since this thesis borrows most of the parameters from other literatures that usually calibrate the parameters quarterly, the quarterly period is chosen. However, trade and financial parameters are mostly computed from data, which requires availability and consistency for a broad range of countries, in particular emerging economies. 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 to calculate parameters are all in the form of percentage ratio relative to GDP, not the amount; thus, it deems usable as a proxy for the quarterly one. More importantly, the parameters derived from data are in line with the parameter values adopted in earlier studies.

4.4.3. Result Check

The simulation results on the separate impacts of FI and TI on business cycles are compared with empirical studies throughout the result discussion in Chapter 5, 6, and 7. The closest empirical literature that can be compared with the combined effect of FI and TI on business cycles is the threshold effect literature although they are not perfectly analogous and most of the threshold studies investigate the effect on growth rather than business cycles. The simulated business cycles for home emerging economy will be compared with the stylized facts of business cycles outlined in Chapter 2. Additionally, sensitivity analysis using different parameter values and alternative shock process will be carried out to check the robustness of the results.

Chapter 5
The Impact of FI and TI on Macroeconomic Volatility and Welfare in Emerging Markets: The Case of Constrained Borrowing

5.1. Introduction

In globalization era, raising funds in international financial markets has become more important for emerging market economies. Firms in many emerging markets can now sell debts in local currency to foreign investors and they raise a larger proportion of fund in foreign markets such as international corporate bond market (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 (World Bank, 2015), but they could also make the countries more exposed to foreign currency and exchange rate risks (International Monetary Fund, 2014b).

This chapter investigates the effect of increased cross-border borrowing together with TI on macroeconomic volatility and welfare in emerging market economies. It focuses on private external debt of the entrepreneurs with the presence of international leverage constraint as one measure of FI. Unconstrained domestic debts are also available, but people have imperfect access to international financial markets.

The study employs a two-country RBC model, in which home country represents an emerging market economy with market imperfections and foreign country represents an advanced economy with frictionless markets. Not everyone in home country can access international financial markets. Home entrepreneurs can access both domestic and foreign funds. Domestic debt is unconstrained, but borrowing from abroad involves international leverage constraints. This constraint is asymmetric and only incurred by the home economy. Household consumers in the emerging markets do not have the 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 restrictions and frictions.

Three aspects of FI are explored. Firstly, it studies cross-border borrowing when home emerging economy is a borrower. Secondly, the higher level of FI 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 FI between autarky and complete. Lastly, the study features asymmetric access to international financial markets among home residents. These reflect the view that FI does not only refer to cross-border financial flows, but also involves equal financial access and reduction of asymmetric frictions.

Trade integration is defined as the amount of cross-border goods trade. It is 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 cost of home entrepreneurs. Home households who are excluded from cross-border financial transactions are not significantly affected by higher FI in terms of both consumption smoothing and welfare gain. This suggests that FI affects people with and without international financial access differently, and domestic 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 TI tends to benefit both aggregate fluctuation and welfare. These findings from the main scenarios are robust to extended and 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 FI seems preferable due to their trade-off consequences on aggregate fluctuation. With restricted and constrained access to international financial markets, domestic financial development 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 emerging market economies to better achieve gains from FI.

This chapter is organized as follows. Section 5.2 describes the model economy in details. Section 5.3 then discusses how financial and trade integration are modeled. The parameter calibration and computation of welfare criteria are discussed in Section 5.4 and 5.5. Section 5.6 presents and discusses the simulation results, and Section 5.7 concludes.

5.2. The Model Economy

This section describes the methodology, which is the DSGE model framework. The model economy is a two-country, two-sector international real business cycle model. The structure of firms and trade closely follows Heathcote and Perri (2002). The financial structure is adapted from Leblebicioğlu (2009) and Pancaro (2010). Other structures are contribution of this thesis. 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 to reflect that the developing countries tend to be less financially developed with more frictions and restrictions. Home country has two kinds of heterogeneous consumers. One is the *household* who supplies labor to the production sector and saves to smooth consumption. Home households do not have access to foreign financial markets and are restricted to domestic saving. The other one is the *entrepreneur* who owns the traded intermediate goods producing firms. Home entrepreneurs invest in physical capitals and need external fund to finance their investment and firms. 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 asymmetric problem and more difficulty to receive loans in foreign credit market as compared to local one. The *intermediate goods firms* produce intermediate goods and supply to both 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, unlike the home emerging economy where not everyone have access to international finance and people face asymmetric frictions. Foreign intermediate and final goods firms are similar to the home counterparts.

Financial transactions are assumed to be facilitated by financial intermediaries. The financial assets traded are modeled by a risk-free non-contingent bond as a proxy for deposits, loans, and corporate bonds. Another supportive reason for using bonds apart from those described in Chapter 4 is that 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).

All goods are differentiated and can be traded freely across countries without any trade friction. Trade frictions such as transportation cost are omitted to focus more on financial frictions and to avoid unnecessarily complicating the model.

Figure 5.1 illustrates the overall model structure and Table 5.1 summarizes the variables and their descriptions. 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 5.1 The model structure

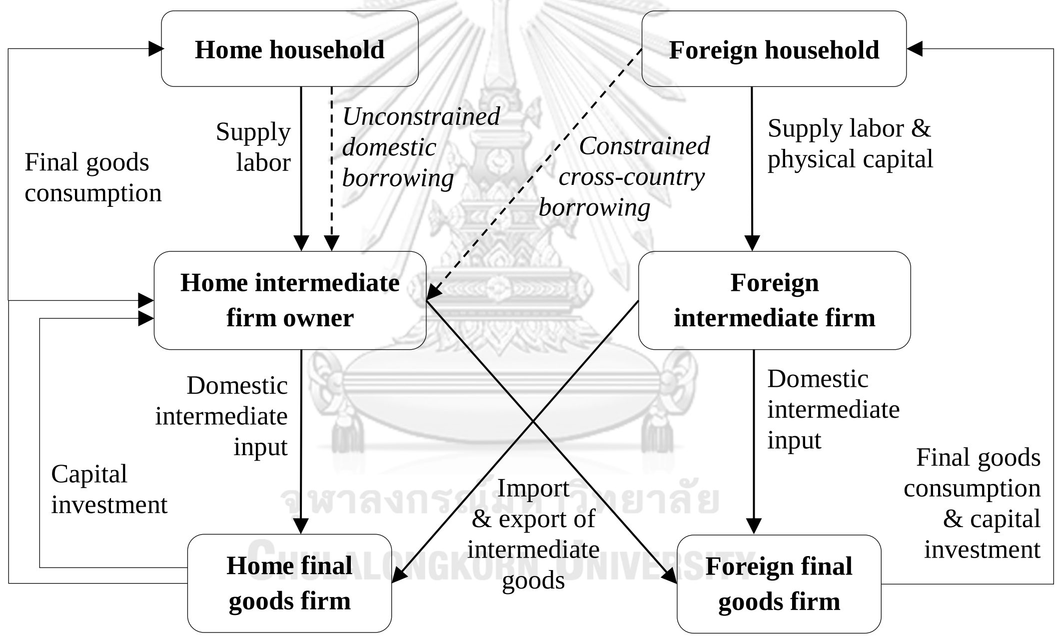

Table 5.1 Summary of variables

Variables	**Descriptions**
U_1^h	Expected lifetime utility of home households
U_1^o	Expected lifetime utility of home entrepreneurs
U_2	Expected lifetime utility of foreign households
C_1^h	Consumption of home households
C_1^o	Consumption of home entrepreneurs
C_2	Consumption of foreign households
Y_1	Home output
Y_2	Foreign output
K_1	Home physical capital
K_2	Foreign physical capital
L_1	Home labor
L_2	Foreign labor
X_1	Home investment in physical capital
X_2	Foreign investment in physical capital
w_1	Home wage
w_2	Foreign wage
r_2	Foreign rent
G_1	Home final goods
G_2	Foreign final goods
a_1	Home-produced intermediate goods used in home final goods production
a_2	Home-produced intermediate goods used in foreign final goods production (home exports)
b_1	Foreign-produced intermediate goods used in home final goods production (home imports)
b_2	Foreign-produced intermediate goods used in foreign final goods production
P_1	Price of home final goods
P_2	Price of foreign final goods
q_1^a	Home price of a_1
q_2^a	Foreign price of a_2
q_1^b	Home price of b_1
q_2^b	Foreign price of b_2
B	International non-contingent risk-free bond
Z	Domestic non-contingent risk-free bond
Q^B	Price of international bond B
Q^Z	Price of domestic bond Z
λ	Lagrange multiplier on the leverage constraint
e	Exchange rate
A_1	Home technology shock
A_2	Foreign technology shock

5.2.1. Home Country

5.2.1.1 <u>Home Households</u>

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}.

$$U_{1t}^h = E_t \sum_{t=0}^{\infty} \beta_1^t \left[\ln\left(C_{1t}^h\right) - \kappa L_{1t}\right] \tag{5-1}$$

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.[25] 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. This assumption is based on Heathcote and Perri (2002) and similarly adopted by Pancaro (2010). Their budget constraint is

$$P_{1t}C_{1t}^h + q_{1t}^a Q_t^Z Z_t \leq w_{1t}L_{1t} + q_{1t}^a Z_{t-1} - q_{1t}^a \frac{\psi}{2}(Z_t - \bar{Z})^2 \tag{5-2}$$

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). $\bar{Z}$ denotes the corresponding steady state values of Z_t. This small cost does not affect the non-stochastic steady state. The reasons behind this feature are presented in Section 3.10.2 and the functional forms are discussed in Section 3.7.6 in Chapter 3.

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

$$w_{1t} = \kappa P_{1t} C_{1t}^h \tag{5-3}$$

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[25] Modeling financial assets using the price of the bond Q_t^Z instead of the interest rate R_t provides numerical convenience to deal with time convention in Dynare software. Nevertheless, the two approaches are interchangeable and yield the same result that the borrowers pay back more than the initial borrowing amount.

$$\frac{q_{1t}^{a}}{P_{1t}C_{1t}^{h}}[Q_{t}^{z}+\psi(Z_{t}-\bar{Z})]=\beta_{1}E_{t}\left[\frac{q_{1,t+1}^{a}}{P_{1,t+1}C_{1,t+1}^{h}}\right] \tag{5-4}$$

Equation (5-3) describes the optimal decision of labor supply. It shows real wage and marginal disutility of labor. Equation (5-4) 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.

5.2.1.2 *Home Entrepreneurs and Intermediate Goods Firms*

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

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

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

$$X_{1t}=K_{1t}-(1-\delta)K_{1,t-1} \tag{5-6}$$

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, pay wages w_{1t} to worker, and finance operation of the firms. They can borrow Z_t from domestic financial markets without any constraint and they can borrow from international financial markets through non-contingent risk-free bond, B_t, but with the following borrowing constraint

$$q_{1t}^{a}B_{t}\le mE_{t}\left[P_{1,t+1}K_{1t}\right] \tag{5-7}$$

where m is a proportion indicating the maximum loan amount the entrepreneurs can get as a ratio of the asset value.

The leverage constraint stems from the problems of asymmetric information and debt contract enforceability (Iacoviello & Minetti, 2006; Leblebicioğlu, 2009). It limits the entrepreneurs' borrowing not to exceed a certain proportion 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. If the entrepreneurs want to invest more in physical capital, they likely have to borrow more. If they want to increase the borrowing, they will have to increase their physical capital in order to have higher asset or collateral values. Therefore, the amount of foreign debt and the capital value can be related.

The borrowing constraint can be interpreted in two ways. First, it represents the level of foreign debt the firm can or is willing to borrow as a proportion of the asset value. Second, the credit constraint describes the problem of contract enforceability. 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 5.3.1.

Although the leverage constraint originally comes from the work by Kiyotaki and Moore (1997), there are several modifications as follows. The form of constraint follows Leblebicioğlu (2009) and Pancaro (2010) closely. 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 (Heathcote & Perri, 2002; Pancaro, 2010). Lastly, the scale parameter m is added to the leverage constraint according to Devereux and Sutherland (2011b), Leblebicioğlu (2009), and Pancaro (2010).

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 $q_{1t}^{a}\frac{\psi}{2}(Z_t-\bar{Z})^2+q_{1t}^{a}\frac{\psi}{2}(B_t-\bar{B})^2$. These are included to make the bonds' law of motion stationary (Schmitt-Grohé & Uribe, 2003). 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 capitals K_{1t} belonging to the entrepreneurs themselves. The firms sell their products to both domestic and foreign final goods producing firms. Their technology is

$$Y_{1t}=A_{1t}K_{1,t-1}^{\alpha_1}L_{1t}^{1-\alpha_1} \tag{5-8}$$

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

$$\begin{aligned} P_{1t}C_{1t}^{o} + P_{1t}X_{1t} + q_{1t}^{a}B_{t-1} + q_{1t}^{a}Z_{t-1} + w_{1t}L_{1t} \\ \leq q_{1t}^{a}Q_t^B B_t + q_{1t}^{a}Q_t^Z Z_t + q_{1t}^{a}Y_{1t} - q_{1t}^{a}\frac{\psi}{2}(Z_t - \bar{Z})^2 \\ - q_{1t}^{a}\frac{\psi}{2}(B_t - \bar{B})^2 \end{aligned} \tag{5-9}$$

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 (5-5). The optimization is subject to the budget constraint, leverage constraint, capital accumulation equation, and production technology (equation (5-6) to (5-9)). 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;

$$w_{1t}L_{1t} = (1-\alpha_1)q_{1t}^{a}Y_{1t} \tag{5-10}$$

$$\frac{1}{C_{1t}^{o}} = \beta_1 E_t \frac{1}{C_{1,t+1}^{o}}\left[\frac{\alpha_1 q_{1,t+1}^{a} Y_{1,t+1}}{P_{1,t+1}K_{1t}} + (1-\delta)\right] + m\lambda_t E_t\left[P_{1,t+1}\right] \tag{5-11}$$

$$\frac{q_{1t}^{a}}{P_{1t}C_{1t}^{o}}\left[Q_t^z - \psi(Z_t - \bar{Z})\right] = \beta_1 E_t\left[\frac{q_{1,t+1}^{a}}{P_{1,t+1}C_{1,t+1}^{o}}\right] \tag{5-12}$$

$$\frac{q_{1t}^{a}}{P_{1t}C_{1t}^{o}}\left[Q_t^B - \psi(B_t - \bar{B})\right] = \beta_1 E_t\left[\frac{q_{1,t+1}^{a}}{P_{1,t+1}C_{1,t+1}^{o}}\right] + \lambda_t q_{1t}^{a} \tag{5-13}$$

where λ_t is the Lagrange multiplier on the leverage constraint.

Equation (5-10) shows the optimal choice of labor demand. It equates the marginal cost and the marginal benefit of hiring labor. Equation (5-11) describes the optimal choice of capital allocation. It equates the marginal utility of consumption to the marginal benefit of investing in capital across time. The marginal benefit of capital has an additional term $m\lambda_t E_t\left[P_{1,t+1}\right]$ due to the leverage constraint. This shows the benefit of having extra capital collateral for additional borrowing. Equation (5-12) and equation (5-13) are consumption Euler equations. Equation (5-12) is standard. Equation

(5-13) 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 consumption and capital (Iacoviello & Minetti, 2006; Pancaro, 2010).

5.2.1.3 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. The form and the notation are taken from Heathcote and Perri (2002).

$$G_{1t} = \left[(1-\omega_1)a_{1t}^{\frac{\sigma-1}{\sigma}} + \omega_1 b_{1t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{5-14}$$

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 TI in this model. Higher ω_1 leads to higher imports, exports, and TI. The relationship between ω_1 and trade will be addressed in Section 5.3.2.

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

$$\pi_{1t}^f = P_{1t}G_{1t} - q_{1t}^a a_{1t} - q_{1t}^b b_{1t} \tag{5-15}$$

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

$$(q_{1t}^a)^\sigma a_{1t} = (1-\omega_1)^\sigma P_{1t}^\sigma G_{1t} \tag{5-16}$$

$$\left(q_{1t}^b\right)^\sigma b_{1t} = \omega_1^\sigma P_{1t}^\sigma G_{1t} \tag{5-17}$$

Equation (5-16) and (5-17) define the optimal levels of intermediate goods inputs a_{1t} and b_{1t}. They equate the marginal benefit to the marginal cost of the intermediate goods.

5.2.2. Foreign Country

5.2.2.1. 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

$$U_{2t} = E_t \sum_{t=0}^{\infty} \beta_2^t [\ln(C_{2t}) - \kappa L_{2t}] \tag{5-18}$$

where C_{2t} is the foreign households' consumption, and β_2 is the discount factor of the foreign households. The foreign household's discount factor β_2 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 (see Leblebicioğlu, 2009, and Faia, 2011 for example).

Foreign households' budget constraint is

$$\begin{aligned} P_{2t}C_{2t} + P_{2t}X_{2t} + q_{2t}^a Q_t^B B_t \\ \leq w_{2t}L_{2t} + r_{2t}K_{2,t-1} + q_{2t}^a B_{t-1} - q_{2t}^a \frac{\psi}{2}(B_t - \bar{B})^2 \end{aligned} \tag{5-19}$$

They invest in capital according to

$$X_{2t} = K_{2t} - (1-\delta)K_{2,t-1} \tag{5-20}$$

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

Foreign households maximize utility in equation (5-18) subject to budget constraint (5-19) and capital accumulation equation (5-20). They choose the optimal levels of labor, capital, and cross-country saving. First order conditions with respect to L_{2t}, K_{2t} and B_t are

$$w_{2t} = \kappa P_{2t} C_{2t} \tag{5-21}$$

$$\frac{1}{C_{2t}} = \beta_2 E_t \frac{1}{C_{2,t+1}} \left[\frac{r_{2,t+1}}{P_{2,t+1}} + (1-\delta) \right] \tag{5-22}$$

$$\frac{q_{2t}^{a}}{P_{2t}C_{2t}}[Q_t^B + \psi(B_t - \bar{B})] = \beta_2 E_t\left[\frac{q_{2,t+1}^{a}}{P_{2,t+1}C_{2,t+1}}\right] \tag{5-23}$$

Equation (5-21) describes the optimal decision of labor supply. Equation (5-22) defines the optimal intertemporal choice of capital allocation. Equation (5-23) is the standard consumption Euler equation. Interpretations are analogous to agents in the home country.

5.2.2.2. 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 both domestic and foreign final goods producing firms. Their technology is

$$Y_{2t} = A_{2t}K_{2,t-1}^{\alpha_2}L_{2t}^{1-\alpha_2} \tag{5-24}$$

They maximize profit according to

$$\pi_{2t}^{i} = q_{2t}^{b}Y_{2t} - w_{2t}L_{2t} - r_{2t}K_{2,t-1} \tag{5-25}$$

Variables and parameters are defined analogously to the home counterparts.

First order conditions with respect to L_{2t} and $K_{2,t-1}$ are

$$w_{2t}L_{2t} = (1-\alpha_2)q_{2t}^{b}Y_{2t} \tag{5-26}$$

$$r_{2t}K_{2,t-1} = \alpha_2 q_{2t}^{b}Y_{2t} \tag{5-27}$$

Equation (5-26) and (5-27) describe the optimal demands for factors of production. They equate the marginal benefits to the marginal costs of labor and capital.

5.2.2.3. Foreign Final Goods Firms

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;

$$G_{2t} = \left[\omega_2 a_{2t}^{\frac{\sigma-1}{\sigma}} + (1-\omega_2)b_{2t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{5-28}$$

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

$$\pi_{2t}^{f} = P_{2t}G_{2t} - q_{2t}^{a}a_{2t} - q_{2t}^{b}b_{2t} \tag{5-29}$$

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

$$(q_{2t}^{a})^{\sigma}a_{2t} = \omega_{2}^{\sigma}P_{2t}^{\sigma}G_{2t} \tag{5-30}$$

$$\left(q_{2t}^{b}\right)^{\sigma}b_{2t} = (1-\omega_{2})^{\sigma}P_{2t}^{\sigma}G_{2t} \tag{5-31}$$

The interpretation of first order conditions is the same as the home final goods firm.

5.2.3. Market Clearing Conditions

Home intermediate goods market:

$$Y_{1t} = a_{1t} + a_{2t} \tag{5-32}$$

Foreign intermediate goods market:

$$Y_{2t} = b_{1t} + b_{2t} \tag{5-33}$$

Home final goods market:

$$G_{1t} = C_{1t}^{h} + C_{1t}^{o} + X_{1t} \tag{5-34}$$

Foreign final goods market:

$$G_{2t} = C_{2t} + X_{2t} \tag{5-35}$$

Moreover, the law of one price applies and implies that

$$e_{t} = \frac{q_{1t}^{a}}{q_{2t}^{a}} = \frac{q_{1t}^{b}}{q_{2t}^{b}} \tag{5-36}$$

where e_{t} is the exchange rate and for each goods;

$$q_{1t}^{a} = e_t q_{2t}^{a} \tag{5-37}$$

$$q_{1t}^{b} = e_t q_{2t}^{b} \tag{5-38}$$

5.2.4. Equilibrium

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.

5.2.5. Solution Method and Quantitative Assessment

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. A system of linear stochastic difference equations is then solved using the calibrated parameters that will be discussed in Section 5.4. The model solutions and simulations are computed using the Dynare software and MATLAB.

The models will be simulated under varying degrees of financial and trade integrations described in Section 5.4.3. 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 market economy.

5.3. 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, and the rationales. Other related issues are also discussed.

5.3.1. International Leverage Constraint and Financial Integration

In this model, the level of FI 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 contract enforceability problem and a reduction of borrowing constraint in international financial markets. These 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 FI. 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 FI. For both interpretations, m is a structural parameter that captures the financial market imperfection and financing choice of the firms. Higher values of m are then associated with higher degree of FI. The use of leverage constraint parameter m as a measure of FI level is similarly used by Pancaro (2010), Pisani (2011) and Faia (2011).

The advantage of modeling FI as a reduction of friction is that the intermediate levels of integration can be investigated instead of two extreme ends between financial autarky and complete integration. Certain degrees of FI seems more appropriate to the current situation that most emerging market countries are generally no longer closed economies, but still have not reached perfect integration either.

It can be shown mathematically that the degree of FI increases with the parameter m in the model. Based on the leverage constraint in equation (5-7), the non-stochastic steady state relationship between parameter m and the ratio of aggregate FI 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

$$FI_1 = \frac{m\alpha_1\beta_1}{1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)} \tag{5-39}$$

The derivation of equation (5-39) is presented in Appendix C.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

$$\frac{\partial FI_1}{\partial m} = \frac{\alpha_1\beta_1[1 - \beta_2(1-\delta)]}{[1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)]^2} \tag{5-40}$$

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 (5-40), the ratio of FI relative to GDP depends solely on the values of parameters. In other words, percentage FI 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.

$$\overline{q_1^a}\bar{B} = \left[\frac{m\alpha_1\beta_1}{1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)}\right]\overline{q_1^a}\overline{Y_1} \quad (5\text{-}41)$$

One crucial factor underlies the steady-state relationship between FI and m in equation (5-39) 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. This assumption and the binding leverage constraint are adopted by many authors, such as Faia (2011), Iacoviello and Minetti (2006), Pisani (2011), and Leblebicioğlu (2009). 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 FI 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, which are not the focus of this research.

The rationale for the presence of leverage constraint in home emerging economy is that the constraint plays a significant role in less financially-developed countries which have limited access to finance (Kose et al., 2011). Surveys of firms in developing economies often suggest that financing constraints are one of the main investment obstacles (Harrison et al., 2004). The constraints can negatively affect financial liberalization (Kose et al., 2011) and lessening of these constraints have positive impact on capital allocation (Bekaert & Harvey, 2003).

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 to borrow from foreign developed countries as compared with borrowing 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 debt 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 maybe an undesirable effect since the study aims to investigate the cross-country borrowing and FI. Constraining both domestic and foreign borrowing could be carried out to investigate particular issues. For example, Iacoviello and Minetti (2006) implement both international and domestic leverage constraints to explore different liquidation technologies and the allocation of collateral between the two markets. However, under those settings, the domestic borrowers would not be able 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 chapter and the issue of domestic leverage constraint will be investigated in the next chapter.

5.3.2. Armington Aggregator and Trade Integration

TI 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 from 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. The Armington aggregator is usually adopted in the trade general equilibrium models (Backus et al., 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. Varying the degree of TI 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 TI 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 TI, albeit different methods and interpretations.

It can be shown mathematically that the degree of TI 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;

$$\omega_1 = \frac{1}{1 + TOT_1^{\frac{1-\sigma}{\sigma}}\left(\frac{1 - XS_1}{MS_1}\right)^{\frac{1}{\sigma}}} \tag{5-42}$$

$$XS_1 = 1 - \left[\left(\frac{1}{\omega_1} - 1\right)^{\sigma} TOT_1^{\sigma-1} MS_1\right] \tag{5-43}$$

$$MS_1 = \frac{TOT_1^{1-\sigma}(1 - XS_1)}{\left(\frac{1}{\omega_1} - 1\right)^{\sigma}} \tag{5-44}$$

where $TOT_1 = \overline{q_1^b}/\overline{q_1^a}$ is the terms of trade.[26] 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. See Ravn and Mazzenga (2004) for example. The derivation is typically used for the calibration of parameter ω_1. The derivation of these relationships is shown in Appendix C.2.

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

$$\frac{\partial XS_1}{\partial \omega_1} = \frac{\sigma MS_1 TOT_1^{\sigma-1}\left(\frac{1}{\omega_1} - 1\right)^{\sigma-1}}{\omega_1^2} \tag{5-45}$$

$$\frac{\partial MS_1}{\partial \omega_1} = \frac{\sigma TOT_1^{1-\sigma}(1 - XS_1)}{\omega_1^2\left(\frac{1}{\omega_1} - 1\right)^{1+\sigma}} \tag{5-46}$$

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.

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

5.4. Parameter Calibration

The model is calibrated to the benchmark parameter values reported in Table 5.2. One period corresponds to one quarter. The home country is set to represent the emerging market economy and the foreign country as the advanced economy. Two key parameters in this study are the leverage constraint parameter m and the weights in Armington aggregator ω. They are derived based on the data of emerging and advanced economies and will be discussed in details in the following sub-sections. Other parameters are standard values in RBC literatures mostly drawn from Backus et al. (1994), Leblebicioğlu (2009), and Pancaro (2010). 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.[27] 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.

The productivity process for A_{1t} and A_{2t} is a vector autoregressive taken from Pancaro (2010) and is described in Table 5.3. 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 widely acknowledged stylized fact that the business cycles of emerging economies are more volatile than the advanced economies (see Gopinath and Aguiar, 2007, and Calderon and Fuentes, 2010). Moreover, developing countries tend to have larger domestic and exogenous shocks than industrial countries; thus, higher macroeconomic volatility (Loayza, Ranciere, Servén, & Ventura, 2007).

[27] See Almekinders et al. (2015), Sarel (1997), Mallikamas, Thaicharoen, and Rodpengsangkaha (2003), and Bhattacharya and Patnaik (2013) for example.

Table 5.2 Benchmark parameters

	Parameter	Value	Source
β_1	Discount factor of home population	0.95	Pancaro (2010)
β_2	Discount factor of foreign population	0.99	Backus et al. (1994), Leblebicioğlu (2009), Pancaro (2010)
κ	Labor effort weight in utility	1	Leblebicioğlu (2009), Pancaro (2010)
δ	Depreciation rate	0.025	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009), Pancaro (2010)
α_1	Capital share of output for home country	0.34	Author's assumption based on Almekinders et al. (2015), Sarel (1997), Mallikamas et al. (2003), and Bhattacharya and Patnaik (2013)
α_2	Capital share of output for foreign country	0.36	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009)
σ	Elasticity of substitution between domestic and foreign goods	1.5	Backus et al. (1994), Faia (2007), Leblebicioğlu (2009)
ω_1	Armington weight in home country	0.33, 0.42, 0.50	Author's calculation and Bacchetta and Van Wincoop (2013)
ω_2	Armington weight in foreign country	0.41	Author's calculation
m	Leverage constraint parameter	0.05, 0.10, 0.15	Author's calculation and hypothetical scenario
ψ	Bond holding coefficient	0.003	Pancaro (2010)

Table 5.3 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)

5.4.1. 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 (5-39), which can be rearranged as;

$$m = \frac{1 - \beta_1(1 - \delta)}{\frac{\alpha_1 \beta_1}{FI_1} + \beta_2 - \beta_1} \tag{5-47}$$

Equation (5-47) shows that m depends on the model parameters and $FI_1 = q_1^a B / q_1^a Y_1$, which in this case represents the total private foreign borrowing to GDP. The data used to compute the parameter are non-financial-institution private external debt from World Bank's Quarterly External Debt Statistics (QEDS) and GDP from WDI. The data is available for 24 EMEs and averaged annually over 2000-2013. This gives the value of 14 percent of GDP and corresponding m = 0.03.[28] Tables in Appendix D.2 list the countries used in computation and their corresponding private external debts.

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 FI respectively. These values of m indicate the ratio of entrepreneur's foreign borrowing to the value of physical capital. However, small size of m at the individual level does not necessarily translate into small FI at the aggregate level. For instance, the corresponding level of FI 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 and FI will be explored in the sensitivity analysis.

5.4.2. 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 (5-42) already discussed in Section 5.3.2. The data used to calculate ω are 2000-2013 annual averages of imports, exports, and terms of trade from WDI. Imports and exports are adjusted to remove imported contents in exports using information from joint OECD – WTO Trade in Value-Added (TiVA) database. 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 emerging market economies are divided into two groups; emerging ASEAN economies, which have evidently higher trade intensity than peers as pointed out in Chapter 2, and other emerging markets that have relatively lower trade.

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

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 5.4 reports the raw trade data from WDI, adjusted trade, and corresponding values of ω. Appendix D.1 explains the computation in more details. 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 raw and adjusted trade than advanced economies, resulting in slightly higher weight of ω_1= 0.42 versus ω_2= 0.41.

Table 5.4 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.

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

5.4.3. 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 the following table.

Table 5.5 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

5.5. Welfare Criteria

Welfare criteria provides an alternative measure of benefit from FI apart from consumption volatility. 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 (2011b). 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 that

$$\sum_{\mathrm{t}=0}^{\infty} \beta^t = 1 + \beta + \beta^2 + \beta^3 + \cdots = \frac{1}{1-\beta} \tag{5-48}$$

to write the steady state value of expected lifetime utility $\overline{U_1^h}$ as

$$\overline{U_1^h} = E_t \sum_{t=0}^{\infty} \beta_1^t \left[ln\overline{C_1^h} - \kappa \overline{L_1} \right] = \frac{ln\overline{C_1^h} - \kappa \overline{L_1}}{1-\beta_1} \tag{5-49}$$

where $\overline{C_1^h}$ and $\overline{L_1}$ denote the corresponding steady-state value 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

$$EU_1^h = \frac{ln[(1+g_1^h)\overline{C_1^h}] - \kappa\overline{L_1}}{1-\beta_1} \tag{5-50}$$

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

$$g_1^h = \frac{exp[(1-\beta_1)EU_1^h + \kappa\overline{L_1}]}{\overline{C_1^h}} - 1 \tag{5-51}$$

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, 2011b). 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;

$$g_1^o = \frac{\exp[(1-\beta_1)EU_1^o]}{\overline{C_1^o}} - 1 \tag{5-52}$$

$$g_1 = \frac{\exp[(1-\beta_1)EU_1 + \kappa\overline{L_1}]}{\overline{C_1^o}\,\overline{C_1^h}} - 1 \tag{5-53}$$

5.6. Results and Discussion

5.6.1. Macroeconomic Volatility

The simulation results of key macroeconomic volatility for nine main scenarios are presented in Table 5.6. The statistics are the averages of 500 simulations, each 400 periods long. The focus of the analysis is the home emerging economy.

Table 5.6 Simulated volatility of key variables

	LTI			MTI			HTI		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Volatility of home variables (%SD)									
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
Volatility of foreign variables (%SD)									
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
Consumption volatility relative to output (%SD/%SD of Y)									
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.

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 TI, increasing financial integration from LFI to HFI raises output volatility from 12.86 percent to 13.16 percent. FI 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 5.6, where the volatility of foreign debt B increases noticeably with the size of the borrowing. The volatility of capital also increases with higher FI but with less extent. These could contribute to increased output volatility.

As Kose et al. (2009) have explained, the high volatility could be caused by a capital inflow into the emerging markets and its procyclical nature. External debts both as portfolio bonds and bank loans are also viewed to be the type of flows that is highly volatile, easily reversible, and related to the likelihood of crisis, especially unfavorable in the environment of underdeveloped and poorly supervised financial systems (Kose, Prasad, Rogoff, et al., 2006).[29]

For the foreign country, higher FI insignificantly lowers the foreign output. Nevertheless, the empirical evidence on this relationship has not yet reached a conclusion. For example, Bekaert et al. (2006) and Prasad et al. (2007) found that FI 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.

For consumption variability, Table 5.6 reports two measures; 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, FI slightly increases their consumption volatility, but when considered relative to output volatility, they are almost unaffected. The volatility of consumption relative to output is almost the same across different levels of FI given certain degree of trade. For instance, the relative consumption volatility ratio remains at about 0.31 for all three levels of FI 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

[29] See more discussion of negative impact from external debt in Kose, Prasad, Rogoff, et al. (2006).

FI to the households because only the foreign borrowing is constrained, while domestic borrowing is unrestricted.

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.

The empirical impact of FI on consumption smoothing in emerging markets is mixed. Bekaert et al. (2006) show that increased FI can help lower consumption growth volatility in the sample of all countries, but the result for emerging market subgroup is weaker. Kose et al. (2003) observed the non-linear relationship between financial openness and consumption volatility, in which developing countries with less financial openness than the advanced economies are associated with higher consumption volatility. Prasad et al. (2007) provide some evidences that FI could lead to higher consumption fluctuation in more financially opened developing countries. Studies adopting DSGE mostly found that FI increases consumption volatility when there are financial frictions or imperfect access to finance[30] since these market imperfections could amplify the impacts of shocks on consumption (Pisani, 2011).

Although home consumers in this study are constrained internationally – entrepreneurs with leverage constraint, and households with no access to foreign markets – they both face no financial 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 affected by cross-border financial flows like the findings from other studies with market imperfections.[31]

Increased TI 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

[30] See Levchenko (2005), Leblebicioğlu (2009), Pancaro (2010), and Pisani (2011) for example.

[31] 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 (2007b) 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.

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 be adjusted instead and become more volatile. The findings suggest that TI could help dissipate the shocks and transmit them across countries through international trade channel.

However, both positive and negative relationships between trade and the volatility of output and consumption growth have been found in empirical literatures. For example, Kose et al. (2003) found that trade induces higher output variability. Haddad et al. (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 FI only slightly increases the volatility of domestic borrowing Z, and the impact is small compared to that of TI, 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. Higher FI also has smaller impact than TI on the volatility of exports, imports, terms of trade, and exchange rate. TI seems to lower down the volatility of exchange rate, but FI almost has no impact on the volatility of relative price between two countries. This suggests that the impact of FI might work through other channels. Price and exchange rate adjustment might not play much role and real variables might adjust instead.

Although the impacts of FI and TI on macroeconomic volatility are generally in opposite direction, they do not evidently offset each other. The consequences of increasing FI do not significantly depend on the degrees of TI, and vice versa, except for entrepreneurs, whose consumption volatility is slightly less affected by increasing FI at higher trade. Interestingly, increasing FI, TI, 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.

Two stylized facts of emerging market business cycles relevant to this study are that, first, observed business cycles in EMEs are generally more volatile than that of the developed countries, and second, consumption is more volatile than output (see Aguiar and Gopinath, 2007, Benczúr and Rátfai, 2014, and Calderon and Fuentes, 2010). The model seems able to capture the former stylized fact to some extent, but fails to exhibit the latter stylized fact.

5.6.2. Welfare Implication

Table 5.7 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

Welfare result as measured by certainty-equivalent consumption relative to non-stochastic steady state is reported in Table 5.7 for households, entrepreneurs, and aggregate population in the home country.

The results show that the welfare of the households is not much impacted by either FI or TI. For the FI 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 (5-1). However, they are influenced more through the domestic channels rather than direct 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 FI seems to undermine welfare slightly. This welfare result is opposite to the consumption smoothing benefit. Higher FI 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 (2007b). In contrast, higher TI 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 less borrowing. These could result in less interest payment and better welfare. At the aggregate level, higher FI 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 (2011b) 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), Leblebicioğlu (2009), and Devereux and Sutherland (2011b) also found that agents with frictions incur welfare loss from increased FI, and Evans and Hatnovska (2007b) and Leblebicioğlu (2009) found that agents without friction tend to have welfare gain.

5.6.3. Impulse Response to Shocks

Selections of simulated impulse responses are presented in Figure 5.2 to 5.4. 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 impulse response results. The underlying shock processes are the same for all cases.

Figure 5.2 shows the IRF from three levels of FI under the case of MTI, and Figure 5.3 shows the IRF from three levels of TI 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.

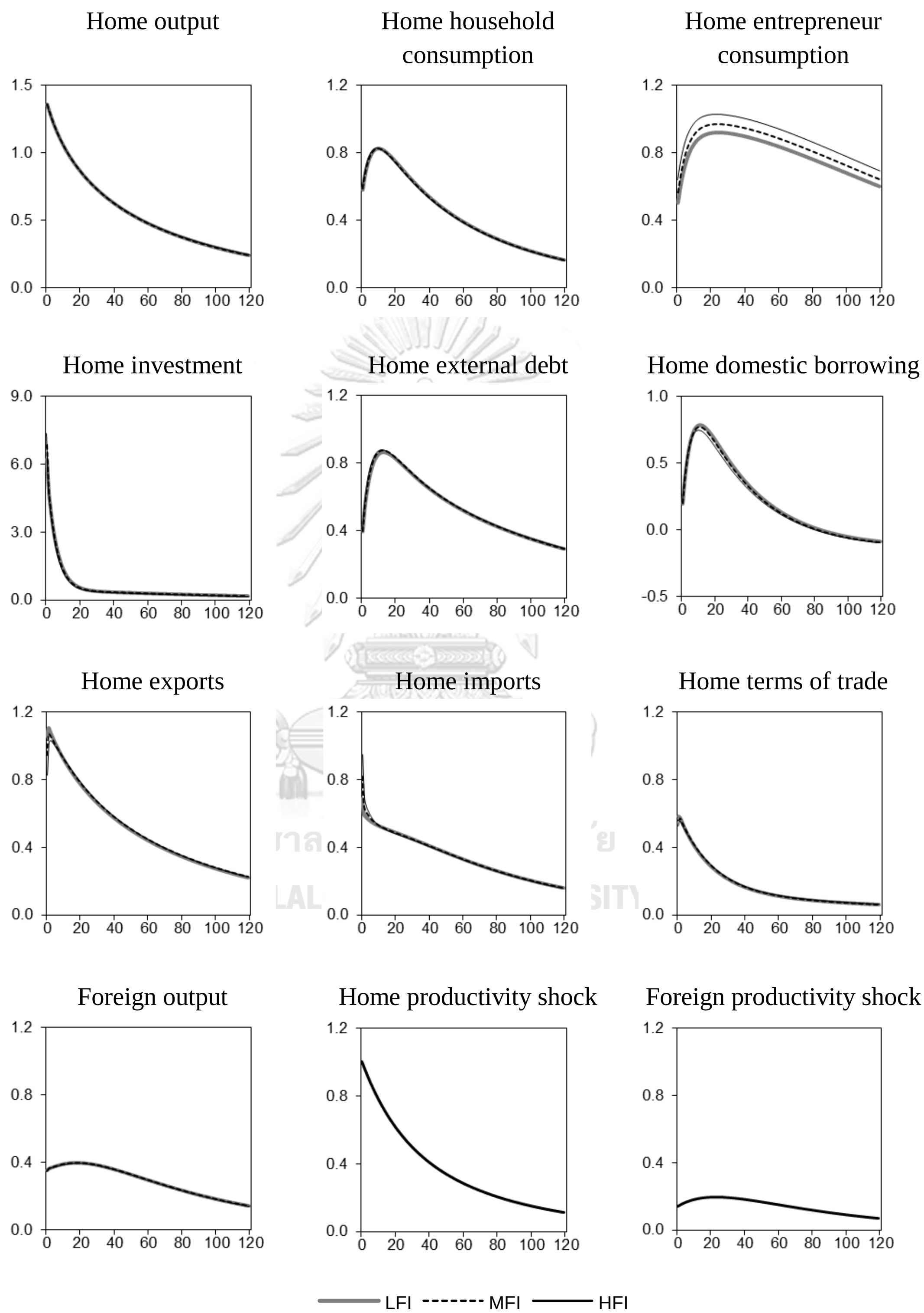
The responses of domestic consumption to shock differ between two types of consumers. First, home entrepreneur's consumption is more affected than households because they own the production firm and directly benefit from higher output. Second, the responses of household consumption to shock vary by different level of TI, but are almost the same for different levels of FI. This results confirm the findings from both macroeconomic volatility and welfare implication that households are largely unaffected by FI. 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 FI, but has similar response for varying degrees of TI. 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 FI. 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.

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 FI, 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.

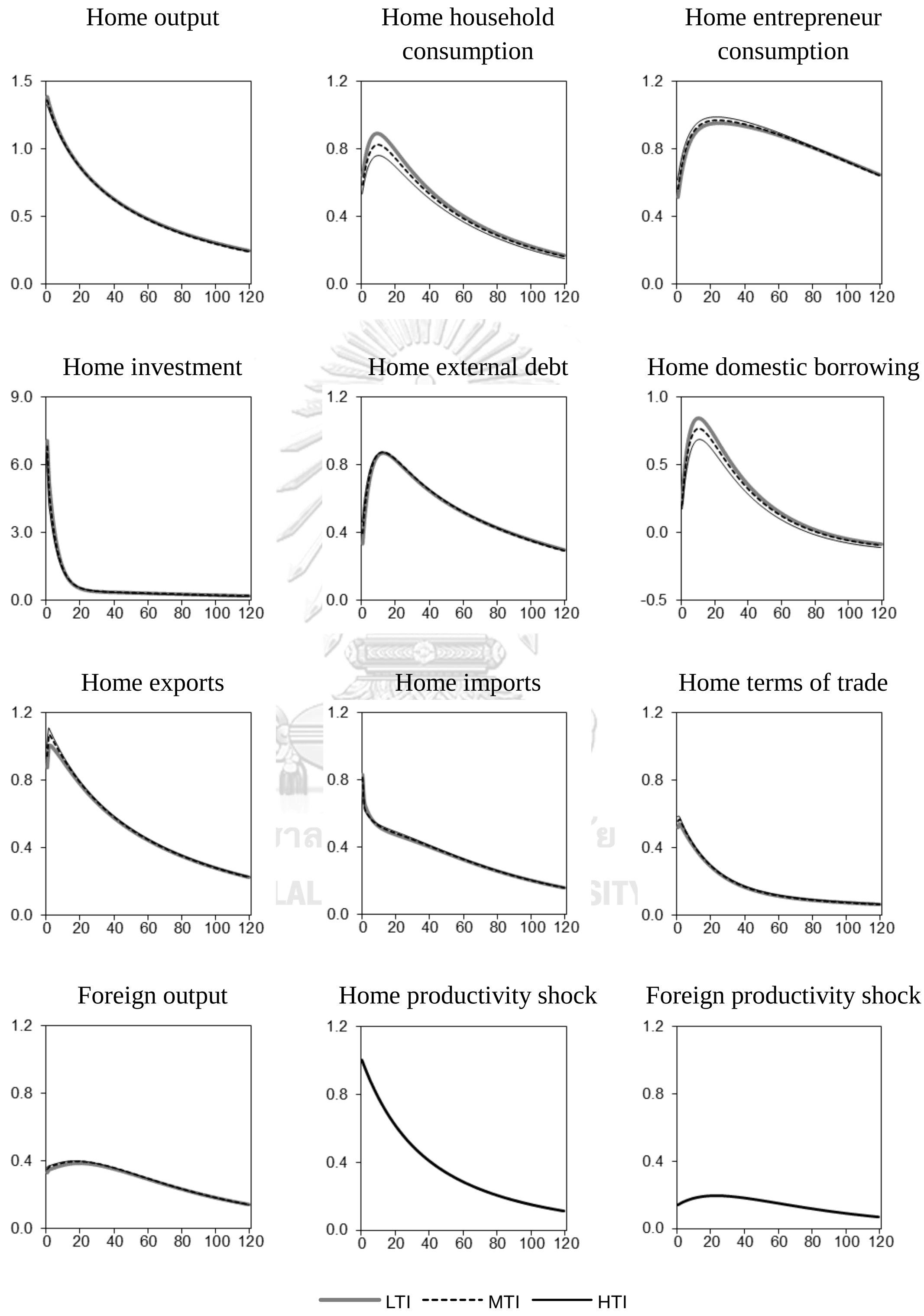
Figure 5.4 shows the impulse response for one-percentage positive shocks from the foreign country. The impulse responses of home variables to foreign shocks also do not differ much among different levels of integration. Most of the home variables respond positively to positive foreign shock though to a lesser degree as compared with 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. The impulse responses for the remaining cases not presented here are similar.

Figure 5.2 Impulse response of main variables to domestic productivity shock for the case of MTI



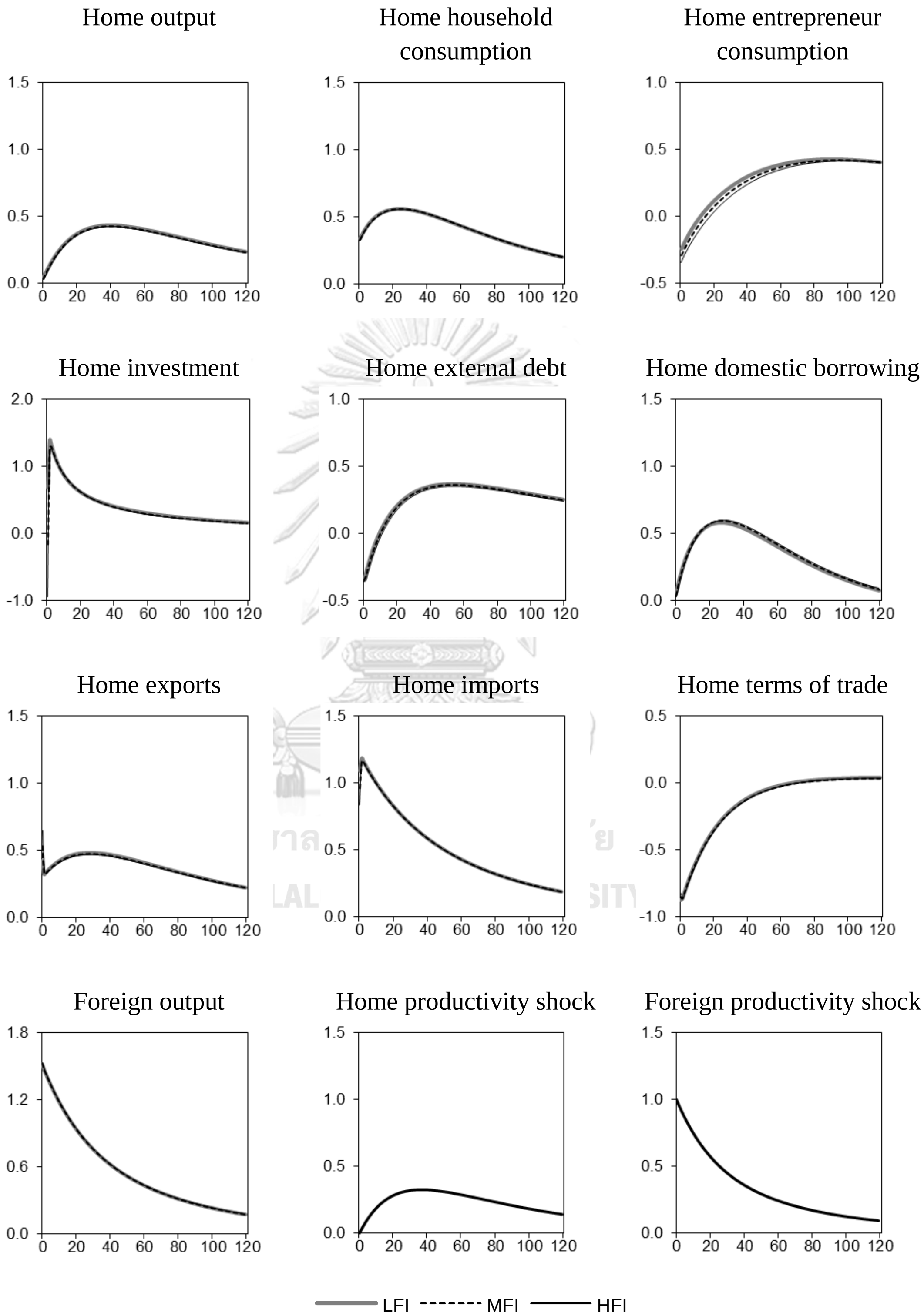
Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter.

Figure 5.3 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 5.4 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.

5.6.4. Pareto Improvement

Table 5.8 Pareto improvement from changes in the level of integration

From \ To		LTI			MTI			HTI		
		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.

This section analyses 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 5.8 summarizes which changes in the degree of integration moving from the left column to the top row constitute Pareto improvement. P denotes the Pareto improving.

To achieve lower aggregate fluctuation, the Pareto improvement is mostly to increase only trade or both FI and TI at the same time. Lowering trade is never Pareto improving because trade lowers all three volatilities considered. Interestingly, either increasing or decreasing FI for a given level of trade is not Pareto improving. This is because there is a benefit-cost trade-off in the effect of FI 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 benefit the country.

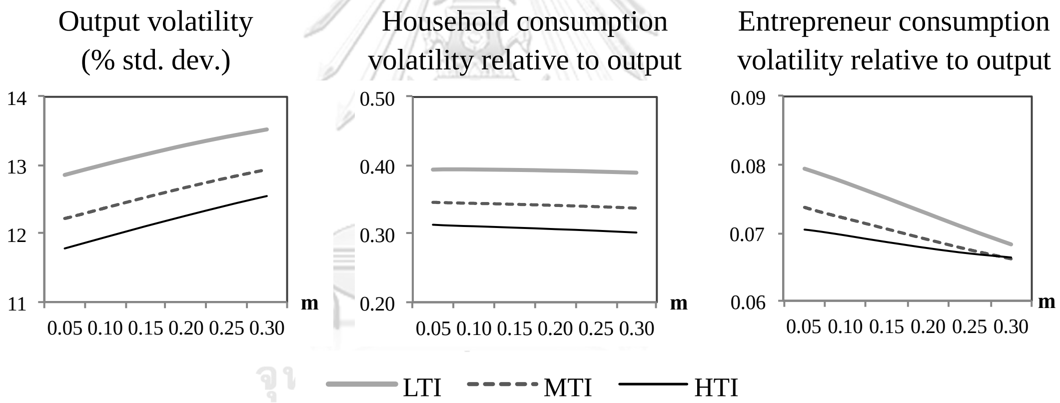
5.6.5. Sensitivity Analysis

To test the robustness of the main findings, this section analyzes the sensitivity of the results to the choices of two parameters.

5.6.5.1. *Varying Values of m*

First, the values of parameter m are extended to 0.20, 0.25, and 0.30 from the main cases. 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.[32] The value of 0.3 gives corresponding foreign debt of about 160 percent of GDP. Figure 5.5 and Table 5.9 depict 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 converge to around 0.067 as m increases. This emphasizes the observation that at lower trade, the entrepreneurs' consumption decreases more as FI increases.

Figure 5.5 The volatility of home variables from varying levels of leverage constraint parameter, m



[32] This is mainly due to the convexity of the adjustment cost, which is a key feature in this study. However, the size of the parameter m in this model 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. This limitation does not apply to parameterization in Chapter 7 that uses the value of m equaled to 0.4, which is greater than the value of 0.3 here, because the model setups are different and the parameter m in Chapter 7 covers both domestic and foreign debts.

Table 5.9 The volatility of home variables from varying levels of leverage constraint parameter, m

m	TI	Output volatility (%SD)	Household consumption volatility relative to output	Entrepreneur consumption volatility relative to output
0.05	LTI	12.86	0.39	0.079
0.10	LTI	13.01	0.39	0.077
0.15	LTI	13.16	0.39	0.075
0.20	LTI	13.29	0.39	0.073
0.25	LTI	13.42	0.39	0.070
0.30	LTI	13.52	0.39	0.068
0.05	MTI	12.22	0.35	0.074
0.10	MTI	12.38	0.34	0.072
0.15	MTI	12.53	0.34	0.071
0.20	MTI	12.68	0.34	0.069
0.25	MTI	12.81	0.34	0.067
0.30	MTI	12.94	0.34	0.066
0.05	HTI	11.78	0.31	0.071
0.10	HTI	11.95	0.31	0.070
0.15	HTI	12.11	0.31	0.069
0.20	HTI	12.26	0.31	0.068
0.25	HTI	12.41	0.30	0.067
0.30	HTI	12.55	0.30	0.066

5.6.5.2. Elasticity of Substitution σ

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 in the Armington aggregator 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 emerging markets data. The value 0.40 is arbitrary. The new weight for foreign country is 0.35.

Table 5.10 shows the volatility of key variables and welfare criteria for the main nine cases. Overall, the main findings are preserved. Increasing FI 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 FI impacts volatility and welfare.

Table 5.10 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.

5.6.6. The Combined Effect of Financial and Trade Integration

Overall, the separate impacts of financial and trade integration on macroeconomic volatility and welfare mostly go in opposite direction. There is no strong evidence of lower fluctuation benefit and welfare gain from higher FI 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, it seems that the consequences of FI and TI are largely independent. Higher trade could not help a country to better achieve gain from FI, and higher FI does not enhance the benefits of international trade. This may be partly because the effect of external debt is rather 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 relation between two types of integration, if any, might not be apparent. Only one exception is that TI slightly weakens the effect of FI on the entrepreneur's consumption volatility.

This finding does not support the sequencing of liberalization[33], 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 FI and economic growth, suggesting that the impact of FI does not depend on the degree of trade.[34] There is another type of threshold effect studies that employ the degree of FI itself as a threshold and argue that FI 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. For instance, Evans and Hnatkovska (2007b) found the hump-shaped relationship between FI and consumption volatility when equity market integration is included in addition to the bond economy.

Comparing with other DSGE studies, the finding of independent consequences of FI and TI 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 synchronization in OECD countries. They concluded that the effect of international trade is similar regardless of the types of international financial arrangement.

[33] However, this dissertation does not aim to test the sequencing of reform conjecture, which is a much broader concept covering the economy in general and not just aggregate fluctuation. This argument is only comparing the findings with existing view in the literature.

[34] Arteta et al. (2001), Friedrich et al. (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 et al. (2011) found threshold effect of trade on FI but it is not robust. There is one case that the trade threshold level is too high that few countries achieve it.

5.6.7. Asymmetric Financial Access, Frictions, and Domestic Financial Development

From the results, financial accessibility and friction seem to be the factors that determine how FI affects heterogeneous agents. This is not unexpected. The entrepreneurs who have cross-border financial linkage are affected by increasing FI, while the households who can only save domestically are largely unaffected.

This finding is partly consistent with and partly different from previous literatures. Leblebicioğlu (2009) and Levchenko (2005) established that FI tends to benefit people with financial access, but leads to welfare loss and more volatile consumption for people with no access. The difference between those two earlier studies and this paper is that this chapter assumes no other financial frictions or constraint in domestic financial markets apart from asymmetric access to international financial 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 the domestic financial markets are underdeveloped and 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 FI 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 that domestic financial development might be even more important 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 provide support for all types of market participants.

5.7. Conclusion

This chapter has developed a two-country DSGE model to examine the effect of increasing financial and trade integration on macroeconomic volatility and welfare in emerging market economies under the case of 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 findings reveal that greater FI increases output fluctuation. Consumption smoothing benefit and welfare gain from higher FI 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. Lastly, international integration likely affects people with and without financial access differently. People with no direct financial linkage tend to be largely unaffected by increasing FI when they face no other frictions domestically. 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. Since FI in a form of private external debt can be both beneficial and harmful, balancing the trade-off by maintaining medium level or enhancing FI together with trade seems preferable than increasing cross-border financial flows alone. Improvement of financial accessibility, frictions, and domestic financial development should also be taken into account for integration-related policies since these factors potentially contribute to reaping gains from FI in emerging market economies.

The shortcomings of this study are that it only examines the degree of FI as determined by the reduction of leverage constraint and the size of cross-border borrowing, and the impact on macroeconomic volatility and welfare. Thus, it is impractical to make a decisive conclusion about FI as a whole since it has a broader definition and multidimensional consequences. In addition, the results are contingent on a particular model setup and a set of assumptions. For instance, the impact of FI 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.

Further extension could be done in many ways. First, 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. Second, financial shocks to credit market implemented through the ability to borrow in the leverage constraint could be added apart from the productivity shock. See Devereux and Sutherland (2011b) for an example of implementing shocks to the financial sector by modeling the leverage constraint coefficient as a random variable instead of a parameter.[35] Third, other types of financial integration and frictions could be studied, such as integration in equity markets and trade friction. Forth, cross-country comovement could be examined, such

[35] Financial shocks and credit tightening of this kind are extensively studied by Jermann and Quadrini (2012) and Perri and Quadrini (2011). They established that financial shocks contribute to larger business cycle movements, economic recession, and financial crisis. Nevertheless, all of these authors explored financial shocks as means to investigate the economic downturn, in particular the 2007-2008 global financial crisis.

as output comovement and comovement of different bond prices in domestic and foreign markets. Further analysis on price differentials between two markets could be explored, but this might need additional feature or modification. See Ueda (2011) for example of investigating the external finance premium arising when borrowing funds from two different countries.

In this regard, investigation of the foreign portfolio investment with adjustment cost of asset holding instead of constrained borrowing and the impact on business cycle synchronization will be addressed in the next chapter. The consequences of different accessibility to international financial markets will be studied in Chapter 7.

Chapter 6
The Impact of FI and TI on Business Cycles in Emerging Markets: The Case of Foreign Asset Investment

6.1. Introduction

Emerging markets have received a large inward portfolio investment in recent years, mostly from industrial economies (International Monetary Fund, 2014a). The debate on capital that flows into emerging markets has received a lot of attention, partly because capital inflow tends to be procyclical, is subject to quick capital withdrawal, and can bring about significant macroeconomic instability (Gelos & Oura, 2014; Kose, Prasad, & Terrones, 2009). On the other hand, outward portfolio investment that associates more with domestic residents' investment decision has received less attention. Emerging markets currently have low level of foreign portfolio investment assets as compared to the liabilities side. These motivate the question whether emerging markets should advance their own outward portfolio investment or not and whether this would benefit them.

From the above observation and the literature discussed in Chapter 3, the objective of this chapter is to examine the impact of higher foreign asset investment together with TI on macroeconomic volatility, business cycle synchronization and different types of market participants in emerging market economies when market imperfections are present. It focuses on outward asset investment of the households that are subject to transaction cost as one measure of FI. The study additionally attempts to find if there is any revealing combination of the two types of integration that would benefit emerging markets.

The study has developed a two-country real business cycle (RBC) model, in which home country represents an emerging market economy with market imperfections and foreign country represents an advanced economy with frictionless markets. Home country has two kinds of heterogeneous consumers. One can invest abroad, but cross-border asset trading entails friction in the form of portfolio adjustment cost. This friction is asymmetric and only incurred by the home economy. The other group cannot access international financial markets and have to borrow in domestic markets. Domestic credit is subject to leverage constraint, reflecting lower financial development in emerging markets.

This chapter explores FI in three aspects. Firstly, it studies cross-border asset investment when home country is an investor in order to examine the financial decision originated from emerging economy residents. Secondly, the degree of FI is measured by a reduction of adjustment cost of foreign asset holding, largely following Sutherland (1996) and Senay (1998). Lastly, the study incorporates imperfect accessibility to international financial markets. These reflect the view that FI does not only refer to cross-border financial flows, but also involves equal financial access and reduction of asymmetric frictions.

Trade integration is defined as the amount of cross-border goods trade and is 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 of FI and two levels of trade are explored, resulting in six cases under the main analysis.

The simulation results show that the net effect of higher foreign asset holding on business cycle is generally stronger under low trade and weaker under high trade. This is because the separate effects of FI and trade tend to go in opposite directions and could offset each other. Increasing one type of integration helps make the economy more tolerant to fluctuation caused by integration in the other market. The results also suggest that different financial accessibility plays a role on how integration affects heterogeneous agents. Higher cross-border financial investment under low trade intensity could lead to large consumption fluctuation for people with restricted financial access.

The central findings of this paper are that the effects of financial and trade integration are intertwined and two types of integration can supplement each other to stabilize the economy. Policies regarding international integration should be considered collectively, and improvement of financial friction and accessibility should also be taken into consideration. These findings help to widen the understanding of the relationship between international integration and business cycle under the context of emerging markets.

This chapter is organized as follows. Section 6.2 describes the model economy in details. Section 6.3 addresses three key concepts, which are financial integration, trade integration, and domestic credit market. How they are modeled, the rationales, and their relations are discussed. The parameter calibration is taken up in Section 6.4. Section 6.5 presents the simulation results and discusses the findings, and Section 6.6 concludes.

6.2. The Model Economy

This section describes the model economy, which is a two-country, two-sector RBC model. The financial structure borrows some features from Leblebicioğlu (2009) model. The structure of firm and trade closely follows Heathcote and Perri (2002). Other structures are contribution of this thesis. 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 market economy with frictions and asymmetric financial access to reflect that the developing countries tend to be less financially developed with more frictions and restrictions. Home country has two kinds of heterogeneous consumers. A proportion n<1 of home population is the *household.* Home households supply labor to the production sector, save in domestic markets, and can invest in foreign assets. They face adjustment cost of asset holding when investing abroad. The other type of population with a share of $1-n$ is the *entrepreneur* who owns the traded intermediate goods producing firms. Home entrepreneurs invest in physical capitals and need external fund to finance their investment and firms. They cannot access international financial markets, and can only borrow from domestic markets, in which they face leverage constraint. There are two types of firms. The *intermediate goods firms* produce intermediate goods and supply to both domestic and foreign productions of final goods. The other one 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 an advanced economy 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 population, unlike the home emerging economy where not everyone have access to international finance and people face asymmetric frictions. Foreign country has two kinds of firms analogous to home intermediate and final goods firms.

Financial transactions are assumed to be facilitated by financial intermediaries. These are not only limited to banking transactions, but also include NBFI such as buying foreign bonds and investment in foreign funds through asset management, broker-dealers, and mutual funds. The financial assets are modeled by risk-free non-contingent bonds as a proxy for deposits, loans, and portfolio investment. All merchandise goods are differentiated and can be freely traded across countries with no trade friction. These assumptions and many parts of the model setup are similar to those in Chapter 5. The rationales behind are the same, and some elaborations are repetitions and hence, omitted.

Figure 6.1 illustrates the overall model structure and Table 6.1 summarizes the variables and their descriptions. 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 6.1 The model structure

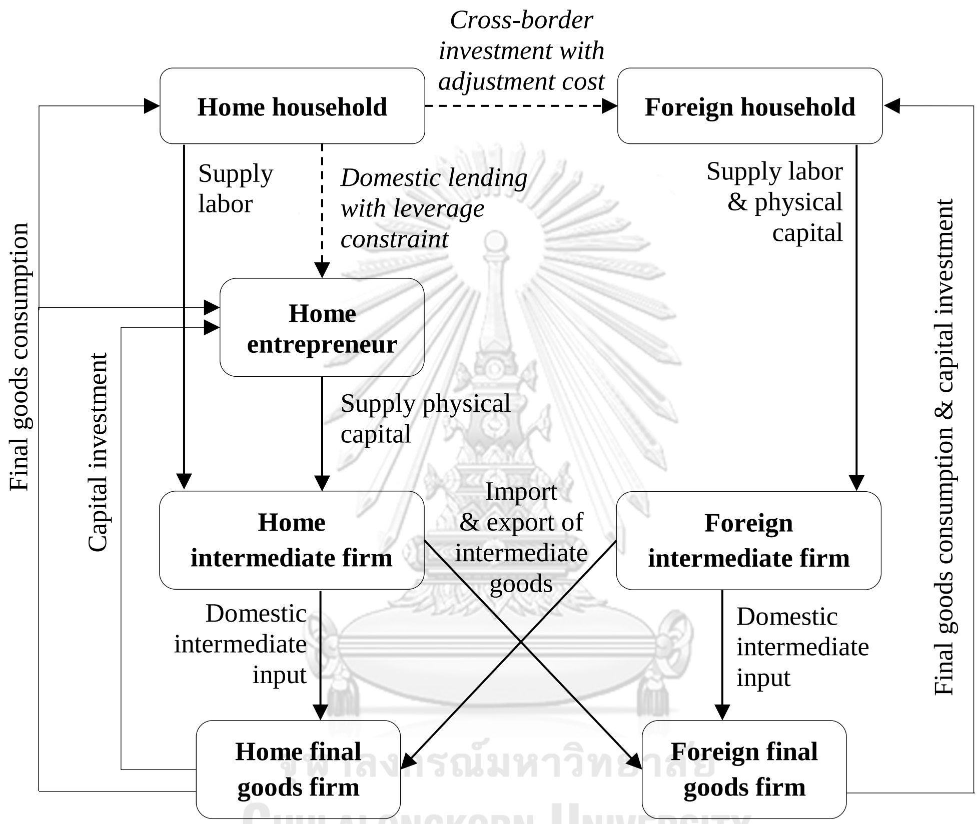


Table 6.1 Summary of variables

Variables	Descriptions
U_1^h	Expected lifetime utility of home households
U_1^o	Expected lifetime utility of home entrepreneurs
U_2	Expected lifetime utility of foreign households
C_1^h	Consumption of home households
C_1^o	Consumption of home entrepreneurs
C_2	Consumption of foreign households
Y_1	Home output
Y_2	Foreign output
K_1^o	Home physical capital
K_2	Foreign physical capital
L_1^h	Home labor
L_2	Foreign labor
X_1^o	Home investment in physical capital
X_2	Foreign investment in physical capital
w_1	Home wage
w_2	Foreign wage
r_1	Home rent
r_2	Foreign rent
G_1	Home final goods
G_2	Foreign final goods
a_1	Home-produced intermediate goods used in home final goods production
a_2	Home-produced intermediate goods used in foreign final goods production (home exports)
b_1	Foreign-produced intermediate goods used in home final goods production (home imports)
b_2	Foreign-produced intermediate goods used in foreign final goods production
P_1	Price of home final goods
P_2	Price of foreign final goods
q^a	Price of home-produced intermediate goods
q^b	Price of foreign-produced intermediate goods
D_1^h	Home households' holding of international non-contingent risk-free bond
D_2	Foreign households' holding of international non-contingent risk-free bond
Z_1^h	Home households' holding of domestic non-contingent risk-free bond
Z_1^o	Home entrepreneurs' holding of domestic non-contingent risk-free bond
Q^D	Price of international bond D
Q^Z	Price of domestic bond Z
I	International net fund transfer
λ	Lagrange multiplier on the leverage constraint
A_1	Home technology shock
A_2	Foreign technology shock

6.2.1. Home Country

6.2.1.1 *Home Households*

Households are worker type of consumers. They supply labor L_{1t}^{h} to the intermediate goods producing firm and get wage w_{1t}. Their preference is defined over consumption, C_{1t}^{h}, and labor;

$$U_{1t}^{h} = E_t \sum_{t=0}^{\infty} \beta^t \left[\ln\left(C_{1t}^{h}\right) - \kappa L_{1t}^{h}\right] \tag{6-1}$$

where β is the discount factor of the households and κ is the labor weight parameter. The form of utility function is taken from Leblebicioğlu (2009).

Home households can save in domestic asset Z_{1t}^{h} with the price Q_t^{Z} without any cost. They can invest in international financial asset D_{1t}^{h} at the price Q_t^{D}, but incur an adjustment cost of foreign asset holding. The cost takes the form $\frac{\phi}{2} I_t^2$ where ϕ is a coefficient indicating the size of the cost, and I_t is the amount of cross-border net fund transfer in each period.[36] I_t is defined as the difference between current-period bond holding, $Q_t^{D} D_{1t}^{h}$, and previous-period bond holding $D_{1,t-1}^{h}$;

$$I_t = D_{1,t-1}^{h} - Q_t^{D} D_{1t}^{h} \tag{6-2}$$

The form of the adjustment cost is based on Sutherland (1996) and Senay (1998).[37]

The adjustment cost of asset holding is one kind of financial frictions that obstructs cross-border investment. It can represent the transaction cost involved with cross-border asset trading, the brokerage fee paid to asset management or mutual funds, the learning costs associated with acquiring information about foreign markets, or restrictions imposed on cross-border financial transaction (Sutherland, 1996; Tille & Van Wincoop, 2010). Even the adjustment cost is present in foreign portfolio

[36] The convexity of the functional form makes the effect of the adjustment cost carries through to the equilibrium, the steady state, and approximation process. Other functional forms such as a one-time cost or a proportional linear cost could result in a temporary friction and the marginal effect being deflated through linearization process (Kose & Yi, 2006). The convex cost also provides analytical convenience (Sutherland, 1996).

[37] Similar forms are also later adopted by other authors such as Buch et al. (2005) and Buch and Pierdzioch (2009). There are other forms of adjustment cost used in the literature, but they are mostly employed to study portfolio choices or other issues that include risky equity investment. Those adjustment costs have different features from this study that uses risk-free bonds as main financial assets and do not fit well with the research question and the model setup of this paper. See Bonaparte, Cooper, and Zhu (2012), Mendoza and Smith (2014), and Tille and Van Wincoop (2010) for example.

investment, home households may still want to invest abroad in addition to domestic saving for diversification purpose such as to share risk and to smooth consumption.

The adjustment cost coefficient ϕ plays an important role in determining the amount of foreign asset holding D_{1t}^{h} of the home households and the level of FI. A higher value of ϕ would result in a larger portfolio adjustment cost that could make foreign asset investment less attractive, whereas people might invest more in foreign markets when the trading cost is lower. Thus, a reduction of ϕ is associated with larger foreign asset holding and higher FI. This relationship will be discussed in more details in the next section.

Combining all the above features, the budget constraint of the home households is as follow;

$$\begin{aligned} P_{1t}C_{1t}^{h} + Q_t^D D_{1t}^{h} + Q_t^Z Z_{1t}^{h} \leq w_{1t}L_{1t}^{h} + D_{1,t-1}^{h} + Z_{1,t-1}^{h} - \frac{\phi}{2} I_t^2 \\ - \frac{\psi}{2}\left(D_{1t}^{h} - \overline{D_1^{h}}\right)^2 - \frac{\psi}{2}\left(Z_{1t}^{h} - \overline{Z_1^{h}}\right)^2 \end{aligned} \tag{6-3}$$

where P_{1t} is the price of home final goods. The last two terms, $\frac{\psi}{2}\left(D_{1t}^{h} - \overline{D_1^{h}}\right)^2$ and $\frac{\psi}{2}\left(Z_{1t}^{h} - \overline{Z_1^{h}}\right)^2$, are included just for stationarity inducing purpose according to Schmitt-Grohé and Uribe (2003), where $\overline{D_1^{h}}$ and $\overline{Z_1^{h}}$ denote the corresponding steady state values of D_{1t}^{h} and Z_{1t}^{h}. These two terms are very small and have no effect on the non-stochastic steady state.

The home households choose the optimal levels of labor, domestic saving, and foreign asset holding to maximize an expected lifetime utility subject to the budget constraint. First order conditions with respect to L_{1t}^{h}, Z_{1t}^{h} and D_{1t}^{h} are;

$$\frac{w_{1t}}{P_{1t}} = \kappa C_{1t}^{h} \tag{6-4}$$

$$\frac{1}{P_{1t}C_{1t}^{h}}\left[Q_t^Z + \psi\left(Z_{1t}^{h} - \overline{Z_1^{h}}\right)\right] = \beta E_t \frac{1}{P_{1,t+1}C_{1,t+1}^{h}} \tag{6-5}$$

$$\frac{1}{P_{1t}C_{1t}^{h}}\left[Q_t^D(1-\phi I_t) + \psi\left(D_{1t}^{h} - \overline{D_1^{h}}\right)\right] = \beta E_t \frac{1}{P_{1,t+1}C_{1,t+1}^{h}}(1-\phi I_{t+1}) \tag{6-6}$$

Equation (6-4) describes the optimal decision of labor, equating real wage to marginal rate of substitution between labor and consumption. Equation (6-5) and (6-6) are Euler equations describing intertemporal consumption choice weighted by discount factor and return from investment. Equation (6-6) takes into account the adjustment cost of asset holding. The terms $\psi\left(Z_{1t}^{h}-\overline{Z_{1}^{h}}\right)$ and $\psi\left(D_{1t}^{h}-\overline{D_{1}^{h}}\right)$ are negligible and absent in the steady state.

Combining equation (6-5) and (6-6) yields arbitrage condition between the prices of domestic and foreign assets;

$$Q_t^D = Q_t^Z E_t\left[\frac{(1-\phi I_{t+1})}{(1-\phi I_t)}\right] \tag{6-7}$$

Equation (6-7) shows the optimal allocation between domestic and international asset holding. If ϕ is zero, which means trading international asset is costless, the above expression simply reduces to

$$Q_t^D = Q_t^Z \tag{6-8}$$

The prices of domestic and international bonds are the same.

6.2.1.2 <u>Home Entrepreneurs</u>

Home entrepreneurs or firm owners own traded intermediate goods firms. Their preference is specified over consumption C_{1t}^{o} as;

$$U_{1t}^{o} = E_t\sum_{t=0}^{\infty}\nu^t[\ln(C_{1t}^{o})] \tag{6-9}$$

where ν is the discount factor of the firm owners, which is assumed to be smaller than home households' discount factor β. In other words, the entrepreneurs who are the borrowers are less patient than the saver households. This assumption ensures a binding leverage constraint and a unique domestic asset position in the equilibrium as previously discussed in Section 5.3.1 of Chapter 5. The same reasoning analogously applies here, but changes from the cross-border borrowing between foreign lenders and home borrowers to domestic credit markets with domestic participants instead.

Home entrepreneurs invest X_{1t}^{o} in physical capital K_{1t}^{o} according to

$$X_{1t}^{o} = K_{1t}^{o} - (1-\delta)K_{1,t-1}^{o} \tag{6-10}$$

They supply physical capital to the intermediate goods firms, receiving rent r_{1t} in return and the firms' profit π_{1t}^{i}.

Home entrepreneurs borrow to finance investments, but they cannot access foreign credit markets. They can only borrow Z_{1t}^{o} from home households in domestic markets. Moreover, they face leverage constraint when borrowing. The constraint restricts the firm owner's borrowing to a certain proportion m of the value of pledged collateral or the asset size, which in this model is the physical capital. The constraint takes the form;

$$Z_{1t}^{o} \leq mE_t(P_{1,t+1}K_{1t}^{o}) \tag{6-11}$$

This form is based on Leblebicioğlu (2009), which is one variant of the leverage constraint of Kiyotaki and Moore (1997). It is similar to the international leverage constraint examined in previous chapter. Section 5.2.1.2 of Chapter 5 has explained the functional form.

The domestic borrowing constraint can be interpreted in two ways. First, it represents the desirable level of debt as a fixed proportion of the asset value. The parameter m in this case can be viewed as the loan-to-value (LTV) ratio. Aggregate domestic credit at the country level is one measure of domestic financial development in empirical studies. Second, the credit constraint portrays the problem of contract enforceability. 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 are reflected by a fraction $1 - m$ of the collateral value. The presence of the borrowing constraint and small values of coefficient m suggest that domestic financial markets of home emerging economy are less developed. Using domestic borrowing constraint to contrast the level of financial development between developing and developed countries is based on Leblebicioğlu (2009) and Levchenko (2005). A high value of m is then associated with more relaxing credit constraint, larger size of domestic credit, less severe contract enforcement problem, and higher domestic financial development. In all aspects, the coefficient m is a structural parameter that reflects the firms' ability to borrow or the domestic financial structure.

Apart from the intermediate goods producing firm, entrepreneurs are assumed to own the brokerage firms indirectly. The firms facilitate cross-country financial asset trade and generate positive profits from the nonlinearity of the transaction cost.[38] Home entrepreneurs have no control over the brokerage firms and cannot choose the amount of assets traded. They receive earning only as the dividend $R_t^{AC} = \frac{n}{1-n}\frac{\phi}{2}I_t^2$ from the profits of the firms.[39] The entrepreneurs take this dividend as given. They choose the

[38] See Kose and Yi (2006) for the profits obtained from the nonlinearity of trading cost.

[39] The assumption that the non-linear trading cost incurred by one agent creates profit for brokerage firms that in turn distribute the profit as dividend to another agent is similarly adopted by many authors. Benigno (2009) and Tille and Van Wincoop (2010) apply this to financial transaction cost. Kose and Yi

optimal amounts of capital and domestic loan to maximize their expected lifetime utility subject to the following budget constraint and the credit constraint in equation (6-11).

$$P_{1t}C_{1t}^{o} + P_{1t}X_{1t}^{o} + Z_{1,t-1}^{o} \le r_{1t}K_{1,t-1}^{o} + Q_t^Z Z_{1t}^{o} + \pi_{1t}^{i} + R_t^{AC} - \frac{\psi}{2}\left(Z_{1t}^{o} - \overline{Z_1^{o}}\right)^2 \tag{6-12}$$

First order conditions with respect to K_{1t}^{o} and Z_{1t}^{o} are

$$\frac{1}{C_{1t}^{o}} = \nu E_t \frac{1}{C_{1,t+1}^{o}}\left[\frac{r_{1,t+1}}{P_{1,t+1}} + (1-\delta)\right] + m\lambda_t E_t\left(P_{1,t+1}\right) \tag{6-13}$$

$$\frac{1}{P_{1t}C_{1t}^{o}}\left[Q_t^Z - \psi\left(Z_{1t}^{o} - \overline{Z_1^{o}}\right)\right] = \nu E_t\left(\frac{1}{P_{1,t+1}C_{1,t+1}^{o}}\right) + \lambda_t \tag{6-14}$$

where λ_t is a Lagrange multiplier of the leverage constraint. Equation (6-13) describes the optimal choice of capital allocation. It equates the marginal utility of consumption to the marginal benefit of investing in capital across time. The additional term $m\lambda_t E_t\left(P_{1,t+1}\right)$ results from the leverage constraint and shows the benefit of having additional capital collateral for borrowing. Equation (6-14) is the consumption Euler equation with an extra term λ_t that describes the marginal effect of changing the constraint.

6.2.1.3 Home Intermediate Goods Firms

Home traded intermediate goods firms produce intermediate goods a_t using labor L_{1t}^{h} from households and capital K_{1t}^{o} from entrepreneurs according to the Cobb-Douglas technology.

$$Y_{1t} = A_{1t}\left[(1-n)K_{1,t-1}^{o}\right]^{\alpha_1}\left[nL_{1t}^{h}\right]^{1-\alpha_1} \tag{6-15}$$

where Y_{1t} is the home output and A_{1t} is the productivity shock for the home tradable sector. The firms supply intermediate goods to both home and foreign final goods producing firms. The goods sold to domestic and foreign firms are denoted by a_{1t} and a_{2t} respectively. The firms choose the optimal levels of labor and capital to maximize period profit π_{1t}^{i} given by

(2006) and Pancaro (2010) apply an analogous treatment to the quadratic transportation cost and trading firms.

$$\pi_{1t}^{i} = q_t^a Y_{1t} - n w_{1t} L_{1t}^h - (1-n) r_{1t} K_{1,t-1}^o \tag{6-16}$$

where q_t^a is the price of home intermediate goods. The goods market is assumed to be frictionless and the law of one price holds. First order conditions with respect to L_{1t}^h and $K_{1,t-1}^o$ are

$$n w_{1t} L_{1t}^h = (1-\alpha_1) q_t^a Y_{1t} \tag{6-17}$$

$$(1-n) r_{1t} K_{1,t-1}^o = \alpha_1 q_t^a Y_{1t} \tag{6-18}$$

Equation (6-17) and (6-18) show the optimal demands for factors of production. They equate the marginal products of labor and capital to their marginal costs.

6.2.1.4 Home Final Goods Firms

Home final goods firms produce final goods for domestic consumption and investment. They combine domestically-produced intermediate goods a_{1t} and foreign intermediate goods imported b_{1t} using the following Armington (1969) aggregator.

$$G_{1t} = \left[(1-\omega_1) a_{1t}^{\frac{\sigma-1}{\sigma}} + \omega_1 b_{1t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{6-19}$$

where G_{1t} is home final goods; σ denotes the elasticity of substitution between home and foreign intermediate inputs; $1-\omega_1$ is the weight of domestic intermediate goods a_{1t} and represents home biasness; and ω_1 is the weight of foreign intermediate goods b_{1t}. The parameter ω_1 indicates relative preference or technology in favor of the foreign goods and determines the degree of TI. A higher value of ω_1 induces more exports and imports, and hence, greater TI. The relationship between ω_1 and TI is the same as established in Chapter 5. Section 5.3.2 already discusses this issue extensively.

The firms choose the optimal levels of intermediate inputs to maximize their profits π_{1t}^f given by

$$\pi_{1t}^f = P_{1t} G_{1t} - q_t^a a_{1t} - q_t^b b_{1t} \tag{6-20}$$

where q_t^a and q_t^b are corresponding prices of intermediate goods. Home final good is a numeraire and its price P_{1t} is set to equal one. First order conditions with respect to a_{1t} and b_{1t} are

$$(q_t^a)^\sigma a_{1t} = (1-\omega_1)^\sigma P_{1t}^\sigma G_{1t} \tag{6-21}$$

$$\left(q_t^b\right)^\sigma b_{1t} = \omega_1^\sigma P_{1t}^\sigma G_{1t} \tag{6-22}$$

Equation (6-21) and (6-22) show the optimal levels of intermediate goods inputs, equating the marginal benefit to the marginal cost.

6.2.2. Foreign Country

Foreign country resembles home country, but has only one type of homogeneous households. All variables and parameters are defined similarly to the home agents.

Foreign households supply labor L_{2t} and physical capital K_{2t} to the traded intermediate goods sector, receiving wage w_{2t} and rent r_{2t}. Their preference is defined as;

$$U_{2t} = E_t \sum_{t=0}^{\infty} \beta^t [\ln(C_{2t}) - \kappa L_{2t}] \tag{6-23}$$

They can hold international assets D_{2t} and invest X_{2t} in capital according to standard capital accumulation.

$$X_{2t} = K_{2t} - (1-\delta)K_{2,t-1} \tag{6-24}$$

They do not face any friction or constraint. Their budget constraint is;

$$P_{2t}C_{2t} + P_{2t}X_{2t} + D_{2,t-1} \leq w_{2t}L_{2t} + r_{2t}K_{2,t-1} + Q_t^D D_{2t} - \frac{\psi}{2}(D_{2t} - \overline{D_2})^2 \tag{6-25}$$

First order conditions with respect to L_{2t}, K_{2t}, and D_{2t} are

$$\frac{w_{2t}}{P_{2t}} = \kappa C_{2t} \tag{6-26}$$

$$\frac{1}{P_{2t}C_{2t}}[Q_t^D - \psi(D_{2t} - \overline{D_2})] = \beta E_t \frac{1}{P_{2,t+1}C_{2,t+1}} \tag{6-27}$$

$$\frac{1}{C_{2t}} = \beta E_t \frac{1}{C_{2,t+1}} \left[\frac{r_{2,t+1}}{P_{2,t+1}} + (1-\delta) \right] \tag{6-28}$$

Equation (6-26) describes the optimal decision of labor supply. Equation (6-27) shows the optimal choice of capital allocation. Equation (6-28) is the standard consumption Euler equation.

Foreign firms are symmetric to their home counterparts. *Foreign intermediate goods firms* produce intermediate goods b_t using the following Cobb-Douglass technology and sell them to final goods firms in both countries with the price q_t^b.

$$Y_{2t} = A_{2t} \left(K_{2,t-1} \right)^{\alpha_2} (L_{2t})^{1-\alpha_2} \tag{6-29}$$

They maximize profit as

$$\pi_{2t}^i = q_t^b Y_{2t} - w_{2t} L_{2t} - r_{2t} K_{2,t-1} \tag{6-30}$$

which yields the following first order conditions.

$$w_{2t} L_{2t} = (1-\alpha_2) q_t^b Y_{2t} \tag{6-31}$$

$$r_{2t} K_{2,t-1} = \alpha_2 q_t^b Y_{2t} \tag{6-32}$$

Foreign final goods firms combine intermediate inputs using Armington aggregator to produce final good G_{2t} with the price P_{2t}.

$$G_{2t} = \left[\omega_2 a_{2t}^{\frac{\sigma-1}{\sigma}} + (1-\omega_2) b_{2t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{6-33}$$

They maximize profit as

$$\pi_{2t}^f = P_{2t} G_{2t} - q_t^a a_{2t} - q_t^b b_{2t} \tag{6-34}$$

which yields the following first order conditions.

$$(q_t^a)^\sigma a_{2t} = \omega_2^\sigma P_{2t}^\sigma G_{2t} \tag{6-35}$$

$$\left(q_t^b \right)^\sigma b_{2t} = (1-\omega_2)^\sigma P_{2t}^\sigma G_{2t} \tag{6-36}$$

Interpretation of optimality conditions is analogous to the home country.

6.2.3. Market Clearing Conditions

Home final goods market:

$$G_{1t} = nC_{1t}^{h} + (1-n)C_{1t}^{o} + (1-n)X_{1t}^{o} \tag{6-37}$$

Foreign final goods market:

$$G_{2t} = C_{2t} + X_{2t} \tag{6-38}$$

Home intermediate goods market:

$$Y_{1t} = a_{1t} + a_{2t} \tag{6-39}$$

Foreign intermediate goods market:

$$Y_{2t} = b_{1t} + b_{2t} \tag{6-40}$$

International financial market:

$$nD_{1t}^{h} = D_{2t} \tag{6-41}$$

Domestic asset market:

$$nZ_{1t}^{h} = (1-n)Z_{1t}^{o} \tag{6-42}$$

6.2.4. Equilibrium and Solution Method

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. A system of linear stochastic difference equations is then solved using the calibrated parameters that will be discussed in Section 6.4. The model solutions and simulations are computed using the Dynare software and MATLAB.

The models will be simulated under varying degrees of financial and trade integrations described in Section 6.4.4. The resulting simulated moments and impulse response function (IRF) from different scenarios will be compared to examine the effect of financial and trade integrations on emerging market economy.

6.3. Financial Integration, Trade, and Domestic Financial Markets

This section discusses how the varying levels of financial and trade integration are modeled by the adjustment cost coefficient and the Armington aggregator respectively, including the rationales behind and their relationship. The domestic leverage constraint and other related issues are also discussed.

6.3.1. Adjustment Cost and Financial Integration

In this model, the level of FI is measured from the size of foreign asset holding and determined by a reduction of adjustment coefficient ϕ. A larger value of ϕ means a higher trading cost $\frac{\phi}{2} I_t^2$ for a given amount of cross-border net fund transfer I_t.

Transaction and information costs are largely viewed as important determinants of cross-border asset investments (C.-Y. Park & Mercado, 2014; Thapa & Poshakwale, 2010). Portfolio flows are generally transacted through intermediaries such as asset management firms and mutual funds (International Monetary Fund, 2014b), which involves fee and other costs. High transaction costs such as from high brokerage fee, capital flow restriction, market thinness, and information barriers to enter foreign markets could discourage people from investing in foreign assets, whereas lower transaction costs could attract more foreign investments (see for example Mihaljek, Scatigna, and Villar (2002), C.-Y. Park and Mercado (2014), and Thapa and Poshakwale (2010)). Lower cost in foreign asset trading is also considered as related to higher financial development (World Bank, 2012). Moreover, the adjustment cost of portfolio holding is another factor that could influence households' saving and consumption smoothing (Bonaparte, Cooper, & Zhu, 2012).

In this regard, a reduction of ϕ, such as from less transaction costs and more favorable regulation, could enhance cross-border asset trade and greater FI. The coefficient ϕ can then be both a structural and a policy parameter since it could represent the brokerage fee structure and market imperfection in the economy, or it could be a proxy for restriction on the capital mobility across countries. The use of adjustment cost coefficient ϕ as a determinant of FI level is based on Sutherland (1996) and Senay (1998). It is also adopted by later studies such as Buch et al. (2005) and Buch and Pierdzioch (2009).

The relationship between the coefficient ϕ and the size of foreign asset holding of the home households D_1^h can be derived mathematically as follows. In the steady state, the foreign asset investment of the home households can be written as the following according to the budget constraint in equation (6-3) when the positive root is chosen as a solution to the convex function.[40]

$$\overline{D_1^h} = \frac{1 + \sqrt{1 + 2\phi\left[\overline{w_1}\overline{L_1^h} + \overline{Z_1^h}\left(1 - \overline{Q^Z}\right) - \overline{P}_1\overline{C_1^h}\right]}}{\phi\left(1 - \overline{Q^D}\right)} \tag{6-43}$$

The variables with bars denote the variables in the steady state. It can be seen from equation (6-43) that the level of foreign asset investment does not depends solely on the size of parameter ϕ, but it also endogenously depends on other variables within the model. The first derivative of equation (6-43) yields;

$$\frac{\partial \overline{D_1^h}}{\partial \phi} = -\left[\frac{1 + \phi[A] + \sqrt{1 + 2\phi[A]}}{\phi^2\left(1 - \overline{Q^D}\right)\sqrt{1 + 2\phi[A]}}\right] \tag{6-44}$$

where $[A] = \left[\overline{w_1}\overline{L_1^h} + \overline{Z_1^h}\left(1 - \overline{Q^Z}\right) - \overline{P}_1\overline{C_1^h}\right] > 0$ given the choice of benchmark parameters. The square root is determinate and non-negative, thus $\frac{\partial \overline{D_1^h}}{\partial \phi}$ is less than zero. A decrease in the fee coefficient ϕ leads to an increase in foreign asset holding and contributes to greater FI given other things being equal.

6.3.2. Armington Aggregator and Trade Integration

TI is defined as the amount of intermediate goods traded across countries and determined by the weight parameter ω in the Armington aggregator similar to Chapter 5. Rationale and discussion concerning the use of Armington weight to determine the degree of trade intensity are provided in Section 5.3.2 in Chapter 5 and not repeated here. The only difference is notation of price variables; thus, the mathematical relationship is shown below for completeness.

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[40] There is also a negative root to the convex function, which means portfolio investment liabilities or loans, but it might not be appropriate to use because this study focuses on the positive foreign asset investment originating from the decision of the home emerging economy residents. Moreover, under some parameterization, there is no steady state when the negative root is chosen.

Analogous to Chapter 5, the degree of TI 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 $MS_1 = \overline{q^b}\overline{b_1}/\overline{q^a}\overline{Y_1}$, and the home export share $XS_1 = \overline{q^a}\overline{a_2}/\overline{q^a}\overline{Y_1}$ can be written in three interchangeably ways as follows;

$$\omega_1 = \frac{1}{1 + TOT_1^{\frac{1-\sigma}{\sigma}}\left(\frac{1 - XS_1}{MS_1}\right)^{\frac{1}{\sigma}}} \tag{6-45}$$

$$XS_1 = 1 - \left[\left(\frac{1}{\omega_1} - 1\right)^{\sigma} TOT_1^{\sigma-1} MS_1\right] \tag{6-46}$$

$$MS_1 = \frac{TOT_1^{1-\sigma}(1 - XS_1)}{\left(\frac{1}{\omega_1} - 1\right)^{\sigma}} \tag{6-47}$$

where $TOT_1 = \overline{q^b}/\overline{q^a}$ is the terms of trade. The derivation is analogous to Chapter 5 and follows Appendix C.2 closely. The relationships of ω_1 with XS_1 and MS_1 are positive and corresponding first derivatives can be derived as;

$$\frac{\partial XS_1}{\partial \omega_1} = \frac{\sigma MS_1 TOT_1^{\sigma-1}\left(\frac{1}{\omega_1} - 1\right)^{\sigma-1}}{\omega_1^2} \tag{6-48}$$

$$\frac{\partial MS_1}{\partial \omega_1} = \frac{\sigma TOT_1^{1-\sigma}(1 - XS_1)}{\omega_1^2\left(\frac{1}{\omega_1} - 1\right)^{1+\sigma}} \tag{6-49}$$

Since the model setup does not allow exporting the imports and $Y_{1t} = a_{1t} + a_{2t}$; hence, $0 \leq XS_1 = \overline{q^a}\overline{a_2}/\overline{q^a}\overline{Y_1} < 1$. 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 TI, which is the sum of export and import shares.

6.3.3. Linkage between Financial and Trade Integration

In this model, financial and trade integration are related, in line with the literature reviewed in Section 3.2. They are argued to have a positive relationship and complement each other through many channels. See for example, Aizenman and Noy (2009), Aviat and Coeurdacier (2007), Feeney (1994) and Shin and Yang (2006).

From equation (6-43), it can be seen that foreign asset holding of the households is endogenously determined within the models and associated with other variables apart from the fee parameter ϕ. Trade integration is also endogenously determined by the interactions of agents both within and across the economies. These imply that the size of foreign portfolio investment and the degree of trade are likely related.

Many channels are possible in this model. The increase in exports and imports could potentially raise production in intermediate and final goods of both countries through the Armington aggregator and to satisfy market clearing equations. More labor is hired and the household consumers might earn more and consequently have more money to invest from the positive relationship between labor supply and foreign asset investment in equation (6-43). Another possible channel is that an increase in preference for imports ω_1 likely lead to a decrease of domestic goods price q^a. Wage accordingly drops from the first order condition of intermediate goods production, and so does household consumption through budget constraint and the optimization of the households since their consumption mainly depends on wage. These could also lead to households having higher net income and thus saving more from the negative relationship between consumption and foreign asset investment in equation (6-43).

On the other hand, the size of adjustment cost and foreign asset investment affect the net income and consumption of both households and entrepreneurs. Higher consumption and net income could generate higher demand for final consumption goods, and potentially intermediate goods imports. The households' decision concerning the foreign asset holding could transfer to the home entrepreneurs through the brokerage firms' dividends the entrepreneurs receive although they cannot choose the amount of foreign asset holding themselves. These could impact the decision of the home entrepreneurs regarding the supply of physical capitals to the production firm. Household consumption may also influence the labor supply. These could influence the production and output, which in turn determines the level of exports. These are examples how trade and FI as measured by the foreign portfolio investment could affect each other within this model.[41]

Under the benchmark parameters, increasing TI parameter ω indeed leads to the steady state with higher FI, and lowering FI parameter ϕ results in the steady state with slightly higher trade, given other things being equal. Nevertheless, the impact from ϕ to TI is very small, and smaller than the impact from ω to FI. This is consistent with

[41] These conjectures are only applicable to this study since they are obtained from the analysis of relationship among variables in the equilibrium and the simulation results obtained from the model.

empirical evidences from Shin and Yang (2006) and Aviat and Coeurdacier (2007) that the impact from TI to FI is stronger than from FI to TI.

However, establishing the functional form of the relationship between financial and trade integration are problematic. There are many variables and parameters related to international integration in the model. FI can be defined by many measures such as the aggregate-level current period foreign asset holding relative to GDP, the total amount as the sum of foreign asset and liabilities, or the net financial flow as the foreign financial assets minus liabilities. TI composes of exports and imports, which at times might move in different directions and are not affected in the same way. Financial and trade integration can also be represented by the adjustment cost coefficient and the Armington weight parameter respectively. Furthermore, the relationship between financial and trade integration could not be written in a clear reduced form where FI is a function of only TI and parameters largely owing to the complex functions of Armington aggregator and the convex adjustment cost. One possible way to show the relationship between FI and TI mathematically is by the following equation.

$$\begin{aligned} TI_{1t} = &\left[1 - 2\omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\right] Q_t^D FAH_{1t} + 2\omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} \\ &+ \left[2\omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} - 1\right]\frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} \end{aligned} \tag{6-50}$$

where TI_{1t} is trade integration measured by the sum of export and import shares of GDP, and FAH_{1t} is a stock measure of FI defined as the current period foreign asset holding of the home country $FAH_{1t} = nD_{1t}^h / q_t^a Y_{1t}$. The derivation of this equation is presented in Appendix C.3.

Under the benchmark parameters and the steady state values of variables, the term $\left[1 - 2\omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\right]$ is positive, and TI and foreign asset holding of the home country are considered positively related. Equation (6-50) shows only one possible linkage between FI and TI. Other forms of relationship can be obtained from other measures of FI such as total asset and liabilities or net financial flows, but the signs of the relationship might vary.

However, the aim of this thesis is not to establish the linkage between FI and TI, but rather to explore how two types of integration jointly influence the business cycles of EMEs. There are a number of papers that investigate and model the linkage between financial and trade integration. See for example, Aizenman and Noy (2009) Feeney (1994), and Portes and Rey (2005). Alternatively, an explicit function connecting financial and trade integration could be done, but the interaction between them would be forced and restricted to the relationship as defined by the functional form, whereas an implicit linkage in this model would be a result of interrelated optimization of agents in the economy and seems to be more suitable with the research question and scope.

6.3.4. Leverage Constraint and Domestic Credit

As discussed, the domestic leverage constraint and the coefficient m reflect the firm's debt level or the presence of contract enforceability problem, and aggregate domestic credit is one empirical measure of domestic financial development. In all aspects, the coefficient m is a structural parameter that reflects the firms' ability to borrow or the domestic financial structure. A higher value of m means more ease of domestic lending, which could stimulate the lenders to lend more and the borrowers to borrow more, or an increased ability or appetite of the firm to raise larger fund. Using domestic borrowing constraint to reflect less developed financial markets in developing countries is based on Leblebicioğlu (2009) and Levchenko (2005).

It can be shown mathematically that home aggregate domestic borrowing depends on the leverage constraint parameter m. Based on the leverage constraint in equation (6-11) and the first order conditions, the non-stochastic steady state relationship between parameter m and the ratio of total domestic credit to GDP in home country defined as $(1-n)\overline{Z_1^o}/\overline{q^a Y_1}$ can be written as

$$\frac{(1-n)\overline{Z_1^o}}{\overline{q^a Y_1}} = \frac{m\alpha_1 \nu}{1 - m(\beta - \nu) - \nu(1-\delta)} \qquad (6\text{-}51)$$

The derivation of this relationship is present in Appendix C.4.

From equation (6-51), it can be seen that the ratio of total domestic credit to GDP in the steady state is exogenously determined by the parameters. However, the size of domestic credit to private sector $(1-n)\overline{Z_1^o}$ per se endogenously depends on other variables within the model and proportionately varies with GDP.

The domestic leverage constraint in this study is always binding likewise to the one in Chapter 5. This is due to the assumption that home household savers are more patient than the home entrepreneurs who are the borrowers. The difference in their discounting behavior leads to a positive value of Lagrange multiplier of the leverage constraint λ, which implies that the constraint plays a role in the equilibrium. Unlike Chapter 5, the home entrepreneurs in this paper have only one choice of fund to borrow from, and due to their less impatience, they borrow to the maximum amount possible. A binding leverage constraint is also needed to obtain a unique value of asset positions in the equilibrium (see Faia, 2011). In contrast, an occasionally binding constraint could lead to multiple equilibria (see Perri and Quadrini, 2011). It is often employed in studies of financial crisis and recessions, which are not the focus of this research. Related issues to the use of leverage constraint are already elaborated in Section 5.3.1 of Chapter 5.

The two financial frictions in this model – the cross-border adjustment cost representing FI, and domestic leverage constraint representing financial development – might affect each other. The home entrepreneurs' domestic loans are bounded by the credit constraint. Home households who are domestic lenders and savers are as well restricted by the same constraint, which could possibly influences the decision regarding foreign asset investment of the households through the budget constraint. In general, domestic financial development and international financial integration are related. Less developed financial markets, weak institutions, and low financial literacy might hinder the ability of the country to access global financial markets and to share risk, and a lack of financial integration may reflect low level of domestic financial developments (Lee et al., 2013). Sound domestic financial markets and institutions could help make the economy more resilient to external shocks from international financial linkages, and deepening FI can help improving domestic competition, providing more liquidity, and introducing boarder range of financial instruments (Baele et al., 2004; Pongsaparn & Unteroberdoerster, 2011).

6.4. Parameter Calibration

The model is calibrated using the benchmark parameter values shown in Table 6.2. The period used is quarterly. The home country is set to represent the emerging market economy and the foreign country as the advanced economy. Three key parameters, which are the adjustment cost coefficient ϕ, the Armington weights ω, and the LTV ratio m, are based on data of emerging and advanced economies and will be discussed in the following sub-sections. The rest of the parameters are taken from RBC literature as reported in the last column in Table 6.2. The discount factor of entrepreneurs, ν, is assumed to be lower than that of the households and equals to 0.98 following Leblebicioğlu (2009). 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 indicates that the home country is relatively more labor intensive than the foreign country. The value is in line with literatures on emerging markets and developing countries.[42] The proportion of

[42] See Almekinders et al. (2015), Sarel (1997), Mallikamas et al. (2003), and Bhattacharya and Patnaik (2013) for example.

home population who can access international financial market, n, is approximated from Vitek (2015) as a pro rata basis and is set to equal to 0.2.[43]

Table 6.2 Benchmark parameters

	Parameter	Value	Source
β	Discount factor of households	0.99	Backus et al. (1994), Leblebicioğlu (2009)
ν	Discount factor of entrepreneurs	0.98	Leblebicioğlu (2009)
κ	Labor effort weight in utility	1	Leblebicioğlu (2009), Pancaro (2010)
n	Proportion of home households	0.2	Approximated from Vitek (2015)
δ	Depreciation rate	0.025	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009), Pancaro (2010)
α_1	Capital share of output for home country	0.34	Author's assumption based on Almekinders et al. (2015), Sarel (1997), Mallikamas et al. (2003), and Bhattacharya and Patnaik (2013)
α_2	Capital share of output for foreign country	0.36	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009)
σ	Elasticity of substitution between domestic and foreign goods	1.5	Backus et al. (1994), Faia (2007), Leblebicioğlu (2009)
ω_1	Armington weight in home country	0.27, 0.38	Author's calculation
ω_2	Armington weight in foreign country	0.41	Author's calculation
ϕ	Adjustment cost coefficient	5, 7, 9	Sutherland (1996), Senay (1998), Buch et al. (2005), and the value that are in line with data
m	LTV ratio in leverage constraint	0.07	Author's calculation
ψ	Bond holding coefficient	0.003	Pancaro (2010)

[43] Vitek (2015) divided households into three groups; people who can trade only domestic financial assets, people who can access both domestic and foreign financial markets, and people who have no access. The author estimated the model using Bayesian maximum likelihood and data from 40 countries, and obtained the posterior means of household proportions as 0.4664, 0.0977, and 0.4358 respectively. The parameter n = 0.2 in this study is a pro rata approximation from the first two groups of people as (0.0977)/(0.4664+0.0977).

Table 6.3 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 6.3. The shocks are correlated and can spill over to the other country. 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 widely acknowledged stylized fact that the business cycles of emerging economies are more volatile than the advanced economies (see Gopinath and Aguiar, 2007, and Calderon and Fuentes, 2010). Moreover, developing countries tend to have larger domestic and exogenous shocks than industrial countries; thus, higher macroeconomic volatility (Loayza et al., 2007).

6.4.1. Adjustment Cost Coefficient ϕ

The adjustment cost coefficient ϕ determines the degree of FI. It is set to equal to 9, 7, and 5 for the case of low financial integration (LFI), medium financial integration (MFI), and high financial integration (HFI) respectively. The choice of parameter value equaled to 5 is used by Sutherland (1996), Senay (1998), and Buch et al. (2005). They adopted the adjustment cost coefficient of 5 to represent imperfect financial market integration.[44] The values of ϕ between 5-9 also give the size of net foreign asset around 11-21 percent of GDP, which is not overstatedly high according to the actual size of net foreign portfolio investment in EMEs. Using data from IMF CPIS, the size of net foreign portfolio investment of EMEs averaging over 2001 to 2013 is about -9 percent of GDP. Appendix D.3 presents net foreign portfolio investment of each emerging market country used in computation and the data description. Nevertheless, the values of ϕ equals to 5, 7, and 9 do not have particular meaning by themselves. They just represent the relative size of the adjustment cost that could induce

[44] They also adopt the value of ϕ equals to zero to represent perfect integration with no friction. Since this paper aims to explore emerging markets with market imperfections and the intermediate degrees of financial integration between international financial autarky and perfect integration, the parameter value $\phi = 0$, which means the adjustment cost is completely removed, is not included.

higher or lower foreign asset holding. Broader range of coefficient ϕ values will be explored in the sensitivity analysis part.

Computing the parameter ϕ directly from the data would be problematic as a specific assumption regarding what the adjustment cost represents is needed; whether it is a proxy of the brokerage fee paid to asset management firms in each country, the degree of capital mobility restriction, or other frictions that are more difficult to measure such as information barrier. Moreover, the availability and consistency of those data across a broad range of EMEs are likely questionable and might not be appropriate to use, unlike the country-level aggregate data such as international trade and private domestic credit that are available from a single source at WDI. The alternative of estimating the coefficient ϕ from the average size of foreign asset investment among EMEs would require a direct reduced form relationship between parameter ϕ and the variable D_1^h, which is complex in this model given the convexity of the adjustment cost and the interaction with other variables within the model.

6.4.2. Armington Weight $\boldsymbol{\omega}$

The weight parameters ω in Armington aggregator determine the level of TI. They are computed from trade data of emerging market and advanced economies according to the steady-state relationship in equation (6-45). The data used to calculate ω are 2000-2013 annual averages of imports, exports, and terms of trade from WDI. Imports and exports are adjusted to remove imported contents in exports using information from joint TiVA database. 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 emerging market economies are separated into two groups of high trade intensity and low trade intensity driven by the data presented in Section 2.4 from Chapter 2.[45] The high trade group comprises of East Asia, emerging Europe, and Middle East and North Africa (MENA). The low trade group comprises of Latin America, South Asia, and Sub-Saharan Africa. Appendix D.3 lists the countries in each group.

Table 6.4 reports the raw trade data from WDI, adjusted trade, and corresponding values of ω. 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,

[45] The grouping is different from Chapter 5 that divides the emerging market sample into ASEAN and non-ASEAN because of the following reasons. First, it is to investigate different and broader grouping of emerging markets than focusing at a particular region. Second, since trade in four ASEAN economies is higher than the AE group, the corresponding Armington weight and the symmetric case of ω_1 = 0.5 are higher than that of the foreign advanced economy. Thus, this chapter alternatively studies the case when both Armington weights of home emerging economy are below that of the foreign advanced country.

2007, Ueda, 2012, Pancaro, 2010, and Bacchetta and Van Wincoop, 2013). 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. Appendix D.1 explains the computation in more details.

Table 6.4 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
High trade EMEs	19	44%	46%	90%	0.97	32%	34%	66%	ω_1= 0.38
Low trade EMEs	11	23%	24%	47%	0.92	19%	19%	38%	ω_1= 0.27

Sources: author's calculation using data from WD and TiVA.

Note: Obs.=observations; Ex = exports; Im = imports; TOT = terms of trade.

6.4.3. Loan-to-Value Ratio m

As discussed, the parameter m in the domestic leverage constraint can denote the firm's LTV ratio or debt level. The steady-state relationship between aggregate domestic credit and parameter m from equation (6-51) can be rearranged as;

$$m = \frac{1-\nu(1-\delta)}{\frac{\alpha_1 \nu}{\left(\frac{(1-n)\overline{Z_1^o}}{\overline{q^a}\overline{Y_1}}\right)} + \beta - \nu} \tag{6-52}$$

Equation (6-52) shows that m depends on the model parameters and the term $(1-n)\overline{Z_1^o}/\overline{q^a}\overline{Y_1}$ which can be interpreted as the ratio of total private domestic credit to GDP in the home country. Therefore, the value of m is computed from domestic credit to private sector data from WDI. The data used is 2000-2013 average of all 30 emerging market economies, which is about 51 percent of GDP. Tables in Appendix D.3 lists the countries used in computation and their private domestic credits. This gives the value of m equaled to 0.07 under benchmark parameters. A higher value of m will be explored in the sensitivity analysis.

6.4.4. Main Cases

From the parameter choices, three levels of FI and two levels of TI are examined under the main analysis. This results in the total of six combinations as shown in the following table. Keeping other parameters at their benchmark values, a lower value of ϕ yields the steady state equilibrium with higher FI as measured by cross-border asset investment, and a higher value of ω_1 yields the steady state equilibrium with higher TI as measured by cross-border goods trade.

Table 6.5 Summary of main cases

#	Case	Level of FI	Level of TI	Value of ϕ	Value of ω_1
1	LFI, LTI	Low	Low	9	0.27
2	LFI, HTI	Low	High	9	0.38
3	MFI, LTI	Medium	Low	7	0.27
4	MFI, HTI	Medium	High	7	0.38
5	HFI, LTI	High	Low	5	0.27
6	HFI, HTI	High	High	5	0.38

6.5. Results and Discussion

6.5.1. Macroeconomic Volatility

The simulation results of key macroeconomic volatility for six main scenarios are presented in Table 6.6. The statistics are the averages of 500 simulations, each 400 periods long. The focus of the analysis is the home emerging economy.

Table 6.6 Simulated volatility of key variables

	Low trade			High trade		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Volatility of home variables (%SD)						
Output (Y_1)	4.02	3.98	3.85	3.94	3.94	3.90
Household consumption (C_1^h)	9.41	9.47	9.53	8.41	8.50	8.65
Entrepreneur consumption (C_1^o)	0.33	0.35	0.59	0.30	0.28	0.37
Aggregate consumption (C_1)	2.02	1.94	1.74	1.85	1.81	1.70
Capital (K_1^o)	23.12	23.09	22.63	21.30	21.54	21.69
Investment (X_1^o)	1.05	1.08	1.12	0.96	1.00	1.07
Foreign asset holding (D_1^h)	52.06	62.17	78.51	44.86	52.89	64.90
Domestic borrowing (Z_1^o)	1.62	1.62	1.58	1.49	1.51	1.52
Exports (a_2)	1.02	1.02	1.00	1.52	1.51	1.49
Imports (b_1)	2.54	2.55	2.90	2.92	2.86	2.71
Terms of trade (TOT_1)	1.10	1.12	1.16	1.35	1.35	1.35
Volatility of foreign variables (%SD)						
Output (Y_2)	10.39	10.25	9.86	10.82	10.76	10.55
Consumption (C_2)	2.42	2.44	2.49	2.67	2.69	2.71
Consumption volatility relative to output (%SD/%SD of Y)						
Home households (C_1^h)	2.34	2.38	2.48	2.13	2.16	2.22
Home entrepreneurs (C_1^o)	0.08	0.09	0.15	0.08	0.07	0.09
Home aggregate (C_1)	0.50	0.49	0.45	0.47	0.46	0.44
Foreign households (C_2)	0.23	0.24	0.25	0.25	0.25	0.26

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.

The volatility of home output

Increased foreign asset holding slightly lowers the volatility of home output. The decline is greater for the case of low trade when moving from LFI to HFI reduces home output volatility from 4.02 to 3.85, than the case of high trade when home output volatility decreases from 3.94 to 3.90. Increased FI seems to help the economy to absorb shocks on the output. Larger cross-border financial linkages could provide better opportunity to share risks and channels for shock transmission across countries. The impact of foreign asset holding on home output in the model presumably works through many channels. For instance, the amount of FI directly impacts the home households' decision of labor supply in output production. It relates to the size of net exports through the balance of payments identity of current account and capital account. The home country has a net financial inflow from the return on asset investment in the steady state, and hence is a net importer. The increase of FI affects the net financial inflows, imports, and exports, which in turn could consequently influence the home output. This relationship is in line with empirical evidences, which often found that FI contributes to lower output variability (see Bekaert et al. (2006), International Monetary Fund (2002), and Prasad et al. (2007) for instance). However, some studies found that the impact of FI on output volatility is insignificant. See Kose et al. (2003) for example.

On the other hand, the impact of trade intensity on home output volatility varies across three levels of foreign asset investment. Trade reduces output volatility in the cases of LFI and MFI, but raises output volatility at HFI. However, the magnitude of the effects is small in all cases. In empirical literatures, both positive and negative relationships between trade and the volatility of output growth have been found. For example, Kose et al. (2003) found that trade induces higher output variability. Haddad et al. (2010) found negative relationship when exports are sufficiently diversified, which are the case for a majority of countries.

<u>*Consumption smoothing*</u>

For consumption variability, Table 6.6 reports two measures; the standard deviation of consumption in the upper two panels, and 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 also important being viewed as inversely related to welfare (Prasad et al., 2007). The results suggest that larger foreign asset investment generally results in higher volatility of consumption for both kinds of domestic consumers regardless of access to international financial markets.

For home households who can invest abroad, increased foreign asset holding raises their consumption volatility more under high trade than low trade, but this is reversed for the relative consumption volatility to output. The relative consumption volatility increases from 2.34 to 2.48 under low trade, slightly bigger than the change from 2.13 to 2.22 under high trade when moving from LFI to HFI. Higher foreign asset holding leads to considerably larger fluctuation of the foreign asset holding itself, as can be seen from the resulting volatility in Table 6.6. This could contribute to higher consumption volatility of the home households, although to a lesser extent because the household consumption also depends on wage and labor supply.

For home entrepreneurs who cannot access international financial markets, FI significantly raises their consumption volatility under low trade intensity, especially moving from MFI to HFI where the relative consumption volatility goes up from 0.09 to 0.15. In contrast, the increase is smaller under high TI. Despite no direct financial linkage, the cross-border financial flow affects the entrepreneurs indirectly through household's labor decision and the labor-capital choice in production sector. The capital plays an important role in the entrepreneurs' optimization regarding to capital investment, borrowing capacity as restricted by the capital collateral, and rent income. Higher foreign asset trading also leads to higher brokerage dividend that the entrepreneurs received. Moreover, the entrepreneurs face domestic credit constraint that might hinder their ability to freely adjust the borrowing amount in response to a changing environment caused by increased FI.

Although FI is supposed to provide consumption smoothing through assets diversification and risk sharing, the lack of consumption smoothing benefit from greater FI in emerging markets is not surprising and has been observed in empirical researches. Kose et al. (2003) and Prasad et al. (2007) found that financial openness is associated with higher consumption variability for more financially opened developing countries, while Bekaert et al. (2006) found insignificant consumption-smoothing benefit for the sub-group of emerging market economies. Studies adopting DSGE mostly found that FI increases consumption volatility when there are financial frictions or imperfect access to finance since these market imperfections could amplify the impacts of shocks on consumption (Pisani, 2011).[46] Low financial development, less financial literacy, weak institutions, and lack of other preconditions might hinder the ability of emerging markets to share risk across countries (Levchenko, 2005; Prasad et al., 2007). This is in line with this study, in which both domestic residents face financial frictions either in domestic or foreign financial markets. Home households incur adjustment cost of foreign asset holding internationally and are subject to contract enforceability problem domestically as a lender through the leverage constraint. They cannot save or invest freely in any market. Home entrepreneurs, on the other hand, cannot access foreign financial markets and are credit constrained domestically. These could be another reason why higher FI is associated with larger consumption fluctuation.

However, when aggregating the consumption at the home country level, the result is opposite to those of households and entrepreneurs separately. This is presumably owing to a low correlation between the consumptions of households and entrepreneurs since they base their consumption decisions on different factors. The observation that the households and the entrepreneur consumptions move in opposite direction is further discussed in the cross-country comovement results in the next section. The labor supply contributes to the utility of home households who are savers both domestically and internationally, whereas the entrepreneurs depend more on capital-related factors and participate in domestic financial markets as borrowers. When considering the home aggregate level, it turns out that the volatility of the aggregate consumption is lower under higher foreign asset holding.[47] This lower aggregate

[46] See Levchenko (2005), Leblebicioğlu (2009), Pancaro (2010), and Pisani (2011) for example.

[47] This is also found by Levchenko (2005) that individual consumptions are more volatile under higher FI, but the volatility of aggregate consumption is less volatile. This is possibly due to low financial development and limited risk sharing opportunities.

consumption volatility might be one factor that contributes to a lower volatility of home output under higher FI.

In contrast, TI helps make the consumption of both home households and entrepreneurs less volatile. When a negative shock hits the home production sector, 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 largely 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 consumption might have to be adjusted instead and become more volatile. The findings suggest that TI could help dissipate and transmit the shocks across countries, and reduce the response of domestic consumption to shocks, providing opportunities for international risk sharing and consumption smoothing. However, the relationship between trade and the volatility of consumption in empirical literature is ambiguous. For instance, 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 volatility of other variables

Increased foreign asset holding has little impact on exports and terms of trade, while higher trade significantly raises both. The impact of financial and trade integration on imports is mixed. Under low trade, higher FI leads to higher imports volatility. The opposite is observed under high trade. Higher international trade generally reduces the volatility of home investment, capital, foreign asset holding, and domestic borrowing. Larger trade seems to help make the economy more tolerant to fluctuation caused by high foreign asset holding. The volatility of physical capital and domestic borrowing shows similar pattern of mixed results from varying levels of FI and lower volatility at higher trade because they are related through the domestic credit constraint. The choices of the home households between investing abroad and lending in domestic markets do not have direct linkage. The former originates directly from the home households themselves and largely determined by cross-border adjustment cost, while the latter mostly originates from the home entrepreneurs' financing needs and is restricted by the leverage constraint. As a result, the effect of FI does not have much impact on domestic borrowing. As for the foreign key variables, higher FI is associated with reduced foreign output volatility and increased consumption volatility similar to the results of home country. However, TI leads to higher volatility for both foreign output and consumption.

<u>The joint impact of FI and TI</u>

Combining the effect of FI and TI together, there are two observations regarding their joint impact. Firstly, the impact of foreign asset holding tends to be stronger at low trade and weaker at high trade. This is observed in the volatility of output and consumption for both home and foreign countries. Because the separate effects of FI and TI broadly go in opposite directions, they might offset each other. The offset might be more pronounced at high degrees of integration, resulting in the net combined effect that is weaker than when there is high FI or TI alone. To illustrate, increasing FI from LFI to HFI decreases the home output volatility from 4.02 percent to 3.85 percent under low trade, but the decrease is only from 3.94 percent to 3.90 percent under high trade. On the other hand, the economy with low trade intensity might not be able to transmit the shocks though trade channels or adjust exports and imports much in response to a shock, which could result in a larger impact of FI.

Secondly, increasing foreign asset trading when trade intensity is low makes the consumption of home entrepreneurs becomes much more volatile, especially for the case of HFI under low trade. Home entrepreneurs have no access to foreign financial markets and face borrowing constraint in domestic markets. In contrast, the increase in consumption fluctuation is less severe for home households who have less restriction and can save and invest in both markets. The results suggest that international trade and financial accessibility could play an important role in how FI affects consumption smoothing.

Two relevant stylized facts of emerging market business cycles are that, first, observed business cycles in EMEs are generally more volatile than that of the developed countries, and second, consumption is more volatile than output (Aguiar & Gopinath, 2007; Benczúr & Rátfai, 2014; and Calderon & Fuentes, 2010). The model fails to capture the first stylized fact when considering the volatility of home and foreign output Y_1 and Y_2.[48] The second stylized fact is observed for the home households, but not for the home entrepreneurs. For the foreign developed country, the consumption is less volatile than the output.

[48] However, when considered the value of outputs as multiplied with the price instead, that is, by comparing $q^a Y_1$ and $q^b Y_2$, the model is able to exhibit higher volatility in EMEs for the case of low trade.

6.5.2. Business Cycle Synchronization

Table 6.7 Simulated correlation of key variables

	Low trade			High trade		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Cross-country correlations						
Output (Y_1, Y_2)	0.62	0.60	0.52	0.67	0.66	0.64
Household consumption (C_1^h, C_2)	0.86	0.86	0.88	0.88	0.88	0.89
Entrepreneur consumption (C_1^o, C_2)	0.65	0.30	-0.27	0.73	0.48	-0.12
Home output and foreign consumption (Y_1, C_2)	0.81	0.82	0.83	0.80	0.80	0.79
Correlations within home country						
Output and household consumption (Y_1, C_1^h)	0.99	0.99	0.99	0.99	0.98	0.98
Output and entrepreneur consumption (Y_1, C_1^o)	0.41	0.08	-0.37	0.59	0.37	-0.09
Output and foreign asset holding (Y_1, D_1^h)	0.43	0.43	0.41	0.52	0.51	0.50
Output and exports (Y_1, a_2)	0.99	0.99	0.98	0.99	0.99	0.99
Output and imports (Y_1, b_1)	0.58	0.43	0.07	0.75	0.71	0.62
Household and entrepreneur consumption (C_1^h, C_1^o)	0.44	0.08	-0.43	0.63	0.40	-0.14
Foreign asset holding and exports (D_1^h, a_2)	0.45	0.43	0.38	0.57	0.56	0.53
Foreign asset holding and imports (D_1^h, b_1)	0.78	0.79	0.71	0.78	0.79	0.81
Foreign asset holding and domestic saving (D_1^h, Z_1^h)	0.52	0.55	0.60	0.61	0.62	0.64

Note: The statistics are the averages of 500 simulations, each 400 periods long.

Business cycle synchronization (BCS) is typically analyzed by cross-country comovement. On the one hand, increased comovement between countries could be viewed as providing more opportunity to share risks. On the other hand, business cycle comovement may mean tight dependency among countries, which can be adverse in the event of crisis spillover. Other related correlations among variables are also discussed in this section. The resulting simulated correlations are presented in Table 6.7. The upper panel reports the cross-country correlations and the lower panel reports the correlations among variables within the home country.

Cross-country output comovement

The simulation results show that higher foreign asset investment slightly lowers cross-country output comovement from 0.62 to 0.52 for the case of low trade, and from 0.67 to 0.64 for the case of high trade. This is consistent with empirical findings of Duval et al. (2014) and International Monetary Fund (2013) that higher FI typically lowers BCS during non-crisis periods.[49] More outward investment could make the economy less dependent on domestic factors. The effect from foreign asset investment may transfer to exports and imports through current and capital account balance, partly reflected by a slight decline in the correlations of home output with cross-border asset holding, exports, and imports in the model. These could cause the outputs of home and foreign countries to diverge.[50]

The impact of TI on BCS is opposite. Higher international trade is associated with larger cross-country output comovement, in line with a strongly robust empirical evidence.[51] Trade integration also raises cross-country consumption correlations for both groups of domestic consumers. Countries that trade more with each other presumably have more common components in their national income. Domestic and foreign consumers consume more similar baskets of goods. Higher trade also increases the correlation of output with imports and exports, possibly resulting in stronger linkages and higher BCS.

Consumption correlation

The consumption of home households and entrepreneurs show different comovement patterns. Firstly, the domestic household's consumption is highly correlated with foreign consumption with the cross-country correlation around 0.8-0.9, whereas the home entrepreneurs who cannot participate in foreign asset markets have lower consumption correlation with foreign households. High consumption comovement can be adverse when a crisis hits the foreign countries and worsens foreign consumption. This result suggests that the home households who have direct international financial linkage would be more affected than the home entrepreneurs.

Secondly, consumption of home households strongly correlates with the home output and correlates more than that of home entrepreneurs, since the households considerably depend on the domestic economy. When the economy is doing well with high output, it results in higher wage, and hence higher consumption for the household.

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[49] However, they both found that the relationship becomes reverse during the crisis periods. There are also different empirical findings. Imbs (2006) found that FI increases output correlation. Dées and Zorell (2012) found that direct relationship between the two is inconclusive.

[50] In the literature, International Monetary Fund (2014c) reasoned that the capital flows to the economy with higher return on capital from, for example, a positive shock. It can lead to the business cycle of the two economies to further diverge, lowering the output comovement. FI could also reduce BCS indirectly by encouraging more specialization and higher inter-industry trade (Duval et al., 2014).

[51] Non-exhaustive lists of studies are Calderon et al. (2007), Dées and Zorell (2012), Duval et al. (2014), Duval et al. (2016), Imbs (2006), and Di Giovanni and Levchenko (2010).

In contrast, high output could stimulate investment and consequently raise the borrowing of the entrepreneur, which can harm the entrepreneur's consumption.

Lastly, under both levels of trade, larger foreign asset holding results in a small increase of cross-country consumption correlation for the home households, but a large decrease of consumption correlation for the entrepreneurs. This is likely because one of the factors that determines consumption for households in both countries is the foreign asset position, which grows larger under higher FI, contributing to higher comovement. For the entrepreneur, a lower consumption comovement mainly results from a combination of a lower correlation of entrepreneur's consumption and domestic output, and in turn a lower synchronization between domestic and foreign outputs.

The correlations between entrepreneur's consumption with home output, home households' consumption, and foreign consumption show similar patterns of a large downward change from increased FI. The reason is because at lower FI, the consumption of the entrepreneurs depends more on domestic output and capital, but as FI increases, the amount of adjustment cost increases, and the brokerage fee the entrepreneurs receive in the form of dividend increases.[52] On the other hand, increasing adjustment cost payment is adverse for home households' consumption. All the above reasons could make the entrepreneurs' consumption diverge from domestic output and home households. The arguments also apply to the cross-country consumption correlation because the comovement among home output, home households' consumption, and foreign consumption remains highly positive and does not change much when FI is increased. The comovement of the entrepreneur's consumption with foreign consumption consequently preserves similar pattern from that with home output and home households' consumption.

The empirical evidences on cross-country consumption correlation are very limited, unlike the literature exploring the cross-country output comovement. Only one paper among the cited references by Imbs (2006) investigated the consumption comovement. The author found that FI tends to increase the correlation.

Correlation of foreign asset holding

The foreign asset holding of home households is positively correlated with home exports and imports, reflecting possible linkage between financial and trade integration and that they somewhat move together within the model as earlier discussed in Section 6.3.3. The correlation between foreign asset investment and domestic lending is also moderately positive and grows larger as FI increases. This suggests that higher

[52] This is one limitation of the model that assumes the entrepreneurs own the brokerage firms and receive the dividend from the firms' profit created by the nonlinearity of the adjustment cost.

financial investment in foreign markets might not necessarily dampen domestic saving and they could be complimentary.

The joint impact of FI and TI

Considering the joint effect of international integration on business cycle comovement, the observation from previous section on macroeconomic volatility carries forwards that the impact of foreign asset investment is weakened when trade is high. This is observed in cross-country correlation of output and household consumption. The same argument that their individual impacts tend to go in opposite directions also applies here.

6.5.3. Impulse Response to Shocks

Selections of simulated impulse responses are presented in Figure 6.2 to 6.5 for the case of low and high trade, and home and foreign shocks. Only main variables are shown due to a large amount of impulse response results. The underlying shock processes are the same for all cases. The analysis is mainly based on a positive productivity shock to the home economy for the case of low trade in Figure 6.2. Other cases will be discussed afterwards.

A positive home productivity shock leads to an increase in domestic and foreign outputs, investment, and exports. Investment has the largest response to shock. The physical capital cannot adjust right away, so it gradually increases after the shock. The response pattern of domestic borrowing closely follows the behavior of capital due to the borrowing constraint that specifies the amount of borrowing based on the level of capital. The terms of trade as defined by the ratio of import prices to export prices in this study respond positively to the shock because the shock leads to a decrease in the price of home goods and an increase in the price of foreign goods. This implies worsen terms of trade for the home country.

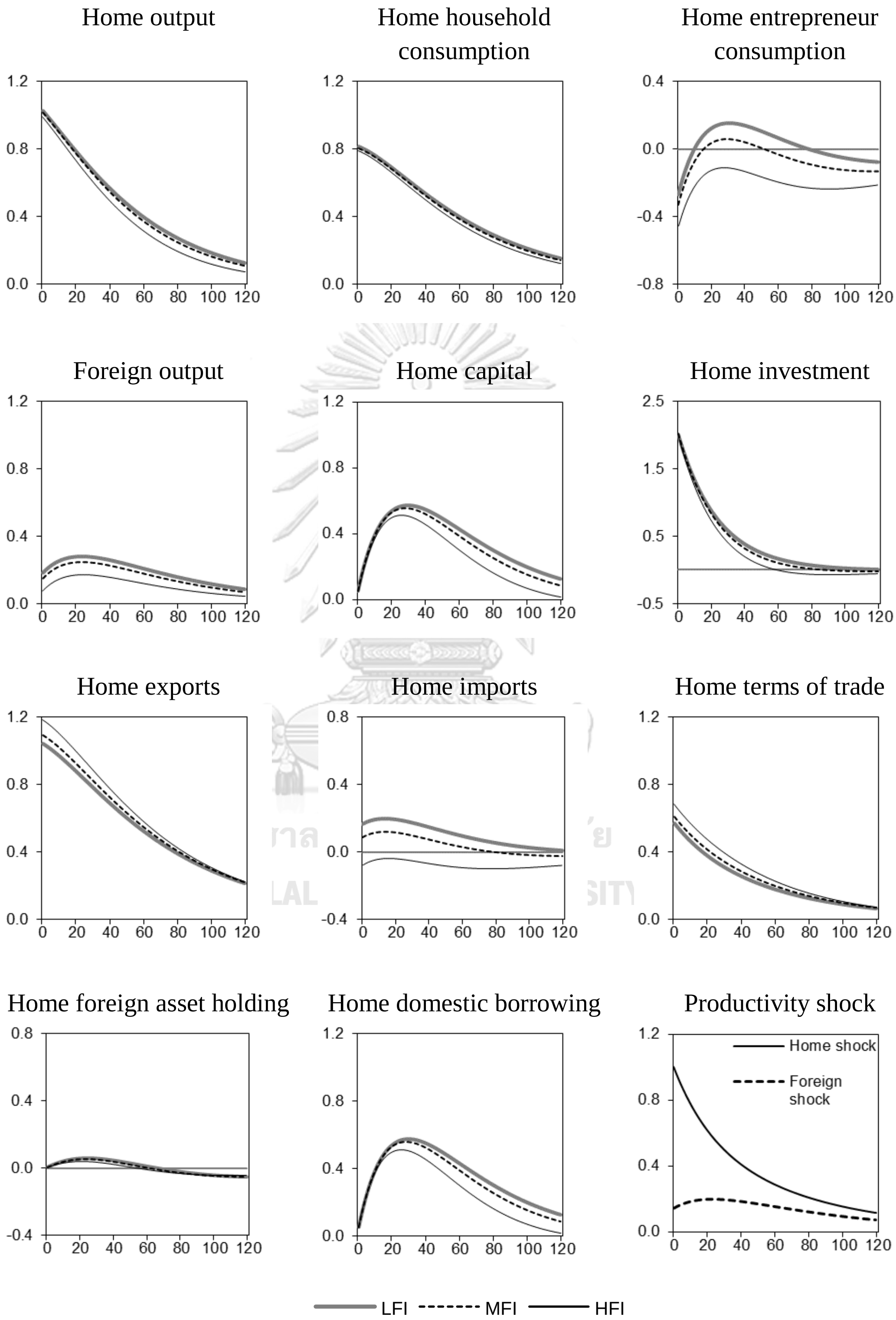
The IRFs for varying degrees of FI generally confirm the main findings. Larger foreign asset size leads to slightly less response to shocks for home output, foreign output, investment, capital, and domestic borrowing. These variables are closely related with the home output, so they likely behave in a similar way when FI increases. This illustrates prior observation made that FI reduces the volatility of output. The responses of capital and domestic borrowing decay slightly faster under higher FI than lower FI. In contrast, exports and terms of trade are more responsive to shock when cross-border financial transaction increases. Larger FI allows exports and terms of trade to adjust more in response to a positive technology shock.

The impacts of shocks on home households' consumption and foreign asset show little differences among three levels of FI. It seems that increasing the amount of foreign asset holding does not have much impact on how the household's consumption and the foreign asset position itself respond to shocks. The results suggest the absence of consumption smoothing benefit similar to the results regarding the macroeconomic volatility.

There are noticeable differences in the response of imports and entrepreneur's consumption to shocks across three levels of FI. Since the home country has a net financial inflow from the return on asset investment, and hence is a net importer in the steady state, the increase of foreign asset holding affects the net financial inflows and consequently imports. For the consumption of the entrepreneur, the response to shock is mixed and can be negative. The negative impact is possible because the entrepreneur consumption depends on the borrowing amounts to support capital investment. When there is a positive productivity shock, the entrepreneur increases their investment in capital. It leads to more borrowing, and for some periods, less consumption. In addition, the entrepreneur cannot freely choose the amount of borrowing due to the credit constraint and may need to adjust the level of consumption instead. The entrepreneurs' consumption seems to fluctuate in a better range under lower FI, in line with the result that increased foreign asset holding dampens their consumption smoothing. However, the impacts of the shock on these two variables are not large and fluctuate around the steady state levels.

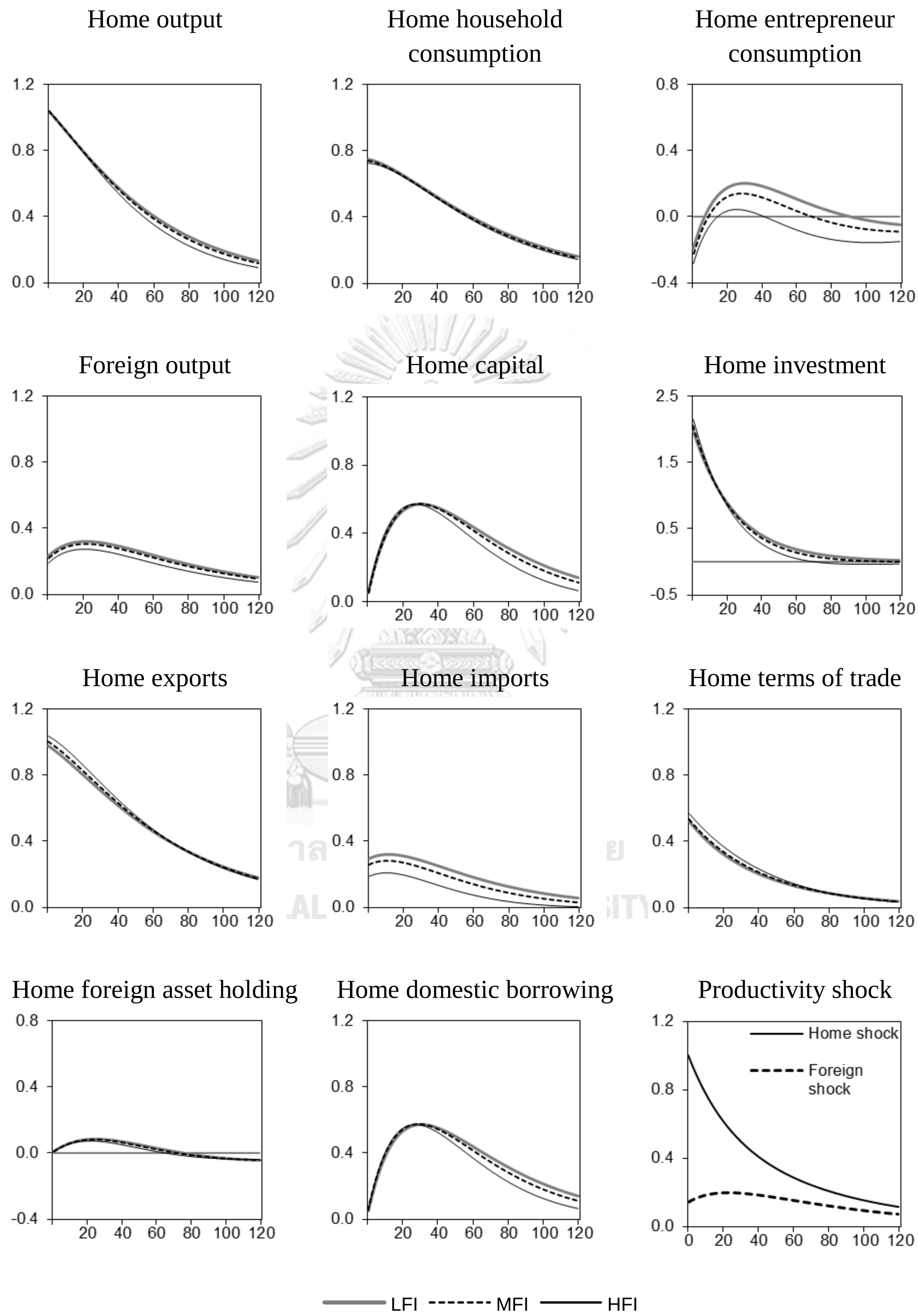
For all variables, the impulse responses decay slowly because the shocks themselves are persistent and can spill over across countries. The impulse responses for the case of high trade are similar to low trade for both home and foreign shocks, but exhibit less difference among three levels of foreign asset holding, further emphasizing that the effect of FI might be overshadowed at high trade. For example, the response of home exports to home shock under low trade (Figure 6.2) can deviate up to about 1.2 percent from the long-run equilibrium for the case of HFI, but only rises to about 1 percent for all three levels of FI under high trade (Figure 6.3). One interesting observation is that under high trade, home imports no longer responds negatively to positive productivity shock, and has largest response under high FI.

Figure 6.2 Impulse response of main variables to domestic productivity shock for the case of low trade



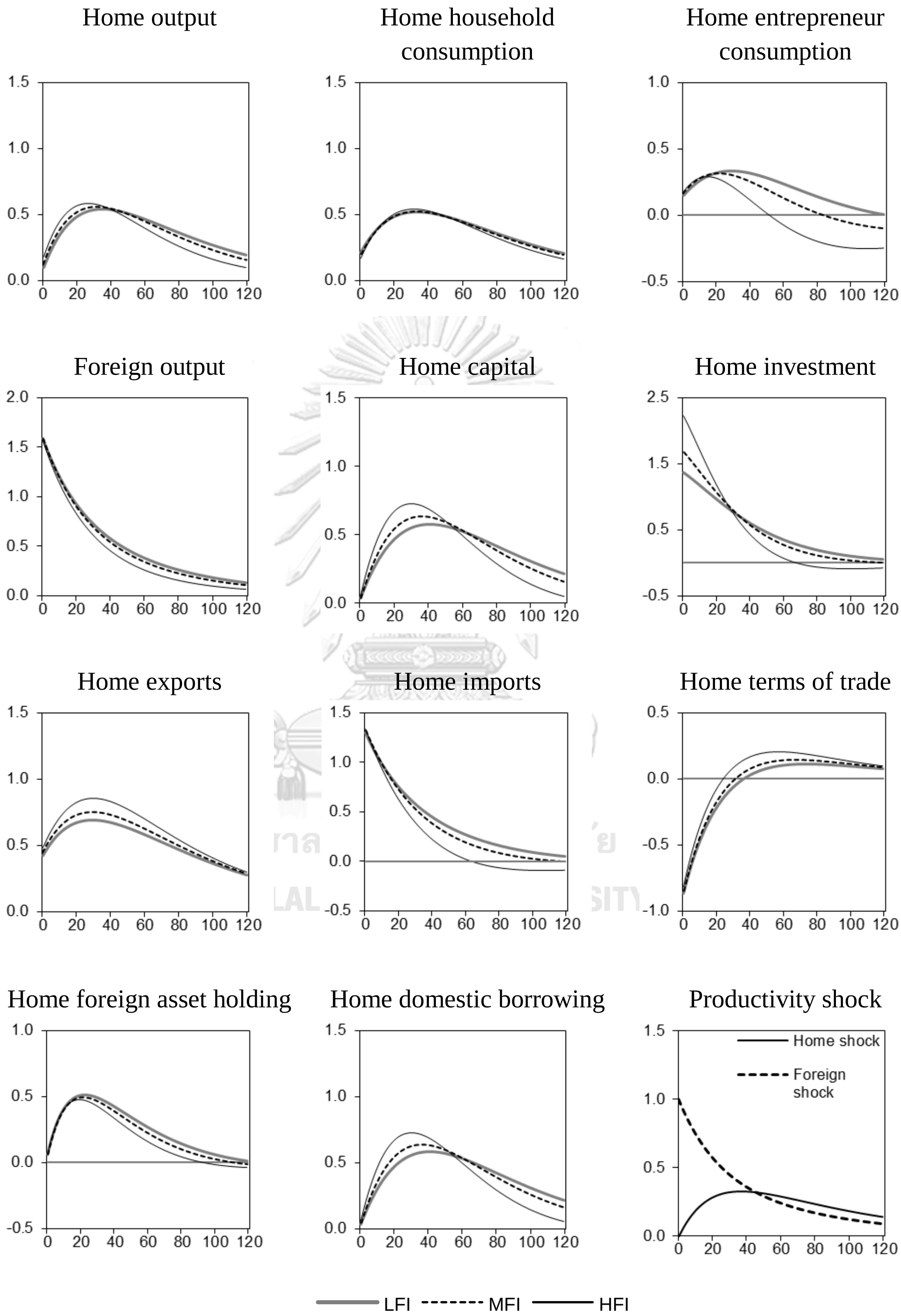
Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter.

Figure 6.3 Impulse response of main variables to domestic productivity shock for the case of high trade



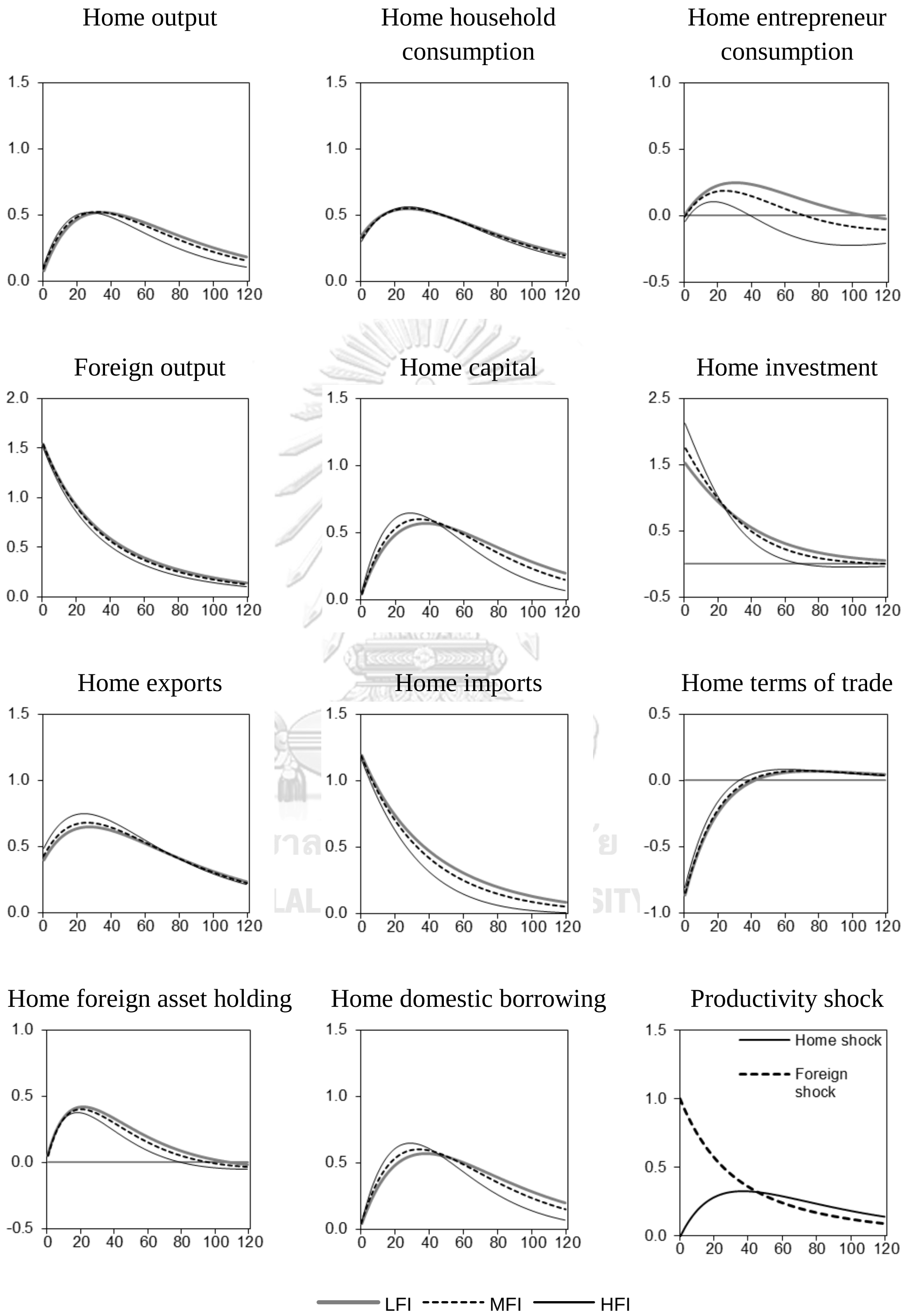
Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter.

Figure 6.4 Impulse response of main variables to foreign productivity shock for the case of low trade



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

Figure 6.5 Impulse response of main variables to foreign productivity shock for the case of high trade

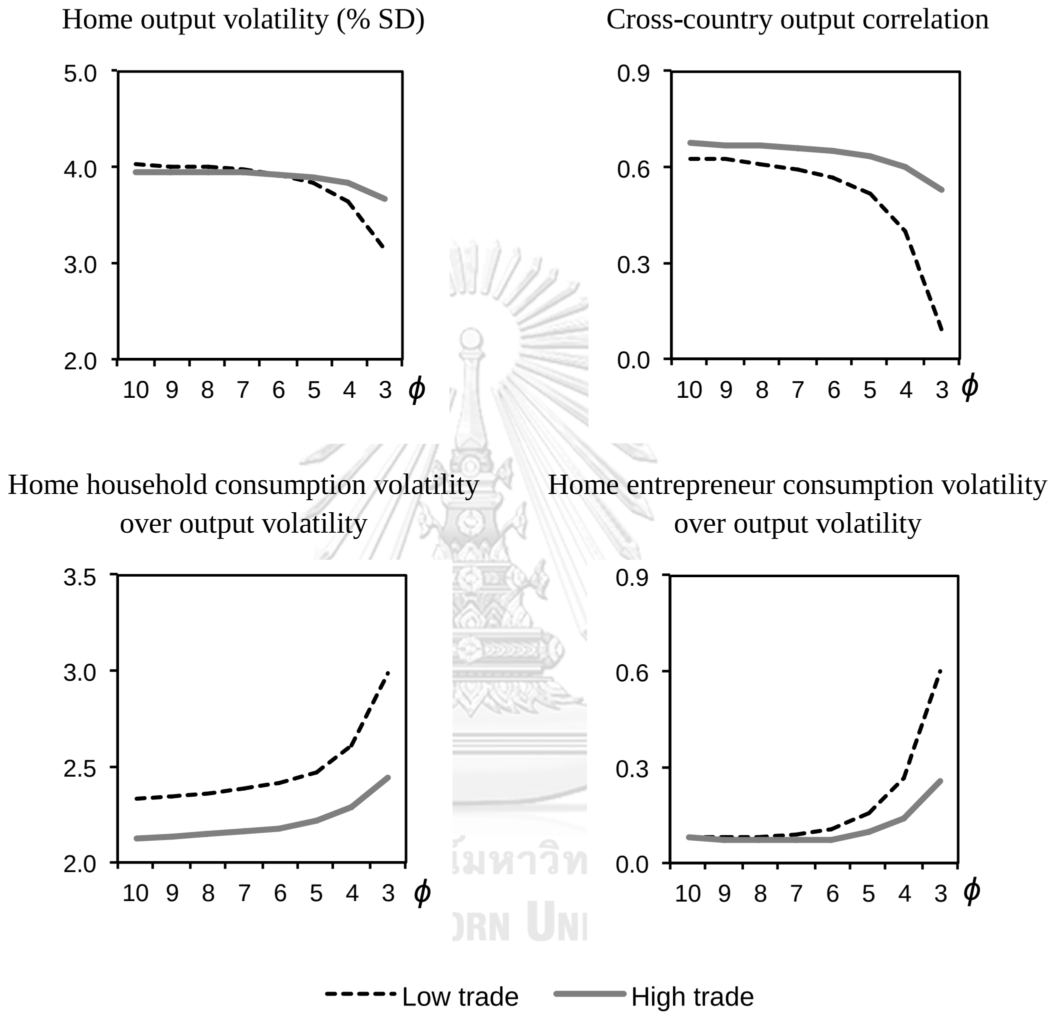


Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the foreign country; one period = one quarter.

Figure 6.4 and 6.5 show the responses of key variables to foreign productivity shock. Most variables respond to the shocks in home and foreign countries in the same directions, but with different magnitude. The exception is the price-related variables, which respond in different directions. In response to the home shock, the terms of trade worsen for the home country. The home intermediate goods price q^a decreases, while the foreign intermediate goods price q^b increases. The opposite is observed with the shock coming from the foreign country. Home (foreign) variables are more responsive to home (foreign) shocks. The spillover from foreign country to home country is more pronounced than the opposite direction due to the parameterization of the productivity processes. It can be noticed that the responses of home output, capital, and domestic borrowings under three levels of FI reverse at certain points after the initial shock. This is possibly because the foreign shock seems to dominate in earlier periods. Under higher FI, the cross-border financial linkages are larger, and the positive foreign shocks could transmit more to the home country, resulting in these three variables becoming more responsive as FI increases. However, as the foreign shocks dissipate and home shocks play more roles, these three variables are less responsive under higher FI.

6.5.4. The Combination of Financial and Trade Integration

Figure 6.6 The volatility and correlation from varying levels of adjustment cost parameter, ϕ



Note: The values of ϕ equal to 1 and 2 lead to explosive simulated series under second-order approximation. Moments cannot be computed. Thus, these two cases are not included.

<u>*Extension to varying levels of ϕ*</u>

Extending the main results for a broader and finer range of foreign asset holdings by varying the values of adjustment cost coefficient ϕ between 3-10, Figure 6.6 depicts the results for the volatility of output, the volatility of consumption relative to output, and the cross-country output correlation. Lower values of ϕ correspond to larger sizes of cross-border asset trading and higher FI. The results in Figure 6.6 are consistent and further emphasize the main results. The initial increase of foreign asset holding seems to have small impact on macroeconomic volatility and comovement. The impacts become evident when FI reaches certain levels around the ϕ values of 6-7, which corresponds to net foreign asset of about 14-18 percent to output in the model. This can be viewed as related to the concept of threshold effect, which conjectures that the benefit of FI can only be realized when there is sufficient integration. Below the threshold level, FI can be insignificant or harmful.[53]

However, the inference regarding the precise threshold level should not be drawn from the results based on the adjustment cost coefficient or its corresponding amount of foreign asset holding. The reasons are that, firstly, the relationship between the parameter ϕ and the size of foreign asset holding is not linear due to the assumption of convex adjustment cost. For instance, the effect of decreasing ϕ from 8 to 7 on the degree of FI itself is already different from the effect of decreasing ϕ from 5 to 4. One implication is that it should not be taken as an evidence for a possible inverted relationship such as an optimal level of FI.

Secondly, the model assumes only one type of assets traded and that the home country is an investor, so it seems ambitious to deduce overall level of FI the country should achieve from a smaller component.

Furthermore, the effects of financial and trade integration might be intertwined. Higher TI delays the impact of increased foreign asset investment taking place, as can be seen from the figures that the low trade lines become steeper earlier than the high trade lines as ϕ decreases. This suggests that the country could engage more in foreign financial markets without much consequence on business cycles if trade intensity is enhanced at the same time. In a way, increasing FI with sufficient trade will not hurt the consumer's consumption smoothing, but the benefits of FI, if any, will likely not be gained either.

The effect of FI depends on trade and accessibility

As discussed earlier, these could be viewed as stronger effect of FI on volatility and comovement under low trade and weaker effect under high trade, which is observed for both positive and negative relationships. Since most of the separate effects of FI and TI are in opposite directions, there is more possibility that they offset each other at higher trade, making the effect of increasing FI seems less significant. The implications are that trade could help lessen the adverse impact of FI on consumption fluctuation, whereas FI could help reduce output volatility and cross-country comovement when

[53] See Kose et al. (2011) and Chen and Quang (2014) for examples of researches on the threshold effects of FI.

trade increases them. Thus, this supports the view that trade and FI are complementary; they should work together in stabilizing the economy. The view that financial and trade integration support each other and should go hand in hand is suggested by International Monetary Fund (2002, 2015b) and Pancaro (2010) for example.

Nevertheless, the high trade can only weaken the effect of FI, but it does not reverse the relationship of FI with macroeconomic volatility and business cycle synchronization. Figure 6.6 also shows different experiences between people with and without access to international financial markets. These suggest that the desirable level of FI depends on TI and financial accessibility and there seems to be no absolute optimal degree of FI.[54]

Desirable financial and trade integration mix

Searching for a desirable combination of financial and trade integration is also not straightforward because there is a trade-off among the effects. Contingent on the results from this study, FI lowers output volatility and business cycle synchronization, but increases consumption volatility, while trade increases cross-country output comovement, but lowers consumption volatility. Furthermore, the consequences of integration are multidimensional, but only the volatility seems applicable to be used as a criterion. There is no apparent preference in the literatures whether higher or lower synchronization is better and the resilience to shocks is difficult to quantitatively rank.

If supposing that high correlation provides more opportunity to share risk across countries and hence the higher output comovement the better, four criteria can be established.[55] These are the volatility of output, the volatility of household's consumption, the volatility of entrepreneur's consumption, and cross-country output comovement, where the lower volatility the better. The comparison is carried out by ranking the values of volatility and correlation for all scenarios, and then picking the combinations of financial and trade integration that have relatively good ranks in all four criteria. The ranks are presented in Appendix E.1.

Comparing all scenarios presented in Figure 6.6, the combinations of FI and TI that fare well in all four criteria are when ϕ equals to 6 under low trade, and ϕ ranging between 4 to 7 under high trade. The results suggest that higher international trade could

[54] The research on optimal FI has not received much attention and the evidences may be insufficient to arrive at a conclusion that there exists an optimal level of FI. Additionally, the questions may not reach the state of too much financial integration yet as many countries still have low level of FI, unlike domestic financial development. Thus, the literature pays more attention to finding the threshold where international financial markets are integrated enough for the country to start gaining benefit.

[55] This assumption is not unacceptable since the output correlations from the simulation are not very high, ranging around 0.5 to 0.7.

allow for a broader range of suitable FI, whereas only one level of cross-border asset investment yields good results when trade is low. In other words, higher trade gives more flexibility in terms of the choice of foreign asset size that are beneficial and not detrimental to the economy. A further experiment has been done to analyze the case of even higher trade than the main scenarios studied. The trade parameter ω is arbitrary set to 0.41, which is the parameter obtained from advanced economies. The results presented in Appendix E.1 show that suitable FI range for a higher trade level is around ϕ between 10 to 4, which is broader. The results additionally confirm the conjecture here.

Another takeaway is that the medium size of foreign asset holding seems to be more favorable to the business cycles than high and low levels. This is intuitive both from the results and from the trade-off between diversification benefit and contagion risk associated with financial globalization.

Pareto improvement

The last analysis on integration mix is regards to Pareto improvement for the home country in the case of low trade. Pareto improvement in this context is referred to an increase of foreign asset holding, trade, or both that lowers at least one volatility considered while not increases other volatilities. Three volatilities considered are home output, home households' consumption, and home entrepreneurs' consumption. Table 6.8 summarizes which changes in the degree of integration moving from the left column to the top row constitute Pareto improvement. P denotes the Pareto improving. Only the increase of integration is considered, shown in the top right triangle.

For the countries with low TI to attain lower variability, the Pareto improvement is to increase the two types of integration at the same time, or for some cases, to enhance only TI. Increasing only cross-border financial investment given certain level of trade is not Pareto improving since it worsens consumption smoothing. Table 6.9 illustrates one example. Starting from low trade with ϕ = 5, increasing both FI (to ϕ = 4) and trade (to high) will result in lower volatility for all three variables, whereas increasing only either foreign asset investment or trade is not Pareto improving.

Although no move is considered as Pareto improving under the case of high trade, it does not mean that these combinations constitute Pareto optimum, and it seems impractical to find one. This is because the levels of integration are, at least ideally, not strictly bounded by resource constraints. The country can always integrate deeper if there is a right balance between two types of integration that benefit the country.

Table 6.8 Pareto improvement from the increased level of integration

From \ To Trade	Trade ϕ	Low trade 10	9	8	7	6	5	4	3	High trade 10	9	8	7	6	5	4	3
Low trade	10		-	-	-	-	-	-	-	P	P	P	P	P	-	-	-
	9			-	-	-	-	-	-		P	P	P	P	-	-	-
	8				-	-	-	-	-			P	P	P	-	-	-
	7					-	-	-	-				P	P	-	-	-
	6						-	-	-					P	P	-	-
	5							-	-						-	P	-
	4								-							-	-
	3																-
High trade	10										-	-	-	-	-	-	-
	9											-	-	-	-	-	-
	8												-	-	-	-	-
	7													-	-	-	-
	6														-	-	-
	5															-	-
	4																-
	3																

Note: P = Pareto improving; - = not Pareto improving; the grey cell means no change in the degree of integration; the blank cell means a decrease of integration, which is not considered in this analysis.

Table 6.9 Example of Pareto improvement

Trade	ϕ	Output volatility (%SD)	Household relative consumption volatility	Entrepreneur relative consumption volatility
Low	5	3.85	2.48	0.15
Low	4	3.66	2.60	0.26
High	5	3.90	2.22	0.09
High	4	3.83	2.29	0.14

Note: the consumption volatility reported is relative to the output volatility.

<u>*Comparison with previous studies*</u>

The model seems able to capture the relationships found in empirical studies to some extent. Most of the individual impacts of FI or TI alone on macroeconomic volatility and business cycle synchronization are largely consistent with empirical findings. Caveats are that for some relationship such as trade and consumption volatility, the empirical evidences themselves are still inconclusive. However, empirical researches do not focus much on the joint effect of financial and trade integration.

A few DSGE papers explore this issue under the setting of general or developed countries and found that the impacts of financial and goods market integration on business cycle are broadly independent. For instance, Senay (1998) investigated macroeconomic volatility in general and symmetric countries with adjustment cost in foreign asset trading similar to this study. Kose and Yi (2006) explored the impact of transportation cost and different asset market structures on business cycle synchronization in OECD countries. They concluded that the effect of international trade is similar regardless of the types of international financial arrangement. The findings from this chapter are partly in line with earlier studies in the sense that the direction of FI effect does not change with varying degrees of trade. What this paper has found in addition is that the magnitude differs. The impact of FI, either good or bad, is more pronounced when a country has lower trade and weakened when a country already has higher trade.

6.5.5. Sensitivity Analysis

To test the robustness of the main findings, this section analyzes the sensitivity of the results to the choices of three key parameters and the shock process.

First, the ratio of entrepreneur's domestic debt to asset value or the parameter m in the borrowing constraint is increased from 0.07 to 0.14. As discussed previously, this parameter represents the domestic credit to private sector and implies the level of domestic financial development. The value of m = 0.14 chosen here is obtained from 2000-2013 average of domestic credit to private sector from 35 advanced economies, which equals to 110 percent of GDP. The data is from WDI. The data source and computation are the same as EMEs in Section 6.4.3. The results in Table 6.10 show very similar patterns and magnitude to the benchmark case with slightly larger volatility effect. The differences are not apparent likely because both parameter values are small.

Table 6.10 Main macroeconomic volatility and output correlation when the borrowing constraint parameter m = 0.14

	Low trade			**High trade**		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Output volatility (%SD)	4.05	3.99	3.83	3.99	3.98	3.92
Household consumption volatility	2.34	2.39	2.51	2.13	2.16	2.23
Entrepreneur consumption volatility	0.08	0.09	0.17	0.07	0.07	0.10
Output correlation	0.62	0.59	0.50	0.67	0.66	0.63

Note: The other parameters are kept at their benchmark values. The consumption volatility in the tables is the ratio of the standard deviation of consumption over the standard deviation of output. The statistics are the averages of 500 simulations, each 400 periods long.

Second, the proportion of the households who can access international financial markets is increased from n = 0.2 to n = 0.5. The value of 0.5 is arbitrarily chosen to examine the symmetric setup between people with and without international financial access or between the savers and the investors. The proportion n = 0.5 was used by Devereux and Sutherland (2011b) for example.

The effects of international integration on the volatility and correlation as reported in Table 6.11 still have similar patterns as the benchmark case but with larger magnitude. More people engaging in cross-country asset trading raise the total amount of foreign asset holding. The output volatility is significantly higher and the impacts of FI on consumption volatility of the entrepreneur and output correlation are much stronger under low trade.[56] The value of consumption volatility of the households over output volatility may looks much smaller, but this is mainly the effect from significant increase of output volatility.

Table 6.11 Main macroeconomic volatility and output correlation when the proportion of household n = 0.5

	Low trade			**High trade**		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Output volatility (%SD)	9.19	8.94	8.31	8.83	8.73	8.50
Household consumption volatility	0.86	0.88	0.93	0.74	0.75	0.78
Entrepreneur consumption volatility	0.08	0.11	0.27	0.08	0.09	0.15
Output correlation	0.54	0.44	0.10	0.63	0.60	0.52

Note: The other parameters are kept at their benchmark values. The consumption volatility in the tables is the ratio of the standard deviation of consumption over the standard deviation of output. The statistics are the averages of 500 simulations, each 400 periods long.

Third, the elasticity of substitution between domestic and foreign goods or σ in 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) and Pancaro (2010). Lower elasticity in the Armington aggregator means the domestic and foreign goods are more complements, and higher elasticity means the goods are more substitutions (Kose & Yi, 2006). Kose and Yi (2006) argue that under lower Armington elasticity, comovement and its responsiveness to changes are expected to be higher. According to the results in Table 6.12, both are observed. The cross-country output correlations are slightly higher and exhibit larger changes to increased FI than the benchmark case. The overall results

[56] The results from increasing the proportion of the households cannot be equivalently interpreted as the consequences of increasing financial accessibility because the two types of consumers differ not only in the access to finance, but also other aspects that impact the business cycles. The analysis here is only for the sensitivity analysis purpose.

are not qualitatively much different from the main results, but the magnitude and responsiveness are much larger especially for the case under low trade.

Table 6.12 Main macroeconomic volatility and output correlation when the elasticity of substitution between domestic and foreign goods σ = 0.9

	Low trade			**High trade**		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Output volatility (%SD)	4.13	4.00	3.64	4.15	4.11	3.96
Household consumption volatility	2.56	2.58	2.47	2.42	2.46	2.54
Entrepreneur consumption volatility	0.14	0.26	0.98	0.09	0.11	0.23
Output correlation	0.66	0.44	0.04	0.79	0.75	0.64

Note: Since the parameters are chosen to fit the elasticity value of 1.5, the second-order approximation of the model under σ = 0.9 yields explosive simulation. Hence, the model is solved adopting the first-order approximation instead. The other parameters are kept at their benchmark values. The consumption volatility in the tables is the ratio of the standard deviation of consumption over the standard deviation of output. The statistics are the averages of 500 simulations, each 400 periods long.

Lastly, different shock process is adopted. In the main results, the shocks for domestic and foreign countries are correlated, not symmetric, and can spillover across countries. Here, the shocks are assumed to be uncorrelated, symmetric between countries, cannot spill over, and have lower persistence. The parameters for the productivity process are taken from Leblebicioğlu (2009). The autocorrelation is set to equal 0.95. The standard deviation of the shocks is the same for domestic and foreign countries and equals to 0.007. Both are lower than the benchmark case. The results are reported in Table 6.13. The cross-country output comovements are notably lower because shocks do not transmit from one country to another. Increasing cross-border asset trade almost has no impact on the output correlation. The magnitude of the output volatility is also smaller as a result of lower shock persistence and standard deviation. Other qualitative effects from the main results still largely hold under a different productivity process but with smaller magnitudes.

Table 6.13 Main macroeconomic volatility and output correlation when shocks are less persistent and uncorrelated

	Low trade			High trade		
	LFI	**MFI**	**HFI**	**LFI**	**MFI**	**HFI**
Output volatility (%SD)	1.21	1.18	1.11	1.20	1.19	1.18
Household consumption volatility	2.33	2.42	2.61	2.15	2.20	2.30
Entrepreneur consumption volatility	0.12	0.17	0.34	0.08	0.10	0.20
Output correlation	0.16	0.16	0.16	0.18	0.18	0.17

Note: The other parameters are kept at their benchmark values. The consumption volatility in the tables is the ratio of the standard deviation of consumption over the standard deviation of output. The statistics are the averages of 500 simulations, each 400 periods long.

For all four cases, many key findings are preserved from the main results although the magnitudes of the impacts are sensitive to the choice of some parameters. The impacts of increased cross-border financial transactions on output volatility and comovement are still weaker under high trade. The observation that high FI coupled with low trade greatly impairs consumption smoothing of the entrepreneur is highly robust. Other robust results are that higher foreign asset holding lowers output volatility and output comovement but increases consumption volatility, and trade raises business cycle synchronization and improves consumption smoothing.

6.6. Conclusion

This chapter has developed a two-country DSGE model to examine the joint effect of increasing financial and trade integration on business cycles of emerging market economies under the case of foreign asset investment. The model incorporates three market imperfections, which are adjustment cost of cross-border asset holding, domestic leverage constraint, and asymmetric access to international financial markets among domestic consumers.

The main finding is that the effects of FI as measured from foreign asset investment and TI are intertwined. The impact of increasing cross-border asset holding on macroeconomic volatility and comovement tends to be stronger when trade intensity is low, and weaker when trade intensity is high because the individual effects of two integrations might offset each other. The implications are that TI could help lessen the adverse impact of FI on consumption fluctuation. On the other hand, FI could help stabilize output and lower dependence of the economy on foreign countries when trade increases both output volatility and cross-country comovement. These suggest that financial and trade integration could supplement each other in stabilizing the economy of emerging markets. Furthermore, there might be a certain range of integration mixes that are preferable than other combinations. The medium amount of foreign asset holding together with sufficient trade seems more favorable to the business cycles of EMEs. Higher trade intensity could provide flexibility to integrate deeper financially with not much negative consequence to the economy. However, determining the precise optimal combination between financial and trade integration is impractical and beyond the scope and tools of this study.

Apart from trade, the results also reveal that financial accessibility and friction might play an important role in how international integration impacts heterogeneous consumers. There is no consumption smoothing benefit for either people who can or cannot access foreign financial markets when there are financial frictions in both international and domestic financial markets. Increased cross-border financial investment could bring about large consumption volatility for people who have limited financial access when trade intensity is low. At high trade intensity, this negative impact is lessened. In contrast, households with direct financial linkages have higher consumption correlation with foreign households, suggesting that they would be more affected by a foreign consumption shock.

The robustness of these findings is examined using alternative parameter values. The main results are qualitatively robust although the magnitudes of the impacts are sensitive to the choice of some parameters.

Policy implications could be drawn from the findings. First, for the emerging market countries that already have high trade intensity, increasing cross-border asset holding could help lower output fluctuation slightly, while should not increase the volatility of consumption much with the mitigation effect from trade. For the emerging markets with currently low trade and market imperfections, deepening FI without sufficient international trade may greatly dampen consumption smoothing for some groups of people in the economy. This relates to the concept of sequencing of liberalization, which conjectures that a country should liberalize trade first before capital account liberalization.[57] However, this does not mean that countries with low trade should refrain from international financial activity. Rather, extra cautions should be taken and policies concerning international integration should be considered collectively. Integrating deeper in both financial and goods markets may be a better policy choice under some circumstances than pursuing integration only in one of the markets. Given multifaceted consequences of financial and trade integration beyond just business cycles, there seems to be no one-size-fits-all combination, and the desirable levels depend on the policymaker's discretion. Another important

[57] For the literatures on the sequencing of liberalization, see for example, McKinnon (1993), Edwards (2001), Arteta et al. (2001) and Edwards and Van Wijnbergen (1986).

development is to simultaneously ease frictions and constraints both internationally and domestically, and to improve financial accessibility to make sure that no one is left out of risk-sharing opportunity since these factors could help emerging markets in achieving the benefits from international integration.

The shortcoming of this study is that incorporating convex adjustment cost might induce nonlinearity relationship among the variables and the parameters. The dividend the entrepreneurs receive from the adjustment cost might be one factor that contributes to the combined effect found. Nevertheless, it is needed as a model closure, which is commonly done in the literature. It is not included for the purpose of forcing the linkage between FI and TI. Thus, the findings must be applied in the light of the underlying assumptions. Other shortcomings are that the findings are based on a specific model, which investigates FI only in the aspects that the emerging market economy is the investor investing in bond and facing adjustment cost of asset holding. The study yields the resulting impacts of financial and trade integration that work in opposite directions. Hence, the results point toward a more balanced mix of integration.

Extensions to this paper would be to examine other types of FI such as equity market integration or opposite cross-border portfolio investment coming from the advanced economy. Trade integration could be alternatively modeled by a reduction of trade frictions instead of the preference parameter like the work by Kose and Yi (2006). Other functional forms of adjustment cost could be explored and risk-premium shock could be added to analyze yield differentials between domestic and foreign markets. See Mendoza and Smith (2014) and Buch et al. (2005) for instance.

Chapter 7
International Financial Access and Business Cycles in Emerging Markets

7.1. Introduction

The objective of this chapter is to examine the implication of international financial accessibility on business cycles and different types of people in emerging markets under varying degrees of trade and the presence of financial frictions. It aims to explore what happens if everyone in the emerging economy can access international financial assets but both cross-border borrowing and investment incur financial frictions. The study compares this full financial access with the situations when some people in the economy are restricted from international asset trading. How FI under imperfection impacts people and the economy and whether more financial access is better are the main questions for this research.

The study employs a two-country RBC model. Countries are identical except for the financial frictions and agent's inaccessibility to international financial market in the home country, which is assumed to be an emerging economy. Home worker households are savers who face adjustment cost when they invest, and home capital owner households are borrowers who are restricted by the leverage constraint. Moreover, home population may not be able to access world financial market in some cases. Foreign country is assumed to be a frictionless advanced economy where everyone can access international financial markets.

The model has some similarities to the model setup in Chapter 5 and 6, but is not a combination of those two models. This chapter focuses on who gets the access to foreign markets instead of how much FI level is given certain group of people have financial access. It compares three variations of the model inclusive of the case where everyone in the home country can access, contrary to varying financial parameter and asymmetric financial access in the first two studies. However, when there are common issues that have already been addressed in earlier chapters, discussion is shortened or omitted to avoid repetition.

This chapter explores FI in the aspect of agents' ability to access financial assets in international markets, which involve both saving and borrowing. More accessibility can be considered as removing restriction on people who initially cannot access world financial markets. These views are related to financial integration both as a reduction of frictions and constraints, and financial access and inclusion. Same as the studies in

Chapter 5 and 6, TI 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. Two levels of trade are combined with three types of financial access, leading to six cases to investigate.

The simulation results show that more access to international financial markets does not necessarily lead to lower aggregate fluctuation when there are market imperfections. People are not only impacted by their own financial accessibility, but they are also affected from the participation of other people in financial markets. Home saver households could smooth consumption better when more borrowers can access the markets, but home capital owners who are credit constrained do not gain consumption smoothing benefit from participation of more lenders. As for TI, it influences home capital owners more than home worker households, and plays more significant role in the business cycle synchronization than different types of financial accessibility.

The implications are that although no optimal form of financial accessibility is found, opening up more financially could be beneficial when implementing with accompanying measures. More people participating in the markets could support saving to smooth consumption and may improve overall risk sharing, but this should be supplemented with appropriate risk management tools like hedging to help the borrowers. Trade integration could also help lower aggregate fluctuation. Equally important is that everyone should be able to access and appropriately utilize both saving and borrowing opportunities, such as by reducing restriction, easing frictions, and improving financial literacy.

The rest of the chapter is structured as follows. Section 7.2 reviews related literatures. Section 7.3 describes the model economy and Section 7.4 discusses the aspects of FI explored and relevant issues. Section 7.5 presents parameter calibration. Results, findings, and discussion are in Section 7.6. Section 7.7 concludes.

7.2. Literature Review

This study is related to the literatures that investigate international financial access under heterogeneous agent framework. Agent heterogeneity within the same country has two implications. First, the country can have asymmetric financial access where only certain group of population can access international financial markets, while the rest do not. Second, everyone in the country does not need to act as the same type of market participants; one can be a saver, and the other can be a borrower.

The first strand of literatures focuses on the implication of asymmetric financial access mostly in the setting of developing and emerging economies where not everyone has access to finance. Among others, Leblebicioğlu (2009) employs a two-country RBC model where home country is an emerging market economy with market imperfections and only some groups of domestic consumers have international financial access. The results show that when there are frictions that limit the ability of agents to share risk, FI leads to higher volatility of consumption and output. People who have international access are better off with FI, while those who do not have the access are worse off as measured from welfare criteria. Other studies of restricted financial access in EMEs mostly adopt one-country model economy. Levchenko (2005) and Araujo (2008) study the consumption volatility of developing countries. Levchenko (2005) found that financial liberalization potentially benefits people who have access more than people without access. Calibrated to Mexico, Araujo (2008) found that FI increases consumption volatility when access is restricted, but decreases consumption volatility when all people have access to international finance. Buch and Pierdzioch (2009) investigate the financial accessibility for countries in general. They found that financial globalization could lower the volatility of consumption for people with international financial access. However, these papers generally examine the case when only certain kind of population have access to international finance, but not the reverse case or when no one is restricted, of which this study aims to explore along with TI.

The second strand of literatures incorporates within-country heterogeneous agents to investigate different roles of savers and borrowers rather than asymmetric financial access. These researches usually allow everyone in the economy the access to international financial markets. The closest study to this chapter is Devereux and Sutherland (2011b) who investigate the impact of FI as modeled by different asset market structures. Both domestic savers and borrowers have full access to finance. Under integration in both equity and bond markets, FI decreases macro volatility, increases comovement, and leads to welfare gain. The results are largely opposite when the cross holding of equity is not allowed. Iacoviello and Minetti (2006) and Perri and Quadrini (2011) adopt similar setup with lenders and borrowers, but do not study FI directly. Iacoviello and Minetti (2006) mainly focus at the debtor-creditor relationship with different technology of liquidations, and Perri and Quadrini (2011) try to explain the global financial crisis using multiple equilibrium framework. Ueda (2012) seeks to understand what circumstances a global economic downturn is likely to occur by examining the relationship between banking globalization and business cycle synchronization with investors, entrepreneurs, and financial institutions. The author’s main results indicate that banking globalization, unfavorable shocks to the net worth of financial institutions, and the credit constraints faced by financial institutions all play key roles in understanding the latest financial crisis. In addition, both financial and trade openness tend to strengthen the business cycle synchronization. However, these papers typically study advanced economies or general symmetric countries where everyone has financial access, neglecting the possibilities that some people might be restricted from accessing foreign markets and emerging economies have lower level of financial development than developed countries, which are the main goal of this chapter.

7.3. The Model Economy

The model economy is a two-country, two-sector IRBC model. 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 financial frictions and possible financial inaccessibility to reflect that developing countries tend to be less financially developed with more frictions and restrictions. Foreign country is assumed to be a developed country with frictionless markets and perfect financial access. Other than those, the two countries are identical. There are two kinds of heterogeneous consumers. A proportion n<1 of population in each country is the *worker household.* The worker households supply labor to the production sector and save to smooth consumption. Home worker households incur adjustment cost of asset holding when they save or invest, similar to the home households in Chapter 6. The other type of population with a share of $1-n$ is the capital owner household. The capital owners invest in physical capital, supply labor and capital to the production sector, and borrow to finance their investment. Home capital owners face the leverage constraint when they borrow, similar to the home entrepreneurs in Chapter 5. Foreign worker households and foreign capital owners do not face any friction or constraint. There are two types of firms. The *intermediate goods firms* produce intermediate goods and supply to both domestic and foreign productions of final goods. The other one is the *final goods firm* that combines intermediate inputs from both domestic and abroad into final goods for domestic consumption and investment.

This model setup uses a combination of features from many papers. The structure of firm and trade closely follows Heathcote and Perri (2002). The setup of two types of consumers and factors of production come from Buch and Pierdzioch (2009) and Bhattacharya and Patnaik (2013). The financial market structure is based largely on Devereux and Sutherland (2011b). The adjustment cost of asset holding is taken from Sutherland (1996) and Senay (1998), and the leverage constraint closely follows Leblebicioğlu (2009) and Pancaro (2010).

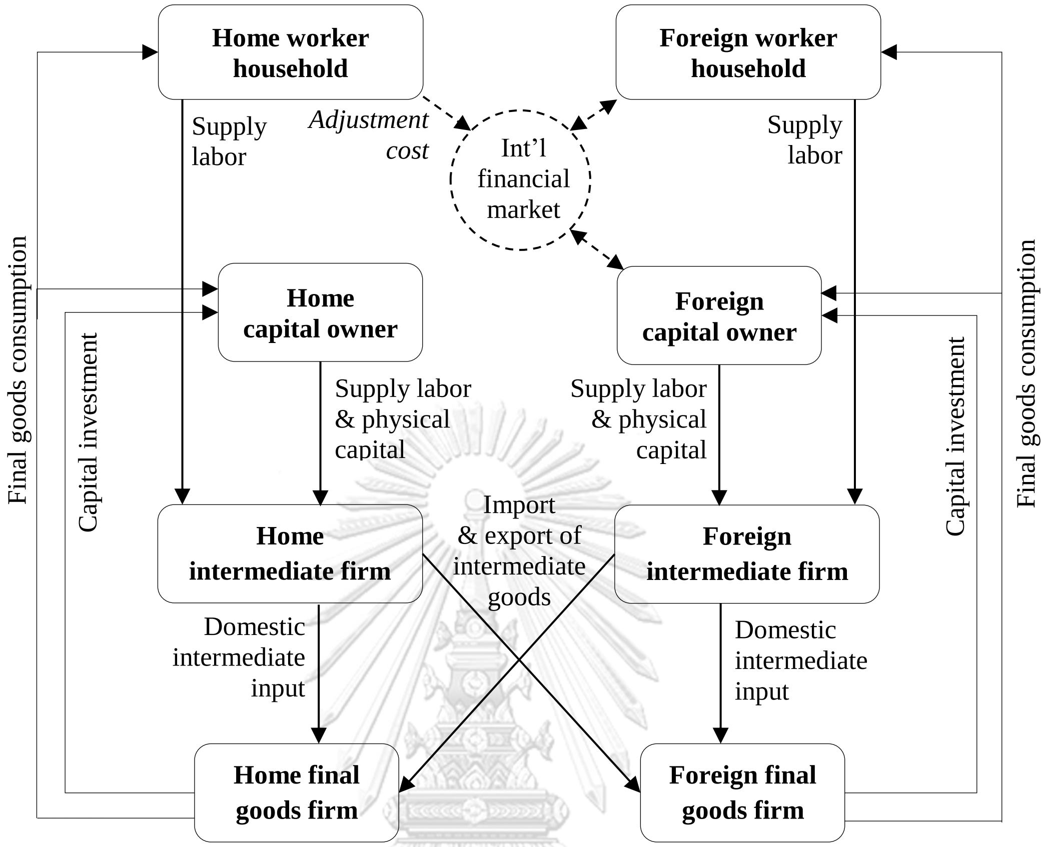
Financial transactions are assumed to be facilitated by financial intermediaries. The financial assets are modeled by risk-free non-contingent bonds as a proxy for deposits, loans, and portfolio investment. All merchandise goods are differentiated and can be freely traded across countries with no trade friction. These assumptions and many parts of the model setup are similar to those in Chapter 5 and 6. The rationales behind are the same, and some elaborations are repetition and hence, omitted.

As this study examines FI in the aspect of access to international financial markets, it comprises of three sub-models that differ only in the financial accessibility of the home population. Model H is when home worker households can access international financial markets, but home capital owners cannot. Model O is the reverse; home capital owners can access international financial markets, but home worker households do not have the access. Lastly, model A is when everyone in the home country has financial access to international markets. All home residents still face the same financial frictions nevertheless. Under all three scenarios, both kinds of foreign population have perfect access to financial assets and face no frictions.

Figure 7.1 to 7.3 illustrate the overall model structure for model H, O, and A respectively. The dash lines in the figures represent financial sector. The arrows show the direction of financial flow. Financial asset position of foreign population is not specified and both directions of financial flow are possible.

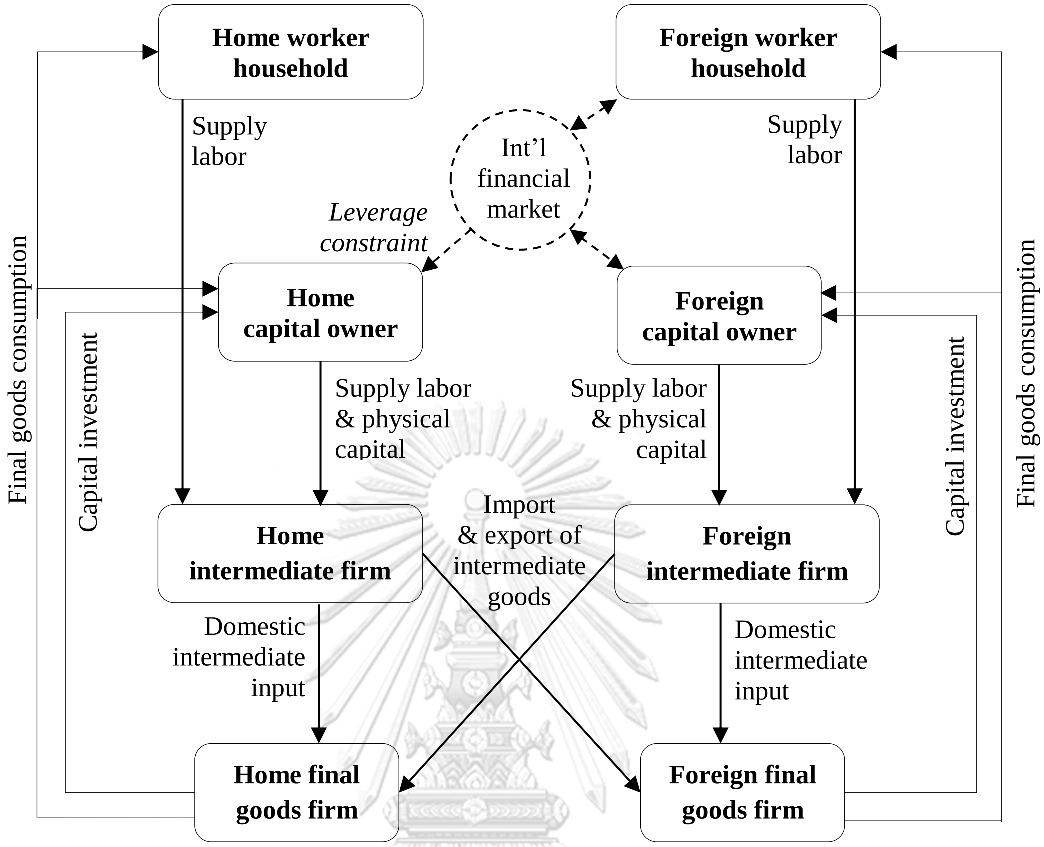
Table 7.1 summarizes the variables and their descriptions. The last three columns show whether variables are present or not in the three sub-models. Subscript *1* and *2* denote the variables related to home country and foreign country respectively. Superscript h denotes worker households and superscript o denotes capital owners. Model H and O where only one type of home population has access can be viewed as a smaller part of model A; therefore, model A will be described first in Section 7.3.1 to 7.3.3 and Section 7.3.4 and 7.3.5 will discuss the other two financial scenarios.

Figure 7.1 The structure of model H



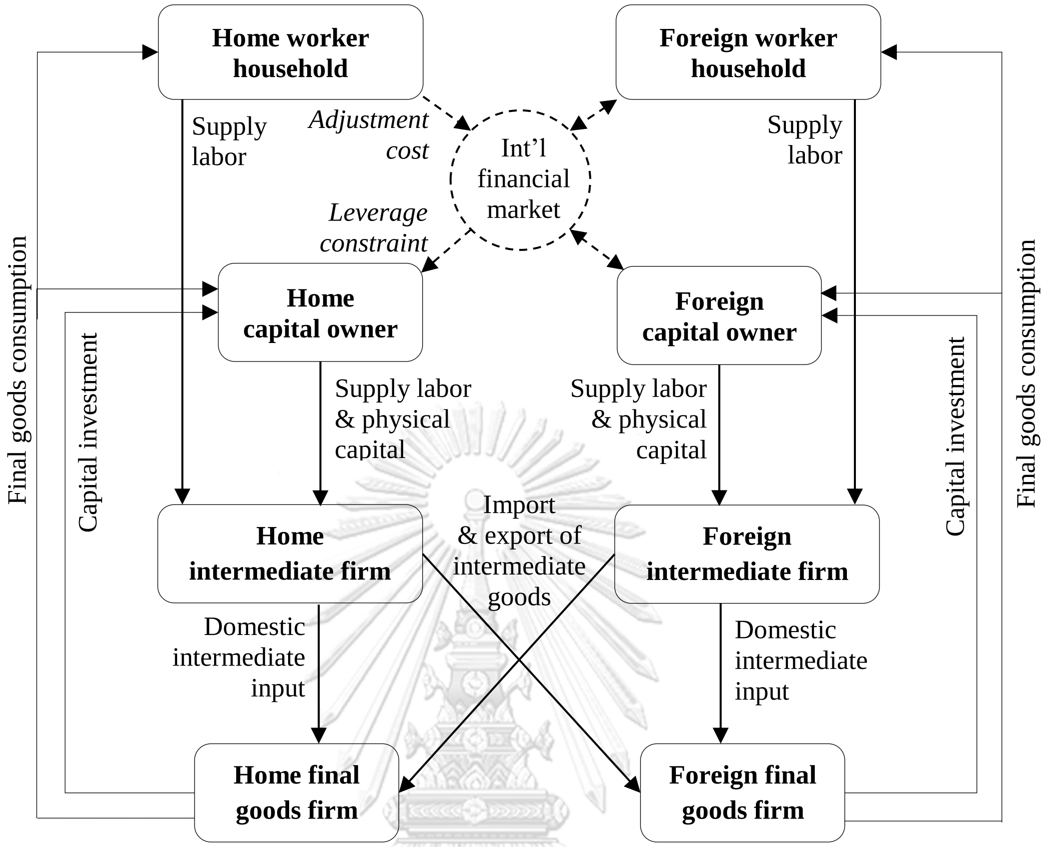
Note: Int'l = international.

Figure 7.2 The structure of model O



Note: Int'l = international.

Figure 7.3 The structure of model A



Note: Int'l = international.

Table 7.1 Summary of variables

Variables	Descriptions	Model		
		H	O	A
U_1^h	Expected lifetime utility of home worker households	✓	✓	✓
U_1^o	Expected lifetime utility of home capital owners	✓	✓	✓
U_2^h	Expected lifetime utility of foreign worker households	✓	✓	✓
U_2^o	Expected lifetime utility of foreign capital owners	✓	✓	✓
C_1^h	Consumption of home worker households	✓	✓	✓
C_1^o	Consumption of home capital owners	✓	✓	✓
C_2^h	Consumption of foreign worker households	✓	✓	✓
C_2^o	Consumption of foreign capital owners	✓	✓	✓
Y_1	Home output	✓	✓	✓
Y_2	Foreign output	✓	✓	✓
K_1^o	Home physical capital	✓	✓	✓

Variables	Descriptions	Model		
		H	O	A
K_2^o	Foreign physical capital	✓	✓	✓
X_1^o	Home investment in physical capital	✓	✓	✓
X_2^o	Foreign investment in physical capital	✓	✓	✓
L_1	Home aggregate labor supply	✓	✓	✓
L_2	Foreign aggregate labor supply	✓	✓	✓
L_1^h	Labor supply of home worker households	✓	✓	✓
L_1^o	Labor supply of home capital owners	✓	✓	✓
L_2^h	Labor supply of foreign worker households	✓	✓	✓
L_2^o	Labor supply of foreign capital owners	✓	✓	✓
w_1	Home wage	✓	✓	✓
w_2	Foreign wage	✓	✓	✓
r_1	Home rent	✓	✓	✓
r_2	Foreign rent	✓	✓	✓
G_1	Home final goods	✓	✓	✓
G_2	Foreign final goods	✓	✓	✓
a_1	Home-produced intermediate goods used in the production of home final goods	✓	✓	✓
a_2	Home-produced intermediate goods used in the production of foreign final goods (home exports)	✓	✓	✓
b_1	Foreign-produced intermediate goods used in the production of home final goods (home imports)	✓	✓	✓
b_2	Foreign-produced intermediate goods used in the production of foreign final goods	✓	✓	✓
P_1	Price of home final goods	✓	✓	✓
P_2	Price of foreign final goods	✓	✓	✓
q^a	Price of home-produced intermediate goods	✓	✓	✓
q^b	Price of foreign-produced intermediate goods	✓	✓	✓
D_1^h	Asset holding of home worker households	✓		✓
D_1^o	Borrowing of home capital owners		✓	✓
D_2^h	Asset holding of foreign worker households	✓	✓	✓
D_2^o	Asset holding of foreign capital owners	✓	✓	✓
Q	Price of financial assets	✓	✓	✓
I	International net fund transfer of home worker households	✓		✓
λ	Lagrange multiplier on the leverage constraint		✓	✓
A_1	Home technology shock	✓	✓	✓
A_2	Foreign technology shock	✓	✓	✓

Note: H = only home worker households have financial access; O = only home capital owners have financial access; A = all domestic consumers have financial access.

7.3.1. Home Country

7.3.1.1. Home Worker Households

Worker households supply labor L^h_{1t} to intermediate goods sector, receive wage w_{1t}, and save to smooth consumption. They maximize an expected lifetime utility defined over consumption C^h_{1t} and labor as follows.

$$U^h_{1t} = E_t \sum_{t=0}^{\infty} \beta^t \left[\ln(C^h_{1t}) - \frac{\kappa}{\eta} (L^h_{1t})^\eta \right] \tag{7-1}$$

where β is their discount factor, κ is the labor weight parameter, and η is the labor disutility parameter. The form of utility function is taken from Pancaro (2010) and Senay (1998).

When home worker households can access international financial markets, they invest in non-contingent bonds with the amount D^h_{1t} and the price Q_t. They pay adjustment cost $\frac{\phi}{2} {I_t}^2$ when they trade international assets. The cost is a function of adjustment cost coefficient ϕ that indicates the size of the cost, and the amount of cross-border net fund transfer I_t each period. I_t is defined as the difference between current-period bond holding, $Q_t D^h_{1t}$, and previous-period bond holding $D^h_{1,t-1}$;

$$I_t = D^h_{1,t-1} - Q_t D^h_{1t} \tag{7-2}$$

The adjustment cost is convex and based on Sutherland (1996) and Senay (1998). It is a financial friction that could represent the transaction cost, the brokerage fee, the learning costs, or cross-border restrictions. This adjustment cost is the same as in Chapter 6. The use, the interpretation, and the implication of the adjustment cost are already discussed in Chapter 6 throughout, and in particular Section 6.3.1 and Section 6.4.1.

All the above features result in the budget constraint of the home worker households as follow;

$$P_{1t} C^h_{1t} + Q_t D^h_{1t} \leq w_{1t} L^h_{1t} + D^h_{1,t-1} - \frac{\phi}{2} {I_t}^2 - \frac{\psi}{2} \left(D^h_{1t} - \overline{D^h_1} \right)^2 \tag{7-3}$$

where P_{1t} is the price of home final goods. The last term, $\frac{\psi}{2} \left(D^h_{1t} - \overline{D^h_1} \right)^2$ is a small cost included for the purpose of making the asset's law of motion stationary (Schmitt-Grohé & Uribe, 2003), where $\overline{D^h_1}$ denotes the steady state value of D^h_{1t}. This small stationary-inducing feature has no effect on the non-stochastic steady states. It serves for different purpose and functions separately from the main adjustment cost $\frac{\phi}{2}{I_t}^2$.

The worker households choose the optimal levels of consumption, labor, and asset holding to maximize the utility subject to the budget constraint. First order conditions of the optimization problem with respect to L_{1t}^h and D_{1t}^h are

$$\frac{w_{1t}}{P_{1t}} = \kappa C_{1t}^h \left(L_{1t}^h\right)^{\eta-1} \quad (7\text{-}4)$$

$$\frac{1}{P_{1t}C_{1t}^h}\left[Q_t(1-\phi I_t)+\psi\left(D_{1t}^h-\overline{D_1^h}\right)\right] = \beta E_t \frac{1}{P_{1,t+1}C_{1,t+1}^h}(1-\phi I_{t+1}) \quad (7\text{-}5)$$

Equation (7-4) describes the optimal labor supply choice. The real wage is equated to the marginal rate of substitution between labor and consumption. Equation (7-5) is the Euler equation. It describes the intertemporal consumption choice taking into account the cost of cross-country asset holding. The term $\psi\left(D_{1t}^h-\overline{D_1^h}\right)$ is negligible and absent in the non-stochastic steady state.

7.3.1.2. Home Capital Owners

Capital owner households consume final goods C_{1t}^o, and supply labor L_{1t}^o and capital $K_{1,t-1}^o$ to intermediate goods sector. Their preference is;

$$U_{1t}^o = E_t \sum_{t=0}^{\infty} \nu^t \left[\ln(C_{1t}^o) - \frac{\kappa}{\eta}(L_{1t}^o)^\eta\right] \quad (7\text{-}6)$$

The functional form and parameters are analogous to the worker households. The discount factor ν of home capital owners is assumed to be smaller than home workers' discount factor β. In other words, the capital owners who are borrowers are less patient than the saver workers. This assumption ensures a binding leverage constraint, a unique asset position in the equilibrium, and that the capital owners are net borrowers as previously discussed in previous two chapters.

The capital owner households receive wage w_{1t} and rent r_{1t} for supplying factors of production. They invest X_{1t}^o in physical capital each period according to

$$X_{1t}^o = K_{1t}^o - (1-\delta)K_{1,t-1}^o \quad (7\text{-}7)$$

where δ is the depreciation rate.

When home capital owners can access international financial markets, they borrow in a form of non-contingent risk-free bonds with the amount D_{1t}^{o} and the price Q_t. They face the following leverage constraint when they borrow.

$$D_{1t}^{o} \leq mE_t(P_{1,t+1}K_{1t}^{o}) \tag{7-8}$$

The constraint restricts the borrowing to a certain proportion m of the value of pledged collateral or the asset size.[58] It plays a significant role in less financially-developed countries that have limited access to finance (Kose et al., 2011). The form and interpretation of the borrowing constraint are the same as in Chapter 5 and 6.

The home capital owners are also assumed to indirectly own a brokerage firm that facilitates cross-country financial asset trade. They have no control over the firms and cannot choose the amount of assets traded. They receive earning only as the dividend $R_t^{AC} = \frac{n_1}{1-n_1}\frac{\phi}{2}I_t{}^2$ from the profits of the firms, which they take as given. This assumption is the same as that of the home entrepreneurs in Chapter 6. More discussion is provided in Section 6.2.1.2.

From all the characteristics outlined, the capital owners' budget constraint is

$$\begin{aligned} &P_{1t}C_{1t}^{o} + P_{1t}X_{1t}^{o} + D_{1,t-1}^{o} \\ &\qquad \leq w_{1t}L_{1t}^{o} + r_{1t}K_{1,t-1}^{o} + Q_tD_{1t}^{o} + R_t^{AC} - \frac{\psi}{2}\left(D_{1t}^{o} - \overline{D_1^{o}}\right)^2 \end{aligned} \tag{7-9}$$

where the term $\frac{\psi}{2}\left(D_{1t}^{o} - \overline{D_1^{o}}\right)^2$ is a small cost included to induce stationarity.

The optimization problem of the capital owners is to choose the amount of capital, labor, and borrowing to maximize utility subject to the budget constraint, the capital accumulation, and the leverage constraint. First order conditions with respect to L_{1t}^{o}, K_{1t}^{o} and D_{1t}^{o} are

$$\frac{w_{1t}}{P_{1t}} = \kappa C_{1t}^{o}(L_{1t}^{o})^{\eta-1} \tag{7-10}$$

$$\frac{1}{C_{1t}^{o}} = \nu E_t \frac{1}{C_{1,t+1}^{o}}\left[\frac{r_{1,t+1}}{P_{1,t+1}} + (1-\delta)\right] + m\lambda_t E_t\left(P_{1,t+1}\right) \tag{7-11}$$

[58] The borrowing can be subject to adjustment cost of asset trading similar to the saving of worker households, but the credit constraint seems more relevant and critical when the borrowers take out loan rather than paying fees or other overhead costs.

$$\frac{1}{P_{1t}C_{1t}^{o}}\left[Q_t - \psi\left(D_{1t}^{o} - \overline{D_1^{o}}\right)\right] = \nu E_t\left(\frac{1}{P_{1,t+1}C_{1,t+1}^{o}}\right) + \lambda_t \qquad \text{(7-12)}$$

where λ_t is a Lagrange multiplier for the credit constraint.

Equation (7-10) describes the optimal decision of labor supply. Equation (7-11) describes the optimal allocation of capital. It equates the marginal utility of consumption to the marginal benefit of investing in the capital. The marginal benefit has an additional term $m\lambda_t E_t\left(P_{1,t+1}\right)$ due to the leverage constraint. Equation (7-12) is the consumption Euler equation with an additional term λ_t that takes into account the presence of the borrowing constraint.

7.3.1.3. <u>Home Intermediate Goods Firms</u>

Home traded intermediate goods firms produce intermediate goods a_t using total labor supply L_{1t} and physical capitals K_{1t} according to the Cobb-Douglas technology.

$$Y_{1t} = A_{1t}\left[(1-n_1)K_{1,t-1}^{o}\right]^{\alpha_1}(L_{1t})^{1-\alpha_1} \qquad \text{(7-13)}$$

where Y_{1t} is the home output, A_{1t} is the technology shock for the home tradable sector, and L_{1t} is the aggregate labor supply from a combination of two kinds of households as follow.

$$L_{1t} = n_1 L_{1t}^{h} + (1-n_1)L_{1t}^{o} \qquad \text{(7-14)}$$

The firms supply intermediate goods to both home and foreign final goods producing firms. The goods sold to domestic and foreign firms are denoted by a_{1t} and a_{2t} respectively. The firms choose the optimal levels of labor and capital to maximize period profit π_{1t}^{i} given by

$$\pi_{1t}^{i} = q_t^{a}Y_{1t} - w_{1t}L_{1t} - (1-n_1)r_{1t}K_{1,t-1}^{o} \qquad \text{(7-15)}$$

where q_t^{a} is the price of the intermediate goods. The goods market is assumed to be frictionless and the law of one price holds. First order conditions with respect to L_{1t} and $K_{1,t-1}^{o}$ are

$$w_{1t}L_{1t} = (1-\alpha_1)q_t^{a}Y_{1t} \qquad \text{(7-16)}$$

$$(1-n_1)r_{1t}K^{o}_{1,t-1} = \alpha_1 q^{a}_{t} Y_{1t} \tag{7-17}$$

Equation (7-16) and (7-17) define the optimal levels for factors of production. They equate the marginal benefits to the marginal costs of labor and capital.

7.3.1.4. Home Final Goods Firms

Home final goods firms are perfectly competitive. They produce final goods G_{1t} for domestic consumption and investment using domestic and foreign intermediate goods, a_{1t} and b_{1t} respectively, as inputs in Armington (1969) aggregator.

$$G_{1t} = \left[(1-\omega_1)a_{1t}^{\frac{\sigma-1}{\sigma}} + \omega_1 b_{1t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{7-18}$$

where σ denotes the elasticity of substitution between home and foreign intermediate inputs; $1-\omega_1$ is the weight of domestic intermediate goods a_{1t} and represents home biasness; and ω_1 is the weight of foreign intermediate goods b_{1t}. The weight ω_1 is a structural parameter that indicates the preference for foreign intermediate goods relative to domestic goods or the technology of final goods production from intermediate inputs. It is used to determine the degree of TI. A higher value of ω_1 induces more exports and imports, and hence, greater trade across countries. The relationship between ω_1 and TI is the same as established in Chapter 5 and 6 and discussion regarding TI in both chapters also applies here.[59]

The firms choose the optimal levels of intermediate inputs to maximize their profits π^{f}_{1t} given by

$$\pi^{f}_{1t} = P_{1t}G_{1t} - q^{a}_{t}a_{1t} - q^{b}_{t}b_{1t} \tag{7-19}$$

where q^{a}_{t} and q^{b}_{t} are corresponding prices of intermediate goods. Home final good is the numeraire and its price P_{1t} is set to equal one. First order conditions with respect to a_{1t} and b_{1t} are

$$(q^{a}_{t})^{\sigma}a_{1t} = (1-\omega_1)^{\sigma}P^{\sigma}_{1t}G_{1t} \tag{7-20}$$

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[59] The rational concerning modeling trade integration with the Armington weight parameter and their relationship are the same for all three studies in Chapter 5 to 7, but the notations are slightly different. This chapter resembles that of Chapter 6.

$$\left(q_1^b\right)^\sigma b_{1t} = \omega_1^\sigma P_{1t}^\sigma G_{1t} \tag{7-21}$$

Equation (7-20) and (7-21) show the optimal choices of intermediate goods inputs. They equate the marginal benefits to the marginal costs.

7.3.2. Foreign Country

7.3.2.1. Foreign Worker Households

Foreign worker households solve a similar problem to their home counterparts except that they always have access to international financial markets and do not incur any friction. Variables and parameters are defined analogously. Their preference and budget constraint are given by

$$U_{2t}^h = E_t \sum_{t=0}^{\infty} \beta^t \left[\ln\left(C_{2t}^h\right) - \frac{\kappa}{\eta}\left(L_{2t}^h\right)^\eta \right] \tag{7-22}$$

$$P_{2t}C_{2t}^h + Q_t D_{2t}^h \leq w_{2t}L_{2t}^h + D_{2,t-1}^h - \frac{\psi}{2}\left(D_{2t}^h - \overline{D_2^h}\right)^2 \tag{7-23}$$

The optimized first order conditions with respect to L_{2t}^h and D_{2t}^h are

$$\frac{w_{2t}}{P_{2t}} = \kappa C_{2t}^h \left(L_{2t}^h\right)^{\eta-1} \tag{7-24}$$

$$\frac{1}{P_{2t}C_{2t}^h}\left[Q_t + \psi\left(D_{2t}^h - \overline{D_2^h}\right)\right] = \beta E_t \frac{1}{P_{2,t+1}C_{2,t+1}^h} \tag{7-25}$$

The interpretation of the optimality conditions is similar to the home country.

7.3.2.2. Foreign Capital Owners

Foreign capital owner households solve a similar problem to their home counterparts except that they do not face any constraint. Variables and parameters are defined analogously. Their expected lifetime utility, budget constraint, and capital accumulation are given by

$$U_{2t}^{o} = E_t \sum_{t=0}^{\infty} \beta^t \left[\ln(C_{2t}^{o}) - \frac{\kappa}{\eta} (L_{2t}^{o})^{\eta} \right] \tag{7-26}$$

$$P_{2t}C_{2t}^{o} + P_{2t}X_{2t}^{o} + Q_t D_{2t}^{o} \leq w_{2t}L_{2t}^{o} + r_{2t}K_{2,t-1}^{o} + D_{2,t-1}^{o} - \frac{\psi}{2}\left(D_{2t}^{o} - \overline{D_2^{o}}\right)^2 \tag{7-27}$$

$$X_{2t}^{o} = K_{2t}^{o} - (1-\delta)K_{2,t-1}^{o} \tag{7-28}$$

First order conditions with respect to L_{2t}^{o}, K_{2t}^{o}, and D_{2t}^{o} are

$$\frac{w_{2t}}{P_{2t}} = \kappa C_{2t}^{o} (L_{2t}^{o})^{\eta-1} \tag{7-29}$$

$$\frac{1}{C_{2t}^{o}} = \beta E_t \frac{1}{C_{2,t+1}^{o}} \left[\frac{r_{2,t+1}}{P_{2,t+1}} + (1-\delta) \right] \tag{7-30}$$

$$\frac{1}{P_{2t}C_{2t}^{o}} \left[Q_t + \psi\left(D_{2t}^{o} - \overline{D_2^{o}}\right) \right] = \beta E_t \frac{1}{P_{2,t+1}C_{2,t+1}^{o}} \tag{7-31}$$

The interpretation of the optimality conditions is the same as the home country.

7.3.2.3. Foreign Firms

Foreign firms are symmetric to the corresponding home firms. Foreign intermediate goods firm produces intermediate goods b_t and sells it to both domestic and home final goods firm with the price q_t^b. Foreign final goods firms combine intermediate inputs to produce final goods. Their behaviors are given by equation (7-32) to (7-40). The interpretation of the optimality conditions is the same as the home country.

Foreign intermediate goods firms

$$Y_{2t} = A_{2t}\left[(1-n_2)K_{2,t-1}^{o}\right]^{\alpha_2} (L_{2t})^{1-\alpha_2} \tag{7-32}$$

$$L_{2t} = n_2 L_{2t}^{h} + (1-n_2)L_{2t}^{o} \tag{7-33}$$

$$\pi_{2t}^{i} = q_t^b Y_{2t} - w_{2t} L_{2t} - (1 - n_2) r_{2t} K_{2,t-1}^{o} \tag{7-34}$$

$$w_{2t} L_{2t} = (1 - \alpha_2) q_t^b Y_{2t} \tag{7-35}$$

$$(1 - n_2) r_{2t} K_{2,t-1}^{o} = \alpha_2 q_t^b Y_{2t} \tag{7-36}$$

<u>*Foreign final goods firms*</u>

$$G_{2t} = \left[\omega_2 a_{2t}^{\frac{\sigma-1}{\sigma}} + (1 - \omega_2) b_{2t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{7-37}$$

$$\pi_{2t}^{f} = P_{2t} G_{2t} - q_t^a a_{2t} - q_t^b b_{2t} \tag{7-38}$$

$$(q_t^a)^\sigma a_{2t} = \omega_2^\sigma P_{2t}^\sigma G_{2t} \tag{7-39}$$

$$\left(q_t^b\right)^\sigma b_{2t} = (1 - \omega_2)^\sigma P_{2t}^\sigma G_{2t} \tag{7-40}$$

7.3.3. Market Clearing Conditions

Home intermediate goods market:

$$Y_{1t} = a_{1t} + a_{2t} \tag{7-41}$$

Foreign intermediate goods market:

$$Y_{2t} = b_{1t} + b_{2t} \tag{7-42}$$

Home final goods market:

$$G_{1t} = n_1 C_{1t}^{h} + (1 - n_1) C_{1t}^{o} + (1 - n_1) X_{1t}^{o} \tag{7-43}$$

Foreign final goods market:

$$G_{2t} = n_2 C_{2t}^{h} + (1 - n_2) C_{2t}^{o} + (1 - n_2) X_{2t}^{o} \tag{7-44}$$

International bond market:

$$(1 - n_1)D_{1t}^{o} = n_1 D_{1t}^{h} + n_2 D_{2t}^{h} + (1 - n_2)D_{2t}^{o} \tag{7-45}$$

7.3.4. Model H: Home Worker Households Have the Access

When home capital owners are restricted from international asset trade, their budget constraint in equation (7-9) reduces to

$$P_{1t}C_{1t}^{o} + P_{1t}X_{1t}^{o} \leq w_{1t}L_{1t}^{o} + r_{1t}K_{1,t-1}^{o} + R_t^{AC} \tag{7-46}$$

The leverage constraint (7-8) and the first order condition with respect to D_{1t}^{o} (equation 7-12) are absent. The market clearing condition for international financial market changes to

$$0 = n_1 D_{1t}^{h} + n_2 D_{2t}^{h} + (1 - n_2)D_{2t}^{o} \tag{7-47}$$

The financial access of home worker households and both kinds of foreign households is the same as in model A.

7.3.5. Model O: Home Capital Owners Have the Access

When home worker households are restricted from international asset trade, their budget constraint in equation (7-3) reduces to

$$P_{1t}C_{1t}^{h} \leq w_{1t}L_{1t}^{h} \tag{7-48}$$

The first order condition with respect to D_{1t}^{h} (7-5) is absent and there is no net fund transfer (equation 7-2). The market clearing condition for international financial market changes to

$$(1 - n_1)D_{1t}^{o} = n_2 D_{2t}^{h} + (1 - n_2)D_{2t}^{o} \tag{7-49}$$

The financial access of home capital owners and both kinds of foreign households is the same as in model A.

7.3.6. Equilibrium and Solution Method

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. The solution method is the same as in preceding two chapters. The solutions are obtained by the second-order perturbation method. A system of linear stochastic difference equations is then solved using the calibrated parameters that will be discussed in the next section. The model solutions and simulations are computed using the Dynare software and MATLAB.

The models will be simulated under three types of financial access and two levels of TI described in Section 7.5.1. The resulting simulated moments and impulse response function (IRF) from different scenarios will be compared to investigate the implication of different financial accessibility and the effect of TI on emerging market economy.

7.4. Financial Integration, Accessibility, Domestic Markets, and Trade Integration

In this chapter, FI is explored in the aspect of agents' ability to access financial assets in international markets, which has not been much investigated in Chapter 5 and 6. The study compares three variations of the model economy when each group of home consumers can or cannot access foreign financial markets inclusive of the case when everyone in the emerging economy has the access. Moving from scenario H or O to scenario A is considered as increased accessibility, which leads to more cross-border financial transactions and thus greater FI. More accessibility can be viewed as removing restriction on people who initially cannot access world financial markets. Access to finance in general is also one dimension of financial development. These views are related to FI as a reduction of frictions and constraints, financial access and inclusion, and financial development.

One issue arises from the model setup. It can be seen clearly from Figure 7.1 to 7.3 that there is no explicit domestic financial market and the only financial market available is not distinguishable whether it is domestic or international. The implications are twofold. Firstly, there would be no difference between foreign and domestic markets in terms of interest rate, frictions incurred, and accessibility. That is, if home population has financial access, they have access to all types of financial assets available and always face the same kind of frictions. One cannot have access just to domestic assets but not foreign assets, or credit constrained internationally but not domestically. Secondly, in the strict sense, the total asset holding amount needs not be an equivalent measure of the degree of FI since it contains domestic financial transaction, if any, between home worker households and home capital owners.[60] Nevertheless, it could not be said that this international financial access is identical to domestic one, because the two countries and their respective population are subject to different shocks, have separate production sectors, and consume different final goods. Borrowing from home worker households is not necessarily the same as borrowing from foreign worker households. Therefore, the concept of financial accessibility in this chapter encompasses FI although they are not exactly the same thing. Studying international financial integration using this same structure of combined domestic and foreign financial markets is adopted by Devereux and Sutherland (2011b).

Explicitly separating the financial markets into domestic and international would be very complicated given that this study aims to include TI, market imperfection, agent heterogeneity within country, and two different economies altogether. There are papers that study heterogeneous agents with separate domestic and foreign financial markets, but they mainly focus at the financial parts. See Iacoviello and Minetti (2006) and Ueda (2012) for example. For this study, modeling financial access as a whole deems sufficient to answer the research question and is able to keep the model operational. The setup of clear division between domestic and foreign markets has already been explored in Chapter 5 and 6.

Although international financial access is the main aspect of FI investigated in this chapter, the level of FI in each sub-model is also determined by the parameter m in the leverage constraint and adjustment cost coefficient ϕ similar to the studies in Chapter 5 and 6 respectively. Moreover, there is an endogenous linkage between the percentage level of FI and TI in model A and H similarly to that in Chapter 6. Since this chapter incorporates the cross-border borrowing with international leverage constraint same as Chapter 5, and the foreign asset investment with the adjustment cost of foreign asset holding same as Chapter 6, it acquires the FI-TI relationship from both studies. The arguments and the logics are the same. The amount of private external debt is endogenously affected by other variables within the model, but the ratio of private external debt to GDP is determined mainly by the parameters. Section 5.3.1 in Chapter 5 discusses this issue in more details. On the other hand, the size of foreign asset holding is endogenously related to the level of TI such that greater integration in one market encourages higher level of integration in the other market. Section 6.3.3 in Chapter 6 discusses this relationship in more details.

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[60] This problem arises because there are two types of heterogeneous market participants in the home economy, where one is the saver and the other one is the borrower. Consequently, pure domestic financial transactions are possible. Financial integration studies that explore only one type of homogeneous in the home country are not subject to this issue.

7.5. Parameter Calibration

The model is calibrated using the benchmark parameter values shown in Table 7.2. The period used is quarterly. The home country is set to represent the emerging market economy and the foreign country as the advanced economy. The parameters are taken from RBC literature as shown in the last column of Table 7.2 except the Armington weights ω that are taken from Chapter 6. The discount factor of home capital owners, ν, is assumed to be lower than that of the saver households and equals to 0.98 following Leblebicioğlu (2009). The population proportion n_1 and n_2 of home and foreign workers respectively are set to be symmetric at 0.5. This symmetric population share between savers and investors is also adopted by Devereux and Sutherland (2011b) for example. The capital share in production for the home emerging economy α_1 is set to equal 0.34. The elasticity of substitution between domestic and foreign goods, σ, is set to 1.5. The adjustment cost coefficient ϕ is set to equal 5 based largely on Sutherland (1996), Senay (1998), and Buch et al. (2005).[61] The leverage constraint parameter m is based on the papers adopting the constraint in international financial markets, and is set to 0.4 following Pancaro (2010) and Faia (2011).[62]

The weight parameters ω in Armington aggregator that determine the level of TI are taken from Chapter 6. This is possible because the trade structures in are the same. Consequently, the derivation of relationship between export share, import share, terms of trade, and Armington weights ω is the same as presented in Appendix C.2, and the values of parameters obtained from Chapter 6 can be used in this chapter. To recap, the weights are computed from 2000-2013 trade data of emerging market and advanced economies. The EMEs are separated into two groups of high and low trade intensity. Appendix D.3 lists the countries in each group and Table 6.4 in Chapter 6 reports the trade data and corresponding values of ω. The weights from advanced economies, high trade EMEs, and low trade EMEs are 0.41, 0.38, and 0.27 respectively. The weight from advanced economies is used as ω_2 for the foreign country and the weights obtained from emerging markets are used as ω_1 for the home country.

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[61] Sutherland (1996) and Senay (1998) adopted the adjustment cost coefficient of 5 to represent imperfect financial market integration. They also adopt the value of ϕ equals to zero to represent perfect integration with no friction. Buch et al. (2005) also used the parameter value of 0 and 5, but to represent high and low degree of cross-border capital mobility respectively.

[62] Both authors use m = 0.4 as their base case. Pancaro (2010) explored the emerging market economy and varied the parameter between 0 to 0.8. Faia (2011) studied countries in general and varied the parameter between 0.2 to 0.8. Pisani (2011) who examined the international leverage constraint calibrating to Malaysia used the parameter value of m = 0.3 as the base case and varied the parameter value between 0.15 to 0.45.

Table 7.2 Benchmark parameters

	Parameter	Value	Source
β	Discount factor of home worker households and foreign households	0.99	Backus et al. (1994), Leblebicioğlu (2009)
ν	Discount factor of home capital owners	0.98	Leblebicioğlu (2009), Iacoviello and Minetti (2006)
κ	Labor effort weight in utility	1	Leblebicioğlu (2009), Pancaro (2010)
η	Labor disutility	2	Pancaro (2010)
n_1	Proportion of home worker households	0.5	Symmetric setup, Devereux and Sutherland (2011b)
n_2	Proportion of foreign worker households	0.5	Symmetric setup, Devereux and Sutherland (2011b)
δ	Depreciation rate	0.025	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009), Pancaro (2010)
α_1	Capital share of output for home country	0.34	Author's assumption based on Almekinders et al. (2015), Sarel (1997), Mallikamas et al. (2003), and Bhattacharya and Patnaik (2013)
α_2	Capital share of output for foreign country	0.36	Backus et al. (1994), Heathcote and Perri (2002), Leblebicioğlu (2009)
σ	Elasticity of substitution between domestic and foreign goods	1.5	Backus et al. (1994), Faia (2007), Leblebicioğlu (2009)
ω_1	Armington weight in home country	0.27, 0.38	Author's calculation from Chapter 6
ω_2	Armington weight in foreign country	0.41	Author's calculation from Chapter 6
ϕ	Adjustment cost coefficient	5	Sutherland (1996), Senay (1998), Buch et al. (2005)
m	LTV ratio in leverage constraint	0.4	Pancaro (2010), Faia (2011)
ψ	Bond holding coefficient	0.003	Pancaro (2010)

Table 7.3 Productivity process

Autocorrelation matrix	$\begin{bmatrix} 0.906 & 0.088 \\ 0.088 & 0.906 \end{bmatrix}$
Standard deviation of productivity shock	σ_{ε_1} = 0.00852
	σ_{ε_2} = 0.00852
Correlation of productivity shock	$corr(\varepsilon_1, \varepsilon_2)$ = 0.258

Source: Backus et al. (1994)

The productivity process for A_{1t} and A_{2t} is a vector autoregressive taken from Backus et al. (1994) and is described in Table 7.3.[63] The shocks are correlated and can spill over to the other country. An alternative shock process will be investigated in the sensitivity analysis.

7.5.1. Main Cases

There are six main scenarios to be examined, as shown in Table 7.4. Three model economies varied by different financial accessibility are 1) Model H: home worker households have financial access, 2) Model O: home capital owners have financial access, and 3) Model A: all home population have financial access. Moving from scenario H or O to scenario A is considered as greater FI. Three financial scenarios are combined with two levels of trade – high and low.

Table 7.4 Summary of main cases

#	Case	Type of financial access to international markets	Level of TI	Value of ω_1
1	H-LTI	Home worker households have financial access	Low	0.27
2	O-LTI	Home capital owners have financial access	Low	0.27
3	A-LTI	All home population have financial access	Low	0.27
4	H-HTI	Home worker households have financial access	High	0.38
5	O-HTI	Home capital owners have financial access	High	0.38
6	A-HTI	All home population have financial access	High	0.38

[63] The shock process is different from Chapter 5 and 6 to examine a more conventional parameterization.

7.6. Results and Discussion

7.6.1. Macroeconomic Volatility and Cross-country Comovement

The simulation results of key macroeconomic volatility and correlation for six main cases are presented in Table 7.5. The top panel reports the volatility, the middle panel reports consumption volatility relative to output volatility, and the bottom panel reports the cross-country output correlation. Six cases comprise of two degrees of trade – low and high – and three kinds of financial access; model H, O, and A. The focus of the analysis is the home emerging economy.

Table 7.5 Simulated volatility and correlation of key variables

Level of TI	LTI			HTI		
Type of financial access	H	O	A	H	O	A
Volatility (%SD)						
Home output (Y_1)	11.91	11.42	11.81	11.04	10.82	11.11
Home worker household consumption (C_1^h)	5.54	5.03	3.92	4.55	4.15	3.45
Home capital owner consumption (C_1^o)	4.41	5.80	11.20	3.69	4.77	8.17
Home exports (a_2)	2.74	2.81	1.71	3.90	3.90	3.05
Home imports (b_1)	2.09	3.50	7.20	3.40	4.22	6.28
Home terms of trade (TOT_1)	1.43	0.78	0.81	1.38	1.07	0.93
Asset holding of home worker households (D_1^h)	41.92		54.13	34.12		47.03
Asset holding of home capital owners (D_1^o)		32.63	39.89		28.53	33.86
Foreign output (Y_2)	10.55	12.45	14.26	12.29	13.14	14.46
Consumption volatility relative to output (%SD/%SD of Y)						
Home worker households (C_1^h)	0.46	0.44	0.33	0.41	0.38	0.31
Home capital owners (C_1^o)	0.37	0.51	0.95	0.33	0.44	0.74
Cross-country correlation						
Output (Y_1, Y_2)	0.87	0.88	0.89	0.90	0.90	0.90

Note: The statistics are the averages of 500 simulations, each 400 periods long; Y = output; SD = standard deviation; LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; D_1^h variable is absent under scenario O, and D_1^o variable is absent under scenario H.

The volatility of home output among six cases does not differ much, ranging between 10.82 to 11.91 percent. The output fluctuation tends to be lower under scenario O or when trade is high. Comparing three types of access, it is not necessary that more or full financial access provide better outcomes in terms of lower volatility than when some domestic residents cannot access international financial assets. This might be because of the presence of two financial frictions imposed on home population. It could also relate to greater fluctuation from larger cross-country financial flow, as can be seen that the volatility of home asset holdings is highest under scenario A, which is intuitive since more access likely leads to greater amount of asset holding and possibly larger fluctuation. It may also influence higher imports volatility through capital and current account balance.

For consumption variability, Table 7.5 reports two measures; the standard deviation of consumption in the top panel, and consumption volatility relative to output volatility in the middle panel. The two measures give similar results for both types of home population. It seems that FI in the form of financial accessibility leads to relatively higher consumption fluctuation for the group of people with financial access when the other group of people do not have the access, as compared to the inverse case. In other words, the volatility of home worker households' consumption is higher under scenario H when they are the only home population who has the access than scenario O when they do not have any access at all. This is also true for the home capital owners. This suggests that FI might bring more fluctuation rather than to smooth consumption. The absent consumption smoothing benefit of FI has also been found in both empirical and DSGE studies that associated with financially opened developing countries and models with financial frictions (see Kose et al. (2003), Prasad et al. (2007), and Pisani (2011) for example). However, when everyone has the access in scenario A, it tends to be favorable for the worker households, but adverse for the capital owners. This will be discussed in the next sub-section on the IRF results.

Greater TI generally decreases the volatility of output and consumption in all three financial scenarios, but it is associated with more volatile exports and imports. These results are similar to those of Chapter 5 and 6, likely because the international trade structures are the same for all three studies in this thesis. High trade is also associated with lower volatility of asset holding, contrary to more financial access that leads to higher volatility of asset holding. One observation is that the capital owner type of people seems to be affected by TI more significantly than the worker households, particularly under scenario A when higher TI lowers consumption volatility from 11.20 to 8.17 percent and relative consumption volatility from 0.95 to 0.74. The home capital owners supply both labor and capital, and their borrowing is tied to the capital stock through the leverage constraint. Consequently, they could be more connected to the production sector and cross-border trade than the home worker households.

Combining the effect of FI and TI together, there seem to be larger difference among three cases of financial access at low TI. Moving from scenario H or O to scenario A under low trade leads to more significant change of consumption fluctuation for both groups of home households.

Lastly, regarding the cross-country output comovement, international trade tends to have more influence on output correlation than FI. The correlation is almost the same across three kinds of financial access, whereas TI enhances business cycle synchronization. The positive relationship between trade and output comovement is in line with robust empirical evidences and the results from Chapter 6.[64] Again, this might be owing to the same trade structure.

7.6.2. Impulse Response to Shocks

Simulated impulse responses of main variables under six scenarios are presented in Figure 7.4 and 7.5 for home and foreign positive productivity shocks respectively. The IRFs shown are percentage deviation from steady state for one percentage productivity shock. Only main variables are shown due to a large amount of impulse response results. The underlying shock processes are the same for all cases.

A positive productivity shock to the home production sector leads to an increase in wage, investment, output, and consumption of the home country. For all variables, the impulse responses decay slowly because the shocks themselves are persistent and can spill over across countries (figure q. and r.). *Home output* (figure a.) responds to home technology shock in a similar pattern as the shock itself since the shock directly impacts the output through production function. One percentage of positive shock leads immediately to larger than one percent increase in the home output and the effect then slowly dissipates. The responses of output under low trade and high trade do not show significant difference, but home output is more responsive under scenario H, A, and O respectively. This latter observation is similar to the results of output volatility in previous sub-section.

It is also the case that *foreign output* (figure p.) responds to shocks in a similar pattern to the foreign technology shock itself. However, foreign output is least affected under scenario H where only worker group of home households can trade financial assets internationally. This might be because the asset investment from home worker households are less related to the production sector and hence cross-border trade as compared to that of the capital owners who supply both labor and capital and whose borrowing is tied to the physical capital stock through the leverage constraint. Thus, under scenario H, the home productivity shock might pass through the financial linkage of home worker households less and transmit less to foreign output. Larger trade linkages help shock transmission more as the response under case H-HTI is higher than H-LTI.

[64] Examples of these empirical studies are Calderon et al. (2007), Dées and Zorell (2012), Duval et al. (2014), Duval et al. (2016), Imbs (2006), and Di Giovanni and Levchenko (2010).

For the *consumption of home worker households* (figure b.), the response to shock is not significantly affected by different levels of trade, but is least responsive under financial access type A, which is similar to the result of consumption volatility. The home worker households might be able to smooth consumption better under scenario A due to the ability to adjust the saving amount more, as can be seen from the response of their asset holding that are slightly more volatile under scenario A (figure n.). Moreover, it seems that they are not only affected by their own access, but they might also benefit from the home capital owners' access since their consumption is less volatile under scenario A than under scenario H, as has been found in the volatility results.[65] As there are more borrowers in the financial markets when home capital owners have the access under scenario A, the home worker households can better save to smooth consumption. The impulse responses also show a small sign that the worker households can smooth consumption better with access than without access as comparing scenario H and O. Their consumption under scenario H initially increases less, but falls slower than under scenario A, suggesting that they could possibly save more right after the positive shock for later consumption.

The *consumption of home capital owners* (figure c.) is least responsive when they have no access to financial markets. Their response is moderate when they are the only group of domestic consumers with financial access, and highest when everyone in the home country have the access, with the increase of consumption to higher than one percentage. The access to cross-border borrowing of the capital owners seems to bring about higher fluctuation. Different degrees of trade only have influences on home capital owners under scenario A, where higher trade notably lowers down the responses, but not under scenario H and O. The results are in line with the volatility of consumption.

Interestingly, although more volatile asset holding of the home worker households (figure n.) is associated with better consumption smoothing (figure b.), more volatile borrowing of the home capital owners under scenario A (figure o.) is associated with more consumption fluctuation (figure c.). The home capital owners can borrow more from the participation of the home worker households in the markets as there are more lenders, but that does not help to smooth their consumption. Similar to the worker households, the capital owner households are not only impacted by their own financial access, but also the participation of other people in the financial markets.

The *physical capital* (figure e.) cannot adjust right away after the initial shock, and it gradually rises before declines. The differences of capital responses among six

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[65] In this analysis, higher response is interpreted as higher volatility, which is adverse, since shocks can be both positive and negative, but the IRFs shown here are only for the case of positive shocks. For example, when the shock is negative, the consumption of home worker households would decrease least under scenario A, which is considered to be a better case than the others.

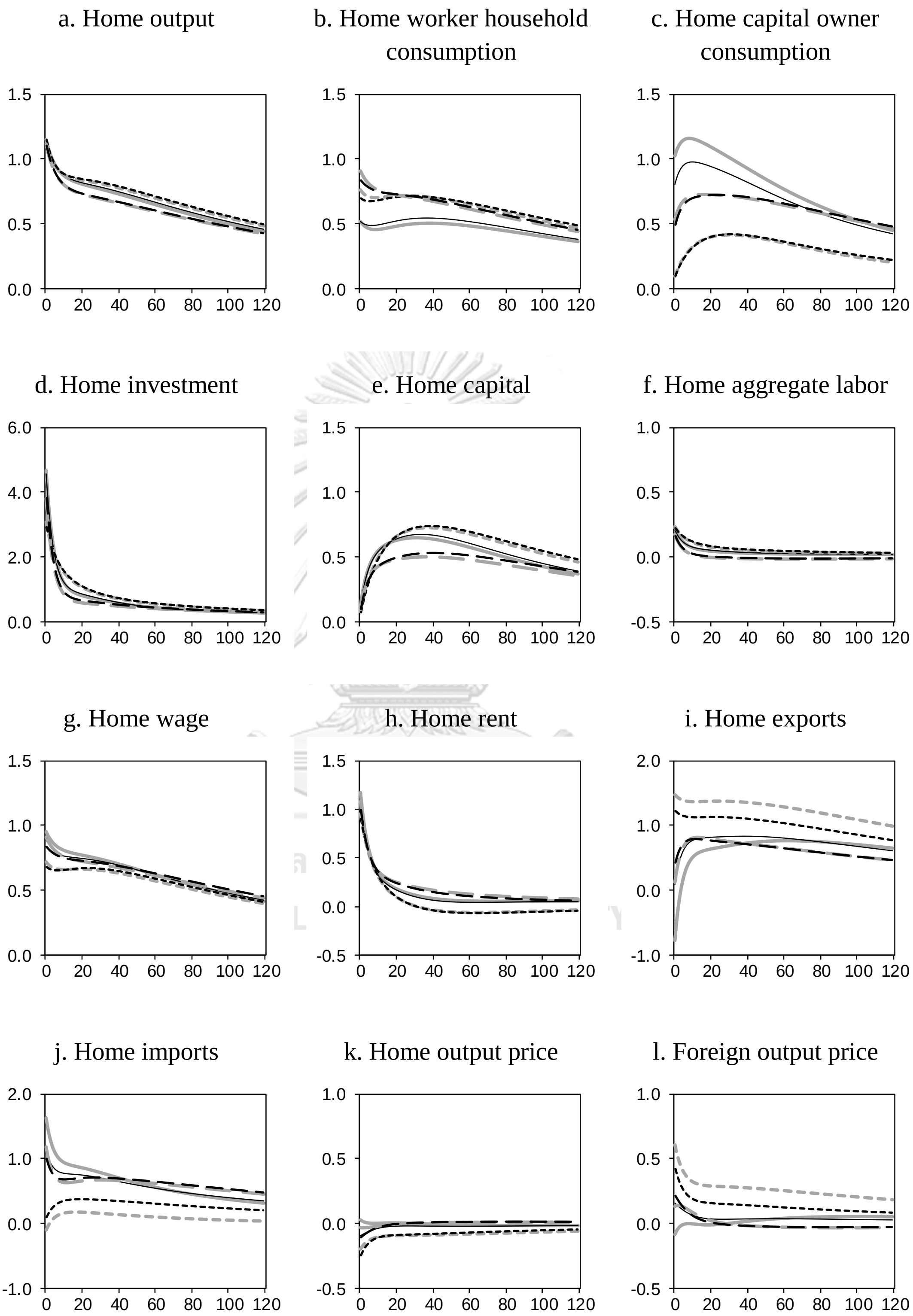
cases, along with those of the *capital investment* (figure d.), resemble the home output. They are more responsive under case H, A, and O respectively. The home *aggregate labor*, *wage*, and *rent* (figure f., g., and h.) also largely respond positively to shocks, although the magnitude of the labor response is quite small.

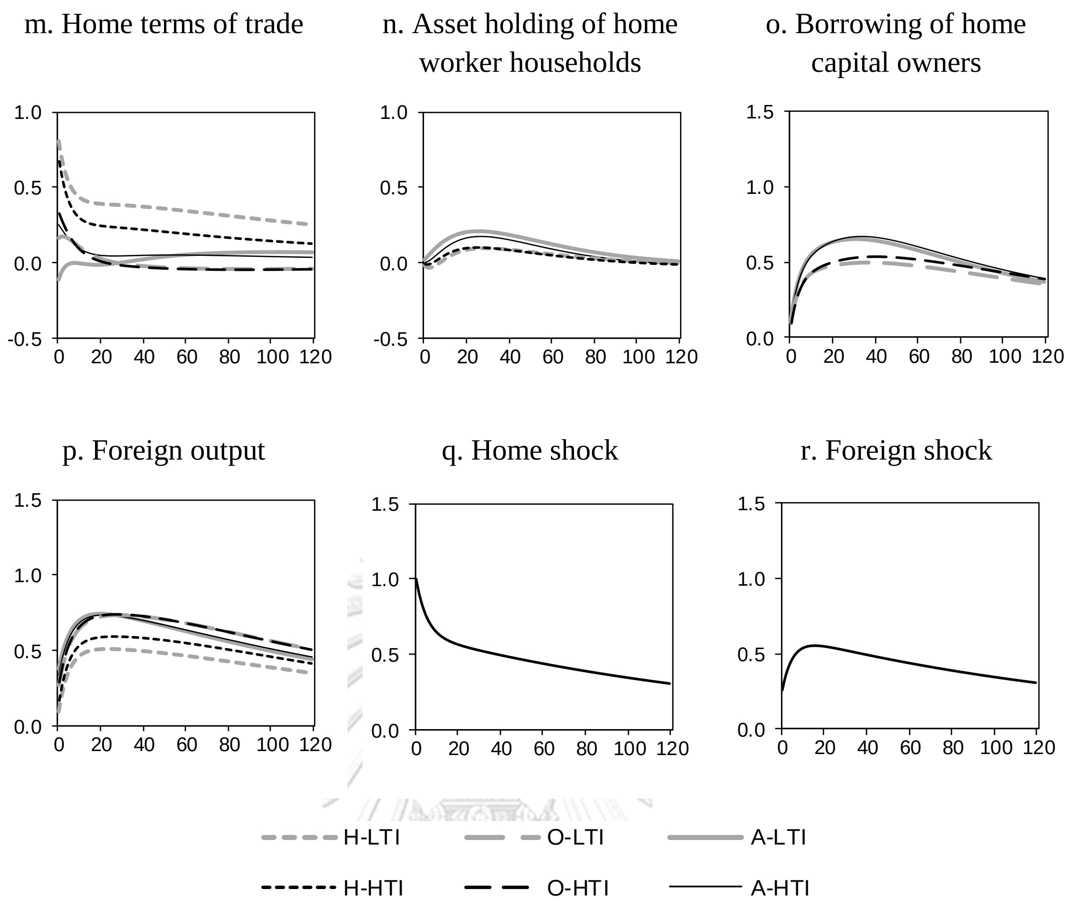
The *relative price of home output* (figure k.) falls after the positive technology shock that leads to relatively more abundant home output. The foreign output is relatively scarcer and their relative price rises (figure l.). These result in deterioration of *home terms of trade* (figure m.), as defined by the ratio of import prices to export prices. The home terms of trade and *home exports* (figure i.) are most responsive under scenario H and especially under low trade. For the former observation, it is possibly because the asset holding of home worker households is less related to the production sector and cross-border trade under scenario H and repercussion among the variables might be more limited, making the terms of trade and exports having to adjust more. The latter observation shows that the impact of FI is likely more pronounced under lower trade. On the other hand, the response of *imports* (figure j.) is opposite, being least responsive under scenario H and especially under low trade, similar to the response of foreign output as discussed above. Both imports and exports response positively to the home technology shock nevertheless.

The *asset holding of worker households* (figure n.) is only available under scenario H and A. The response slightly increases after the shock and then gradually declines. It is most responsive to shock under scenario A and low trade. The overall response is not large as the financial investment of the worker households is not closely related to the production sector like the capital owners; thus, it is likely less affected by the productivity shocks.

The *borrowing of home capital owners* (figure o.), which is available only for scenarios A and O, follows the response of physical capital closely since they are linked thought the leverage constraint as the capital owners use the physical capital as the collateral.

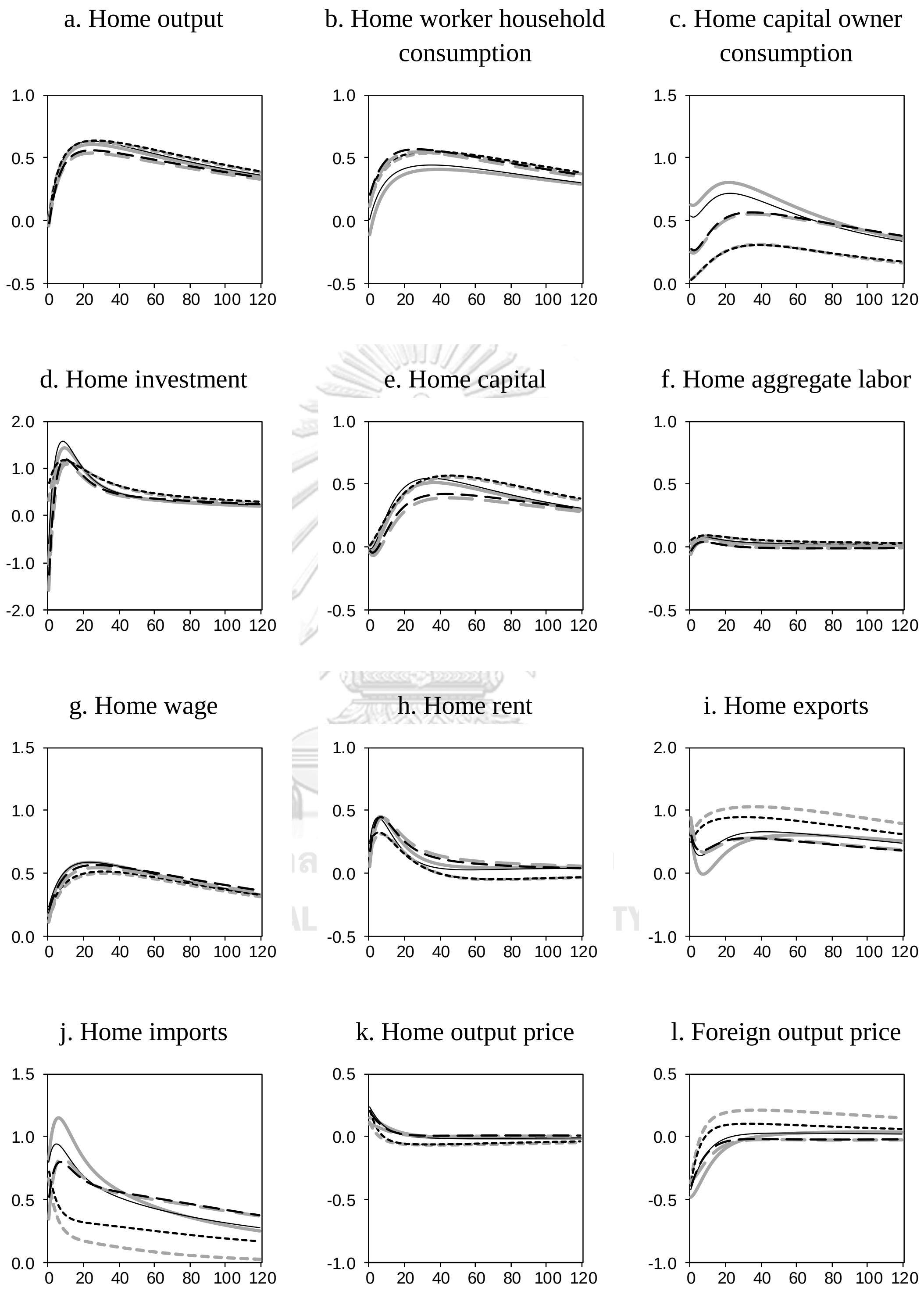
Figure 7.4 Impulse response of main variables to domestic productivity shock

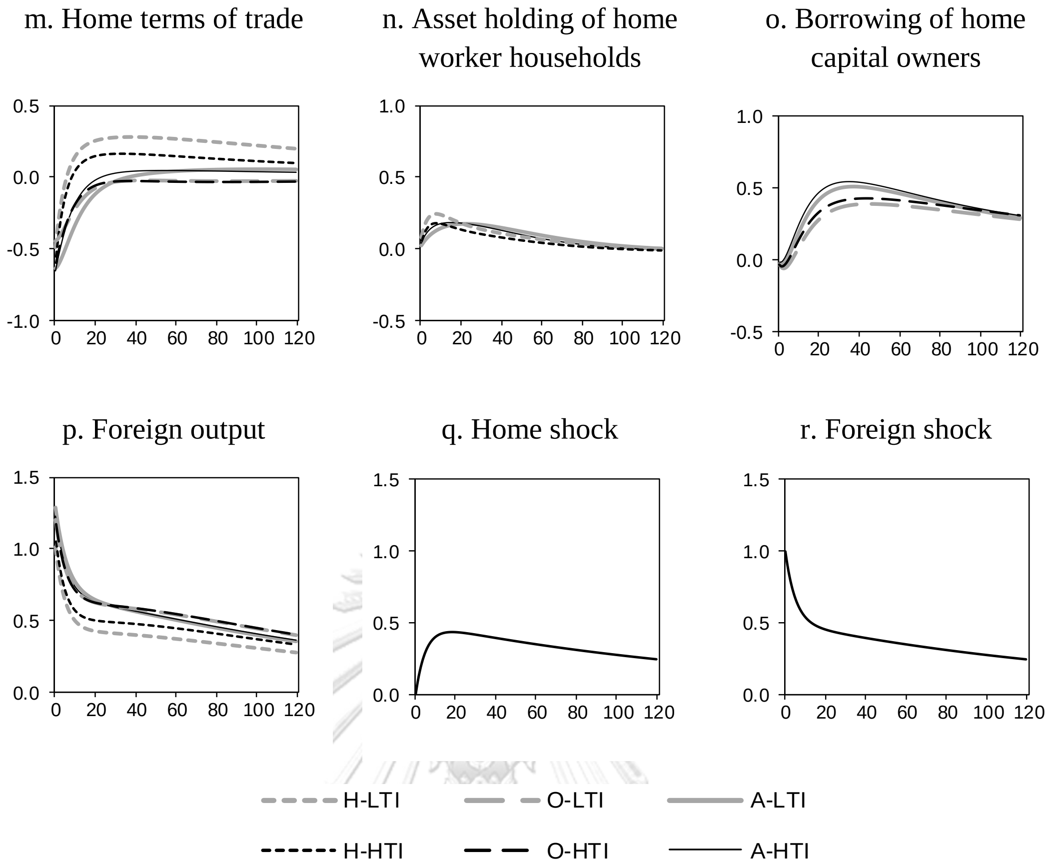




Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter. The shocks are the same for all six cases. LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; asset holding of home worker households is absent under scenario O, and borrowing of home capital owners is absent under scenario H.

Figure 7.5 Impulse response of main variables to foreign productivity shock





Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the foreign country; one period = one quarter. The shocks are the same for all six cases. LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; asset holding of home worker households is absent under scenario O, and borrowing of home capital owners is absent under scenario H.

When positive shocks coming from the foreign country (Figure 7.5), many home variables such as home output (figure a.), worker households' consumption (figure b.), and wage (figure g.), gradually increases in response to the shock transmitted from foreign economy to the home economy as opposed to a sudden increase in response to the home shock. This pattern of response also resembles the home shock. Most home variables respond positively to the foreign technology shocks. The responses of home output prices, foreign output prices, and terms of trade (figure k., l., and m.) are in the opposite direction to when shocks originate from the home production sector. However, the differences among six cases examined are broadly similar to the home shock case in Figure 7.4 although to a lesser degree. A possible reason for this is that the home shock process is influenced by foreign shock and vice versa since shocks are correlated and can spill over. Which country the shock hits only evidently matters during the initial periods, but there is less difference afterwards as shock transmission and repercussion take place (see figure 7.4 q., 7.4 r., 7.5 q. and 7.5 r.).

7.6.3. Sensitivity Analysis

This section analyzes the sensitivity of the results to the choice of shock process to examine whether and how shocks transmit, possibly through financial and trade linkages, when the underlying shocks are uncorrelated and do not spill over across countries. The parameters for the productivity shock process are taken from Leblebicioğlu (2009). The autocorrelation is set to equal 0.95, higher than the benchmark case. The standard deviation of the shocks is the same for domestic and foreign countries and equals to 0.007, lower than the benchmark case. The other parameters apart from the shocks are kept at their benchmark values. The results of key simulated moments for the six cases are reported in Table 7.6. Figure 7.6 and 7.7 depict the impulse responses of main variables to home and foreign technology shocks respectively.

The resulting impacts of FI and TI on the volatility and correlation are not qualitatively different from the main analysis. Every people having international financial access do not necessarily provide the best outcomes regarding aggregate fluctuation when market imperfections exist. Greater TI generally decreases volatility of output and consumption, while increases the cross-country output comovement. However, the magnitude of overall moments is small and significantly lower than the main analysis, especially the cross-country output comovement. This is due to the underlying shocks that have smaller standard deviation, do not spill over and are uncorrelated across countries.

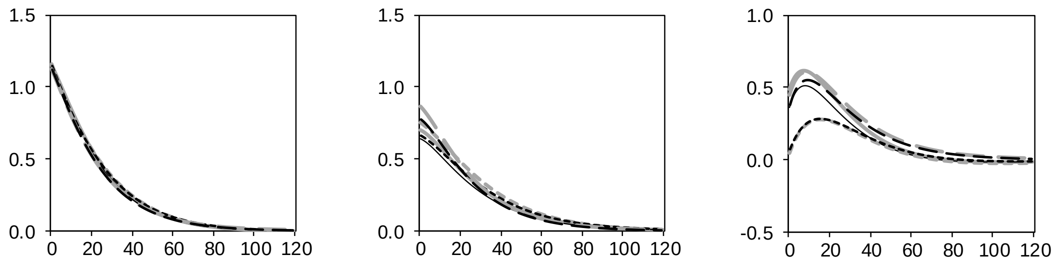
Table 7.6 Simulated volatility and correlation of key variables when shocks are uncorrelated and cannot spill over

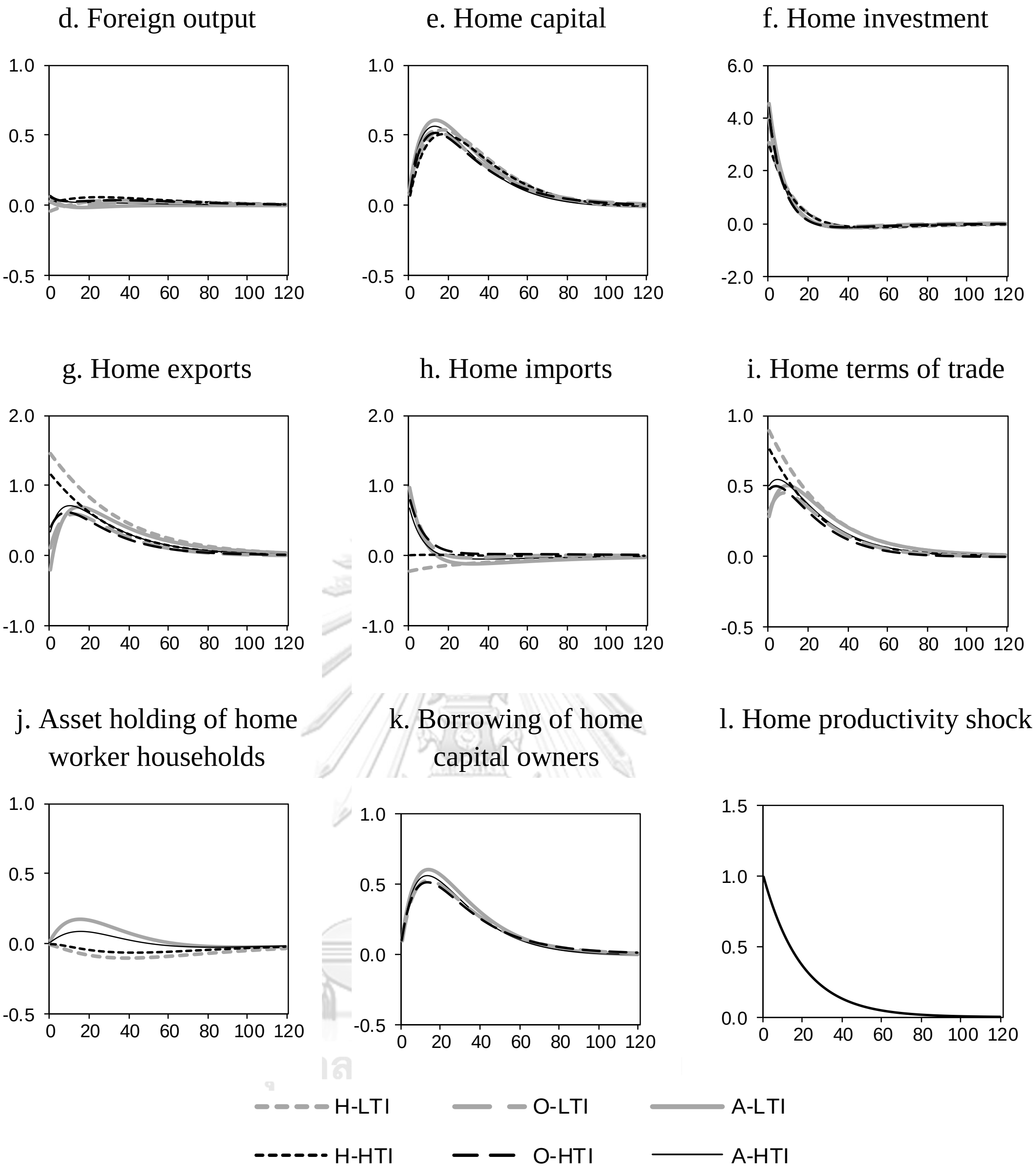
Level of TI	LTI			HTI		
Type of financial access	**H**	**O**	**A**	**H**	**O**	**A**
Volatility (%SD)						
Home output (Y_1)	5.58	5.89	5.88	5.06	5.44	5.35
Home worker household consumption (C_1^h)	2.35	2.21	2.13	1.78	1.67	1.66
Home capital owner consumption (C_1^o)	1.60	2.27	3.08	1.31	1.72	2.12
Home exports (a_2)	1.19	1.09	0.86	1.55	1.51	1.31
Home imports (b_1)	1.73	1.64	2.37	1.85	1.90	2.37
Home terms of trade (TOT_1)	1.15	1.52	1.05	1.48	1.94	1.52
Asset holding of home worker households (D_1^h)	27.21		31.68	20.80		25.98
Asset holding of home capital owners (D_1^o)		16.29	18.67		13.14	14.45
Foreign output (Y_2)	6.35	6.14	6.68	6.74	6.33	6.84
Consumption volatility relative to output (%SD/%SD of Y)						
Home worker households (C_1^h)	0.42	0.37	0.36	0.35	0.31	0.31
Home capital owners (C_1^o)	0.29	0.39	0.52	0.26	0.32	0.40
Cross-country correlation						
Output (Y_1, Y_2)	0.04	0.02	0.04	0.13	0.09	0.11

Note: The other parameters are kept at their benchmark values. The statistics are the averages of 500 simulations, each 400 periods long; Y = output; SD = standard deviation; LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; D_1^h variable is absent under scenario O, and D_1^o variable is absent under scenario H.

Figure 7.6 Impulse response of main variables to domestic productivity shock when shocks are uncorrelated

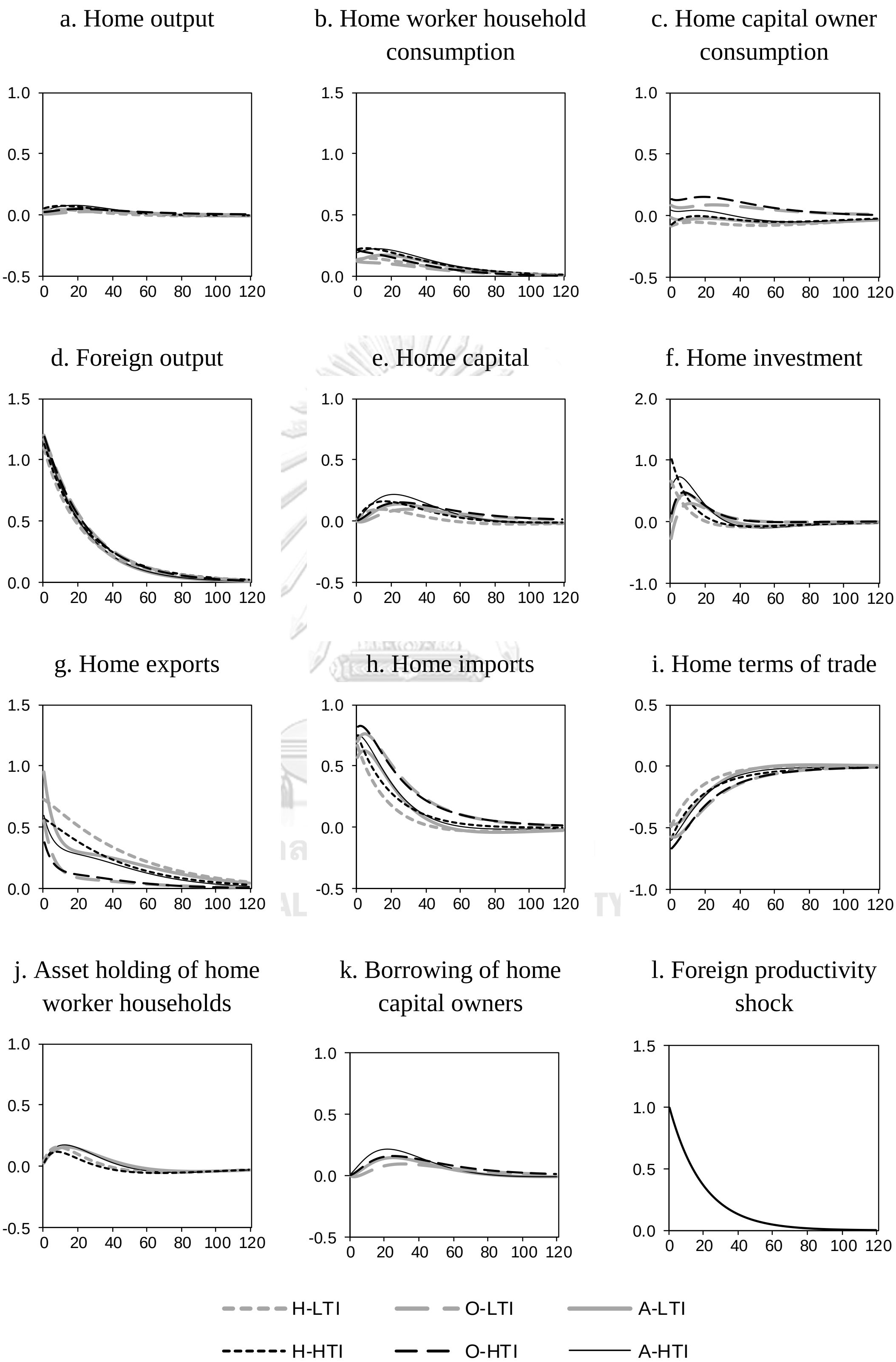
a. Home output b. Home worker household consumption c. Home capital owner consumption





Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the home country; one period = one quarter. The shocks are the same for all six cases. The foreign shocks are zero for all periods. LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; asset holding of home worker households is absent under scenario O, and borrowing of home capital owners is absent under scenario H.

Figure 7.7 Impulse response of main variables to foreign productivity shock when shocks are uncorrelated



Note: Vertical axis = percentage deviation from steady state for 1% positive productivity shock to the foreign country; one period = one quarter. The shocks are the same for all six cases. The home shocks are zero for all periods. LTI = low trade integration; HTI = high trade integration; H = home worker households have financial access; O = home capital owners have financial access; A = all home population have financial access; asset holding of home worker households is absent under scenario O, and borrowing of home capital owners is absent under scenario H.

Less volatile and uncorrelated shocks result in the responses of home variables decline much faster than the main results. The responses during initial periods are still qualitatively similar to the main results, albeit very small differences among six cases. When home and foreign shocks neither correlate nor spill over, shocks originating from the home country have a very small impact on foreign output (Figure 7.6 d.). The consumption of home capital owners (Figure 7.6 c.) is no longer significantly more responsive under case A, suggesting that their extra volatile consumption under scenario A in the main analysis (Figure 7.4 c.) might come from the repercussion between shocks from the two countries enhanced by their own financial linkage. Nevertheless, their consumption is generally more responsive when they have the access (scenario O and A) than when they do not have the access (scenario H).

Similarly, the shocks coming from the foreign country have smaller impact on the home variables, but they still indeed transmit to the home economy, likely through trade and financial channels. Home variables broadly respond positively to foreign shocks, for example, home consumption (Figure 7.7 b. and c.), capital (Figure 7.7 e.), and investment (Figure 7.7 f.). However, different kinds of financial access in the home country and different levels of trade almost have no effect on the response of foreign output (Figure 7.7 d.). The foreign output is highly influenced by the foreign shock itself. One observation is that the consumption of home population is broadly more responsive to foreign shocks under high TI than low TI for a given financial scenario (Figure 7.7 b. and c.), suggesting that a larger trade linkages could enhance shock transmission from foreign country to the home economy.

7.6.4. Result Discussion

Studies that examine FI in developing countries with market frictions and restricted access to finance usually find that greater FI is associated with higher consumption volatility. Leblebicioğlu (2009) found that when moving from financial autarky to complete asset market arrangement, people who have the access are better off, while those who do not have the access are worse off as measured from welfare criteria. Levchenko (2005) found that financial opening potentially benefits people who have access more than people without access in terms of consumption smoothing. Buch and Pierdzioch (2009) also suggest that financial globalization in the form of friction reduction could lower the volatility of consumption for people with international financial access. However, these studies only examine FI in other aspects under a single setup of financial accessibility for a fixed group of people and do not include the situation when every domestic resident can access international financial markets. In this regards, Araujo (2008) compares financial autarky versus FI when access is partly restricted and when access is complete. Calibrated to Mexico, it is found that FI increases consumption volatility when access is restricted, but decreases consumption volatility when all people have access to international finance. This chapter alternatively explores three types of financial access and finds that FI in the form of accessibility is associated with higher consumption volatility for the capital owner type of people in line with the findings from existing literature. In contrast, it is also found that FI seems to be associated with lower consumption volatility for the saver-worker type of households, suggesting that heterogeneous agents might be affected by financial integration and accessibility differently. Nevertheless, the model in this chapter fails to capture two related stylized facts of emerging market business cycles that, first, their observed business cycles are generally more volatile than that of the advanced countries, and second, consumption is more volatile than output (see Aguiar and Gopinath, 2007, Benczúr and Rátfai, 2014, and Calderon and Fuentes, 2010).

Combining the implication of financial accessibility and international trade under market imperfections and heterogeneous agents, there are four key takeaways. First, the results suggest that people are not affected only by their own access to international financial markets, but they are also impacted from the participation of other people in financial markets. The home saver households seem to benefit from the access of the home capital owners since there are more borrowers in the markets, making them better off under scenario A than H. However, more lenders in the markets from the participation of home worker households might ease the borrowing of the capital owners, but it does not help to smooth their consumption, as the capital owners face more volatile consumption moving from scenario O to A. This might be partly because the model setup only allows the capital owners to borrow, but they are unable to save to smooth their own consumption. Furthermore, their borrowing is constrained to a certain proportion of capital and influenced by the production sector, unlike the saving workers who only pay additional fees from investing, but their investment amount is not restricted per se.

This leads to the second finding that full access to international financial markets is not necessarily the best outcome for everyone in terms of aggregate fluctuation. This might be due to the existence of financial frictions in this study, namely, the leverage constraint the capital owners face, and the adjustment cost of asset holding the worker households incur. Moreover, as aforementioned, the capital owners are restricted from saving.

Third, it is apparent that heterogeneous agents are affected by international integration differently. The capital owners seem to be influenced by TI more than the worker households are, and full access of the home economy to international financial assets seems to benefit the saver workers, but not the borrower households. However, it is difficult to distinguish which of the differences lead to this result since two groups of home consumers differ in more than one aspect. They play different roles of market participants where one is a saver and the other one is a borrower; they face different financial frictions; and only the capital owner households supply physical capital to the production of goods and receive rent income.

Lastly, there are small evidences that higher trade may lower down the magnitude of FI's effect. To illustrate, moving from scenario H or O to A, the consumption volatility of home capital owners seems to increase less under higher trade, which might be because high trade is associated with lower aggregate fluctuation in this model including lower volatility of asset holding. The finding that trade weakens the impact of FI is in line with that from Chapter 6.

Based on the results, no certain type of financial accessibility deems optimal or a dominant strategy that a country should aim to. Moving from one financial setup to another also does not seem to be Pareto improving as some parties are better off, but some parties are worse off. On the other hand, deepening TI is generally beneficial as it tends to lower the aggregate fluctuation. However, the results should not be interpreted as evidences against greater international financial access. On the contrary, the results suggest that countries that are now internationally open for only one direction of capital flow, either saving or borrowing, could consider open up for the other type of flow. These would benefit worker-savers although may raise output volatility slightly and worsen risk sharing of the borrowers, but that could be supplemented with other forms of risk mitigation such as hedging, as well as utilizing TI to manage aggregate fluctuation. In practical, people are not entirely restricted to only borrowing like the capital owners in this model; thus, greater access to international financial markets and more market participants might support saving to smooth consumption even further and improve overall risk sharing. For countries that are already open for both outward and inward investment, going back to prohibit one side of the capital flow might not be executable. What could be done in addition to abovementioned measures is to enable people to access and ensure that everyone can appropriately employ saving, investment and borrowing opportunities available in the financial markets, such as by reducing restriction, easing frictions, and improving financial literacy.

7.7. Conclusion

This chapter has developed a two-country DSGE model to examine the implication of financial accessibility on business cycles of emerging markets economies whether more access is better. The study is carried out with two levels of TI and the presence of market imperfections. The model has three variations of financial access, and incorporates frictions in the form of leverage constraint and adjustment cost of asset holding.

The findings are that, first; more access to international financial markets does not necessarily provide better outcomes for everyone in terms of aggregate fluctuation when there are market imperfections. Outputs could be more volatile, and consumption smoothing of some people are dampened. Secondly, heterogeneous consumers are affected by international integration differently. Furthermore, they are not only impacted by their own financial accessibility, but also affected from the participation of other people in financial markets. The home saver households could better smooth consumption when more borrowers can access the financial markets, but the home capital owners who are credit constrained do not gain consumption smoothing benefit from the participation of more lenders. Trade integration seems to influence home capital owners more than home worker households, and plays more significant role in the business cycle synchronization than different types of financial accessibility. Lastly, there are slight evidences suggesting that higher trade might weaken the magnitude of FI's effect similar to the finding from Chapter 6. The robustness of the findings is examined using alternative shock process. Overall, the main results are qualitatively preserved although the magnitudes of the impacts and impulse responses to shocks are small.

Although the results suggest no optimal form of financial accessibility when market imperfections are present, opening up more financially could be favorable when implementing with accompanying measures. More people having access to international financial markets could support saving to smooth consumption and improve overall risk sharing. This should be supplemented with other risk management tools such as hedging to help the borrowers, as well as enhancing TI as it could help lower aggregate fluctuation. Equally important is that people should be able to access both saving and borrowing opportunities, and to properly utilize financial instruments for appropriate purposes. These could be encouraged such as by reducing restriction, easing frictions, and improving financial literacy.

The limitations of this study are that the two groups of home consumers differ in more than one aspect, making it difficult to identify which difference is the underlying reason for the findings. The three sub-models themselves might not be perfectly comparable, so the findings must be applied with caution. In addition, the home capital owners are not allowed to save to smooth their own consumption, and their borrowing is related to the production of goods. These might be the cause why they are worse off with full financial access of the home economy. Lastly, domestic and foreign financial markets are combined, and the differentiation between domestic and international financial access is ambiguous.

Further studies could be extended in these regards. A more specific model examining each difference between two heterogeneous consumers one at a time could be developed, such as focusing on the lenders versus borrowers or only the frictions are different. Clear separation of financial markets into domestic and international similar to Iacoviello and Minetti (2006) or Ueda (2012) could be done, but some other features might need to be dropped from the model to keep it functional. Other minor alterations could also be explored, such as using different kinds of frictions, and investigating asymmetric population share instead of the symmetric one used in this study.

Chapter 8
Comparison and Result Discussion of Three Studies

This chapter firstly recaps key features of three studies in Chapter 5 to 7 in Section 8.1. Section 8.2 then compares, discusses, and summarizes the findings regarding both similarities and dissimilarities.

8.1. Comparison of Three Studies

All three studies explore the implication of international financial integration for EMEs with the presence of TI, market imperfection, and agent heterogeneity. The resulting impacts are examined on macroeconomic volatility, business cycle synchronization, responses to shocks, and welfare. Each chapter investigates this question in different aspects using three different models. Table 8.1 compares the main features of the three studies.

The common characteristics are that the model economy consists of two countries; the home country is always an emerging market economy with some forms of market imperfection and two types of heterogeneous consumers, and the foreign country is a frictionless advanced economy. The trade structure and how TI is implemented are also the same. It is measured from the amount of cross-border goods trade and is determined by the Armington weight that represents relative preference for foreign goods. In addition, many of the parameters share the same values.

The three chapters differ primarily in the financial structures and the aspects of FI in focus. Chapter 5 studies the cross-border borrowing that is subject to international leverage constraint. FI is measured as the amount of private external debt and determined by the LTV parameter in the credit constraint. Chapter 6 investigates foreign asset investment of the home households who have to pay adjustment cost of foreign asset holding. FI is measured as the size of foreign asset holding and determined by the coefficient of the adjustment cost. In both studies, some people in the emerging economy cannot access international financial markets and can only rely on domestic financial markets. The domestic market in Chapter 5 is frictionless, but that in Chapter 6 incurs domestic borrowing constraint. Chapter 7 explores both cross-border investing and borrowing and includes both kinds of frictions from Chapter 5 and 6, but turns the focus to different types of accessibility to international financial markets among the home residents. Higher FI is viewed as greater access to global financial markets. Its implication is analyzed by comparing three types of financial accessibility. There is no explicit domestic financial market in Chapter 7. In addition, Chapter 5 is the only study that includes exchange rate variable, but its role is limited.[66]

Apart from these, the relationship between FI and TI in the model also differs. In Chapter 5, there is no endogenous linkage between the two, meaning that higher TI does not enhance higher FI and vice versa, but in Chapter 6 and 7, FI and TI are complementary such that greater integration in one market is associated with greater integration in the other market.

There are two issues that need clarification. Firstly, the models in Chapter 5 and 6 do not differ only in the direction of financial asset positions. Other important differences include which group of domestic consumers has the access to international financial markets, and whether domestic credit is constrained or not. The latter point shows the extent of domestic financial markets' ability to serve as recourse for people who do not have the international access. Examples of minor differences are that the proportion of two types of home population is symmetric in Chapter 5, but asymmetric in Chapter 6, and Chapter 5 explores the welfare implication, while Chapter 6 investigates the business cycle synchronization instead.

Secondly, the model economies in Chapter 5 and 6 are not smaller parts of that in Chapter 7. In other words, the model economy in Chapter 7 is not a simple combination of the models from the first two studies. They share some common features, but also differ in many aspects. For instance, Chapter 7 does not have a separate domestic financial market, and the capital owner households supply both capital and labor. These issues should be taken into account when analyzing the findings from the three studies, as the results might not be straightforwardly comparable.

[66] The other two studies in Chapter 6 and 7 do not include exchange rate variable both due to the above mentioned limited role the exchange rate plays and because the models in Chapter 6 and 7 are more complex than the one in Chapter 5. Adding the exchange rate variable would make the equilibrium considerably volatile.

Table 8.1 Comparison of three studies

	Chapter 5	**Chapter 6**	**Chapter 7**
Aspect of FI explored	• Cross-border borrowing • Asymmetric financial access	• Cross-border investment • Asymmetric financial access	• Access to international financial markets • Cross-border saving and borrowing
Measure of FI	Size of private external debt determined by LTV ratio	Size of foreign asset investment determined by adjustment cost	Greater access to international financial markets by comparing three scenarios
Frictions and constraints	International leverage constraint	• Adjustment cost of foreign asset holding • Domestic leverage constraint	• Adjustment cost of foreign asset holding • International leverage constraint
Domestic financial markets	Separate market with no friction	Separate market with friction	Combined market with same frictions
Financial access of home population	Only entrepreneurs can access	Only households can access	1) Model H: Only worker households 2) Model O: Only capital owners 3) Model A: Both types of households
Measure of TI	The amount of cross-border goods trade determined by the Armington weight parameter		
Relationship between FI and TI in the model	None	FI and TI are complementary	Model H, A*: FI and TI are complementary Model O: None

* Model A has the financial features from both Chapter 5 and Chapter 6; hence, the FI-TI relationship is a combination of those from the first two chapters and is a complementary relation due to the feature of adjustment cost that resembles that in Chapter 6.

8.2. Result Discussion of Three Studies

Table 8.2 compares key results and findings from three chapters in four main aspects; the impact of FI; the impact of TI; the implication of market imperfection, financial access, and agent heterogeneity; and the combination of FI and TI. The analysis only focuses on the home emerging economy.

FI and output volatility

The impact of higher FI on output volatility in emerging market economy is mixed. Chapter 5 finds that greater FI is associated with more volatile output, Chapter 6 finds the opposite, and the result from Chapter 7 inclines towards that of Chapter 5 more. One possible reason is that the impact of FI might depend on the direction of the flow. The capital inflow in Chapter 5 from cross-border borrowing might bring more fluctuation to the domestic economy, agreeing with the conjecture that external debt tends to be more volatile and procyclical, and could amplify the negative shocks and harm growth (Kose, Prasad, Rogoff, et al., 2006; Kose et al., 2009). Nevertheless, borrowing from abroad could have benefit of generating more liquidity in the domestic markets and financing investment projects of firms (Kose, Prasad, Rogoff, et al., 2006). On the other hand, the capital outflow in Chapter 6 from outward asset investment might be associated with lower output fluctuation in the domestic country.

This finding might also explain the inconclusive impact of FI on output volatility found in earlier studies that tend to examine total financial integration rather than distinguishing into different types of flows. There are papers investigating FI-growth relationship that take into account different types of flows. For example, Aizenman et al. (2013) empirically found that the relationship between FI and growth depends on the types of flow, of which the short-term debts have a negative impact on growth, as it is a liability and must be repaid. However, empirical papers investigating FI-volatility relationship mostly examine overall degree of FI (See for example, Kose et al., 2003, Bekaert et al., 2006, and Haddad et al., 2010), while DSGE researchers also found mixed results. Senay (1998) found that moving from low FI with friction to frictionless FI reduces output volatility. Heathcote and Perri (2002) and Leblebicioğlu (2009) both found that moving from financial autarky to complete integration is associated with higher output fluctuation. Evans and Hnatkovska (2007b) found both positive and negative relationship depending on the types of FI whether it is only integration in the bond markets or both bond and equity markets.

Table 8.2 Comparison of results from three studies

	Chapter 5	**Chapter 6**	**Chapter 7**	**Summary**
FI	• Increases output volatility • Small impact on consumption volatility and welfare of households • Small consumption smoothing benefit, but welfare loss of entrepreneurs	• Reduces output volatility and comovement • Increases consumption volatility	• Usually associates with higher volatility of output and consumption • Almost no effect on output comovement	• Result on output volatility is mixed • No robust evidence for consumption smoothing benefit and welfare gain • Small impact on output comovement
TI	• Reduces volatility of output and consumption • Small impact on households' welfare, but small welfare gain for entrepreneurs	• Impact on output volatility varies with FI • Reduces consumption volatility • Increases output comovement	• Reduces volatility of output and consumption • Slightly increases output comovement	• Usually reduces output volatility • Associates with lower consumption fluctuation • Enhances output comovement

	Chapter 5	Chapter 6	Chapter 7	Summary
Market imperfection, financial access, and agent heterogeneity	• Savers with no access internationally and no friction domestically are generally not impacted from higher FI • Borrowers who are credit constrained internationally are not much worse off when they have unconstrained domestic funds	• Investors that face friction internationally are affected by FI but not much worse off • Borrowers with no access internationally and are constrained domestically are significantly worse off from higher FI, particularly at low trade	• Savers/investors who face adjustment cost benefit from the participation of more borrowers • Credit constrained borrowers face more volatile consumption from both their own and others' financial access	• People with more restrictions (friction, no access) are more negatively affected by FI • People who have no financial access or face frictions internationally are better off if they face no friction domestically
Combined effect of FI and TI	• Largely independent • Medium FI is broadly preferable • Increasing TI or both FI and TI is Pareto improving for macro volatility; increasing or decreasing FI is not	• TI weakens the effect of FI • Medium FI is usually preferable • Increasing TI or both FI and TI is Pareto improving for macro volatility, but increasing FI is not	• Small evidence that TI weakens the effect of FI • No moving from one setup of financial accessibility to another is Pareto improving regardless of trade	• Mixed result on the combined effect of FI and TI • FI consequences have a trade-off; enhancing only FI might not be beneficial for everyone

Note: All results refer to the home emerging economy except output comovement, which means cross-country correlation between home and foreign outputs.

FI and business cycle synchronization

The study in Chapter 6 found that FI tends to reduce cross-country output correlation, but the study in Chapter 7 only found small influence from FI. More outward investment could make the economy less dependent on domestic factors. The effect may transfer to exports and imports through current and capital account balance. These could cause the outputs of home and foreign countries to diverge.

The negative relationship found is in line with the empirical evidence of Duval et al. (2014) and International Monetary Fund (2013) that higher FI typically lowers business cycle synchronization during non-crisis periods. However, the results from DSGE studies are less conclusive. Faia (2007) found that FI lowers business cycle comovement, while Ueda (2012) found that opposite when focusing at only banking integration.

FI and consumption smoothing

The results on consumption volatility from three studies point towards the same conclusion that there is no robust evidence for consumption smoothing benefit and welfare gain from higher FI when market imperfections exist.

In Chapter 5, saving households who has no access internationally and face no friction domestically are almost unaffected from higher FI, while borrowing entrepreneurs who are credit constrained internationally but are not domestically gain small consumption smoothing benefit. In Chapter 6, higher FI increases consumption fluctuation for all domestic consumers, but borrowers who are restricted in both international and domestic financial markets face much more volatile consumption than the investors who only incur adjustment cost internationally. In Chapter 7, saving workers have less volatile consumption from the participation of more borrowers in the market, but credit constrained borrowing households face more volatile consumption from both their own and other’s international financial access.

The absence of consumption smoothing benefits and welfare gain, especially in emerging markets has been similarly found by earlier researches. Empirical studies usually find a negative or insignificant impact of FI on consumption smoothing in more financially opened developing countries and emerging economies (See for example, Kose et al., 2003, Bekaert et al., 2006, and Prasad et al., 2007). Studies adopting DSGE mostly found that FI increases consumption volatility when there are financial frictions or imperfect access to finance. See Levchenko (2005), Leblebicioğlu (2009), Pancaro (2010), and Pisani (2011) for example. Low financial development, less financial literacy, weak institutions, and lack of other preconditions might hinder the ability of emerging markets to share risk across countries (Levchenko, 2005; Prasad et al., 2007).

In addition to previous papers, the findings from this dissertation seem to suggest that people with more restrictions – in terms of frictions, constraints, or inaccessibility to financial markets – tend to be more negatively impacted by higher FI. FI could benefit people under some circumstances, in particular, people with freer access to more choices of financial assets, and investors or savers who face adjustment cost of foreign asset holding.

Possible reasons that the results tend to favor savers-investors in this study are twofold. First, it might be because of the asset position itself, and second, it might be because the assumptions regarding the different natures of friction and constraint they face. Saving households only have to pay additional fees from investing, but their investment amount is not restricted. Hence, they can save to smooth consumption more freely than the borrowers whose borrowing amount is constrained and tied to the production sector.[67] Moreover, the borrowers cannot save to smooth their own consumption. These assumptions might influence the results, since in reality, people are not restrained from saving like the borrowers in this study.

Another observation from Chapter 6 is that the financial linkage likely comes with higher consumption correlation with the foreign economy, suggesting that people with cross-border financial linkage would be more impacted by a foreign shock. Chapter 6 also shows that people who are restricted both internationally and domestically would be adversely affected from increased FI. On the other hand, Chapter 5 suggests that people who are excluded from cross-border financial asset trade or face frictions internationally would not be much adversely affected by imperfect FI when they have well-developed domestic financial markets to turn to. This finding is in line with the literature on the relationship between financial development and international financial integration, which argues that they support each other (International Monetary Fund, 2014b; Kose, Prasad, Rogoff, et al., 2006).

Lastly, consumers are not only impacted by their own financial accessibility, but also affected from the participation of other people. The results from Chapter 7 suggest that the savers might be able to smooth consumption better from the participation of more borrowers in the markets.

Overall, the result that different groups of people are affected differently is not surprising due to the underlying assumption of heterogeneous agents within the home country. More important implications that the findings point out are that less financial restriction, more access to saving, investment and borrowing, and the presence of unconstrained domestic financial market could help lessen the adverse consequences of imperfect FI.

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[67] This thesis does not investigate the switching case, when the borrowing is subject to some fees instead of the constraint on the amount, and the investment is subject to some amount restriction. This matching of frictions and financial transaction seem less relevant than the current setup being used.

TI and business cycles

The effect of TI on macroeconomic volatility and welfare is broadly favorable. Only Chapter 6 finds that the relationship between TI and output volatility varies with the level of FI, while Chapter 5 and 7 find that TI tends to lower output fluctuation. Trade is also found to decrease consumption fluctuation. A possible explanation is that TI could help dissipate the shocks and transmit them across countries since larger international trade linkages could allow exports, imports, and terms of trade to adjust more flexibly in response to shocks, reflected by these variables become more volatile as trade increases.

The impact of TI on business cycle synchronization is positive. Countries that trade more with each other likely have more common components in their national income and consumers in different countries consume more similar baskets of goods, causing stronger output comovement at higher trade. Additionally, TI is found to have larger influence on constrained borrowers who are connected to the production sector more than investors, and play a more significant role in cross-country comovement than FI.

The resulting impacts of trade on aggregate fluctuation and output comovement across three studies are similar likely due to the same trade structure and measure of TI, although Chapter 5 uses different parameters from the other two. Comovement is only explored under Chapter 6 and 7. Welfare is only explored in Chapter 5 so the result cannot be compared with the others.

The positive impact of TI found agrees with Kose, Prasad, Rogoff, et al. (2006), who argued that TI has a more favorable cost-benefit trade-off than FI. The finding that TI raises business cycle synchronization is consistent with a strong evidence found in both empirical and DSGE studies. See Calderon et al. (2007), Dées and Zorell (2012), and Duval et al. (2014) for examples of empirical studies, and Kose and Yi (2006), Faia (2007), and Ueda (2012) for examples of DSGE studies. However, a positive relationship between TI and output volatility are more often found than a negative relationship in previous studies such as by Senay (1998) and Pancaro (2010), and the papers investigating the relationship between TI and consumption variability is very limited.

Combined effect of FI and TI

Considering the effect of FI and TI together, the results are mixed.

Chapter 5 that examines cross-border borrowing finds that the effects of FI and TI are largely independent. The consequence from increasing one integration does not significantly depend on the degree of integration in the other market. This result is similar with Senay (1998) and Kose and Yi (2006) that investigate general and OECD countries respectively. It is also in line with empirical threshold studies that could not establish a significant role of trade on the relationship between FI and growth.

However, Chapter 6 suggests that the consequences of two types of integration are related. There are some evidences that the impact of FI on business cycles is weakened under higher trade and the effect of TI on output volatility might vary with differing degrees of FI. FI under low trade could lead to large consumption fluctuation for some people. This is possibly because two kinds of integration usually affect aggregate fluctuation in opposite directions and might offset each other. Chapter 7 finds small evidence in support of the finding from Chapter 6. This finding supports many views in the literature that trade liberalization should precede financial liberalization; TI could mitigate the risks associated with FI; the economy could achieve gains from FI when there is sufficient TI; and the two types of integration should go hand in hand in stabilizing the economy.[68]

Possible explanations for different findings based on this study are as follow.

Firstly, there is less endogenous linkage between FI and TI within the model economy in Chapter 5, in contrast to a complementary relationship between the two in Chapter 6 and Chapter 7.[69] FI and TI mostly affect business cycles in opposite direction and a stronger linkage between the two might lead to a more offsetting joint effect. This could also result from the incorporation of convex adjustment cost as discussed in Section 6.6 that it might induce nonlinearity relationship among the variables and the relationship between home households and home entrepreneurs. However, two types of integration empirically tend to be related, and in practice, people within the economy are interrelated through many possible economic activities. Thus, it is more likely that the impacts of FI and TI are not independent.

Secondly, Chapter 5 is the only study that frictionless domestic market is available as an alternative to FI, which could support people who have restricted access to international financial markets.[70] The incorporation of unconstrained domestic credit might make the foreign financial assets less influential as manifested in the resulting small impact of FI in Chapter 5. The effect of trade is relatively larger and could overshadow the interaction between two kinds of integration, if any.

Lastly, the inconsistent results might be simply owing to different types of FI, financial access, and frictions employed.

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[68] See, for example, Kose, Prasad, Rogoff, et al. (2006), Arteta et al. (2001), International Monetary Fund (2002, 2015b), Pancaro (2010) and Kose et al. (2011).

[69] In Chapter 7, there is a linkage between FI and TI under model H and A, similarly to that in Chapter 6. However, the linkage in model O resembles that in Chapter 5 with less relation between the two.

[70] The domestic market in Chapter 6 is subject to leverage constraint. Home population always face some forms of frictions in the combined financial markets under Chapter 7.

All three studies similarly find that the consequences of FI with market imperfections have a trade-off. Increasing FI could be positive to some parties, while negative to the others. The Pareto improvement analysis shows that no change either increasing or decreasing the level of FI, or enabling more people to access international financial markets could lead to lower fluctuation of output and consumption at the same time. However, enhancing FI together with TI could contribute to lower volatility of output and consumption. The analysis on desirable combination of two integrations suggests that medium amount of FI combined with sufficient trade tend to be preferable than other combinations. This is intuitive both from the results of this study and from the trade-off between diversification benefit and contagion risk associated with financial globalization.

However, determining the optimal combination between financial and trade integration is impractical and beyond the scope and tools of this study because the degree of integration is not bounded by strict resource constraints. [71] The country can continually integrate deeper in both markets. More importantly, FI is multifaceted. Different types of flows could lead to contrasting outcomes and the effect possibly depends on many interrelated factors such as financial frictions and people's accessibility to foreign markets.

<u>*Business cycle stylized facts*</u>

Comparing the aggregate fluctuation generated by the models with business cycle stylized fact in emerging market economies, Chapter 5 could establish business cycle in EMEs that are more volatile than that of the developed countries to some extent, while Chapter 6 observes that consumption of households is more volatile than output. However, Chapter 7 fails to capture those two related stylized facts.

Apart from different model setups, these might also be owing to different underlying shock processes. In Chapter 5 and 6, the shock in the home emerging economy has higher standard deviation than the foreign shock, taking into account the stylized fact that the business cycles of emerging economies are more volatile than the advanced economies. However, Chapter 7 turns to examine symmetric shocks between the two countries. This might influence the resulting simulated volatility.

[71] The literature on optimal level of FI is currently very limited. This issue was discussed in Section 3.3 of Chapter 3.

Chapter 9
Conclusion

This dissertation investigates the impact of increasing financial and trade integration together on international business cycles and different types of market participants in emerging markets under the presence of financial frictions and imperfect access to finance. Three RBC models have been developed to examine the issues from various aspects. This chapter first concludes the main findings and contributions of this study in Section 9.1 and 9.2. It summarizes policy implication in Section 9.3, and ends with limitations of the study and suggestion for future researches in Section 9.4 and 9.5.

9.1. Main Findings

Overall findings suggest that the effect of FI on international business cycles and different market participants depends on TI, types of financial flow, frictions, and financial accessibility. There is a trade-off among the consequences of FI and greater FI is not necessarily better.

The impact of increasing FI on output volatility in emerging market economy is found to vary by the directions of financial flows. Higher external debt is found to be associated with more volatile output possibly because it is more procyclical and could amplify the effect of adverse shocks (Kose, Prasad, Rogoff, et al., 2006; Kose et al., 2009). In contrast, higher outward foreign asset investment tends to be associated with less volatile output, and the effect of greater access to international markets is mixed. This finding might explain the inconclusive impact of FI on output volatility found in earlier empirical studies that tend to examine total financial integration rather than distinguishing into different types of flows.

The effect of greater FI on business cycle synchronization is found to reduce cross-country output correlation in Chapter 6, but only small influence from FI is found in Chapter 7.

The results on consumption volatility from three studies point towards the same conclusion that consumption smoothing benefit and welfare gain from higher FI is absent when market imperfection exists, consistent with previous researches. What this study has found in addition is that the negative consequences of FI tend to be lessened when there are less financial restrictions, people having more access to saving, investment and borrowing, and unconstrained domestic financial market is available.

People with more restrictions in terms of friction, constraint, and inaccessibility to financial markets tend to be more negatively affected by increasing FI. FI could benefit people under some conditions such as people with freer access to more choices of financial assets, and investors or savers who just pay additional fees from investing rather than borrowers who cannot save and whose borrowing is more restricted. Savers might be able to smooth consumption better from the participation of more borrowers in the markets, suggesting that people are not only impacted by their own financial accessibility, but also affected from the participation of other people. Evidences also show that people who are restricted internationally would not be much worse off if they have unconstrained domestic market to turn to, implying the importance of domestic financial markets when international FI is imperfect. On the other hand, people with direct cross-border financial linkage likely have higher consumption correlation with the foreign economy, suggesting that they would be more impacted by a foreign shock.

Trade integration is found to generally lower output and consumption fluctuation, increase business cycle synchronization, and slightly enhance welfare. Overall, its effect is broadly beneficial and similar across three studies. International trade also seems to influence constrained borrowers who are connected to the production sector more than investors, and play a more significant role in cross-country comovement than FI.

Combining two integrations together, evidences from Chapter 6 and 7 suggest that the impacts of FI and TI could be intertwined. FI has weakened effect on business cycles at higher trade and FI under low trade could lead to large consumption fluctuation for some market participants, while the effect of TI on output volatility might vary with differing degrees of FI. However, the consequences of FI and TI are found to be largely independent in Chapter 5 that examines cross-border constrained borrowing.

Possible explanations for different findings are that a stronger linkage between FI and TI within an economy like in Chapter 6 might lead to a more offsetting joint effect, whereas if people can well utilize domestic financial markets when FI is imperfect like in Chapter 5, the impact of FI might be small and overshadowed by trade and domestic market. Also, the inconsistent results might be owing to different types of FI, financial access, and frictions employed.

Given a trade-off among its various impacts, greater FI and more access to international financial markets are not entirely favorable to business cycles in emerging markets. Neither increasing nor decreasing the level of FI seems to be Pareto improving that reduces aggregate fluctuation, but enhancing FI together with trade could contribute to lower volatility of output and consumption. The analysis on desirable combination of two integrations suggests that medium amount of FI combined with sufficient trade tend to be preferable than other combinations. Nevertheless, determining the optimal combination between two integrations is impractical since the country can continually integrate deeper in both markets without being bounded by strict resource constraints and the consequences of FI are multifaceted.

From these findings, the three sub-studies under this thesis have achieved the objectives and have answered research questions based on the evidences found.

9.2. Contributions of the Study

This dissertation contributes to the literature by attempting to fill the research gap that few studies examine the impact of FI and TI together on business cycles in emerging market economies. It has developed three RBC models to investigate imperfect FI from various aspects. They were built upon many existing models to incorporate trade integration, financial frictions, asymmetric financial access, heterogeneous agents, and domestic market together with FI. Adopting the DSGE approach provides a framework that could analyze what-if questions and complement the empirical evidences that rely on historical data. Parameter calibration employs recent financial and trade data from emerging markets. The results are largely able to capture the individual impacts of FI or TI alone on business cycles found in empirical studies. The models could establish some stylized facts of business cycles in emerging markets that the output is more volatile than advanced economies and consumption fluctuates more than output.

The study extended the researches examining the effect of financial and trade integration on business cycles in general and advanced economies to cover market imperfections in emerging economies. The result from the study in Chapter 5 is similar to previous findings such as by Senay (1998) and Kose and Yi (2006) that the consequences of FI and TI are broadly independent, but the studies in Chapter 6 and 7 show some new evidences that TI could weaken the magnitude of FI's effect and their consequences on business cycles could balance each other. In addition, the findings from this study highlight the importance roles of asymmetric frictions, unequal access, different kinds of market participants and domestic markets on the impact of FI. These factors have been limitedly explored by this strand of literature, for example, the work by Senay (1998), Kose and Yi (2006), and Pancaro (2010).

The thesis also expanded the literatures focusing on the consequence of imperfect FI on consumption volatility in emerging markets to include TI. It is similarly found that FI could dampen consumption smoothing and welfare when market imperfections exist and people with access to international financial markets tend to benefit from FI more than people with no access like the work by Leblebicioğlu (2009) and Levchenko (2005) for instance. Nevertheless, the findings from this study additionally suggest that TI could help mitigate this negative effect of FI on consumption fluctuation, people with more severe frictions tend to be more adversely affected, and savers could smooth consumption better with the participation of more borrowers in the market. Apart from consumption volatility that has been the main focus in the existing literature, this study also found that FI influences output fluctuation and cross-country output comovement, and these impacts potentially depend on types of financial assets and the degree of international trade.

The findings provide a comprehensive view and a better understanding of imperfect FI and business cycles. The impact of FI measuring as cross-border borrowing, foreign asset holding, and access to international financial markets yields different results, similarly to the findings from previous researches that measure FI as the type of asset market structures and compare autarky and complete integration. But this study offers some evidences that the inconclusive result might be owing to the interplay among many related factors and diverse aspects of FI. It suggests that there might be no ultimate answer whether FI is beneficial or not at the aggregate level, but breaking it down and analyzing different components might yield useful results.

The findings also provide some suggestions for macroeconomic stability and international integration policies, which will be discussed next.

9.3. Policy Implication

On the basis of the findings, emerging market economies might not be able to achieve evident gains from only deepening FI when there are market imperfections. The consequences from increasing FI on business cycles are diverse and can be positive to one party and negative to the other. Thus, the findings point towards maintaining a well-balanced level of FI.

Different directions of financial flows might matter. Given that the emerging markets generally have more foreign liabilities than assets, encouraging outward cross-border investment might help lower output volatility associated with inward financial flows and improve the cost benefit trade-off of FI.

Some evidences suggest that financial and trade integration could support each other regarding macroeconomic stability. Trade could help mitigate the adverse impact of FI on consumption fluctuation, while FI could potentially help lower output volatility and dependence on foreign countries when TI increases them. This implies that for

EMEs that already have high TI, increasing FI and access to international financial markets would not hurt macroeconomic stability much and might improve overall risk sharing and consumption smoothing from the participation of more market participants. For EMEs with currently low TI and market imperfections, integrating deeper into world financial markets without sufficient international trade might increase aggregate fluctuation.

The findings also show that heterogeneous consumers are affected by international integration differently, likely depending on the severity of financial restrictions they face both internationally and domestically. Hence, differentiated policies might be more suitable for different groups of people.

All these findings suggest that integrated policies are preferred. The issue of appropriate type and degree of FI should be considered together with TI, reduction of market frictions, improvement of unequal financial access, and domestic financial development. Deepening integration in both markets together may be more favorable to business cycles than focusing at integration in only one of the markets. Everyone should be able to access and appropriately utilize saving, investment and borrowing opportunities, ensuring that no one is left out of risk sharing. Supplementary risk management tools such as hedging might be needed to help some market participants alleviating the risks associated with FI. These could be encouraged such as by reducing transaction cost, information barriers, and restrictions as well as improving financial literacy. Lastly, a sound domestic financial market is important as a support when FI is imperfect.

Although the findings favor higher trade and medium level of FI, there seems to be no one-size-fits-all combination of FI and TI given their multifaceted impacts beyond just the business cycles. The desirable level of integration depends on specific economy's circumstance and the policymaker's discretion. Evidences from this study have shown that many interrelated factors could contribute to reaping gains from FI and policies in emerging market economies should take these factors into account.

9.4. Limitations

The limitation that may affect the generalizability of findings is that the results are contingent on the model setup and assumptions. Including unconstrained domestic market in Chapter 5 might induce the importance of domestic market and overshadow the effect of FI. The assumption regarding the adjustment cost in Chapter 6 might influence the relationship between FI and TI in the model, contributing to the combined effect found. The assumption in Chapter 7 that the home capital owners can only borrow but cannot save might cause the finding that their consumption smoothing is worsen under full financial access. The study yields the impact of FI that has a trade-off and the effects of financial and trade integration that work in opposite directions. Hence, the results point toward a more balanced mix of FI. The three models differ in many aspects, making it difficult to clearly distinguish what causes differences in the findings across three sub-studies. Therefore, the interpretation of the findings must be applied in the light of the underlying assumptions.

Furthermore, this study has addressed only certain aspects of FI. The analysis covers cross-border borrowing, foreign portfolio investment, and access to international financial market, focusing at the private sector. It does not examine FDI and public sector. The study was carried out under one type of asset market structure, which is the bond economy. Only the consequences on aggregate fluctuation, business cycle synchronization, and welfare are explored, but international integration could affect many other facets of the economy, such as overall economic growth and domestic markets. Hence, the results of this study cannot be taken as a decisive conclusion for the impact of FI as a whole.

Lastly, this dissertation only focuses at the real consequences of FI while neglecting monetary facets. Two important factors related to FI are not investigated, namely, financial shocks and exchange rate. Shocks to the financial sector, financial crisis, and crisis contagion could reverse the benefits of FI, if any. For example, Duval et al. (2014) and International Monetary Fund (2013) found that the relationships between FI and business cycle comovement are opposite during crisis versus non-crisis periods. The foreign exchange rate itself and the exchange rate regimes are important variables that influence cross-border financial flows. The exchange rate variable is included in Chapter 5, but its relationship with FI is limited. It is omitted in Chapter 6 and 7. Also, the emerging markets investigated adopt various exchange rate arrangements, ranging from conventional peg in Jordan and Venezuela, managed arrangement in China, Malaysia, and Pakistan, to floating in Thailand, South Africa, Hungary, and Brazil and free-floating in Mexico and Russia for example (International Monetary Fund, 2016). Different exchange rate regimes could influence the implication of FI, which could not be explored extensively under the RBC type of models. The findings from this study could be changed if these issues are incorporated.

9.5. Future Researches

Possible extension from this study could be carried out in many ways.

Firstly, the models could be extended to incorporate monetary variables or modified into NK type of models. Financial shocks could be added, both under RBC model like Devereux and Sutherland (2011b), who apply a shock to credit market, and NK model like Ueda (2012), who inserts a shock to the net worth of financial institution sector. See Jermann and Quadrini (2012) and Perri and Quadrini (2011) for extensive investigation of negative financial shocks and credit tightening. The issue of exchange rate and different exchange rate policy regimes could be explored in more depth, but this needs to be applied within the NK model setup. See for examples, Ueda (2011) who found that the exchange rate is one important channel linking the banking integration with financial crisis, and Faia (2007) who explores the impact of different exchange rate regimes on business cycle comovement. Both papers are carried out using Bernanke, Gertler and Gilchrist's (1999) financial accelerator model. Ueda (2011) also examines the external finance premium arising when borrowing funds from two different countries. This could also be included. Benigno (2009) is another example of paper exploring the role of exchange rate and prices.

Secondly, a particular region of EMEs or a specific country could be investigated instead of across-the-board emerging market group. See for example, Pisani (2011) and Ma (2016) who calibrate their model to Malaysia and China respectively.

Thirdly, parameter estimation could be adopted instead of parameter calibration like in recent studies by Ma (2016) and Vitek (2015). Both researchers use Bayesian technique to estimate the models. However, the issue of availability, quality, and consistency of data should also be taken into account when studying the emerging economies. Vitek (2015) examines a large group of countries inclusive of advanced economies, while Ma (2016) only focuses at China.

Fourthly, other types of financial integration and frictions could be explored such as integration in equity markets in addition to the bond markets and trade friction. The inclusion of equity market integration could provide an investigation of a non-linear relationship between FI and macroeconomic volatility. For example, Evans and Hnatkovska (2007b) found a hump-shaped relationship between FI and consumption volatility under equity market integration. Equity risk premium between bond risk-free rate and equity risky return can also be examined when including equity market integration, such as the work by Mendoza and Smith (2014) and Perri and Quadrini (2011). Another example of paper examining equity market integration is Devereux and Sutherland (2011b). Trade frictions like transportation cost could be incorporated as carried out by Kose and Yi (2006) and Pancaro (2010). They both model trade integration as a reduction of this transportation cost.

Lastly, a more specific model examining a particular issue could be developed to clearly distinguish the underlying reasons for the findings found, such as focusing at constrained versus frictionless domestic markets as a support for imperfect financial integration, or testing the sequencing of reform conjecture by simulating increased TI first before increasing FI.

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APPENDIX

Appendix A: Data Appendix

Table A.1 List of countries and grouping

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

Note: EMEs = emerging market economies. Countries are firstly categorized as advanced economies according to International Monetary Fund (2015c), and then grouped as emerging economies based on International Monetary Fund (2010) and International Monetary Fund (2015a). The region is taken from World Bank's WDI 2015. In total, there are 35 AEs, 30 EMEs, and 4 emerging ASEAN countries.

Table A.2 Data source and description

Variables	**Area**	**Data period used**	**Data description**	**Data Source**
Domestic credit to private sector (% of GDP)	Financial development	2014	Financial resources provided to the private sector, such as loans, purchases of non-equity securities, and trade credits and other accounts receivable, which establish a claim for repayment. For some countries, these claims include credit to public enterprises.	GFDD, World Bank
Bank accounts per 1,000 adults	Financial development	2014	This is calculated as 1,000 times the reported number of depositors/adult population in the reporting country.	GFDD, World Bank
Bank net interest margin (%)	Financial development	2014	Calculated from underlying bank-by-bank unconsolidated data from Bankscope. Numerator and denominator are aggregated on the country level before division.	GFDD, World Bank

Variables	Area	Data period used	Data description	Data Source
Bank Z-score	Financial development	2014	It represents the probability of default of a country's banking system. Z-score compares the buffer of a country's banking system with the volatility of those returns. It is estimated as the ratio of the sum of Return On Assets (ROA) and equity capital to assets over the standard deviation of ROA. ROA, equity, and assets are country-level aggregate figures. A higher z-score suggests a lower probability of default.	GFDD, World Bank
Market capitalization excluding top 10 companies to total market capitalization (%)	Financial development	2014	This is the ratio of the value of listed shares outside of the top ten largest companies to total value of all listed shares.	GFDD, World Bank
Stock market capitalization to GDP (%)	Financial development	2014	The value of listed shares to GDP deflated using CPI.	GFDD, World Bank
Outstanding domestic private debt securities to GDP (%)	Financial development	2014	Total amounts outstanding of domestic private debt securities issued in domestic markets as a share of GDP. It covers data on long-term bonds and notes, commercial paper and other short-term notes. The figures are deflated using CPI.	GFDD, World Bank

Variables	Area	Data period used	Data description	Data Source
Stock market turnover ratio (%)	Financial development	2014	Ratio of the value of total shares traded to average real market capitalization. The denominator is deflated using CPI.	GFDD, World Bank
Stock price volatility	Financial development	2014	The average of the 360-day volatility of the national stock market index.	GFDD, World Bank
Financial Development Index	Financial development	2012	The score representing the level of financial development on the scale of 1 to 7. The higher score represents higher development. The index consists of seven pillars that together measure the financial development. The 2012 index is the latest data available.	World Economic Forum (WEF)
Chinn-Ito capital account openness (KAOPEN)	Financial integration	2000-2014	The index is a de jure measure of capital account openness based on the data from IMF's AREAER. The calculation method is principal component analysis and based on Chinn and Ito (2006, 2008). The index used in this thesis is normalized to range between zero and one. A higher value of the index indicates higher degree of capital account openness. The index is only available up to 2014.	Chinn-Ito index (KAOPEN) available at http://web.pdx.edu/~ito/Chinn-Ito_website.htm
Foreign direct investment (FDI)	Financial integration	2000-2015	FDI series include inward and outward flows and stock as a share of GDP	United Nations Conference on Trade and Development (UNCTAD)

Variables	Area	Data period used	Data description	Data Source
Foreign portfolio investment (FPI)	Financial integration	2001-2015	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. The series are based on survey. The liabilities are derived from creditor data. Only data points (country-year) with available data from both assets and liability sides are included in the computation to avoid bias between assets and liabilities. The earliest data available is 2001.	Coordinated Portfolio Investment Survey (CPIS), International Monetary Fund (IMF)
Foreign assets and liabilities	Financial integration	2000-2011	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. Net foreign asset (NFA) is also reported. The latest data available is 2011.	Lane and Milesi-Ferretti's The External Wealth of Nations Mark II database 2011 available at http://www.philiplane.org/EWN.html

Variables	Area	Data period used	Data description	Data Source
International bank claim	Financial integration	2000-2014	Amounts outstanding of international consolidated bank claims on an immediate borrower basis. It is calculated as a sum of cross-border bank claims and local claims of foreign affiliates in foreign currency. The data is collected from reporting countries and might be underreported. The series are discontinued in middle 2015; hence, the latest data available is 2014.	Bank for International Settlements (BIS)
Private external debt	Financial integration	2000-2015	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
Gross Domestic Product (GDP)	Financial integration	2000-2015	GDP at purchaser's prices in current U.S. dollars. Dollar figures for GDP are converted from domestic currencies using single year official exchange rates.	World Development Indicators (WDI), World Bank
Trade (% of GDP)	Trade integration	2000-2015	The ratio of the sum of export and import of goods and services to GDP	World Development Indicators (WDI), World Bank

Table A.3 Average Chinn-Ito index of capital account openness (KAOPEN) in advanced and emerging market economies 2000-2014

Year	**AEs**	**EMEs**
2000	0.85	0.43
2001	0.86	0.43
2002	0.87	0.45
2003	0.89	0.47
2004	0.92	0.51
2005	0.93	0.52
2006	0.94	0.53
2007	0.95	0.53
2008	0.94	0.56
2009	0.94	0.53
2010	0.94	0.50
2011	0.93	0.49
2012	0.93	0.47
2013	0.93	0.45
2014	0.93	0.47

Table A.4 Trend of financial and trade integration in advanced and emerging market economies 2000-2015 (in percent of GDP)

Year	Total FDI flow		Total FDI stock		FPI		Total foreign assets and liabilities	
	AEs	EMEs	AEs	EMEs	AEs	EMEs	AEs	EMEs
2000	15.96	3.82	71.25	27.98			778.67	123.99
2001	8.29	3.25	73.48	29.15	308.29	14.84	815.51	125.17
2002	8.08	2.73	83.08	31.66	326.88	14.27	904.29	132.49
2003	7.22	3.56	91.58	34.41	373.66	17.77	970.36	137.91
2004	13.72	4.17	107.02	35.50	402.45	18.68	1,024.46	138.65
2005	27.15	5.56	122.29	37.70	424.74	20.12	1,038.18	136.85
2006	24.95	6.50	153.63	41.69	497.60	23.48	1,217.16	149.82
2007	37.38	6.59	197.09	46.27	509.28	25.58	1,324.81	163.62
2008	16.00	6.29	206.96	39.16	351.18	15.25	1,112.87	139.78
2009	8.96	4.40	244.50	47.90	454.98	22.95	1,347.31	171.88
2010	20.60	4.10	253.54	48.03	465.43	24.96	1,358.77	167.64
2011	14.07	4.12	237.12	44.76	392.41	21.31	1,286.75	155.50
2012	25.17	4.48	261.39	49.10	475.08	26.97		
2013	9.57	3.66	252.01	50.41	495.67	26.99		
2014	12.04	3.95	240.65	50.76	524.76	28.67		
2015	17.61	3.47	264.58	55.24	543.20	27.64		

Year	Net foreign asset		International bank claim		Private External Debt		TI	
	AEs	EMEs	AEs	EMEs	AEs	EMEs	AEs	EMEs
2000	-5.98	-33.15	70.05	15.63	24.61	14.24	105.70	67.68
2001	-3.97	-32.67	72.82	15.11	24.93	11.48	104.11	67.50
2002	-0.87	-32.43	72.11	14.77	68.90	13.00	101.73	67.67
2003	3.51	-32.00	71.89	14.57	60.49	17.07	101.93	69.03
2004	0.86	-30.67	79.41	14.40	64.14	15.73	107.77	75.23
2005	2.00	-30.55	83.98	15.16	74.64	14.40	112.37	76.67
2006	1.42	-29.69	103.41	18.14	93.77	14.05	118.16	78.40
2007	-5.68	-32.70	115.90	21.32	100.37	14.89	118.99	78.85
2008	-16.21	-26.06	94.45	17.86	119.26	14.13	124.25	80.15
2009	-22.97	-31.73	102.22	19.96	149.57	16.53	110.60	68.19
2010	-21.95	-33.56	92.25	19.46	141.49	14.46	121.52	71.53
2011	-15.91	-29.33	77.05	17.91	112.57	13.39	128.56	75.67
2012			86.53	18.80	145.47	14.34	130.95	75.88
2013			78.26	17.81	152.41	14.66	130.33	74.95
2014			69.13	16.51	135.47	14.95	129.96	75.02
2015					132.54	15.95	130.28	74.28

Table A.5 FPI composition breakdown by asset types 2001-2015 (in percent of GDP)

Year	Assets - Debt Securities		Assets - Equity and Investment Fund Shares		Liabilities - Debt Securities		Liabilities - Equity and Investment Fund Shares	
	AEs	**EMEs**	**AEs**	**EMEs**	**AEs**	**EMEs**	**AEs**	**EMEs**
2001	109.98	1.32	71.04	1.99	49.53	7.37	77.99	3.61
2002	127.13	1.53	62.98	2.14	57.74	7.38	79.90	3.57
2003	141.50	1.67	80.34	2.29	61.75	8.39	89.71	4.83
2004	145.30	1.64	89.63	2.24	69.99	8.90	98.79	5.72
2005	143.01	1.67	103.82	2.67	73.04	8.10	104.63	6.85
2006	157.60	2.36	127.46	3.47	80.63	9.18	131.91	8.42
2007	155.05	2.69	134.20	4.20	78.86	8.16	141.09	10.48
2008	136.31	2.41	68.92	2.82	65.12	5.04	80.02	4.59
2009	165.33	2.63	100.23	4.92	79.16	7.07	110.16	8.27
2010	161.11	2.96	110.65	5.01	73.45	8.13	115.06	8.71
2011	141.34	2.62	88.30	4.19	67.65	7.96	95.36	6.43
2012	165.48	3.09	107.70	4.75	83.56	11.02	118.78	8.01
2013	159.07	3.38	123.36	5.61	85.02	10.56	132.78	7.42
2014	158.85	3.60	150.97	6.36	78.78	10.74	136.40	7.95
2015	156.93	3.76	165.33	6.68	77.29	10.09	142.94	6.90

Table A.6 FPI and TI by country (2001-2015 average, in percent of GDP)

a.) Advanced economies

Country name	Country code	FPI	TI
Australia	AUS	99.72	41.23
Austria	AUT	173.48	96.75
Belgium	BEL	228.42	149.96
Canada	CAN	105.55	66.66
Cyprus	CYP	164.12	114.48
Czech Republic	CZE	26.14	126.79
Denmark	DNK	162.96	93.97
Estonia	EST	36.16	142.27
Finland	FIN	198.71	76.12
France	FRA	179.61	55.32
Germany	DEU	143.94	75.62
Greece	GRC	94.53	56.00
Hong Kong	HKG	414.02	388.08
Iceland	ISL	161.47	86.06
Ireland	IRL	1101.63	173.91
Israel	ISR	54.38	70.95
Italy	ITA	116.82	52.19
Japan	JPN	77.42	28.78
Latvia	LVA	27.92	103.03
Lithuania	LTU	33.79	126.93
Luxembourg	LUX	8741.39	321.10
Malta	MLT	354.91	266.12
Netherlands	NLD	382.41	133.67
New Zealand	NZL	58.55	59.12
Norway	NOR	193.87	69.83
Portugal	PRT	143.95	69.17
Singapore	SGP	312.08	380.58
Slovak Republic	SVK	31.31	156.44
Slovenia	SVN	69.44	126.60
South Korea	KOR	37.16	84.73
Spain	ESP	110.32	56.49
Sweden	SWE	181.01	84.84
Switzerland	CHE	296.12	109.40
United Kingdom	GBR	226.95	55.60
United States	USA	86.14	27.00

b.) Emerging market economies

Country name	Country code	FPI	TI
Argentina	ARG	15.25	34.74
Brazil	BRA	20.72	25.95
Bulgaria	BGR	17.20	107.54
Chile	CHL	52.58	68.35
China	CHN	9.60	51.21
Colombia	COL	13.41	36.42
Croatia	HRV		84.00
Egypt	EGY	7.94	50.00
Hungary	HUN	45.91	148.63
India	IND	18.92	44.05
Indonesia	IDN	12.17	53.79
Jordan	JOR		123.60
Lebanon	LBN	18.68	97.24
Malaysia	MYS	46.61	174.76
Mexico	MEX	21.88	58.58
Morocco	MAR		72.85
Pakistan	PAK	1.88	32.41
Peru	PER		47.54
Philippines	PHL	25.53	81.05
Poland	POL	23.02	78.89
Romania	ROU	7.02	75.66
Russian Federation	RUS	12.30	53.00
Saudi Arabia	SAU	29.35	80.71
Serbia	SRB		79.57
South Africa	ZAF	64.84	59.33
Sri Lanka	LKA		62.56
Thailand	THA	23.01	129.02
Turkey	TUR	14.14	52.17
Ukraine	UKR	7.47	102.14
Venezuela	VEN	12.31	50.75

Appendix B: Comparison of Thesis with Other Studies

Paper	Aim/Focus	Type of model	Study EMEs
Chapter 5	Impact of FI and TI on macro volatility, business cycle comovement, and welfare	RBC (Heathcote & Perri, 2002; Pancaro, 2010)	Yes
Chapter 6		RBC (Leblebicioglu, 2009; Heathcote & Perri, 2002)	
Chapter 7		RBC (Devereux & Sutherland, 2011; Heathcote & Perri, 2002)	
Senay (1998)	Impact of FI and TI on macro volatility	NK new open economy model (Obstfeld & Rogoff, 1995)	No
Heathcote & Perri (2002)	Introducing financial autarky to solve some puzzle	RBC	No
Kose & Yi (2006)	Varied transportation costs within different financial scenarios on comovement	RBC (Backus et al., 1994; Heathcote & Perri, 2002)	No
Faia (2007)	Different monetary policy regimes on international business cycles	NK financial accelerator (Bernanke et al., 1999)	No
Leblebicioglu (2009)	Consequences of market friction and credit constraints on consumption smoothing	RBC	Yes
Pancaro (2010)	Impact of FI and TI on consumption smoothing	RBC (Heathcote & Perri, 2002; Kose & Yi, 2006)	Yes
Devereux & Sutherland (2011)	Exploring portfolio choice between autarky, bond, and equity	RBC	No
Ueda (2012)	FI and recent crisis on international business cycle	NK financial accelerator (Bernanke et al., 1999)	No

Paper	No. of consumer	No. of firm	No. of country	Country difference
Chapter 5	2 consumers (household, entrepreneur)	2 firms (traded and non-traded)	2	Different in agent type, financial conditions and parameters (emerging markets versus advanced country)
Chapter 6				
Chapter 7	2 consumers (worker, capital owner)			Different in financial conditions and parameters (emerging markets versus advanced country)
Senay (1998)	1 household	2 firms (traded and non-traded)	2	Symmetry
Heathcote & Perri (2002)	1 household	2 firms (traded and non-traded)	2	Different parameters (USA and rest of the world)
Kose & Yi (2006)	1 household	2 firms (traded and non-traded)	3	Different in country size and parameters (Different OECD countries)
Faia (2007)	2 consumers (household, entrepreneur)	1 traded firm	2	Different in financial conditions (OECD countries with different monetary policy regimes and bankruptcy environment)
Leblebicioglu (2009)	2 consumers (household, firm owner)	2 firms (traded and non-traded)	2	Different in country size, agent type, and financial conditions (developing versus developed countries)
Pancaro (2010)	1 household	2 firms (traded and non-traded)	2	Different in financial conditions (emerging markets versus advanced country)
Devereux & Sutherland (2011)	2 consumers (saver, borrower)	1 firm	2	Symmetry
Ueda (2012)	2 consumers (household, entrepreneur)	4 firms (capital goods, final goods, retail, wholesale)	2	Symmetry

Paper	Financial asset	Key financial frictions/constraint	Asset market complete-ness*	Asymmetric access to international financial markets
Chapter 5	Domestic and international non-contingent bond	International leverage constraint, financial inaccessibility	Incomplete	Yes
Chapter 6		Adjustment cost of cross-border asset holding, domestic leverage constraint, financial inaccessibility		
Chapter 7	International non-contingent bond	Adjustment cost of cross-border asset holding, international leverage constraint, financial inaccessibility		Yes for two model economies and no for the full model
Senay (1998)	Non-contingent bond, domestic money	Adjustment cost of bond holding	Incomplete	Not applicable**
Heathcote & Perri (2002)	Non-contingent bond, Arrow securities	None	Autarky, Incomplete, Complete	Not applicable
Kose & Yi (2006)	International state-contingent bond	None	Autarky, Complete	Not applicable
Faia (2007)	Non-contingent bond	Cost of portfolio allocation, domestic lender participation constraint	Incomplete	Yes
Leblebicioglu (2009)	Domestic bond, international state-contingent portfolio	Domestic leverage constraint, financial inaccessibility	Autarky, Complete	Yes
Pancaro (2010)	International non-contingent bond	International leverage constraint	Autarky, Incomplete	Not applicable
Devereux & Sutherland (2011)	Bond, equity	International leverage constraint	Autarky, Incomplete	No (both types of consumers have access)
Ueda (2012)	Loans	Credit constraint	Incomplete	Yes

Paper	Investigation of TI	Modeling FI	Modeling TI	Study of FI & TI Effect
Chapter 5	Yes	Reduction of leverage constraint	Inverse home bias parameter in Armington aggregator	Combined effect
Chapter 6		Reduction of adjustment cost		
Chapter 7		Different accessibility of people in the same country		
Senay (1998)	Yes	Reduction of adjustment cost	Existence of purchasing power parity	Combined effect
Heathcote & Perri (2002)	No	Different asset market structure	-	Only FI
Kose & Yi (2006)	Yes	Different asset market structure	Reduction of transportation costs	Separate effect
Faia (2007)	Yes	Ability to hold international asset	Inverse home bias parameter in Dixit-Stiglitz CES aggregator	Separate effect
Leblebicioglu (2009)	No	Different asset market structure	-	Only FI
Pancaro (2010)	Yes	Reduction of leverage constraint	Reduction of transportation costs	Separate effect
Devereux & Sutherland (2011)	No	Different asset market structure	-	Only FI
Ueda (2012)	Yes	Amount of cross-country borrowing	Inverse home bias parameter in Dixit-Stiglitz CES aggregator	Separate effect

Note

* Asset market completeness refers to the available financial assets and the level of risk sharing. Autarky means there is no international financial asset trading at all. Incomplete asset market means there are some financial assets available such as bonds and equities, but they are not enough to provide complete risk sharing. Complete asset market means there is a complete array of financial assets that can provide full risk sharing. This is usually implemented by employing a state-contingent asset or Arrow securities.

** Asymmetric access to international financial markets being not applicable means there is only one homogeneous type of consumers or agents. Therefore, it is implicitly assumed that everyone has access to international finance and different accessibility among people cannot be implemented within this setting.

Appendix C: Technical Appendix

C.1 Chapter 5 Derivation of Relationship between FI and m

From the international leverage constraint in equation (5-7) 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

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

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 (5-4) and (5-23), 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 (5-13) and put this in FOC equation (5-11) yields;

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

Rearrange to get

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

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

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

This is equal to equation (5-39) in Chapter 5.

$$FI_1 = \frac{m\alpha_1\beta_1}{1 - m(\beta_2 - \beta_1) - \beta_1(1-\delta)} \tag{5-39}$$

C.2 Chapter 5 Derivation of Relationship between TI and ω

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

$$\left(\overline{q_1^a}\right)^{\sigma}\overline{a_1} = (1-\omega_1)^{\sigma}\overline{P_1^{\sigma}}\overline{G_1} \tag{5-16}$$

$$\left(\overline{q_1^b}\right)^{\sigma}\overline{b_1} = \omega_1^{\sigma}\overline{P_1^{\sigma}}\overline{G_1} \tag{5-17}$$

Divide (5-16) with (5-17)

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

Rearrange to obtain;

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

From the market clearing condition in equation (5-32), multiply both sides with the price $\overline{q_1^a}$.

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

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

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

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

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

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

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

This equation can be rearranged to yield equation (5-42) to (5-44) in Chapter 5.

C.3 Chapter 6 Derivation of Relationship between FI and TI

From the market clearing conditions of home intermediate goods in equation (6-39), multiply it with the price q_t^a to obtain;

$$q_t^a Y_{1t} = q_t^a a_{1t} + q_t^a a_{2t} \tag{C-11}$$

Using the profit equation of final goods firm that has zero profit in the equilibrium that

$$P_{1t} G_{1t} = q_t^a a_{1t} + q_t^b b_{1t} \tag{C-12}$$

Combining these two equations together yields;

$$P_{1t} G_{1t} = q_t^a Y_{1t} - (q_t^a a_{2t} - q_t^b b_{1t}) \tag{C-13}$$

where the term $(q_t^a a_{2t} - q_t^b b_{1t})$ is the net exports. Using the balance of payments identity of current account and capital account that[72]

$$q_t^a a_{2t} - q_t^b b_{1t} = nQ_t^D D_{1t}^h - nD_{1,t-1}^h \tag{C-14}$$

Substituting the net exports in equation (C-13) using equation (C-14) yields;

$$P_{1t} G_{1t} = q_t^a Y_{1t} + nD_{1,t-1}^h - nQ_t^D D_{1t}^h \tag{C-15}$$

From the FOC of home final goods firm in equation (6-22), substituting out G_{1t} in equation (C-15) yields

$$P_{1t}\left[\left(\frac{q_t^b}{P_{1t}}\right)^{\sigma} \frac{1}{\omega_1^{\sigma}} b_{1t}\right] = q_t^a Y_{1t} + nD_{1,t-1}^h - nQ_t^D D_{1t}^h \tag{C-16}$$

[72] This identity can be obtained from aggregating the budget constraints of two domestic consumers – home households and home entrepreneurs. It implies that the size of net exports is equal to the size of net financial flow.

Multiplying the left hand side with q_t^b/q_t^b and dividing both sides with $q_t^a Y_{1t}$ yields;

$$\frac{P_{1t}}{q_t^b}\left[\left(\frac{q_t^b}{P_{1t}}\right)^{\sigma}\frac{1}{\omega_1^{\sigma}}\frac{q_t^b b_{1t}}{q_t^a Y_{1t}}\right] = 1 + \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} - \frac{nQ_t^D D_{1t}^h}{q_t^a Y_{1t}} \tag{C-17}$$

The term $q_t^b b_{1t}/q_t^a Y_{1t}$ represents the import share, denoting with MS_{1t}. Financial integration is defined as foreign asset holding of the home country $FAH_{1t} = nD_{1t}^h/q_t^a Y_{1t}$.[73] Rearranging (C-17) yields

$$\left(\frac{q_t^b}{P_{1t}}\right)^{\sigma-1}\frac{1}{\omega_1^{\sigma}}MS_{1t} = 1 + \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} - Q_t^D FAH_{1t} \tag{C-18}$$

The term $nD_{1,t-1}^h/q_t^a Y_{1t}$ is the investment and return from the previous period as a ratio of GDP. By definition, this does not equal to $FAH_{1,t-1}$. Equation (C-18) can be rearranged to obtain the import share as a function of foreign asset holding as follows;

$$MS_{1t} = \omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\left[1 + \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}}\right] - \omega_1^{\sigma} Q_t^D \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} FAH_{1t} \tag{C-19}$$

For the export share, divide equation (C-14) with $q_t^a Y_{1t}$ to obtain;

$$XS_{1t} - MS_{1t} = Q_t^D FAH_{1t} - \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} \tag{C-20}$$

Put equation (C-19) into equation (C-20)

$$\begin{aligned} XS_{1t} = \omega_1^{\sigma}\left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\left[1 + \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}}\right] - \omega_1^{\sigma} Q_t^D \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} FAH_{1t} \\ + Q_t^D FAH_{1t} - \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} \end{aligned} \tag{C-21}$$

Sum equation (C-19) and (C-21) together to obtain TI, which by definition is the sum of exports and imports to GDP; $TI_{1t} = XS_{1t} + MS_{1t}$.

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[73] FI can be defined by many measures. Apart from the current period foreign asset holding as defined above, FI can also be measured by the total amount as the sum of foreign asset and liabilities, or the net amount or net financial flow as the foreign financial asset minus liabilities. All kinds of measure of FI are related to TI, but the signs of the relationship might vary.

$$TI_{1t} = \left[1 - 2\omega_1^\sigma \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\right] Q_t^D FAH_{1t} + 2\omega_1^\sigma \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} + \left[2\omega_1^\sigma \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma} - 1\right] \frac{nD_{1,t-1}^h}{q_t^a Y_{1t}} \tag{C-22}$$

Under the benchmark parameters and the steady state values of variables, the term $\left[1 - 2\omega_1^\sigma \left(\frac{q_t^b}{P_{1t}}\right)^{1-\sigma}\right]$ is positive, and from equation (C-22), TI and foreign asset holding of the home country has positive relationship.

Note that from equation (C-13) and using market clearing of home final goods market in equation (6-37), the national income identity of home country that the output is a sum of consumption, investment, and exports minus imports can be obtained as follows;

$$q_t^a Y_{1t} = P_{1t} C_{1t} + (1-n) P_{1t} X_{1t}^o + q_t^a a_{2t} - q_t^b b_{1t} \tag{C-23}$$

where C_{1t} is the home aggregate consumption and equals to $C_{1t} = nC_{1t}^h + (1-n)C_{1t}^o$.

C.4 Chapter 6 Derivation of Relationship between Domestic Credit and m

From the domestic leverage constraint equation (6-11) in the steady state, divide both sides with GDP; $\overline{q^a}\overline{Y_1}$, where variables with bar means their corresponding state steady values. This yields

$$\frac{\overline{Z_1^o}}{\overline{q^a}\overline{Y_1}} = m \frac{\overline{P_1}\overline{K_1^o}}{\overline{q^a}\overline{Y_1}} \tag{C-24}$$

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 (6-5) and (6-27), it can be deduced that in the steady state, $\overline{Q^Z} = \beta$ and $\overline{Q^D} = \beta$.[74] Obtaining the leverage constraint Lagrange multiplier $\bar{\lambda} = (\beta - \nu)/\overline{P_1}\overline{C_1^o}$ from FOC in equation (6-14) and put this in FOC equation (6-13) yields;

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[74] Note that $\overline{Q^Z} = \overline{Q^D} = \beta$ only in the non-stochastic steady state, but actual values of the two bond prices can deviate due to the presence of cross-border adjustment cost. Even though $\overline{Q^Z} = \overline{Q^D}$, the home households do not feel indifferent between domestic and foreign financial asset because there is the adjustment cost that affects the household's budget constraint.

$$\frac{1}{\overline{C_1^o}} = \nu \frac{1}{\overline{C_1^o}} \left[\frac{\overline{r_1}}{\overline{P_1}} + (1-\delta) \right] + m \frac{(\beta - \nu)}{\overline{C_1^o}} \tag{C-25}$$

Rearrange to get

$$\overline{r_1} = \left[\frac{1 - m(\beta - \nu)}{\nu} - (1-\delta) \right] \overline{P_1} \tag{C-26}$$

Put $\overline{r_1}$ into the FOC of home intermediate goods' profit optimization equation (6-18);

$$(1-n) \left[\frac{1 - m(\beta - \nu)}{\nu} - (1-\delta) \right] \overline{P_1} \overline{K_1^o} = \alpha_1 \overline{q^a} \overline{Y_1} \tag{C-27}$$

Rearrange to get

$$\frac{\overline{P_1}\overline{K_1^o}}{\overline{q^a}\overline{Y_1}} = \frac{\alpha_1}{(1-n) \left[\frac{1 - m(\beta - \nu)}{\nu} - (1-\delta) \right]} \tag{C-28}$$

Put this back in equation (C-24) to get

$$\frac{\overline{Z_1^o}}{\overline{q^a}\overline{Y_1}} = m \frac{\alpha_1}{(1-n) \left[\frac{1 - m(\beta - \nu)}{\nu} - (1-\delta) \right]} \tag{C-29}$$

Rearrange to obtain

$$\frac{(1-n)\overline{Z_1^o}}{\overline{q^a}\overline{Y_1}} = \frac{m\alpha_1\nu}{1 - m(\beta - \nu) - \nu(1-\delta)} \tag{6-51}$$

This is equation (6-51) in Chapter 6. The ratio of total domestic credit to GDP $(1-n)\overline{Z_1^o}/\overline{q^a}\overline{Y_1}$ in the steady state is determined by the parameters.

Appendix D: Parameter Calibration

D.1 Computation of Adjusted Trade

Trade data used to derive the Armington weight parameters are from WDI and joint OECD – WTO Trade in Value-Added (TiVA) database.[75] Table D.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 raw series 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 or country group's average of imports and exports percentage adjustment would be used instead to adjust the raw trade downward. These average values depend on the grouping of country; ASEAN/non-ASEAN for Chapter 5, and high/low trade for Chapter 6 and 7. 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 grouping; emerging ASEAN and other EMEs for Chapter 5, and high trade and low trade EMEs for the other two chapters.

[75] The TiVA database is chosen due to its larger country coverage and more updated data compared to other database of value-added trade such as Koopman et al. (2014).

Table D.1 Summary of trade data for parameter calibration

Series	Type	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	Percentage of gross exports	TiVA	2011	55
Imports of goods and services	Percentage of GDP	WDI	2000-2013 average	65
Exports of goods and services	Percentage of GDP	WDI	2000-2013 average	65

D.2 Chapter 5 Parameter Calibration

Table D.2 Chapter 5: List of countries and grouping

Advanced economies	ASEAN EMEs	Other EMEs
Australia	Indonesia	Argentina
Austria	Malaysia	Brazil
Belgium	Philippines	Bulgaria
Canada	Thailand	Chile
Cyprus		China
Czech Republic		Colombia
Denmark		Croatia
Estonia		Egypt
Finland		Hungary
France		India
Germany		Jordan
Greece		Lebanon
Hong Kong		Mexico
Iceland		Morocco
Ireland		Pakistan
Israel		Peru
Italy		Poland
Japan		Romania
Latvia		Russian Federation
Lithuania		Saudi Arabia
Luxembourg		Serbia
Malta		South Africa
Netherlands		Sri Lanka
New Zealand		Turkey
Norway		Ukraine
Portugal		Venezuela
Singapore		
Slovak Republic		
Slovenia		
South Korea		
Spain		
Sweden		
Switzerland		
United Kingdom		
United States		

Note: The grouping of advanced and emerging economies is based on International Monetary Fund (2010, 2015a, 2015c). In total, there are 35 AEs, 4 ASEAN EMEs, and 26 other EMEs.

Table D.3 Chapter 5: Private external debt of emerging markets

Country	Private external debt (% of GDP, 2000-13 average)
Argentina	13.45%
Brazil	5.22%
Bulgaria	28.93%
Chile	24.26%
Colombia	9.86%
Croatia	28.91%
Egypt	4.53%
Hungary	18.38%
India	10.07%
Indonesia	11.95%
Jordan	6.97%
Malaysia	21.57%
Mexico	10.71%
Morocco	13.67%
Peru	8.81%
Philippines	5.79%
Poland	13.19%
Romania	17.96%
Russian Federation	14.42%
South Africa	6.61%
Sri Lanka	7.40%
Thailand	17.73%
Turkey	15.48%
Ukraine	29.97%
Average	14.41%

Sources: QEDS; WDI; and author's calculation.

Note: The series in QEDS used as private external debt are gross external debt position of other sectors. These exclude government, central bank, deposit-taking corporations, and intercompany lending.

D.3 Chapter 6 Parameter Calibration

Table D.4 Chapter 6: List of countries and grouping

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

Note: The grouping of advanced and emerging economies is based on International Monetary Fund (2010, 2015a, 2015c); the region is taken from WDI. In total, there are 35 AEs, 19 high trade EMEs, and 11 low trade EMEs.

Table D.5 Chapter 6: Private domestic credit and net foreign asset of emerging markets

Country	Domestic credit to private sector 2000-2013 (% of GDP)	Net FPI 2001-2013 (% of GDP)
Argentina	13.43%	-2.66%
Brazil	43.32%	-19.12%
Bulgaria	47.23%	-4.76%
Chile	86.99%	18.71%
China	118.65%	
Colombia	34.86%	-3.44%
Croatia	55.90%	
Egypt	43.96%	-4.77%
Hungary	47.13%	-36.25%
India	41.54%	-18.15%
Indonesia	26.59%	-9.77%
Jordan	77.57%	
Lebanon	81.77%	5.84%
Malaysia	114.33%	-28.65%
Mexico	20.30%	-15.35%
Morocco	56.37%	
Pakistan	23.32%	-1.33%
Peru	23.89%	
Philippines	32.15%	-17.14%
Poland	37.75%	-16.20%
Romania	28.79%	-4.11%
Russian Federation	33.33%	-8.89%
Saudi Arabia	34.38%	
Serbia	35.35%	
South Africa	139.16%	-2.38%
Sri Lanka	29.66%	
Thailand	115.37%	-13.96%
Turkey	32.84%	-12.68%
Ukraine	49.84%	-6.12%
Venezuela	17.68%	-5.03%
Average	51.45%	-9.37%

Sources: WDI; CPIS; and author's calculation.

Note: Net FPI is computed as total foreign portfolio assets minus total foreign portfolio liabilities. Portfolio investment includes debt and equity securities. The data from CPIS is only available back to 2001 the earliest. Only the countries with available data from both asset and liability sides are shown and included in computation. For example, Sri Lanka only has data available on the liability side and is thus excluded.

Table D.6 Summary of financial data for Chapter 6 parameter calibration

Series	Type	Source	Data period	Number of countries
Domestic credit to private sector	Percentage of GDP	WDI	2000-2013	30
Foreign portfolio investment	Value	CPIS	2001-2013	22
GDP	Value	WDI	2001-2013	22

Appendix E: Chapter 6 Additional Analysis: Combination of FI and TI

Table E.1 Volatility and correlation of key variables from varying levels of financial and trade parameters and corresponding rank

ϕ	ω_1	Y_1 vol.	C_1^h vol.	C_1^o vol.	Y_1, Y_2 corr.	Rank			
						Y_1 vol.	C_1^h vol.	C_1^o vol.	Y_1, Y_2 corr.
10	0.27	4.02	2.33	0.083	0.63	24	15	13	13
9		4.02	2.34	0.081	0.62	23	16	11	15
8		4.00	2.36	0.082	0.61	22	17	12	16
7		3.98	2.38	0.089	0.60	21	19	14	18
6		3.93	2.42	0.108	0.57	14	20	17	19
5		3.85	2.48	0.153	0.52	6	22	20	22
4		3.66	2.60	0.263	0.40	2	23	23	23
3		3.15	2.99	0.602	0.09	1	24	24	24
10	0.38	3.94	2.12	0.078	0.67	18	5	10	4
9		3.94	2.13	0.075	0.67	20	6	7	6
8		3.94	2.14	0.073	0.67	19	8	4	7
7		3.94	2.16	0.072	0.66	17	9	2	9
6		3.93	2.18	0.077	0.65	10	11	8	10
5		3.90	2.22	0.094	0.64	8	12	16	12
4		3.83	2.29	0.141	0.60	5	14	19	17
3		3.66	2.45	0.259	0.53	3	21	22	21
10	0.41	3.93	2.08	0.078	0.68	12	1	9	1
9		3.93	2.09	0.075	0.68	13	2	6	2
8		3.94	2.10	0.072	0.68	16	3	3	3
7		3.93	2.11	0.071	0.67	15	4	1	5
6		3.93	2.13	0.074	0.66	11	7	5	8
5		3.91	2.17	0.089	0.65	9	10	15	11
4		3.86	2.23	0.129	0.63	7	13	18	14
3		3.73	2.37	0.230	0.57	4	18	21	20

Note: Y_1 vol. = home output volatility (% SD); C_1^h vol. = home households' consumption volatility relative to home output; C_1^o vol. = home entrepreneur s' consumption volatility relative to home output; Y_1, Y_2 corr. = cross-country output correlation; the rank is assigned by comparing all 24 combinations for each criteria; the lower rank the better.

VITA

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