Essays on Financial Integration, Natural Disasters, and Commercial Banks in East Asia

by

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ABSTRACT

The thesis examines the impact of financial integration on commercial banks in East Asia. The thesis comprises three essays examining the relationship between financial integration and bank cost efficiency, financial integration and bank default risk, and the moderating role of financial integration on the impact of natural disasters on bank performance.

More specifically, the first essay tests whether there is a non-monotonic relationship between financial integration and bank cost efficiency. A sample of commercial banks from nine East Asian countries over the period 1997–2014 is examined. This is the first study to apply the non-monotonic stochastic frontier model to this relationship. The essay consistently reports a non-monotonic impact of financial integration on bank cost efficiency. Financial integration contributes to the improvement in bank cost efficiency up to a threshold. The model suggests that when the foreign claims are greater than 100% of GDP and when more than 40% of banks are non-domestic, a further increase in financial integration becomes efficiency-impeding.

The second essay examines the impact of different forms of financial integration on bank default risk. Using the system generalized method of moments (GMM) and sampling eight East Asian countries during 1999–2014, the essay finds that financial integration lowers bank default risk in the recipient countries. The impact is primarily driven by the foreign claims extended by Asian lenders and the foreign claims extended via local affiliates. These results show that close proximity of lenders and borrowers or ‘local’ knowledge via an affiliate presence alleviates information asymmetry, allowing for effective monitoring and disciplining of the loan relationship. The result supports the fostering of financial integration, promoting deeper intra-regional connectedness

throughout East Asia. Where foreign claims come from outside East Asia, policy makers should encourage presence through local affiliates, as this has an equivalent impact.

The third essay analyses the impact of natural disasters on commercial bank performance and the moderating impact of financial integration on the relationship. Commercial banks from seven East Asian countries during 1999–2014 are sampled. The system GMM regression reveals that natural disasters significantly lower the deposits ratio but have no contemporaneous relationship with liquidity, credit risk, profitability, and default risk. The essay also shows that foreign banking claims, specifically those extended by Asian lenders, help to alleviate the deposits decline in the aftermath of natural disasters. These results highlight the role of commercial bank deposits and foreign banking claims as sources of finance for post-disaster recovery. The resilience of the Asian foreign claims in the event of local shocks also provides evidence to support deeper intra-regional financial integration in East Asia.

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LIST OF ABBREVIATIONS

ADB: Asian Development Bank

BIS: Bank for International Settlement

CBS: Consolidated Banking Statistics

EM-DAT: Emergency Events Database

FDI: Foreign Direct Investment

GMM: Generalized Method of Moments

IC: Intermediate Counterparty (reporting basis)

IMF: International Monetary Fund

IPCC: Intergovernmental Panel on Climate Change

M&As: Mergers and Acquisitions

ML: Maximum Likelihood

OECD: Organization for Economic Cooperation and Development

SFA: Stochastic Frontier Analysis

UR: Ultimate Risk (reporting basis)

UNCTAD: United Nations Conference on Trade and Development

VIFs: Variance Inflation Factors

WB: World Bank

CHAPTER 1: INTRODUCTION

1.1 OVERVIEW OF THE THESIS

1.1.1 Research background

Financial integration is the term used to refer to the phenomenon of closely linked financial markets at the sub-national, national, regional, or global level. It encapsulates concepts such as financial openness, free movement of capital, and integration of financial services (Agénor, 2001; Fung et al. 2008). The key expected benefits of financial integration are efficient capital allocation and international risk-sharing; however, financial integration also carries substantial costs, including capital volatility and the transmission of shocks across markets (Agénor, 2001; Allen et al., 2011). The dual nature of financial integration means that academic researchers, financial sector practitioners, and policy makers have all been challenged by the long-standing question: "*How can a country maximize the benefits and mitigate the costs of financial integration?"*

Across the finance industry, financial integration in the banking sector best illustrates both the potential benefits and the costs of financial integration (World Bank, 2018). The key driver of the banking integration process are international banks- banks that do business outside the country they are headquartered. From theoretical perspective, the international expansion of these banks could be explained by the eclectic and internalization theories (see William (1997) for a detailed review of these theories). Both theories relate the motives for international expansion of banks to that of the non-financial multinational corporations.

The eclectic theory suggests that multinational firms possess ownership advantage and location advantage (Dunning, 1977). Specifically, ownership advantage

(i.e. access to the endowments of the parent company at costs below market price) enables a firm to profit from extending its operations into other markets. Location advantage (i.e. barriers to trade or institutional arrangements) help a firm to decide on the destination of its foreign investment. The internalization theory emphasizes that multinational enterprises overcome international market barriers (i.e. taking the forms of tariffs, restrictions on capital flows, differences in taxation regimes, and legal framework) and avoid excessive transaction costs by developing internal markets across national boundaries (Buckley, 1988; Buckley and Casson, 1991). Yannopoulos (1983) specified these advantages in the context of banking sector. He argued that the locational advantages (i.e. follow-the-client, country-specific regulations, and entry restrictions), the ownership advantages (i.e. product differentiation), and internalization advantages (i.e. informational advantages, and access to local deposit bases in order to exploit maturity transformation) are the key motives for banks to undertake multinational operations.

Using a similar approach that relates foreign direct investment with banks' oversea expansion, Grubel (1977) and Gray and Gray (1981) emphasize that banks establish facilities in locations where they have some type of comparative advantage. On the one hand, home-country customers with business abroad may generate demand for banking services abroad. Accordingly, banks following their customers abroad to seek new profits. On the other hand, a domestic bank has a comparative advantage (i.e. due to its greater familiarity with domestic procedures) in servicing foreign firms doing business in its home country. Therefore, openning a foreign branch is largely to market its services to the firm's foreign parent.

International banks are involved in two main types of international activities, namely cross-border lending and foreign participation in domestic banking systems via

brick-and-mortar operations (World Bank, 2018). These activities could bring both benefits and risks to the host countries. Research dedicated to understanding these impacts has produced a substantial literature; however, the existing evidence is inconclusive. On the positive side, foreign capital channelled by international banks could serve as an alternative source of external financing to ease the financial constraint in host countries in times of local crisis (Agénor, 2001). De Hann and Van Lelyveld (2010) empirical validated this argument; their evidence confirms that when a host economy is hit by a banking crisis, parent banks can inject funds in their subsidiaries in order to maintain their levels of credit supply. Additionally, the receipt of foreign capital may pressure policy makers in host countries to adopt good policies and better governance practices so they can attract foreign lending and to maintain those policies to avoid capital flight (Gourinchas and Jeanne, 2009).

Similarly, foreign bank presence could improve the efficiency of host countries' banking system via transferring technological know-how and management expertise, and via changing the local market's structure (Goldberg, 2009). The study of Claessens et al. (2001) suggests the presence of the former channel. Specifically, foreign banks operating in developing countries have lower overhead costs, higher interest margins, and higher profitability, which may suggest that foreign banks, in general, bring better technologies to less developed banking sectors (Claessens et al., 2001). The latter channel is evident in the study of Jeon et al. (2011), who examined banks in 17 developing countries and found that foreign banks improve competition in the banking sector of host economy. The increased competition from new foreign players puts pressure on local banks to increase their efficiency by, for example, reducing their costs and offering products of higher quality. The positive impact is found to be more pronounced particularly when

more efficient and less risky foreign banks enter markets with less concentrated banking systems.

On the negative side, banking globalization could pose threats to the local financial stability. Excessive liquidity caused by foreign capital inflows induces local banks to take risks (Acharya and Naqvi, 2012) and fuels credit booms in the host countries (Dell'Ariccia and Marquez, 2006). Besides, if foreign banks are not efficient in their oversea markets, the technology and management spill-over effect and efficiency improvement may not happen. This could be the case when banks fail to overcome the 'liability of foreignness' which is defined as the extra-costs of doing business abroad (Miller and Parkhe, 2002). These costs include monitoring from a distance, staff turnover in overseas postings, diseconomies of operation in the retail sector, and barriers to entry such as language, culture, market structure, and regulations (Miller and Parkhe, 2002). Additionally, foreign banks could also change the local market structure in a negative manner; for instance, local market consolidation following fierce competition with foreign banks can lower overall bank efficiency (Casu and Girardone, 2009). Finally, foreign banks could also destabilize host economies by transmitting shocks from their home country (Goldberg, 2009). Specifically, Jeon et al. (2013) reveal the existence of an active cross-border internal capital market whereby global banks reallocate funds across their branches and subsidiaries to buffer shocks to the parent bank's balance sheet. The study shows how a monetary policy shock in the home country can spill over to other countries through a reduction in lending by global banks' subsidiaries.

On balance, some research suggests that economic development (Lensink and Hermes, 2004), institutional quality (Mian, 2006; Detragiache et al., 2008), and financial development (Kose et al., 2011) serve as essential prerequisites for a country to reap net benefits from international banking. For instance, Lensink and Hermes (2004) confirm

that the short-term impact of foreign bank presence on domestic banks depend on the economic development of the host country. Specifically, at lower levels of economic development, foreign bank entry is associated with higher costs for domestic banks while at the higher level of economic development, the impact is less clear. In the former case, there exists a large gap between foreign banks' and domestic banks' level of management and technology; accordingly, domestic banks are under pressure to make investment to upgrade their systems, leading to higher operation costs. In the latter case, the gap as well as the room for improvement is not pronounced; therefore, banks are less motivated to improve their operations.

Studying the behaviour of foreign banks in developing countries, Mian (2006) and Detragiache et al. (2008) underscore the role of institutional quality to tackle the 'cherry picking' behaviour of foreign banks in host countries. To explain, in weak institutional environments with poor information and contract enforcement, international banks may focus on large corporations and governments, leaving the less transparent and more risky group of customers for domestic banks. Kose et al. (2011) empirically validated the existence of certain 'threshold' levels of financial and institutional development which could help an economy to attain the net benefits of financial integration. A deep and well-supervised financial sector is essential for an efficient allocation of foreign capital into local productive investments. Similarly, countries with better institutions could attract and maintain the stable inflow of foreign capital to avoid the adverse impact of capital volatility.

The global financial crisis has certainly led to a re-evaluation of the potential benefits and costs of bank globalization. Section 1.2 describes the evolution of international banking landscape before and after the global financial crisis with emphasis on the post-crisis change. The section, then, highlights the need for understanding the

benefits and cost of integration and addressing the long-standing question from new perspectives.

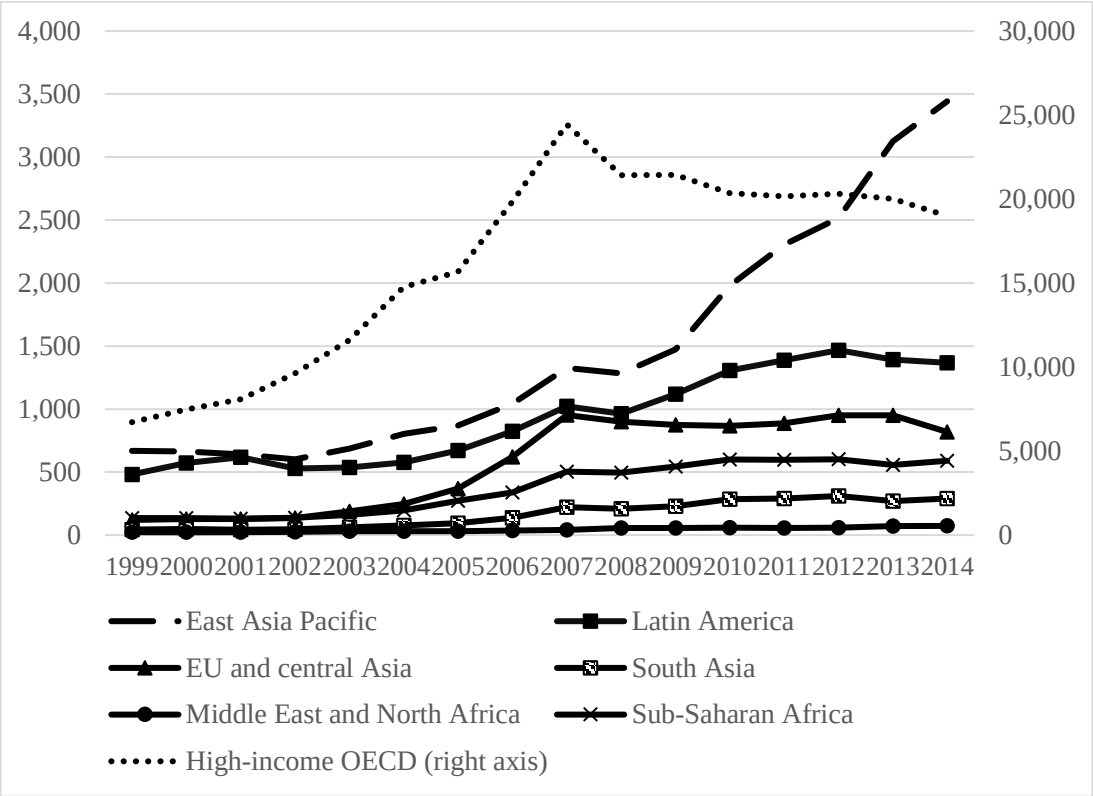
1.1.2 Research motivation

The decade before the GFC was characterised by a significant increase in banking globalization. The increase is partly explained by the deregulation in several countries, especially with emerging and developing further opening their capital account (Fernandez et al., 2015). The change was manifested in both a rise in cross-border lending and a growing participation of foreign banks around the world (Lane and Milesi-Ferretti, 2001 and 2007). Figure 1.1 best illustrates the former point; BIS data shows that the foreign banking claims (on all counterparty regions) were on a sharply increasing trend just before the crisis. Furthermore, international banks from advanced countries play the key role both as the providers and recipients of foreign claims (Claessens, 2017). With regard to the latter, Claessens and Van Horen (2014a) presented evidence of the large increase in foreign bank presence especially in emerging and developing market. Foreign bank presence became very large in some emerging markets, with market shares (in terms of the number of banks) in 2007 exceeding 80% in 14 countries and more than 50% in 63 out of 118 countries. This trend was triggered by the removal of foreign banks entry restrictions and banking system privatization in many regions such as East Asia, Latin America, and Central and Eastern Europe during the 1990s (Goldberg, 2009). In contrast, foreign bank presence remained low (i.e. less than 25%) in many advanced countries.

During the post-crisis period, banking globalization reversed. Regulatory change also affects international banks' expansion. Among the key regulatory reforms were the Basel Committee on Banking Supervision (BCBS)'s new and stringent capital and liquidity requirements for banks under the third Basel framework, Basel III. Accordingly, both foreign bank presence and foreign banking claims experienced retrenchment and

shift in their structure. While banks based in high-income countries began a retreat or reversal from foreign operations, developing country banks continued their international expansion, accounting for nearly 60% new entry into foreign markets (Claessens and Van Horen, 2014a). Cross-border bank claims also experienced significant retrenchments, but transactions from developing countries to other developing countries started growing (though these were likely dominated by regional expansion heralding a push towards regionalization). These changes in the international banking landscape are further described below and provide further motivation for this thesis.

The latest reversal and regionalization trends in the international banking landscape following the global financial crisis further motivate the examination of the long-standing research concern from two new perspectives, namely the level of financial integration and the types of financial integration. Specifically, the first trend is the reversal in international banking activities that is mainly observable among developed countries (World Bank, 2018). Figure 1.1 documents the substantial decline experienced by foreign banking claims on high-income Organization for Economic Cooperation and Development (OECD) countries during the post-crisis period. Further, a series of financial crises in the 1990s made multinational organizations, such as the International Monetary Fund (IMF), soften their insistence on full financial liberalization (International Monetary Fund, 2012). Taken together, the recent reversal following the global financial crisis increases the attention given to the level of financial integration and, in particular, identifying the point beyond which the costs of financial integration outweigh its benefits.



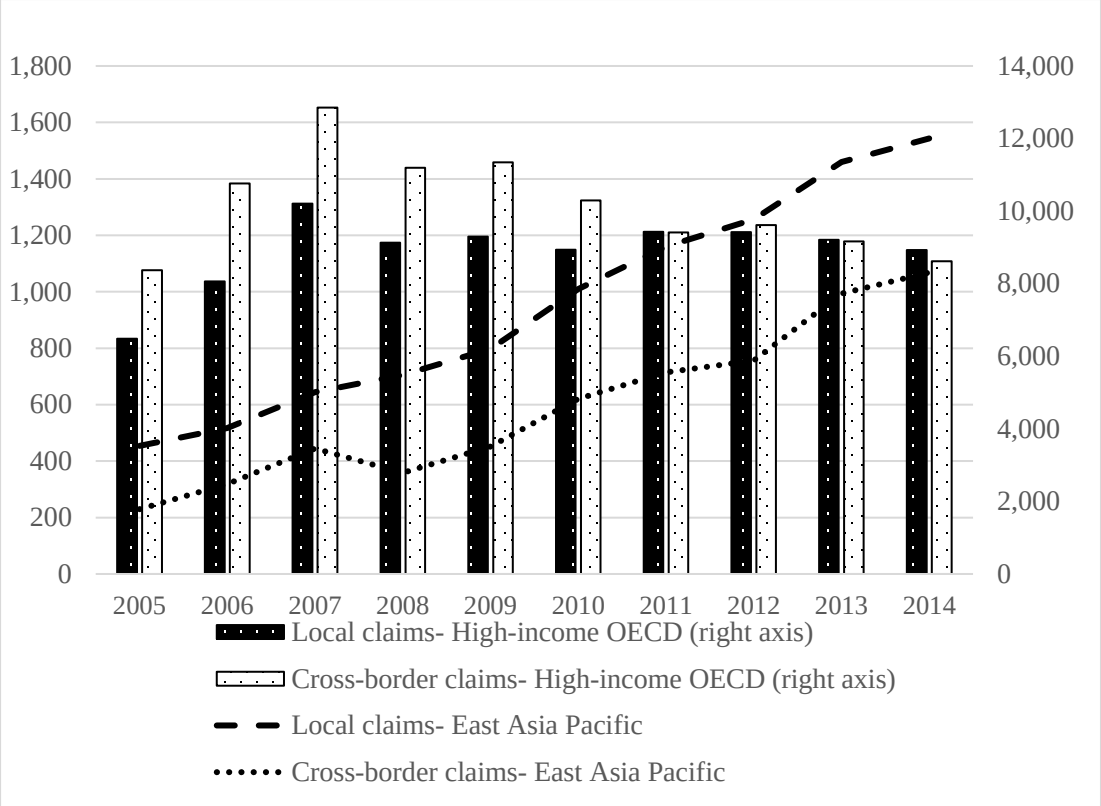
Source: Compiled from Bank for International Settlement (BIS) Consolidated Banking Statistics on Immediate Counterparty basis (CBS-IC), bank type "All excluding 4C banks, excluding domestic position".

Figure 1.1: The foreign banking claims on counterparty regions in the world (in US$ billions)

In contrast to the retrenchment among developed countries, the post-crisis period has witnessed the expansion of international banks among developing and emerging country banks in other regions (World Bank, 2018). For instance, referring to Figure 1.1, the East Asia Pacific region emerges as a region witnessing large growth in foreign banking claims after the crisis, contrasting markedly with other developed and developing regions of the world. More importantly, emerging international banks have started expanding primarily within their region of origin (Claessens and Van Horen, 2015). For example, Asian banks stepped in to take up the gaps created by the retrenchment of European banks in Asia (Remolona and Shim, 2015). This is described as the trend of regionalization in the post-crisis international banking landscape (World

Bank, 2018). As the potential benefits and costs of financial regionalization remain largely unknown (World Bank, 2018), a thorough examination should take into account the impact of different types of financial integration with regard to their origination.

Thus, an examination of foreign banking capital by its geographical source is critical in the contemporary international banking context. A further related lens to view foreign banking capital through is its methods of extension. Specifically, foreign claims can be extended either via local affiliates set up by international banks in the recipient countries or extended by international banks across borders. Local claims, which carry more 'local' knowledge than their counterparts, were resilient during the global financial crisis (World Bank, 2018). As clearly depicted in Figure 1.2, in high-income OECD countries, the cross-border claims were much higher in the pre-crisis period but fell substantially in the post-crisis, while the local claims exhibited much less fluctuation. In the East Asia Pacific region, the local claims were the main type of claims during the whole period; interestingly, this region was less affected by the global financial crisis. This further motivates studying the impact of different types of financial integration with regard to their methods of extension as well as their geographical source (regionalization).



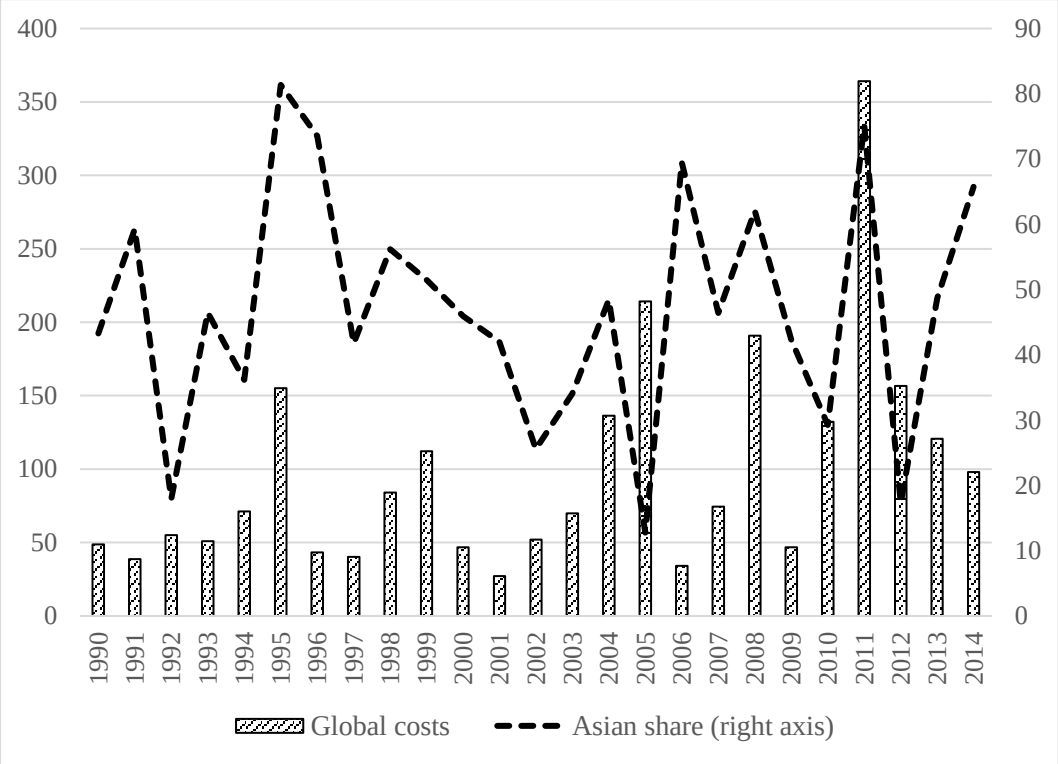
Source: Compiled from BIS CBS on Ultimate Risk basis (CBS-UR), bank type "Domestic banks, excluding domestic position".

Figure 1.2: The foreign banking claims (classified by methods of extension) on high-income OECD and East Asia Pacific region (in US$ billions)

Following the recent reversal and regionalization trend of international banking activities, this thesis examines the impact of financial integration on the banking sector with a focus on the level and different types of financial integration. Specifically, the first essay explores the non-monotonic relationship between financial integration and bank cost efficiency. The second essay examines the differential impact of different types of financial integration (i.e. classified by their geographical origin and methods of extension) on bank default risk.

Over the past 20 years, the devastating impact of natural disasters has been felt globally; however, Asia has borne a considerable share of the associated damage caused (see Figure 1.3). This is of increasing concern because there is evidence that climate change is altering the frequency and severity of natural hazards (Intergovernmental Panel

on Climate Change, 2014). Given the realized damage of past disastrous events, together with a current rising concern about climate change, the thesis brings together issues of the impact of disasters and financial integration in the third essay. This essay investigates the impact of natural disasters on a broad range of bank performance measures and, in particular, explores whether financial integration moderates these impacts.



Source: Compiled from the Emergency Events Database (EM-DAT).

Figure 1.3: The global economic damage of natural disasters (in US$ billions) and the Asian share of those damages (%)

1.1.3 Approach to measure financial integration in banking sector

There are several approaches to measure the level of financial integration. Quinn et al. (2011) categorise financial openness and integration into three types of *de jure, de facto* and *hybrid* indicators. *De jure* indicators are law-based indicators to proxy for the degree of legislated capital account openness. *De facto* indicators are quantities-based indicators to represent a country's realized outcomes of its international transactions with

other countries. *Hybrid* indicators are the combination of the two previous types. Some examples of these indicators are listed in Table 1.1.

Table 1.1: Review of financial openness indicators

Name	Coverage	Content	Source
KAOPEN	182 nations, 1970-2014	*De jure* measure of financial currents and capital accounts openness. It provides information about 'multiple exchange rates', 'current account', and 'surrender of export proceeds'.	Chinn and Ito (2008)
Economic Freedom Index	183 nations, 1995-2016	*De jure* measure of economic freedom. It provides information about 'rule of law'; 'government size', 'regulatory efficiency', and 'market openness' (including trade freedom, investment freedom, and financial freedom)	The Heritage Foundation (2019)
eGLOB-KOF	141 nations, 1970–2016	*Hybrid* measure. It is based on 'actual flows' of trade, FDI, portfolio, and remittances, plus restrictions on imports, tariffs, taxes on trade and capital account restrictions.	Dreher (2006)
TOTAL	145 nations 1970–2017	*De facto* measure. Its key measure is a country's aggregate assets and liabilities over GDP ratio. Several types of integration including FDI, equity investment, external debt, and official reserves are considered.	Lane and Milesi-Ferretti (2001, 2007)

(Source: Adapted from Quinn et al. (2011))

De jure indicators have wide coverage both in terms of sampled countries and time period. However, they are quite static in nature and therefore may not closely reflect the actual levels of financial integration. This limitation is raised by Quinn et al.'s (2011, p. 494) noting that *de jure* indicators "do not necessarily reflect a country's actual degree of financial integration, highlighted by the fact that even countries with relatively closed capital accounts became substantially more financially integrated over the past decades". Therefore, the thesis uses the *de facto* approach to measure financial integration in banking sector.

Quantity-based *de facto* indicators are popular to measure different types of financial integration, ranging from trade in financial service, foreign direct investment to portfolio investment, and foreign bank claims (i.e. Pongsaparn and Unteroberdoerster 2011; Australian Centre For Financial Studies (ACFS) 2015). ACFS (2015) review different type of measures with emphasis on their sources of data and limitations (see Table 1.2); most of these measures face data limitations on the Asian context.

Table 1.2: De facto measures of financial integration, data sources, and limitations

Measures	Data Sources	Key limitations
Trade in financial service	International organization (OECD, UNCTAD)	Poor coverage of trade in service and bilateral trade for developing Asia
Foreign Direct Investment	International organization (UNCTAD, IMF)	Data is aggregated. Therefore, it is not able to track whether FDI flows into manufacturing or financial sector.
Portfolio investment	IMF coordinated portfolio investment survey	Not cover some large holders of external assets
Foreign banking claims	Bank for international settlements (BIS)	BIS cover 44 reporting countries, poor coverage of Asia (notably China only started reporting to BIS in 2015)

(Source: Adapted from ACFS (2015))

As the thesis focuses on financial integration in banking sector, the measure based on foreign banking claims data provided by Bank for International Settlement (BIS) is the most relevant one. As seen in Table 1.2, no single source of data is perfect; BIS data is not an exception (see Section 5.1. for further discussion on BIS's limitations). Accordingly, the thesis is motivated to use foreign bank penetration ratio as another measure of financial integration in banking sector. These two measures could provide a complementary assessment on the level of banking integration. Furthermore, they also reflect the two main types of international activities conducted by international banks,

namely cross-border lending and foreign participation in oversea banking systems through brick-and-mortar operations (World Bank, 2018).

In shorts, the thesis analyses the impact of financial integration from the perspective of countries that receive foreign capital extended by international banks and host foreign affiliates of these international banks. The former aspect refers to the receipt of foreign banking claims, while the latter refers to foreign bank penetration. Data on the receipt of foreign banking claims are sourced from BIS. Data on the foreign bank penetration are sourced from the foreign bank database developed by Claessens and Van Horen (2015) (see Section 2.3.3. in Chapter 2 for further description of these measures).

1.1.4 The sampled East Asian countries

All three essays focus on commercial banks in East Asia. Specifically, commercial banks from China, Hong Kong, Korea, Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam are sampled. The 1997 Asian financial crisis led to high-profile bank defaults and a painful economic contraction in these East Asian economies, notably Thailand, Indonesia, Malaysia, the Philippines, and Korea (Asian Development Bank, 2008). Despite this troubled history, these countries are integrating further into the global financial markets, with China standing out as the newly emergent key player in the international banking markets (World Bank, 2018). More interestingly, the last six countries in the list, which belong to the Association of Southeast Asian Nations (ASEAN), are pro-actively promoting intra-regional integration with several cooperative initiatives such as the Chiang Mai Initiative in 2000, the Asian Bond Markets Initiative in 2003, and the formation of the ASEAN Economic Community in 2015 (Asian Development Bank, 2018). Furthermore, there exists considerable heterogeneity in the degree of economic and financial development as well as financial integration among these sampled countries (see Section 2.4 in Chapter 2), which would

potentially affect the process of intra-regional co-operation. In shorts, these features highlight these countries as an important group to examine and are an ideal match with the research focus of the thesis.

The following three sub-sections outline the motivation, methodology, and findings of each of the three essays, respectively. The last section highlights the overall contributions and outlines the structure of this thesis.

1.2 THE IMPACT OF FINANCIAL INTEGRATION ON BANK COST EFFICIENCY

A thorough examination of the impact of financial integration should take into account the level of financial integration. Accordingly, the first essay (Chapter 2) tests whether a non-monotonic relationship between financial integration and bank cost efficiency exists.

There have been arguments, theoretical models, and propositions advanced in the literature that suggest a non-monotonic impact of financial integration on bank performance. For example, based on portfolio diversification theory, Allen et al. (2011) hypothesize that the marginal benefits of integration diminish while its marginal costs rise as the level of financial integration increases. Following this hypothesis, there is an optimal level of financial integration such that additional integration efforts adversely impact capital allocation efficiency and international risk-sharing benefits. A mathematical model developed by Bacchetta and Wincoop (2016) shows that when a country passes a certain threshold of financial integration, it exposes itself to greater risks from financial integration.

Empirical findings from the bank efficiency literature suggest the existence of a non-monotonic relationship between financial integration and cost efficiency. For instance, Fries and Taci (2005) suggest that the association between a country's progress

in banking reform and cost efficiency is non-linear. Casu et al. (2016) find that financial liberalization improves bank cost efficiency; the effect is more evident in countries with pronounced regulatory change and less so in the case of limited liberalization. Unfortunately, these studies only highlight the potential existence of the non-monotonicity but do not formally test it. Additionally, these studies focus on the impact of financial reforms and financial liberalization, which are considered as a prerequisite for financial integration (Vo and Daly, 2007; Kim and Lee, 2008). This essay addresses this important gap in the literature by formally testing, for the first time, the non-monotonic impact of financial integration on bank cost efficiency.

The essay applies the non-monotonic efficiency effect model developed by Wang (2002). The model uses stochastic frontier analysis (SFA), which allows a single-step approach to estimate the best-practice cost frontier and the determinants of the inefficiency term. More specifically, in Wang's (2002) model, the marginal impact of an environmental variable, such as financial integration, on inefficiency could change direction depending on the values of the variable. Using a sample of commercial banks from nine East Asian countries (China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, Thailand, and Vietnam) over the period 1997–2014, the first essay focuses on two aspects of financial integration: foreign bank penetration and the receipt of foreign banking claims.

The essay consistently reports the non-monotonic impact of financial integration on bank cost efficiency. Specifically, greater financial integration contributes to higher cost efficiency up to a point; thereafter, additional financial integration becomes efficiency-impeding. The essay documents the turning points in cost efficiency when more than 40% of banks are non-domestic and the foreign claims of international banks exceed 100% of GDP. In short, the finding confirms the need to consider the level of

financial integration in examining the impact of financial integration on the banking sector.

1.3 DIFFERENT FORMS OF FINANCIAL INTEGRATION AND THEIR IMPACTS ON BANK DEFAULT RISK

A comprehensive examination of the impact of financial integration on banking systems should consider different types of financial integration in terms of lenders' nationality and the form of the foreign claims extension. The second essay (Chapter 3) explores these issues in the context of bank default risk. While the first essay studies two aspects of financial integration, the second essay focuses on the receipt of foreign banking claims. More specifically, it first examines the impact of foreign banking claims on bank default risk. Then, it investigates whether the types of foreign banking claims moderate that relationship.

With regard to the impact of foreign banking claims on bank default risk, the existing literature provides limited and contrasting findings. For instance, Dinger and Kaat (2017) report that inflows of foreign capital lead to higher impaired loans, while Karolyi et al. (2018) show that cross-border banking flows lower bank systemic risk. To shed more light on the impact of foreign banking claims on bank default risk, the second essay provides additional evidence from East Asian countries, a dynamic and growing region, which relies increasingly on foreign claims from international banks.

After establishing the baseline result, the essay explores the impact of different types of foreign banking claims classified by their lenders' nationality and methods of extension. Based on the former, foreign banking claims are extended either by regional (Asian) lenders or by distant (non-Asian) lenders. Based on the latter, foreign claims are extended via local affiliates set up by international banks in the recipient countries or extended by international banks across borders. The second essay proposes that each type

of capital is associated with different levels of information asymmetry. Specifically, regional (Asian) claims face less information asymmetry in comparison with their non-Asian counterparts due to the geographical, cultural, and institutional proximity between Asian lenders and their regional borrowers (Mian, 2006; Claessens and Van Horen 2014b). Similarly, the extension of funds via local affiliates rather than across borders involves some forms of foreign direct investment (García-Herrero and Martínez Pería, 2007), which also helps to obtain 'local' knowledge. Therefore, the information advantage associated with regional (Asian) claims and local claims arguably creates an effective discipline mechanism and a strong competitive pressure over banks in the recipient countries, thus leading to lower risk-taking behaviour. Although the rationale for expecting the preferential impact of regional (Asian) claims and local claims is highly intuitive, there is currently no research that has investigated this possibility. Therefore, the essay addresses this important gap in the literature.

A dynamic panel data model of bank default risk measured by the distance to default z-score is constructed. The overall and component measures of financial integration as well as other important determinants of bank default risk, such as bank-level characteristics, macroeconomic condition, regulation, and supervision, are included in the model. The two-step system generalized method of moments (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998) is used to estimate the dynamic model. The sample consists of commercial banks from eight East Asian countries during the period 1999–2014.[1]

[1] Bank regulation and supervision are among important determinants of bank risks (Laeven and Levine, 2009), thus the sample of the second essay greatly relies on this data availability. Accordingly, the examined period starts from 1999, which is the first available year of regulation data. In comparison with the first essay's country sample, Vietnam is dropped out due to the unavailability of regulation data. Other than that, the sample remains unchanged.

The second essay finds that financial integration lowers bank default risk in the recipient countries. As hypothesized, the impact is primarily driven by the foreign claims extended by regional (Asian) lenders and the foreign claims extended via local affiliates. The preferential impact of regional claims points to the benefit of financial regionalization since close proximity between lenders and borrowers alleviates information asymmetry, allowing for effective monitoring and disciplining of the loan relationship. The presence of international banks through local affiliates in the recipient countries and the extension of funds via this channel also leads to an equivalent impact. In short, the essay concludes that foreign banking claims from these two 'neighbouring' sources are the preferred types of financial integration. Therefore, the essay confirms that the types of integration, measured by lenders' nationality and the nature of the foreign claims extension, needs to be considered when examining the impact of financial integration.

1.4 THE MODERATING ROLE OF FINANCIAL INTEGRATION ON THE RELATIONSHIP BETWEEN NATURAL DISASTERS AND BANK PERFORMANCE

Rather than examining the direct impact of financial integration (on bank efficiency as in the first essay and on bank default risk as in the second essay), the third essay (Chapter 4) studies the mediating role of financial integration in the context of natural disaster damages. The third essay, therefore, not only contributes to the literature on the impacts of financial integration but also to the growing literature on the impact of natural disaster on the banking systems.

More specifically, the third essay first examines the impact of natural disasters on a broad range of bank performance measures. Then, it investigates the moderating effect of financial integration (measured via the receipt of foreign banking claims) on that

relationship. Finally, it explores whether the moderating role varies by several types of foreign banking claims classified by lenders' nationality and methods of extension, as in the second essay.

Cross-country analyses are rare in studying the impact of natural disasters on the banking sector. Discernible prior studies include Klomp (2014) and Brei et al. (2019), which report the negative impact of disasters on the aggregated country-level measures of bank performance. The third essay augments these studies by examining the impact of disasters on various measures of bank-level performance (including deposits ratio, liquidity, credit risk, profitability, and default risk).

The unconstrained and relatively immediate access to finance is essentially important for post-disaster recovery. Bank deposits and credit, insurance, and governmental support are key domestic sources of finance post-disaster; additionally, foreign capital could serve as an alternative post-disaster funding source in times of local shocks (Noy, 2009). However, the literature provides opposing predictions on the potential moderating role of financial integration. On the one hand, foreign capital could compensate for the volatility of domestic credit (De Haas and Van Lelyveld, 2006; Allen et al., 2011), thus assisting the post-disaster recovery. On the other hand, the likelihood of associated international capital outflows (Yang, 2008; David, 2011) could amplify the shortage of funds, thereby slowing down the recovery process. Therefore, this essay aims to confirm which effect is present (or is dominant) for the case of commercial banks located in the disaster-prone region of East Asia.

As shown in the second essay, each type of the foreign banking claims is associated with a different level of information asymmetry. More specifically, the 'neighbouring' claims which are either regional (Asian) claims or local claims are associated with lower information asymmetry. The information advantage is crucial to

maintaining the credit supply, as lenders face severe information asymmetry when disasters destroy customer information as well as collateral (Chavaz, 2014; Cortés and Strahan, 2015). Relying on this line of argument, the third essay (Chapter 4) re-investigates the preferential effect of 'neighbouring' claims in moderating the relationship between disasters and bank performance.

Similar to essay two, a dynamic panel data model of bank performance ratios is constructed to reveal the short-term and contemporaneous response of banks toward disasters. The two-step system GMM method is used to estimate this dynamic relationship. The essay measures the disaster damages via the ratio of economic loss caused by all disaster events to the one-year lagged GDP of a country. The sample draws on commercial banks from seven countries in East Asia during the period 1999–2014.[2]

The essay finds that natural disasters significantly lower the bank deposits ratio. Further, it shows that foreign banking claims, specifically those extended by regional (Asian) lenders, help to alleviate the deposits decline in the aftermath of natural disasters. These results highlight the role of commercial bank deposits and foreign banking claims as sources of finance for post-disaster recovery. The resilience of regional (Asian) foreign claims in the event of natural disasters provides further evidence to support the importance of financial regionalization.

1.5 RESEARCH CONTRIBUTIONS AND STRUCTURE OF THE THESIS

The thesis contributes to the debate about the benefits and costs of financial integration with the evidence from East Asia, which has seen a growth in integration but also a change in the nature of that integration since the Asian financial crisis. The thesis generally points to the benefits of financial integration. Specifically, the first essay finds

[2] In comparison with the second essay, the list of countries remains unchanged except for Singapore, as no natural disasters were recorded for that country.

that financial integration helps to improve bank cost efficiency up to a certain point. The second essay reports that financial integration helps to lower bank default risk; more specifically, it highlights the benefits of 'neighbouring' foreign claims which are either extended by regional lenders or via local affiliates. The third essay confirms the alleviating effect of financial integration, as the foreign banking claims serve as an alternative source of finance to support post-disaster recovery. Furthermore, it also reinforces the beneficial impact of receiving regional foreign banking claims, which are resilient in times of local shocks.

Existing research, notably Mian (2006), Detragiache et al. (2008), and Kose et al. (2011), suggests that countries should meet a certain threshold of institutional quality and financial development to reap the net benefits of financial integration. Placed in the context of the recent reversal and regionalization trends in the international banking landscape (see Figures 1.1 and 1.2), the thesis highlights the importance of the level of financial integration and the types of financial integration. Specifically, the thesis finds that a healthy amount of financial integration is likely to be beneficial for bank efficiency. Additionally, 'neighbouring' foreign capital is associated with lower information asymmetry and is also beneficial to financial stability in the recipient countries. This conclusion holds even during the periods of local shocks following natural disasters. Overall, in response to the long-standing question of "*How could a country maximize benefits and mitigate the costs of financial integration?"*, policy makers and practitioners can find their answers by considering the level of financial integration and the types of financial integration.

The remainder of this thesis proceeds as follows. Chapters 2, 3, and 4 present the three essays, respectively. Chapter 5 provides an overall conclusion and outlines some research limitations and potential avenues for future research.

CHAPTER 2: THE NON-MONOTONIC RELATIONSHIP BETWEEN FINANCIAL INTEGRATION AND COST EFFICIENCY: EVIDENCE FROM EAST ASIAN COMMERCIAL BANKS

2.1 INTRODUCTION

The global financial crisis of 2008–2009 triggered a discussion about a potential reversal in the global expansion of international banking that had begun in the 1960s (European Central Bank, 2012). Further, since the 1990s, policy makers such as the International Monetary Fund (IMF) have softened their insistence on full financial liberalization and have allowed more space for the employment of macro-prudential policies and capital account management tools (International Monetary Fund, 2012). In practice, after the global financial crisis, a major change in the international banking landscape was the retrenchment of European banks in terms of international intermediating activities (World Bank, 2018). The changes described above have ensured that there is continued academic and policy interest in studying the impact of financial integration with regard to the level of financial integration.

There have been arguments, theoretical models, and propositions advanced in the literature that suggest a non-monotonic impact of financial integration on bank performance. For example, based on portfolio diversification theory, Allen et al. (2011) hypothesize that the marginal benefits of integration diminish, while its marginal costs rise as the level of financial integration increases (see Figure 2.1). Given the declining marginal benefits but increasing marginal costs, an optimal degree of integration is given

An earlier version of this chapter was presented at the Financial Markets and Corporate Governance Conference (FMCG 2018, Melbourne, Australia) and the Vietnam Symposium in Banking and Finance (VSBF 2018, Hue, Vietnam).

by the point at which the marginal costs equal the marginal benefits. A mathematical model developed by Bacchetta and Wincoop (2016) also shows that when a country passes a certain threshold of financial integration, it exposes itself to greater risks from financial integration.

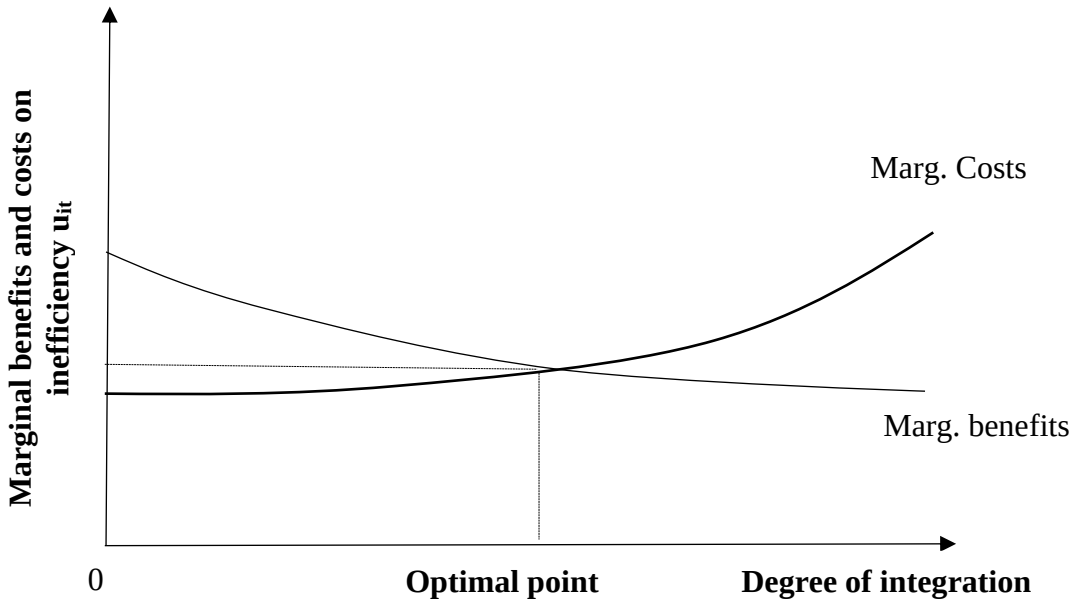


Figure 2.1: The optimal level of financial integration (Source: Adapted from Allen et al., 2011, p. 55)

Notes: In the context of bank cost efficiency, benefits of integration include diversification of funds and investments, knowledge, and technology spill-overs from foreign banks, whereas costs of integration take the form of financial contagions and higher input prices due to cross-border movement and fierce competition with foreign banks, respectively. Given the declining marginal benefits but increasing marginal costs, an optimal degree of integration is given by the point at which the marginal costs equal the marginal benefits.

Empirical findings from the bank efficiency literature suggest the existence of a non-monotonic relationship between financial integration and cost efficiency. For instance, Fries and Taci (2005) suggest that the association between a country's progress in banking reform and cost efficiency is non-linear. Casu et al. (2016) find that financial liberalization improves bank cost efficiency; the effect is more evident in countries with

pronounced regulatory change and less so in the case of limited liberalization. Unfortunately, these studies only highlight the potential existence of the non-monotonicity but do not formally test it. Additionally, these studies focus on the impact of financial reforms and financial liberalization, which are considered as a prerequisite for financial integration (Vo and Daly, 2007; Kim and Lee, 2008).

Given the above practical and academic context, this chapter formally tests whether the non-monotonic relationship between financial integration and bank cost efficiency exists.[4] Cost efficiency (or inefficiency) is measured by the distance of a bank's costs relative to the best-practice bank's costs in producing the same bundle of outputs, given its input prices of financial, physical, and human capital (Berger and DeYoung, 1997). Financial integration is measured in terms of foreign claims of international banks to the country and foreign bank penetration. An unbalanced sample of East Asian commercial banks from China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, Thailand, and Vietnam during the period 1997–2014 is used to test the relationship.

The key contribution of this chapter is to be the the first study to apply the non-monotonic efficiency effect model developed by Wang (2002) to the relationship between financial integration and bank cost efficiency. Hitherto, this relationship has been assumed to be accurately captured by monotonic efficiency effect models. The model is built upon the framework of stochastic frontier analysis (SFA), which allows a single-step approach to estimate the best-practice cost frontier and model the impact of

[4] Bank efficiency is an established filed of research but continues to generate contemporary interest from researchers from a range of perspectives, including income diversification, technology gaps, ownership structure, or cost of credit (Lin et al., 2016; Haque and Brown, 2017; Lee and Huang, 2017; Doan et al., 2018; Shamshur and Weill, 2019).

environmental variables (Z_{it}) through an inefficiency term.[5] More importantly, the employment of Wang's (2002) model has a threefold benefit: (i) the model formally tests for a non-monotonic impact of financial integration on cost efficiency; (ii) it can examine the impact of financial integration on both the mean and variance of the inefficiency term; and (iii) it accounts for the heterogeneity in the degree of financial integration in East Asia. To elaborate on the first (also the key) advantage, the model allows the environmental variable (Z_{it}) to have a non-monotonic impact on the inefficiency term measured by its marginal effect. In other words, depending on the values of the environmental variable, the marginal impact on inefficiency can change direction (from positive to negative or vice versa) in the sample. In linear efficiency effect models, the impact of Z_{it} is necessarily monotonic, being either efficiency-enhancing or -impeding, but not both. It is the accommodation of the non-monotonic efficiency effect that makes Wang's (2002) model unique and the best specification among eight well-known SFA models as supported by Lai and Huang (2010).

Another contribution of this chapter relates to the measurement of financial integration. Two measures are used, namely the receipt of foreign banking claims and foreign bank penetration. Bank for International Settlement (BIS) data on the foreign claims of international banks on the sampled countries to the GDP of the respective country are used to measure the former aspect. The number of foreign banks to total number of banks in a country is used to measure the latter aspect. With this approach, the chapter chooses quantities-based *de facto* indicators to represent a country's realized outcomes of financial integration rather than law-based *de jure* indicators to proxy for

[5] Alternatively, under the two-step approach, the observation-specific efficiency measure is estimated in the first step, then regressed on a vector of determinants in the second step. As the two-step procedure suffers from several criticisms, the preferred approach to studying the impacts of exogenous factors on efficiency is a single-step procedure (Schmidt, 2011; Kumbhakar et al., 2018)

the degree of legislated capital-account openness, such as the KAOPEN index (Chinn and Ito, 2008) and the Index of Economic Freedom (from the Heritage Foundation). Moreover, by using *de facto* measures, the chapter adopts a broader concept of financial integration, which encompasses multiple aspects, such as financial liberalization, free movement of capital, and integration of financial services (Fung et al., 2008). In this sense, financial liberalization could be considered as a prerequisite for international financial integration (Vo and Daly, 2007). This is especially true for the case of emerging markets where financial deregulation and capital account liberalization open doors to capital inflows (Kim and Lee, 2008), but the actual level of integration may evolve subsequently to the doors opening. Therefore, the chapter provides more comprehensive evidence of the impact of financial integration in comparison with almost all existing studies that examine the single facets of financial liberalization on bank efficiency, namely financial deregulation and capital account liberalization (such as Casu et al., 2016 and Luo et al., 2016). Further, the chapter also contributes to the international banking literature more generally by examining the impact of foreign banking capital on bank efficiency, contrasting with the existing empirical focus on the impact of financial contagion, crisis, and bank stability (for instance Jeon et al., 2013; Le and Dickinson, 2016; Ghosh, 2016).

The final contribution comes from the important context examined. The chapter explores the relationship between integration and bank cost efficiency in the context of East Asia, an economically dynamic region of growing importance to the international financial system and the global economy. During the past decade, financial integration in East Asia has continued to advance. The foreign banking claims going to East Asia Pacific increased notably, which is in contrast to the decline among high-income OECD countries and substantially higher than other regions, as depicted in Figure 1.1. However,

there is considerable heterogeneity in the degree of financial integration among countries in Asia. The region is the home of two highly sophisticated global financial centres, namely Hong Kong and Singapore. Other countries in the region, such as Indonesia, Thailand, and Vietnam, have also been integrating, but to a lesser extent (see Section 2.4). Finally, it is worthwhile examining whether the revision of the need for full financial liberalization by international policy makers is also relevant to East Asia – particularly since the region was less affected by the global financial crisis (see Section 1.1).

The baseline result as well as a battery of robustness tests find strong evidence of the non-monotonic impact of financial integration on cost efficiency for the sample of East Asian commercial banks. Specifically, greater financial integration contributes to higher cost efficiency up to a point; thereafter, higher financial integration becomes efficiency-impeding. The turning points of this non-monotonicity occur when more than 40% of banks are non-domestic and the foreign claims of international banks exceed 100% of GDP. In the case of the sub-sampled countries with low integration (i.e. excluding the two financial centres, namely Hong Kong and Singapore), these turning points are approximately at 40% and 55%, respectively. The country-level analysis strengthens the non-monotonicity. Banks operating in the least financially integrated countries (such as China and Vietnam) experience efficiency benefits from integration, while banks in highly integrated countries (Hong Kong and Singapore) do not.

These findings imply that excessive financial integration adversely affects bank performance. The results are strongly aligned with the arguments put forward by Allen et al. (2011, p. 55) that "some degree of integration is beneficial, but an excessive degree is not". The result has implications about the degree to which countries should become financially integrated, especially in the context of ongoing further and deeper financial integration in East Asia. This is not to say financial integration should be halted; the

chapter's results indicate that several countries in the sample would benefit from further financial integration, notably China, Vietnam, Thailand, and the Philippines.

The remainder of the chapter is organized as follows. Section 2.2 reviews the related studies and highlights some existing gaps in the literature. Methodology and data are described in Section 2.3. Section 2.4 and 2.5 present and discuss the descriptive and empirical results, respectively. Concluding remarks are provided in Section 2.6.

2.2 THEORETICAL BACKGROUND, HYPOTHESIS, AND RELATED EMPIRICAL EVIDENCE

Financial integration taking the form of either foreign banking capital or foreign bank penetration could be either beneficial or detrimental to bank cost efficiency. As hypothesized by Allen et al. (2011), the effect depends on the level of financial integration.

At the low level of integration, the marginal benefits of integration on cost efficiency are large (see Figure 2.1). The benefits come from various sources. With regard to foreign banking capital, thanks to the movement of capital across borders, banks could diversify their sources of deposits, thus becoming less susceptible to domestic shocks and channel investments toward countries with more productive opportunities (Baele et al., 2004). With regard to foreign bank penetration, knowledge spill-overs from foreign banks to domestic counterparts, such as better managerial practices and techniques, could enhance efficiency (Lensink et al., 2008). Additionally, both foreign capital and foreign banks intensify competition among the different providers of funds (Agénor, 2001; Jeon et al., 2011). The increased competition, thereby, could put pressure on local banks to increase their efficiency by managing their costs and offering products of higher quality. Finally, banks could take advantage of reduced transaction, overhead,

and information costs because input price differences across integrated markets could be reduced or eliminated over time (Weill, 2009).

As the extent of integration increases, the additional gains from these above-mentioned sources diminish and the marginal costs of integration on cost efficiency increase (see Figure 2.1). Specifically, the domestic banking system could be increasingly vulnerable to external financial shocks or crises since foreign banking flows could open channels for the transmission of financial contagion (Le and Dickinson, 2016; Ghosh, 2016). Further, foreign banking flows are often more volatile than other types of capital, such as foreign direct investment (FDI) (Levchenko and Mauro, 2007). Therefore, it follows that banks could contribute additional financial and human resources to manage their cost performance in an open and volatile environment.

Similarly, the higher level of foreign bank penetration could induce fierce competition which makes banks incur additional operating costs. For instance, as a consequence of competition between banks for deposits, deposit rates would rise and the bank price of funds increase accordingly (Wu et al., 2017). Additionally, foreign banks also tap into local fields of expertise (Cantwell, 1995); their competition for hiring a productive and talented workforce could push up the price of personnel. As illustrated by Kwan (2003), the average wage rates in the financial service industry in Asian highly integrated financial centres, such as Hong Kong and Singapore, were two to three times higher than those in Malaysia, Thailand, and the Philippines during the period 1992–1999. Finally, local banks are forced to merge to have better competitive ability, which could create monopoly power and reduce the overall efficiency of the banking sector (Casu and Girardone, 2009).

Given the declining marginal benefits but increasing marginal costs, an optimal degree of integration is given by the point at which the marginal costs equal the marginal

benefits (see Figure 2.1). Based on this theoretical background, Hypothesis 1 (H1) states: *"Financial integration improves bank cost efficiency up to a point, then becomes efficiency-impeding".*

The existing empirical literature focuses on the impact of financial liberalization (taking the forms of deregulation, banking reforms, and foreign bank entry) and bank cost efficiency. The findings are quite inconclusive. In the earliest contribution, Kwan (2003) uses a sample of seven Asian countries during the period 1992–1999 and finds that operating efficiency, measured by operating cost per unit, is unrelated to banking sector openness, which is assessed via various entry barriers to foreign competition. Similarly, Berger (2003) does not find positive efficiency effects of a single market for financial services in Europe. He attributes this finding to the consolidation of the banking sector which disrupted the supply of relationship credit and led to the loss of relationship information. The later literature finds evidence of a significant relationship, but there is no consensus in the direction of the relationship. Chortareas et al. (2013, 2016) support a positive association between economic freedom and bank cost efficiency in the case of commercial banks from European countries and the US, respectively. Similarly, as found by Lin et al. (2016), in the case of 12 Asian developing economies, foreign bank presence improves bank efficiency in countries with higher financial freedom. In contrast, sampling global commercial banks, Lensink et al. (2008) find that foreign ownership lowers bank cost efficiency, though the negative effect is less pronounced in countries with good governance.

More interestingly, examining banks from 15 post-communist East European countries, Fries and Taci (2005) highlight that the association between a country's progress in banking reform and cost efficiency is non-linear. Specifically, in the early stage of reforms, banks take advantage of liberalized interest rates and credit allocation;

at a more advanced phase, improvement in service quality and innovation to develop banks' market share results in higher costs. In the context of Asia, Casu et al. (2016) suggest the potential existence of a non-linear relation between financial liberalization and cost efficiency. Deregulation of interest rates, removal of restriction on activities, and foreign bank entry generally improves cost efficiency. The effect is more evident in countries with pronounced regulatory change and less so in the case of limited liberalization. The linear efficiency effect model of Battese and Coelli (1995) used by Casu et al. (2016) does not, however, formally test for the existence of a non-linear relationship.

The empirical evidence of foreign banking capital mainly focuses on its impact on bank stability rather than cost efficiency. Some empirical evidence shows that international banking activities can lead to financial contagion. For example, Jeon et al. (2013) present consistent evidence that internal capital markets in multinational banking contribute to the transmission of financial shocks from parent banks to foreign subsidiaries. However, Ghosh (2016) reports that banking sector globalization (indicated by cross-border volume of deposits and loans) significantly reduces the probability of banking crises.

This empirical review highlights some gaps in the literature. First and foremost, there have not been any studies that formally examine the non-monotonic relationship between financial integration and bank cost efficiency. Second, the existing literature, which mainly studies the impact of financial liberalization (in the form of deregulation and foreign bank entry) on bank cost efficiency, provides inconclusive evidence. Addressing the potential non-monotonic relationship between financial integration and bank efficiency would help to explain these mixed empirical findings. Third, foreign banking capital is mainly examined in terms of bank stability. Hence, there is a lack of

empirical evidence concerning the impact of foreign banking capital on bank cost efficiency. The chapter addresses these gaps in the literature.

2.3 METHODOLOGY, VARIABLES AND DATA

2.3.1 Estimation Method

Bank efficiency is defined as the distance to a best-performance frontier which is not explained by statistical noise. SFA is a well-established empirical approach developed by Aigner et al. (1977) and Meeusen and Van Den Broeck (1977) to measure efficiency. SFA distinguishes between statistical noise and an inefficiency component. This feature explains for its popularity compared to other approaches to measure efficiency and productivity in the literature (Berger and Humphrey, 1997).

Cost efficiency is measured based on the comparison between the minimum costs and the actual costs that produce the same bundle of outputs with the given input price (Berger and Mester, 1997). The cost efficiency could be estimated from a cost function. A stochastic cost frontier for panel data can be specified as given by Equation (2.1).

$$TC_{it} = f(W_{it}; Q_{it}) + v_{it} + u_{it} \quad (2.1)$$

$$v_{it} \sim N(0, \sigma^2_v)$$

$$u_{it} \sim N^{+}(\mu_{it}, \sigma^2_{it}),$$

where TC_{it} is the total cost for bank i at time t; W_{it} and Q_{it} are, respectively, vectors of input prices and outputs; v_{it} is a normally distributed error term with zero mean and variance (σ^2_v); and the non-negative component u_{it} follows a truncated normal distribution with an observation-specific mean (μ_{it}) and variance (σ^2_{it}) that measures the

inefficiency term.[6] The parameters of the model are estimated by the maximum likelihood (ML) method.

To study how environmental variables (in addition to input prices and outputs variables) affect inefficiency, either the mean (μ_{it}) or the variance (σ^2_{it}) of the pre-truncated distribution is parameterized. The decision about parameterizing only μ_{it} or σ^2_{it} would become arbitrary without specific assumptions on the impact of the determinants. Thus, Wang (2002) combines features of the two approaches as stated in Equations (2.2) and (2.3).[7]

$$\mu_{it} = \delta_0 + \delta Z_{it} \tag{2.2}$$

$$\sigma^2_{it} = \exp(\gamma_0 + \gamma Z_{it}) \tag{2.3}$$

The model allows both the mean and variance of the pre-truncated distribution to be expressed as the function of some environmental variables (Z_{it}). In particular, the model is able to accommodate the non-monotonic impact of a Z_{it} variable measured by its marginal effect on the inefficiency term. This means that an environmental determinant can positively (negatively) affect the mean and variance of the inefficiency term when its values are within a certain range, and then change to negative (positive) for values outside the range. In linear efficiency effect models, the impact of Z_{it} is either positive or negative, but not both.

[6] In his original study, Wang's (2002) presented his model with a production function. The chapter adopts his approach of parameterizing both the mean and variance of inefficiency term and apply to the cost function as presented in Equation 2.1.

[7] Wang (2002) is also described as heteroscedastic efficiency model since the model parameterises the variance of the inefficiency term as presented in Equation 2.3.
Wang's (2002) model was originally designed for cross-sectional data. Sun and Chang (2011) adapted this model to panel data in examining the impact of risks on bank cost efficiency. The chapter follows Sun and Chang (2011) to apply the model to study the impact of financial integration on bank cost efficiency. The limitation of the model in confounding the time-invariant unobserved heterogeneity and inefficiency terms is further discussed in Section 5.1.

The non-monotonic efficiency effects on $E(u_{it})$ of the *k*th element of Z_{it} are estimated as stated in Equation (2.4).

$$\frac{\eth E(u_{it})}{\eth z[k]} = \delta[k]\left[1 - \Lambda\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right] - \left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right]^2\right] + \gamma[k]\frac{\sigma_{it}}{2}\left[(1+\Lambda^2)\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right] + \Lambda\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right]^2\right] \quad (2.4)$$

where ϕ and ϕ are the probability and cumulative density functions of a standard normal distribution, respectively; $\Lambda = \mu_{it}/\sigma_{it}$; z[k] is the *k*th element of $Z_{it;}$ and $\delta[k]$ and $\gamma[k]$ are the corresponding coefficients in Equations (2.2) and (2.3).

The marginal effect of Z_{it} on $V(u_{it})$ is shown in Equation (2.5).

$$\frac{\eth V(u_{it})}{\eth z[k]} = \delta[k]\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right](m_1^2 - m_2) + \gamma[k]\sigma_{it}^2\left\{1 - \frac{1}{2}\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right]\left(\Lambda + \Lambda^3 + (2+3\Lambda^2)\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right] + 2\Lambda\left[\frac{\phi(\Lambda)}{\phi(\Lambda)}\right]^2\right)\right\} \quad (2.5)$$

where m_1 and m_2 are the first two moments of u_{it} (see Wang, 2002).

To make statistical inferences, the standard error and confidence interval of the marginal effect are obtained by bootstrapping.

2.3.2 Model Specification and Variables

The underlying cost structure of the banking industry (i.e the *f* function in Equation 2.1) is represented by the trans-log functional form.[8] Equation (2.1) is specified in detail in the system of Equations (2.6)–(2.8).

$$ln\left(\frac{TC}{w3}\right) = \beta_0 + \beta_1\, ln\left(\frac{w1}{w3}\right) + \beta_2\, ln\left(\frac{w2}{w3}\right) + \beta_3\, ln(q_1) +$$

$$\beta_4\, ln(q_2) + \beta_5\frac{1}{2}(ln\left(\frac{w1}{w3}\right))^2 + \beta_6 ln\left(\frac{w1}{w3}\right) ln\left(\frac{w2}{w3}\right) + \beta_7\frac{1}{2}(ln\left(\frac{w2}{w3}\right))^2 + \beta_8\frac{1}{2}(ln\,(q_1))^2 +$$

[8] A translog function was introduced by Christensen et al. (1973). This functional form is typically employed in the parametric approach to estimate inefficiency as it is found to be more reliable and flexible than the generalized and extended generalized Cobb-Douglas forms (Coelli et al., 2005). The general form of the trans-log functional form is specified as follows:

$Ln(TC_{it}) = \beta_0 + \sum \beta_k \frac{1}{2} (Ln(Q_{kit}))^2 + \sum \beta_l \frac{1}{2} (Ln(W_{lit}))^2 + \sum\sum \beta_{kl} Ln(Q_{kit})Ln(W_{lit}) + v_{it} + u_{it}$

$\beta_9 ln(\frac{w1}{w3})\ ln(q_1) + \beta_{10} ln(\frac{w2}{w3})\ ln(\frac{w2}{w3}) + \beta_{11}\frac{1}{2}(ln\ (q_2))^2 + \beta_{12} ln(\frac{w1}{w3})\ ln(q_2) + \beta_{13} ln(\frac{w2}{w3})\ ln(q_2) +$

$\beta_{14} ln(q_1)\ ln(q_2) + \beta_{15}\ T + \beta_{16}\ T^2 + \beta_{17}$ HIGH+ $v_{it} + u_{it}$ (2.6)

$\mu_{it} = \delta_0 + \delta_1 SIZE_{it} + \delta_2 CRERISK_{it} + \delta_3 CAP_{it} + \delta_4 CON_t + \delta_5 INTEG_t + \delta_6 IFL_t + \delta_7 PRICRE_t +$ δ_8YEAR1997+ δ_9 YEAR1998 + δ_{10}YEAR1999 + δ_{11}YEAR2007 + δ_{12}YEAR 2008+ δ_{13}YEAR 2009 (2.7)

$\sigma^2_{it} = \exp(\gamma_0 + \gamma_1 SIZE_{it} + \gamma_2 CRERISK_{it} + \gamma_3 CAP_{it} + \gamma_4 CON_t + \gamma_5 INTEG_t + \gamma_6 IFL_t + \gamma 7\ PRICRE_t$ $+\gamma_8$YEAR1997 + γ_9YEAR1998 + γ_{10}YEAR1999 + γ_{11}YEAR2007 + $_{12}$YEAR2008 + γ_{13}YEAR2009) (2.8)

To specify the input prices and outputs of the cost frontier function given by Equation (2.6), the chapter uses the intermediation approach. This approach refers to the banks as financial intermediaries that borrow money from units of surplus or use inputs, such as labour and capital, to transform these resources into loanable funds and other investments as outputs (Sealey and Lindley, 1977). Berger and Humphrey (1997) indicate that the intermediation approach is an appropriate way to estimate a bank's level of efficiency.

In line with previous literature, such as Lensink et al. (2008), the chapter constructs its variables for the cost frontier as follows. The total costs (TC) consist of total interest expenses and total non-interest expenses. The two outputs are gross loans (*Q*1) and total securities (*Q2*).[9] The three input prices are price of funds (*W1*), estimated by the ratio of total interest expenses to total customers deposits; price of physical capital (*W2*), estimated by the ratio of overhead expenses net of personnel expenses to total assets; and price of labour (*W3*), estimated by the ratio of personnel expenses to total

[9] The literature suggests using "net fees and commissions" as the third output variable to account for the increasing proportion of banks' income stemming from fee-based activities. Unfortunately, there are a lot of missing data reported for the sampled countries. The chapter excludes banks with less than three years of available financial data to compute input prices and outputs. The inclusion of this third output will increase the number of excluded banks, leaving a small sample size to run the complex ML estimation.

assets.[10] Among the inputs, the third input (*W3*) is used to normalize the dependent variable and other input prices to ensure the price homogeneity condition. First- and second-order time trends (T and T^2) are included in Equation (2.6) to account for the effect of technological changes. As a common best-practice frontier is constructed for all banks in the sample, a dummy variable to account for the heterogeneity in the country level of financial integration is included in Equation (2.6).[11] Specifically, a dummy variable (HIGH) is added to control for the difference between two groups, namely most countries in the sample and the two financial centres, Hong Kong and Singapore, which are highly financially integrated compared with the rest of the sample (see Section 2.4 for further discussion).

With respect to the function of the level and variance of the inefficiency term given by Equations (2.7) and (2.8), following Fiordelisi et al. (2011), Barth et al. (2013b) and Luo et al. (2016), the environmental group of variables $Z_{it,}$ is included. Specifically, several bank-specific variables are included such as SIZE (the natural logarithm of total assets) to proxy for economies of scale, CRERISK (the ratio of reserves for impaired loans to total loans) to proxy for assets quality, and CAP (the ratio of total equity to total assets) to proxy for leverage level. CON (the ratio of the top three biggest banks' assets to total banks' assets) is used to measure banking market concentration. As predicted by the 'Quiet Life Hypothesis', banks with market power are less motivated to control costs;

[10] With regard to the price of physical capital (W2) and price of labour (W3), their denominators are often constructed from the book value of fixed assets and the number of employees, respectively. As these data are missing for most of the sampled banks, the chapter uses the value of total assets in both denominators, instead. Besides, Ngo and Tripe (2016) suggest that W2 should be measured as the ratio of occupancy expenses to the value of fixed assets to reflect the core cost structure of banks. However, the data for 'occupancy expenses' are not available in Bankscope, the chapter could not follow Ngo and Tripe's (2016) approach.

[11] Empirical studies, such as Fu et al. (2014) and Luo et al. (2016), which use the SFA approach to measure cost efficiency in a cross-country setting also construct a common cost frontier for all sampled banks. To account for the cross-country differences, these studies include a dummy variable to proxy for the level of economic development in the cost frontier. As this chapter examines the impact of financial integration on cost efficiency, it is more relevant to include a dummy variable to proxy for the level of financial integration in the cost frontier function.

therefore, increased market concentration could lead to a decrease in efficiency (Hicks, 1935). By contrast, a positive relationship between efficiency and market concentration could be explained by the 'Efficient Structure Hypothesis'. Specifically, efficient firms with lower costs could earn higher profits; therefore, the most efficient firms could increase their market share, resulting in higher concentration (Demsetz, 1974). Dietsch and Lozano-Vivas (2000) and Berger (2007) conclude that macro-economic variables are important determinants of cost efficiency in cross-country analysis. Accordingly, macroeconomic variables such as IFL (inflation rate), PRICRE (the ratio of private sector credit to GDP), and financial integration indicators (INTEG)- the variable of interest are included. These variables could shape the demand for banks products and services and represent for the cross-country macro-economic differences, which could affect the cost inefficiency term. Year dummy variables are also included to account for the effects of the Asian and global financial crisis, which could negatively affect cost efficiency. Table 2.1 provides the definitions and construction details of all variables.

Table 2.1: Definition and specification of variables

Variables	Definition	Source
Cost frontier		
Dependent variable		
TC	Total costs= total interest expenses + total non-interest expenses	Bankscope and author's calculation
Cost frontier's variables		
W1	Prices of funds = Total interest expenses/ total customer deposits	Bankscope and author's calculation
W2	Price of physical capital = Overhead expenses net of personnel expenses / Total assets	Bankscope and author's calculation
W3	Price of labour = Personnel expenses/ Total assets	Bankscope and author's calculation
Q1	Output = Gross loans	Bankscope
Q2	Output = Total securities	Bankscope
Determinants of inefficiency		
CLAIM	Foreign claims extended by international banks on counter-party country to GDP of that country (%)	BIS CBS-IC
FOR	Numbers of foreign banks to Total number of banks (%)	Claessens and Van Horen (2015)
SIZE	SIZE= Natural logarithm of total assets	Bankscope and authors calculation
CRERISK	Credit risk = Reserves for impaired loans/ total loans (%)	Bankscope and authors calculation
CAP	Equity ratio = Total equity/ total assets (%)	Bankscope and authors calculation
CON	Market concentration = Assets of three largest banks/ Total commercial bank assets in the country (%)	Bankscope and authors calculation
IFL	Inflation = Annual % change of average consumer price index (%)	Global Financial Development (GFD)
PRICRE	Private sector's credit = Bank credit to private sector/ GDP (%)	Global Financial Development (GDF)
HIGH	A dummy variable equals 1 for countries with high level of integration (Hong Kong and Singapore); otherwise	The descriptive analysis of the sample
Year dummies	Dummies variables for the years of the Asian and global financial crisis	Laeven and Valencia (2012)

Variables in robustness tests		
TOTAL	Stocks of foreign assets and liabilities = the sum of the gross stocks of foreign assets and liabilities to GDP	Lane and Milesi-Ferretti (2007)
KAOPEN	Capital account openness	Chinn and Ito (2008)
ODUM	Foreign ownership equals 1, otherwise	Claessens and Van Horen (2015)
REGQ	Quality of regulation: The indicator measures the ability of the government to formulate and implement sound policies and regulations that permit and promote market competition and private sector development. The "estimate" score is used. Higher values mean higher quality of regulation.	World Governance Indicators (WGI)
ACTR	Overall restrictions on banking activities: The index measures the degree to which banks are allowed to engage in securities, insurance, real estate investment, and ownership of non-financial firms. Higher values indicate more restrictiveness.	Barth et al. (2013a)

2.3.3 Financial Integration's Measure and Data

The chapter chooses quantity-based *de facto* indicators to represent a country's realized outcomes of financial integration rather than law-based *de jure* indicators to proxy for the degree of legislated capital-account openness.[12] The level of financial integration (i.e. $INTEG_{jt}$ in Equations 2.7 and 2.8) is measured by foreign bank penetration and the receipt of foreign banking capital. Specifically, to proxy for the former, the percentage of foreign banks relative to the total number of banks in a country (FOR) is used. The data for foreign bank ownership are sourced from Claessens and Van

[12]Another approach to measure financial integration is price-based (Baele et al., 2004). The price-based approach captures the discrepancies in prices or returns on assets caused by the geographic origin of the assets. This approach is mainly used to examine the stock or bond markets integration (as in Rughoo and You, 2016; Billio et al., 2017).

Horen (2015). This measure has been widely studied as a determinant of bank efficiency (Lensink et al., 2008; Pasiouras et al., 2009).

For an individual country, international banking activities can take place in two directions. First, banks of the country may hold claims to the assets of other countries. Second, banks from other countries may invest in assets of the country in question. Being defined as the foreign claims of international banks on a country to the GDP of that country, CLAIM helps to measure the second aspect with the sampled countries acting as the recipients of funds.[13]

The data of foreign claims are sourced from the Consolidated Banking Statistics (CBS) on Intermediate Counterparty basis (IC) published by the Bank for International Settlement (BIS).[14] In detail, foreign claims are reported in their outstanding amount (in million USD) on a quarterly basis. The chapter constructs the annual claims by using the stock data on the last quarter of each year in the sampled period. Bilateral claims of a source-recipient country pair are then aggregated by the recipient country. After these steps, the year- and country-level claims on each of the sampled countries are obtained. The foreign claims are then scaled by the GDP of the corresponding sampled countries to construct the variable CLAIM. In short, CLAIM is relevant to assess the size of the international banking activities of one country in comparison with its GDP. Higher values

[13] As there are few countries in the sample that report bank foreign asset holdings to the Bank for International Settlement (BIS), the chapter could not measure the first aspect.

[14] BIS CBS provides the credit exposures (termed as 'foreign claims') of banks headquartered in 31 BIS-reporting (source/lender) countries to over 200 counterparties (recipient) countries on a bilateral basis. The CBS are structured on the nationality of reporting banks and on a consolidated basis, excluding intra-group transactions (i.e. capital injection, equity investment, intra-group loans, etc.) between offices of the same banking groups. The foreign claims reported in CBS could take the form of direct loans, syndicated loans, and interbank lending (Bank for International Settlement, 2015). Please refer to Appendix B1 in Chapter 3 for further information about CBS's structure.

Though not originally designed with the borrower perspective in mind, BIS CBS statistics are one of the few publicly available sources to provide information on the reliance of a borrower country on foreign bank credit (Cerutti et al., 2012). However, one limitation of CBS is that its data are subject to break-in-series and exchange-rate adjustment. To rule out this concern, following Karolyi et al. (2018), the chapter checked and ensured that the reported statistics for the sampled countries do not exceed 100% increase in their absolute values.

of CLAIM are associated with more participation in international banking activities and greater financial integration.

The construction of CLAIM follows the approach of a popular *de facto* measure in the international finance literature, namely TOTAL to proxy for financial integration. TOTAL is the ratio of the sum of the gross stocks of foreign assets and liabilities to GDP, which is based on the External Wealth of Nations Database (Lane and Milesi-Ferretti, 2007). With regard to the construction approach, being similar to TOTAL, CLAIM is a *stock* measure.[15] With regard to the scope of measurement, while TOTAL is an aggregated index reflecting the overall integration (in various aspects, such as FDI, equity investment, external debt, and official reserves), CLAIM focuses on the international banking activities with its data sourced from BIS CBS.

In comparison to *de jure* indicators of financial liberalization, such as the KAOPEN index from Chinn and Ito (2008) or the Index of Economic Freedom from The Heritage Foundation, the quantity-based *de facto* indicator (i.e. the foreign claims of international banks obtained from BIS) is more dynamic and updated more frequently.[16] CLAIM is particularly relevant to this study, as the sampled countries have experienced rapid growth in financial integration (see Figure 1.1) and are highly divergent in the level

[15] Some studies, such as Houston et al. (2012) and Karolyi et al. (2018), also use BIS CBS to construct a flow measure. Specifically, international banking flow is measured as the difference in the natural logarithm of outstanding foreign claims between year *t* and *t-1*. As the chapter measures the level of financial integration in the banking sector, it follows the approach of TOTAL to construct a stock measure. More importantly, stock measures capture the progress of financial integration better than flow measures (Kose et al., 2009). To explain, the latter can fluctuate markedly due to changes in short-term market conditions (García-Herrero and Wooldridge, 2007) and investor sentiment (Agénor, 2001) and is also prone to measurement errors (Kose et al., 2009).

[16] The *de jure* indicators are more static. For instance, the KAOPEN index for China remains the same during the period 1993–2014 despite some of its liberalized milestones, such as joining the World Trade Organization in 2001 or the full openness to foreign bank entry in 2007. The Index of Economic Freedom scores of some countries, such as the Philippines and Vietnam, are also quite static during the sample period (the associated statistics and analysis are available upon request).

of financial integration; thus, CLAIM better captures this growth and this heterogeneity (see Section 2.4).

2.3.4 Bank Sample

An unbalanced sample of 3,628 bank-year observations (about 386 banks) from nine countries in East Asia (China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, Thailand, and Vietnam) during the period 1997–2014 is examined. Bank-level data are obtained from Bankscope. The chapter starts with all bank specialisations in the database, then excludes non-commercial banks. The chapter also excludes banks with less than three years of available financial data to compute input prices and outputs of the cost frontier as well as bank-specific variables. During the period, a number of mergers and acquisitions (M&As) and bank failures took place, which are taken into account in the dataset. Specifically, both active and inactive banks were included in the dataset so as to avoid selection bias. Unconsolidated statements are preferred in order to reduce the possibility of aggregation bias in the results (if unconsolidated statements are unavailable, then consolidated data are used instead). All monetary values were deflated by using a GDP deflator, with 2010 as the base year. Finally, all bank-level data are winsorized at the top and bottom 0.5^{th} percentile to account for extreme values and unobservable data errors.

2.4 DESCRIPTIVE ANALYSIS

Table 2.2 presents the descriptive statistics for the sample. Most variables have high variation, as the reported standard deviations are much higher than the mean values. The examined period of 1997–2014 spans the two financial crises. The sample also includes nine countries that have differences in their national banking systems, adding to the variability in the data.

Table 2.2: Descriptive statistics

	Mean	Std. Dev	Min	Max
Cost frontier variables				
TC (total cost, $bill.)	99.25	366.86	0.00	2,900.00
Q1 (total loans, $bill.)	861.90	3,333.44	0.01	27,000.00
Q2 (total securities, $bill.)	280.44	1,073.41	0.00	8,200.00
W1 (price of funds %)	9.57	33.26	0.49	474.68
W2 (price of physical capital %)	1.17	1.04	0.07	8.82
W3 (price of labour %)	0.95	0.73	0.05	5.89
Inefficiency terms				
CLAIM (integration %)	34.31	42.74	3.36	290.07
FOR (financial integration %)	28.26	15.82	0.00	76.00
CRERISK (credit risk %)	4.74	7.14	0.09	52.26
CAP (equity ratio %)	10.80	8.25	-15.40	56.00
SIZE (size)	6.25	6.00	-4.49	17.58
IFL (inflation %)	5.55	7.55	-3.95	58.39
PRICRE (private credit %)	86.77	46.74	19.85	233.66
CON (concentration %)	65.68	15.23	35.98	100.00

The table reports descriptive statistics for the variables used in the empirical analysis. There are 3,628 bank-year observations for nine sampled countries (including China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, Thailand, and Vietnam) during 1997–2014. Variables TC, Q1, and Q2 are reported in their absolute values (in US$ billions, deflated by the US GDP deflator with base year 2010). SIZE is the natural logarithm of total assets. Other variables are reported in their relative values (%). For the definition and construction of the variables, see Table 2.1.

Figure 2.2 and Table 2.3 provide detailed statistics for financial integration variables (CLAIM and FOR). As clearly seen, there exists heterogeneity in the level of financial integration among the sampled countries. In terms of CLAIM (see Panel A, Figure 2.2), Hong Kong and Singapore, being the regional financial hubs, have a large percentage of foreign claims to GDP (above 150%). Malaysia, Thailand, Korea, and the Philippines have a relatively high proportion of foreign claims (under 50%), while the ratios in Indonesia and Vietnam are lower (under 20%) and China's is the lowest (8.3%). In terms of foreign bank penetration (see Panel B, Figure 2.2), Hong Kong and Singapore are the most open countries toward foreign banks, accounting for 70% and 54% of the total number of banks, respectively. For the remaining sampled countries, foreign banks

penetration is more evident in Malaysia and Indonesia (about 30%) than in Thailand, China, Vietnam (around 17%), and the Philippines and Korea (about 14%). Based on the descriptive summary of CLAIM and FOR in Table 2.3, Hong Kong and Singapore are grouped together. Both countries have a higher level of financial integration. The remaining countries in the sample are assigned to the low-financial-integration group. In the low-group countries, China and Vietnam are the least financially integrated.

Table 2.4 reports the Pearson pairwise correlation coefficients of the variables. There are no concerns regarding multi-collinearity, since none of the correlations exceed 80%. This is also confirmed by the reported variance inflation factors (VIFs) tests.[17]

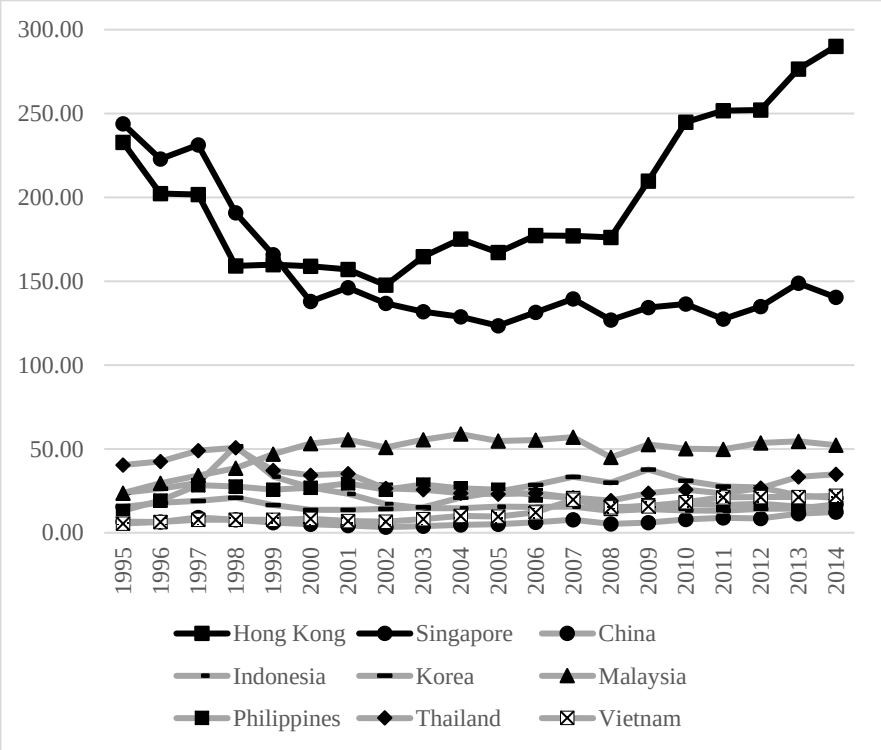
Table 2.3: Descriptive statistics of financial integration indicators by country

	CLAIM				FOR			
	Mean	**Std.**	**Min**	**Max**	**Mean**	**Std.**	**Min**	**Max**
China	8.30	2.41	3.36	12.36	17.56	4.87	6.00	21.00
Hong Kong	187.83	38.05	147.63	290.07	71.71	2.53	67.00	76.00
Indonesia	19.77	9.8	13.04	51.66	38.05	9.27	26.00	50.00
Malaysia	50.41	6.62	34.01	58.81	32.47	5.65	25.00	42.00
Philippines	21.39	5.28	14.19	29.44	13.77	1.84	11.00	17.00
Korea	23.05	6.87	13.67	37.74	14.03	5.29	6.00	19.00
Singapore	147.59	27.92	123.44	231.35	54.07	3.96	43.00	58.00
Thailand	28.78	8.1	19.16	50.65	18.13	5.96	0.00	25.00
Vietnam	16.04	5.1	6.68	22.07	17.52	5.58	9.00	24.00
Full sample	34.31	42.74	3.36	290.07	28.26	15.82	0.00	76.00
High group	171.52	39.58	123.44	290.07	64.65	9.21	43.00	76.00
Low group	23.32	14.79	3.36	58.82	25.18	11.96	0.00	50.00

The table reports the descriptive statistics (by country and by group of countries) for the financial integration indicators as CLAIM (the ratio of foreign claims of international banks to GDP) and FOR (the ratio of number of foreign banks to total number of banks). The high-group countries include Hong Kong and Singapore. The remaining countries are in the low group. Std. refers to standard deviation, Min and Max are the minimum and maximum observations for each variable in the sample.

[17] The VIF test is based on the linear regression with the dependent variable being Total Cost and the independent variables being other environmental variables.

Panel A: The ratio of foreign claims to GDP (CLAIM %)



Panel B: The ratio of foreign banks to total number of banks (FOR%)

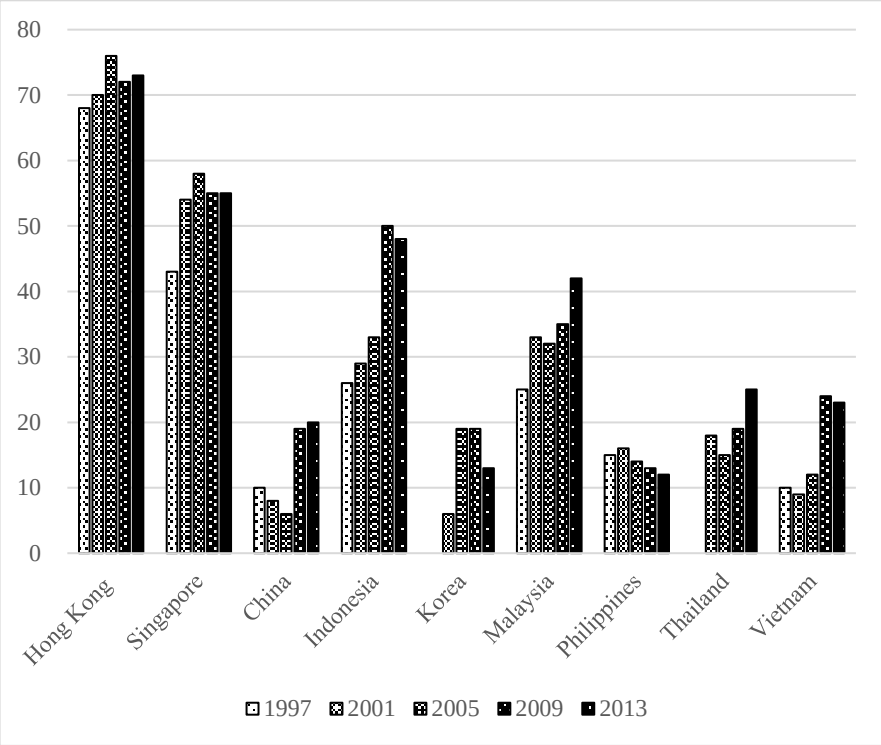


Figure 2.2: Stylized facts about the level of financial integration in the sampled East Asian countries

Table 2.4: The pairwise correlation among variables

	SIZE	CRERISK	CAP	CON	IFL	PRICRE	CLAIM	FOR	VIFs
SIZE	1.0000								1.05
CRERISK	-0.0861**	1.0000							1.18
CAP	-0.1290***	-0.0412**	1.0000						1.01
CON	-0.1120***	0.0348**	-0.0299*	1.0000					1.55
IFL	0.0783***	0.3125***	-0.0840***	-0.1857***	1.0000				1.28
PRICRE	-0.0837***	-0.1619***	-0.0644***	0.2428***	-0.3225***	1.0000			1.69
CLAIM	-0.1223***	0.0513***	0.1238***	0.4936***	-0.0974***	0.3899***	1.0000		3.81
FOR	-0.0349**	-0.0370**	0.2303***	0.1434***	-0.0558***	-0.0062	0.6709***	1.0000	2.58

The table reports the Pearson rank correlation coefficients between environmental variables as determinants of inefficiency term. Additionally, the table also reports variance inflation factors (VIFs) for these variables. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2.5 EMPIRICAL ANALYSIS

2.5.1 The Cost Frontier and Cost Efficiency Score

Table 2.5 presents the coefficients and their significance level based on Equations (2.6) to (2.8).[18] The models estimate the cost frontier and the effects of environmental variables on μ_{it} and σ^2_{it} at the same time. To proxy for financial integration, CLAIM is used in Model 1, while FOR is used in Model 2. In general, the results of the two models are quite consistent in terms of the sign and significance of the coefficients.

Regarding the cost frontier, all coefficients for the outputs and input prices as well as their squared terms are positive and highly significant in both models. This implies that higher input prices and higher outputs lead to an increase in total costs. Additionally, the significant impact of technological change is also found in the cost frontier. A negative and significant time trend is followed by a positive and significant quadratic time trend. This implies that at first, total costs are decreasing due to technological progress, then increasing as the consequence of technological regress later. The dummy variable HIGH is negative and insignificant.

In the non-monotonic efficiency effect models, the coefficients from the function of μ_{it} and σ^2_{it} cannot be used to interpret the economic significance of the determinants of bank inefficiency.[19] In fact, coefficient estimation is more relevant to making decisions about the inclusion or exclusion of the variable to improve the fit of the model. The marginal effects should be used to draw an economic interpretation from the analysis

[18] Before running the SFA model, a Fisher test developed by Maddala and Wu (1999) is used to check for the time series stationarity (T=19 years). The test is based on the augmented Dickey-Fuller test and could be used for unbalanced panel data. With regard to the (unreported) unit root test, the null of non-stationary is rejected at the 1% level for all variables used in the model.

[19] Equations (2.4) and (2.5) show that the marginal effect depends on the slope coefficients from both the mean and the variance functions (expressed via $\delta[k]$ and$\gamma[k]$) and an adjustment function. Thus, the signs of the marginal effects do not necessarily coincide with the signs of either of the slope coefficients obtained from Equations (2.2) and (2.3).

(see Section 2.3.1), bearing in mind that the marginal effects of each determinant depend on both the mean and variance functions and do not necessarily have the same sign as the coefficient estimates.

Berger and Mester (1997) indicated that cost efficiency is represented as the percentage of efficient usage of costs. As reported at the back of Table 2.5, the average cost efficiency score of the sample is 66.54% and 69.76% for Models 1 and 2, respectively. This implies that banks, on average, can improve their costs by about 30% relative to the best-performance bank in the sample. These estimates are broadly comparable with those reported in cross-country analysis studies of Asia banks, such as Sun and Chang (2011).

Table 2.5: Estimation results for the cost frontier

The dependent variable (TC) frontier	**Model 1** Coefficients	**Model 2** Coefficients
Ln(Q1)	0.6980***	0.6807***
Ln(Q2)	0.2961***	0.3093***
Ln(W1/W3)	0.5591***	0.5400***
Ln(W2/ W3)	0.2060***	0.1926***
$Ln(Q1)^2$	0.0661***	0.0647***
Ln(Q1) ln(Q2)	-0.1332***	-0.1316***
$Ln(Q2)^2$	0.0662***	0.0658***
$Ln(W1/W3)^2$	-0.0554***	-0.0569***
Ln(Q1) ln(W1/W3)	0.0265***	0.0205***
Ln(Q2) ln(W1/W3)	-0.0211***	-0.0155
$Ln(W2/W3)^2$	0.0419***	0.0508***
Ln(Q1) ln(W2/W3)	-0.0377***	-0.0337***
Ln(Q2) ln(W2/W3)	0.0407***	0.0346***
Ln(W1/W3) ln(W2/W3)	0.0248	0.0356**
t	-0.1062***	-0.1367***
t^2	0.0026***	0.0037***
HIGH	-0.0412	-0.0162
cons	0.6927***	0.9135***
effects on μ_{it}		
CLAIM	-0.0190***	
FOR		-0.0416***
SIZE	0.0045	0.0412*
CRERISK	-0.0723***	-0.1637***
CAP	-0.0250***	-0.0382***
CON	-0.0091***	0.0028

IFL	0.0757***	0.1167***
PRICRE	0.0082***	-0.0032
year1997	-0.0825	-0.7984
year1998	-1.8905***	-4.4281***
year1999	0.3239	0.0101
year2007	-0.2264	-0.1455
year2008	-0.5896***	-1.2142***
year2009	0.0350	-0.0017
Constant	0.3260	0.3481
effects on σ^2_{it}		
CLAIM	0.0130***	
FOR		0.0218***
SIZE	-0.0295***	-0.0479***
CRERISK	0.0409***	0.0489***
CAP	0.0172***	0.0092*
CON	0.0124***	0.0039
IFL	-0.0278***	-0.0099
PRICRE	-0.0029**	0.0076***
year1997	-0.6429**	-0.1368
year1998	1.1129***	1.0366***
year1999	-0.0502	0.1042
year2007	0.6072***	0.3609
year2008	0.5641***	0.5170***
year2009	-0.2038	-0.0955
Constant	-2.0656***	-1.9421***
σ_v	-2.8058***	-2.7133***
Log-likelihood	-1944.21	-1832.78
Efficiency mean	0.6654	0.6976
Efficiency std.	0.1831	0.1828

The table reports the stochastic cost frontier estimated from Equations 2.6–2.8. The dependent variable is Total Costs comprising interest expenses and non-interest expenses for each sample bank. The output variables include Q1 (total loans) and Q2 (total securities). The input prices include W1 (price of funds), W2 (price of physical capital). These variables are scaled by W3 (price of labour) to ensure the price homogeneity condition. Determinants of μ_{it} and σ^2_{it} are defined as in Table 2.1. CLAIM and FOR are used as the indicator of the financial integration in Models 1 and 2, respectively. It is noted that in the non-monotonic SFA models, the coefficients from the function of μ_{it} and σ^2_{it} typically do not have a good interpretation for the economic significance of the inefficiency's determinants. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2.5.2 The Marginal Effects of Determinants of the Inefficiency Term

In Table 2.6, the (average) marginal effects are reported for both the mean and variance of the inefficiency term. The mean function illustrates the impact of the environmental Z_{it} variable on the expected level of inefficiency, while the variance function explains its contribution toward the cost performance's uncertainty. Model 1 and Model 2 are quite consistent across all the variables in terms of sign and significance

level, suggesting the results are robust for different measures of financial integration. Sections 2.5.2.1 and 2.5.2.2, respectively, discuss in detail the marginal impact of financial integration indicators (CLAIM and FOR) and credit risk (CRERISK) across their average and other percentile values to highlight their non-monotonic impact on the inefficiency term. Section 2.5.2.3 analyses the marginal impact of other variables (only at their average value) on the inefficiency term.[20]

Table 2.6: The marginal effects of environmental variables on the inefficiency term

Statistics	Model 1 The marginal impact		Model 2 The marginal impact	
	on E(u)	on V(u)	on E(u)	on V(u)
CLAIM	-0.0036**	0.0004		
FOR			-0.0021**	0.0010
CRERISK	-0.0157***	0.0001	-0.0190***	-0.0035*
SIZE	-0.0055	-0.0049*	-0.0054*	-0.0064***
CAP	-0.0047**	0.0006	-0.0051***	-0.0013
CON	-0.0002	0.0013	0.0017	0.0010
IFL	0.0201***	0.0027	0.0207***	0.0076***
PRICRE	0.0022***	0.0003	0.0015***	0.0013**
year1997	-0.1840**	-0.1263	-0.2005	-0.0943
year1998	-0.4015**	0.0104	-0.5967***	-0.1542
year1999	0.1026	0.0240	0.0320	0.0223
year2007	0.0660	0.0881**	0.0742	0.0621
year2008	-0.0730	0.0430	-0.0968	0.0056
year2009	-0.0367	-0.0338	-0.0277	-0.0198

This table reports the (average) marginal impact of determinants (Z) on the mean and variance of the inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$, respectively. The marginal effect is calculated based on Equations (2.4) and (2.5) after the estimation of cost frontier and is observation-specific. The marginal effect measures how an increase in the Z variable changes the expected inefficiency and cost uncertainty. A positive sign indicates that the *Z* variable increases cost inefficiency, suggesting a decrease in cost efficiency. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

[20] By graphing the marginal effect of Z_{it} variables and their own value (for instance "the marginal effect of CLAIM" against "CLAIM"), the non-monotonic impact of CLAIM, FOR and CRERISK on the inefficiency term can be seen, but not for other variables. The graphs of other variables are available upon request.

2.5.2.1 The non-monotonic impact of financial integration on the inefficiency term

Table 2.7 reports the sample mean of the marginal effect of financial integration indicators on the inefficiency term, as well as the average marginal effect of the 25th, 50th, 75th, and 90th percentile (ordered by value of the marginal effect). The impact on the mean of the inefficiency term is shown by the significant and non-monotonic relationship reported in Columns (1) and (3) of Table 2.7. The marginal effect of CLAIM holds its negative value through to the 75th percentile, but then becomes positive at the 90th percentile (for the case of FOR, the 50th and 75th percentile, respectively). Specifically, at the 25th percentile, a 1-percentage-point increase in CLAIM reduces total cost approximately by 0.67%.[21] As we move from the 25th percentile to the 75th percentile, the benefit diminishes substantially. At the 90th percentile, an increase in CLAIM increases total cost approximately by 0.18%. In the case of FOR, the efficiency reduction starts at the 75th percentile. To assist the interpretation of the findings, the top left-hand panel of Figure 2.3 roughly points out the turning point of the marginal effect when the value of CLAIM reaches 100% (interpreted as the ratio of the foreign claims to the GDP country; see Section 2.3.3). This means that policy makers should be concerned when the foreign banking claims reach this level, as they may become detrimental to cost efficiency. Similarly, when more than 40% of banks are owned by foreign investors, the level of inefficiency rises (see the bottom left-hand panel of Figure 2.3).

[21] The negative sign of the marginal effect of the Z variable on E(u) implies that Z does not cause an overuse of inputs, which in turn helps to lower costs (and vice versa). In other words, the negative sign indicates the decrease in inefficiency level, which suggests an increase in cost efficiency. With regard to the economic impact, the percentage increase in costs due to inefficiency could be obtained based on the approximation formula: u=ln(actual cost/minimum cost). For instance, the average marginal effect of the first quantile is (-0.0067); this means that a 1-percentage-point increase in CLAIM is translated into a (0.0067*100) 0.67% decrease in total cost.

To summarise, the results imply that at first, the foreign banking capital and foreign bank presence provide competitive incentives for managers to be cost-effective (Lin et al., 2016; Casu et al., 2016). Further, the significant impact of technological change found in the sample's cost frontier suggests that financial integration induces technological and managerial spill-overs that transform the cost efficiency of the domestic banking sector. However, at higher levels of financial integration, additional costs will be incurred from updating bank products and services to keep up with greater competition or managing excess risk-taking behaviour due to the open financial market (Fries and Taci, 2005; Lensink et al., 2008; Casu and Girardone, 2009). These findings lend support to H1 and the theoretical prediction of Allen et al. (2011) on the non-monotonic impact of financial integration on bank cost efficiency (see Section 2.2).

Regarding the impact of CLAIM (FOR) on the variance of the inefficiency term, only the positive impact is significant. Cost performance becomes more variable for banks operating in more competitive and financially integrated systems.

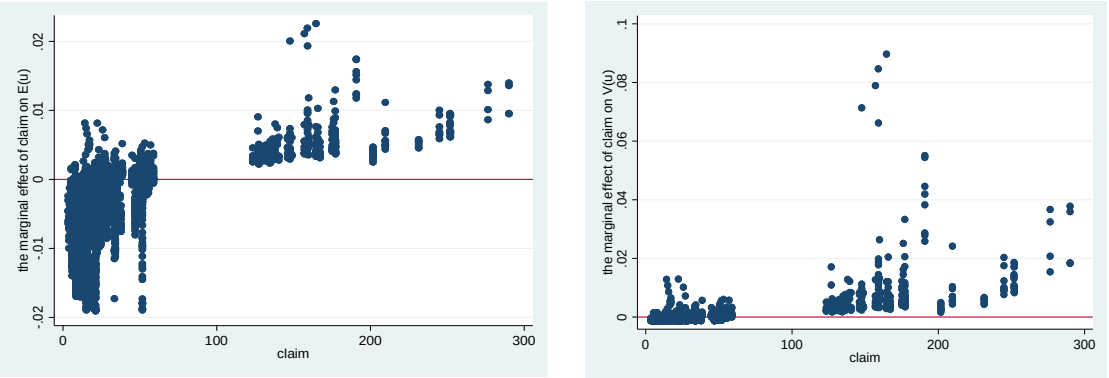
Table 2.7: The non-monotonic impact of financial integration indicators on the inefficiency term

Statistics	The marginal impact of CLAIM		The marginal impact of FOR	
	on E(u)	on V(u)	on E(u)	on V(u)
Average	-0.0036**	0.0004	-0.0021**	0.0010
25th per.	-0.0067**	-0.0009	-0.0042***	-0.0009
50th per.	-0.0024**	-0.0004	-0.0003	0.0002
75 per.	-0.0003	0.0002	0.0018**	0.0013**
90 per.	0.0018**	0.0016***	0.0045***	0.0037***

This table reports the marginal impact of financial integration indicators (at the average, 25th, 50th, 75th, and 90th percentile levels ordered by the value of the marginal effect) on the mean and variance of the inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$, respectively. The change in the sign of the marginal effect across the percentiles illustrates the non-monotonic impact of financial integration on cost efficiency. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: CLAIM (Model 1)

Marginal effect on $E(u_{it})$ | Marginal effect on $V(u_{it})$



Panel B: FOR (Model 2)

Marginal effect on $E(u_{it})$ | Marginal effect on $V(u_{it})$

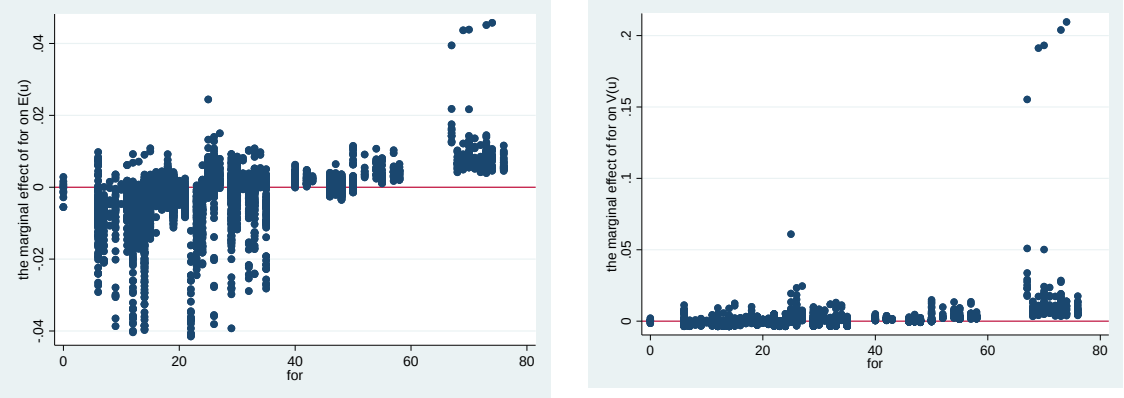


Figure 2.3: The non-monotonic impact of financial integration indicators on the mean and variance of the inefficiency term

2.5.2.2 The non-monotonic impact of credit risk on the inefficiency term

Although not central to the chapter's analysis, the potential for a non-monotonic impact of credit risk on the inefficiency term is also explored, thereby shedding light on a related literature. There is a significant and non-monotonic effect of credit risk on the mean of the inefficiency term. From Table 2.8, CRERISK exercises a negative influence at the 75th percentile and below; the impact becomes positive at the 90th percentile. Figure 2.4 identifies the turning point when CRERISK is around 30%. There is a positive relationship between credit risk and cost efficiency when CRERISK < 30%. This result is in line with the hypothesis of "skimming behaviour" (Berger and DeYoung, 1997). Under this hypothesis, cost efficiency can be achieved through less stringent loan monitoring and fewer resources spent on credit underwriting, leading to an increase in

problem loans.[22] However, at a certain level of credit risk (our results suggest > 30%), a further increase in credit risk causes cost efficiency to deteriorate, as banks start allocating more resources to screen and deal with bad debts.

As most of the previous studies employ the monotonic efficiency effect models, the negative association between credit risk and efficiency is often reported, as in Gardener et al. (2011) and Casu et al. (2016). The notable exception is Sun and Chang (2011), who also employ Wang's (2002) model to examine the impact of bank risks on cost efficiency in emerging Asian countries during 1998–2008. Sun and Chang (2011) report an overall negative association between credit risk and cost efficiency. Further, they find a non-linear relationship; specifically, the magnitude (but not the sign as under the non-monotonic relationship) of the impact varies with the level of credit risk. Together with Sun and Chang (2011), the chapter highlights the importance of applying non-monotonic models to provide new insight into the existing relationship between variables.[23]

With respect to the variance of the inefficiency term, CRERISK also exerts a non-monotonic impact. Below the 75th percentile, an increase in credit risk leads to less variance in cost performance. After the 90th percentile, higher credit risk results in more variable cost efficiency, as the credit risk may increase banks' operating uncertainty.

[22] Tests of the causal relationship between bank risk and bank efficiency (as in Berger and DeYoung, 1997, and Fiordelisi et al., 2011) are used to better understand the nature of this relationship. Both studies find that a decline in bank efficiency precedes an increase in bank risk.

[23] The chapter conducts the same robustness tests as described in Section 2.5.4 on the non-monotonic impact of credit risk on bank cost efficiency. Findings from these robustness tests are provided in Appendix A1. Most of the models confirm the existence of the non-monotonicity except for the first model (i.e. Column 1 in Table A1).

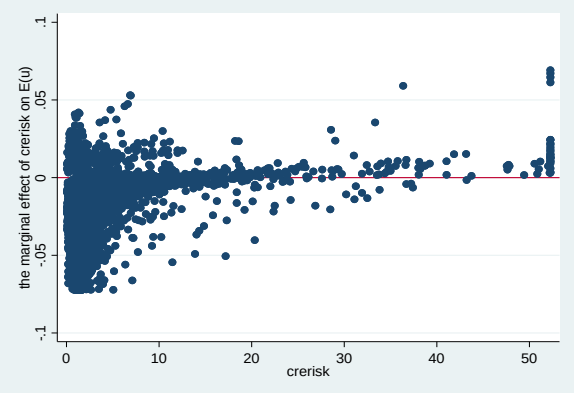
Table 2.8: The non-monotonic impact of credit risk (CRERISK) on the inefficiency term

Statistics	Model 1 Marginal impact		Model 2 Marginal impact	
	on E(u)	on V(u)	on E(u)	on V(u)
Average	-0.0157***	0.0001	-0.0190***	-0.0035
25th per.	-0.0271***	-0.0045**	-0.0265***	-0.0094***
50th per.	-0.0109***	-0.0023**	-0.0102***	-0.0033**
75 per.	-0.0031	-0.0002	-0.0034	-0.0008
90 per.	0.0042*	0.0046***	0.0039*	0.0039**

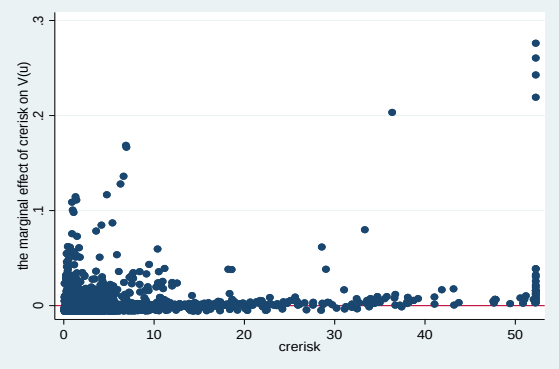
This table reports the marginal impact of credit risk (at the average, 25th, 50th, 75th, and 90th percentile levels, ordered by the value of the marginal effect) on the mean and variance of inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$, respectively. The change in the sign of the marginal effect across the percentiles illustrates the non-monotonic impact of credit risk on cost inefficiency. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: CRERISK (Model 1)

Marginal effect on $E(u_{it})$

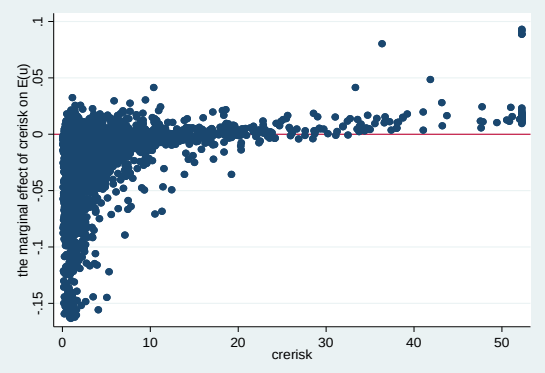


Marginal effect on $V(u_{it})$



Panel B: CRERISK (Model 2)

Marginal effect on $E(u_{it})$



Marginal effect on $V(u_{it})$

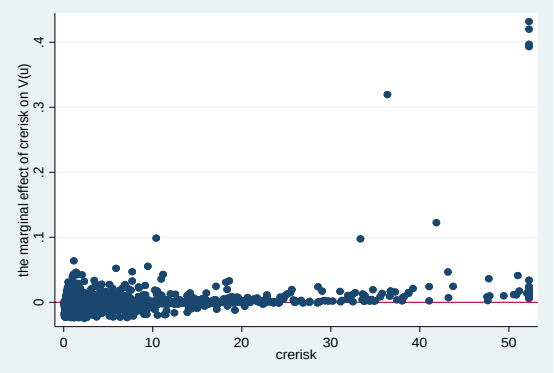


Figure 2.4: The non-monotonic impact of credit risk on the mean and variance of the inefficiency term

2.5.2.3 The marginal impact of other determinants on the inefficiency term

Table 2.6 reports the (average value of) marginal impact of other determinants on the inefficiency term. In detail, SIZE has a negative relationship with the mean of the inefficiency term. In other words, bigger banks taking advantage of economies of scale are more efficient than smaller banks. The result is consistent with the existing literature, such as Barth et al. (2013b) and Luo et al. (2016). Additionally, big banks also experience less variability in their cost efficiency because their market power enables them to manage the unfavourable external influence on cost structure. Further, economies of scope and scale may produce more stable incomes, as envisioned in the universal banking model.

Regarding the equity ratio (CAP), there is a significant and negative relationship with the mean of the inefficiency term. In other words, banks holding more equity capital are more cost-efficient. From the viewpoint of depositors, these banks are considered less risky; thus, they are able to access funds at lower cost. Similarly, thinly capitalized banks may be charged a higher cost of funds, resulting in lower cost efficiency (Gardener et al., 2011; Barth et al., 2013b). The impact of CAP on the variance of inefficiency is insignificant in both models.

Inflation (IFL) has a significant and positive impact on both the mean and variance of the inefficiency term. Higher inflation leads to a higher and more variable cost efficiency because banks need to increase their interest rates on customer deposits in line with the increasing rate of inflation (Gardener et al., 2011). Inflation is also associated with higher transaction costs and uncertainty, thus contributing to greater inefficiency.

Consistent with Pasiouras et al. (2009), higher private sector credit, PRICRE ratios, leads to greater bank inefficiency and more variability. The mean value of

PRICRE is 84%. The corporate sector of the sampled East Asian countries is highly reliant on bank loans. Banks are less motivated to control their cost structure relative to financial systems where they compete more with capital markets.

The effect of a three-year window around the Asian and global financial crisis is quite consistent in both models. As the sample includes those countries worst hit by the Asian financial crisis, business shrinkage resulting in a material drop in bank output (synonymous with an increasing cost efficiency level) may have had an impact. However, Asia was less influenced by the global financial crisis, which only significantly increases the variance of cost performance in 2007.

2.5.3 Country-level Analysis of Financial Integration's Marginal Impact

Table 2.9 reports the marginal impact of financial integration indicators on the mean of the inefficiency term at the country level. The impact is different for the sampled countries. The negative marginal impact of integration on the inefficiency level implies that the majority of banks operating in China, Vietnam, and Korea benefit from financial integration. CLAIM exerts an efficiency-impeding effect on most of the banks based in Hong Kong and Singapore (in the case of FOR, also for Malaysia). The marginal impact is mixed in the rest of the sample, including Indonesia, the Philippines, and Thailand. These results confirm that banks based in countries with a lower level of integration benefit from financial integration. In contrast, financial integration negatively affects the cost efficiency of banks operating in countries with higher levels of financial integration. These findings once again lend support to H1 and the proposition by Allen et al. (2011) that the marginal benefits of integration are likely to be large, while the costs are probably small at low levels of integration.

Table 2.9: A country-level analysis of financial integration indicators on the mean of the inefficiency term

Panel A: Marginal impact of CLAIM on $E(u_{it})$

Country	mean	p25	p50	p75	p90
China	-0.0094**	-0.0130***	-0.0100**	-0.0067**	-0.0022
Hong Kong	0.0066	0.0044**	0.0057**	0.0076	0.0100
Indonesia	-0.0028	-0.0040	-0.0025*	-0.0011	0.0003
Malaysia	-0.0010	-0.0014*	-0.0007	0.0005	0.0012
Philippines	-0.0002	-0.0012	-0.0004	0.0005	0.0016**
Korea	-0.0054**	-0.0073**	-0.0058**	-0.0035**	-0.0020
Singapore	0.0050***	0.0032**	0.0040**	0.0056**	0.0080**
Thailand	-0.0017**	-0.0033***	-0.0015**	-0.0001	0.0009
Vietnam	-0.0103***	-0.0154***	-0.0097***	-0.0061***	-0.0030

Panel B: Marginal impact of FOR on E(uit)

Country	mean	p25	p50	p75	p90
China	-0.0030**	-0.0049	-0.0024	-0.0006	0.0013
Hong Kong	0.0094***	0.0061***	0.0076***	0.0101***	0.0140***
Indonesia	-0.0018	-0.0022**	-0.0001	0.0011	0.0024***
Malaysia	0.0026	0.0011	0.0020	0.0032*	0.0053***
Philippines	-0.0023	-0.0043**	-0.0015	0.0005	0.0021***
Korea	-0.0062***	-0.0084***	-0.0052***	-0.0022*	-0.0004
Singapore	0.0044**	0.0027*	0.0038**	0.0055***	0.0080***
Thailand	0.0008	-0.0010	0.0011	0.0022**	0.0039***
Vietnam	-0.0160***	-0.0218***	-0.0133***	-0.0066***	-0.0036**

This table reports the marginal impact of CLAIM in Panel A and the marginal impact of FOR in Panel B on the mean of the inefficiency term at the country level. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

2.5.4 Robustness Tests of the Impact of Financial Integration

This section provides findings from robustness tests on the non-monotonic impact of financial integration on bank cost efficiency. The first set of tests are conducted under a different sub-sampling strategy. The first test is conducted by applying Wang's (2002) model only for the low-group countries (specifically, all sampled countries excluding Hong Kong and Singapore). This is to address the concern that the non-monotonic relationship between financial integration and cost efficiency may originate from the heterogeneity in the level of financial integration between the two groups of countries (low-integration and high-integration). The non-monotonic impact of CLAIM and FOR on the inefficiency level is observable in Columns (1) and (3) in Table 2.10, which reports Equations 2.6–2.8 for the low-integration countries. The magnitude of the marginal

impact of financial integration indicators, in general, is higher than the baseline model's result. In other words, the impact of financial integration on cost efficiency in the low-group countries is more evident than in the whole sample. Moreover, Panel A of Figure 2.5 roughly shows that the turning point for the marginal impact of CLAIM on the inefficiency level occurs at 55%, while the turning point for FOR remains at 40%. Regarding other determinants of inefficiency, the impact of market concentration (CON) becomes positive and significant in both models, implying that the higher market concentration exerts a negative impact on cost efficiency in the low-group countries. The result is consistent with the 'Quiet Life Hypothesis', which suggests that banks with market power are exempt from the pressure of competition to control costs (Casu and Girardone, 2009; Lin et al., 2016).

Financial crises may exert potential changes in banking technologies and structures. Hence, the next robustness test splits the examined time horizon into two periods, specifically around the Asian (1997–2006) and the global financial crisis (2007–2014). The non-monotonic relationship between the financial integration indicators and inefficiency as well as their turning points are consistently in line with the baseline result. However, when the global financial crisis is sampled separately (see Columns (9) to (12) in Table 2.10), its impact becomes more manifest. The crisis increases not only cost performance variability but also cost inefficiency in 2007. The result implies that banks in the sampled countries, though not being directly affected by the global financial crisis, still incurred certain costs to protect them against financial contagion as a result of their higher level of connectedness to the international financial markets.

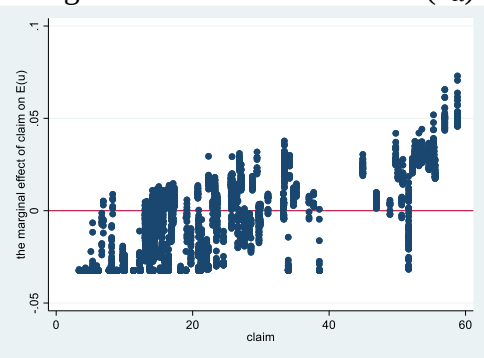
Table 2.10: Sub-sampling robustness tests for the impact of financial integration

Statistics	Low-group countries				The Asian financial crisis period (1997–2006)				The global financial crisis period (2007–2014)			
	Model 1 (CLAIM) The marginal impact		Model 2 (FOR) The marginal impact		Model 1 (CLAIM) The marginal impact		Model 2 (FOR) The marginal impact		Model 1 (CLAIM) The marginal impact		Model 2 (FOR) The marginal impact	
	on E(u) (1)	on V(u) (2)	on E(u) (3)	on V(u) (4)	on E(u) (5)	on V(u) (6)	on E(u) (7)	on V(u) (8)	on V(u) (9)	on V(u) (10)	on E(u) (11)	on V(u) (12)
INTEGRA -TION												
Average	-0.0069***	0.0058***	0.0020	0.0010*	0.0108***	-0.0019	-0.0011	0.0042**	-0.0034***	0.0016	-0.0021	0.0012
25th per.	-0.0320***	0.0010***	-0.0038***	-0.0006	-0.0147***	-0.0057***	-0.0017	0.0001	-0.0083***	-0.0001	-0.0050*	0.0001
50th per.	-0.0060***	0.0020***	0.0008	0.0007	-0.0027***	-0.0009*	0.0035***	0.0020**	-0.0025**	0.0003	-0.0019	0.0005
75th per.	0.0077***	0.0042***	0.0033	0.0021	0.0013*	0.0008*	0.0072**	0.0043***	-0.0002	0.0010***	-0.0003	0.0009*
90th per.	0.0239***	0.0172***	0.0054**	0.0040**	0.0055***	0.0038*	0.0137*	0.0121***	0.0022**	0.0020***	0.0015*	0.0016
CRERISK	-0.176***	-0.0011	-0.0184**	-0.0049***	-0.0066*	0.0001	-0.0194**	-0.0046	-0.0191**	0.0042	-0.0111	0.0040
SIZE	0.0044*	-0.0014	-0.0031	-0.0038**	-0.0041	-0.0036	-0.0031	-0.0041*	-0.0075	-0.0069*	-0.0123	-0.0074***
CAP	-0.0032**	0.0007	-0.0051***	-0.0011	-0.0055***	-0.0023	-0.0062**	-0.0032**	-0.0065***	0.0032	-0.0081***	0.0024
CON	0.0022***	0.0025***	0.0029*	0.0015	0.0013	-0.0013	0.0021***	0.0001**	-0.0099***	-0.0050	-0.0086***	-0.0026
IFL	0.0200***	0.0021	0.0223***	0.0086***	0.0142***	0.0049*	0.0092	0.0042	0.0201**	-0.0005	0.0212***	0.0032
PRICRE	0.0016***	0.0009	0.0026***	0.0044***	-0.0006	0.0007*	-0.0009*	-0.0003	0.0046***	0.0015***	0.0053***	0.0037***
year1997	-0.1220*	-0.1311	-0.1913	-0.1022	-0.3993***	-0.3371***	-0.2702	-0.1856				
year1998	-0.0891	-0.1528*	-0.6539***	-0.2069	-0.0621	-0.0918	-0.0076	-0.0079				
year1999	0.1049	-0.0253	0.0144	0.0157	0.0966	0.0205	0.0705	0.0442				
year2007	0.0200	0.0148	0.0466	0.0291					0.1710**	0.1669*	0.0960	0.1512**
year2008	-0.0334	0.0218	-0.1203	-0.0221					0.0293	0.1020	0.01987	0.0584
year2009	-0.0277	0.0119	-0.0420	-0.0124					0.0294	0.0029	-0.0123	-0.0116

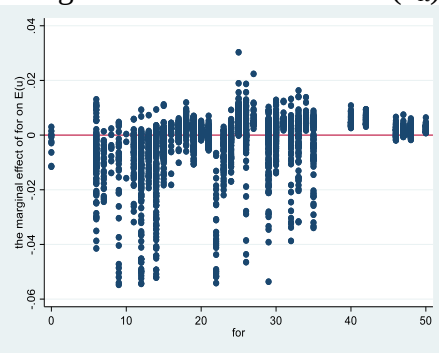
This table reports results from several robustness tests including the modelling on the sample of low-group countries (Columns 1 to 4), the Asian (Columns 5 to 8) and the global financial crisis (Columns 9 to 12). The table reports the marginal impact of financial integration indicators and other determinants on the mean and variance of the inefficiency term i.e. $E(u_{it})$ and $V(u_{it})$ respectively. The former is reported at the average, 25th, 50th, 75th, and 90th percentile levels; the change in the sign of the marginal effect across the percentiles illustrates the non-monotonic impact of financial integration on cost efficiency. The marginal effect of other determinants is only reported at the average value; a positive sign indicates the *Z* variables increase cost inefficiency. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. Significance level *10%; **5%, ***1%.

Panel A: Low group country sampling

Marginal effect of FLOW1 on E(u_{it})

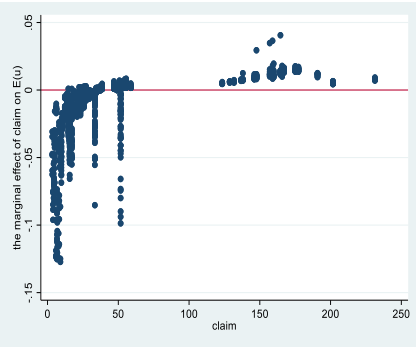


Marginal effect of FOR1 on E(u_{it})

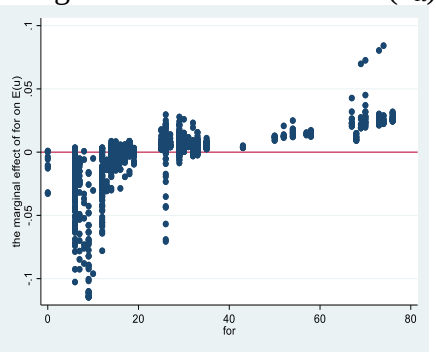


Panel B: The Asian financial crisis (1997-2006) sampling

Marginal effect of FLOW1 on E(u_{it})

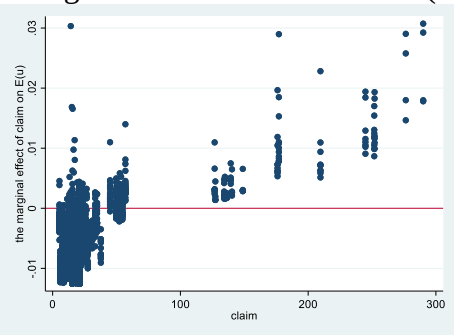


Marginal effect of FOR1 on E(u_{it})



Panel C: The global financial crisis sampling (2007-2014)

Marginal effect of FLOW1 on E(u_{it})



Marginal effect of FOR1 on E(u_{it})

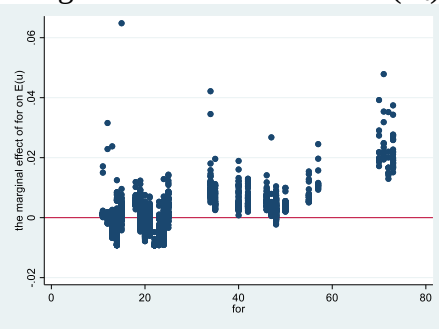


Figure 2.5: Sub-sampling robustness tests – The non-monotonic impact of financial integration indicators on inefficiency term

In the second set of robustness tests, additional control variables are included in the inefficiency equations (Equations 2.7 and 2.8) to account for the cross-country difference in regulations and policies. After controlling for these variables, the non-monotonic impact of CLAIM and FOR on the inefficiency level is still observable, as seen across columns in Table 2.11. The associated graphs illustrating the marginal impact of financial integration on the mean of the inefficiency term also consistently confirm the turning points of 100% (CLAIM) and 40% (FOR) obtained in the original results.[24] The first variable (REGQ) is taken from the Worldwide Governance Indicators to proxy for the country's regulation quality. REGQ measures the ability of the government to formulate and implement sound policies and regulations that promote market competition and the private sector environment. As reported in Columns (1) to (4), better regulation quality is associated with more bank efficiency. The second variable (ACTR) is extracted from Barth et al. (2013a) to proxy for the overall restrictions on bank engagement in fee-based activities and ownership of non-financial firms.[25] As reported in Columns (5) to (8), stringent restrictions on activities negatively affect bank cost efficiency. The impact of REGQ and ACTR on the level of the efficiency term is consistent with the findings of Pasiouras et al. (2009), Barth et al. (2013b), and Haque and Brown (2017). More noteworthy, both REGQ and ACTR significantly increase the variance of the inefficiency term. Regardless of the impact of regulations and policies on the level of cost efficiency, they always come at the cost of increasing variability in the cost structure of banks. This finding highlights the advantage of Wang's (2002) model,

[24] These graphs are available upon request.

[25] Other aspects of bank regulations and supervision to indicate the private monitoring and power of supervisory authorities (as in Barth et al., 2013b, and Luo et al., 2016) are also examined. The impact of financial integration on bank cost efficiency remains non-monotonic in these robustness tests. The results are not reported to save space, but available upon requests. Additionally, due to missing data, the simultaneous inclusion of all three regulation variables results in the substantial loss of data, which likely renders the running of the complex ML estimation. Accordingly, the chapter does not include the three variables at once in the model.

which provides additional insight into the impact of regulations and policies not only on the level but also on the variance of inefficiency.

In Columns (9) to (12), the chapter directly addresses the concern that integration-friendly policies could also exert a positive impact on bank efficiency by including the capital account openness measure (KAOPEN). At the same time, a dummy variable (ODUM) is included to proxy for foreign and domestic bank ownership in the inefficiency equation. Countries with integration-friendly policies are likely to have higher foreign bank presence. Foreign banks are generally more efficient than their domestic counterparts (Detragiache et al., 2008; Doan et al., 2018). Taken together, the banking system in countries which support integration will be more efficient. After controlling for this concern, the marginal impact of CLAIM and FOR on bank inefficiency remains non-monotonic. The negative marginal impact of KAOPEN on the level of inefficiency implies that higher capital account openness is associated with higher bank efficiency, although the impact is insignificant. This could be explained by the fact that the *de facto* measure of integration, such as CLAIM and FOR, already captures the realized benefit from the country's opening of its capital account.

Table 2.11: Robustness tests with regulations and policies control variables (for the impact of financial integration)

	Regulation quality				**Activities restrictions**				**Capital account openness and bank ownership**			
	Model 1 (CLAIM) The marginal impact		**Model 2 (FOR) The marginal impact**		**Model 1 (CLAIM) The marginal impact**		**Model 2 (FOR) The marginal impact**		**Model 1 (CLAIM) The marginal impact**		**Model 2 (FOR) The marginal impact**	
	on E(u) (1)	**on V(u) (2)**	**on E(u) (3)**	**on V(u) (4)**	on E(u) (5)	on V(u) (6)	on V(u) (7)	on V(u) (8)	on E(u) (9)	on V(u) (10)	on E(u) (11)	on V(u) (12)
INTEGR A-TION												
Average	-0.0010	0.0006	-0.0017	0.0025***	0.0026***	0.0029***	0.0026	0.0027***	0.0002	0.0014	0.0040***	0.0014***
25th per.	-0.0032*	-0.0001	-0.0065	0.0001	-0.0016***	0.0007***	-0.0014	0.0005	-0.0013	0.0003	-0.0020**	0.0003***
50th per.	0.0001	0.0001	0.0009	0.0008***	0.0022***	0.0014***	0.0031***	0.0017***	0.007	0.0005	0.0041***	0.0005***
75th per.	0.0008	0.0005*	0.0029***	0.0019***	0.0031***	0.0024***	0.0049***	0.0034***	0.0017***	0.0010	0.0059***	0.0010***
90th per.	0.0014*	0.0010**	0.0052***	0.0039***	0.0043***	0.0038***	0.0081***	0.0076***	0.0033***	0.0023	0.0093***	0.0023***
REGQ	-0.4520	0.0440*	-0.4296	0.0284*								
ACTR					0.0588***	0.0329***	0.0023	0.0097*				
ODUM									-0.0765	0.0041*	-0.0793	-0.0073
KAOPEN									-0.6756	-0.2241	-0.7244	-0.2545
CRERISK	-0.0103	0.0025*	-0.0077	0.0033**	0.0025	0.0034**	0.0037**	0.0032**	-0.0240***	-0.0014	-0.0244	-0.0017
SIZE	-0.0065	-0.0042	-0.0068	-0.0053	-0.0097	-0.0104	-0.0085	-0.0065	-0.0062***	-0.0063**	-0.0064	-0.0060
CAP	-0.0051	0.0010	-0.0049	0.0004	-0.0018	-0.0010	-0.0015	-0.0011	-0.0041***	0.0001	-0.00045	-0.0006
CON	-0.0015	-0.0021	-0.0019	-0.0017	-0.0037*	-0.0038	-0.0057	-0.0025*	-0.0009*	0.0013*	0.0002*	0.0025***
IFL	0.0056*	0.0001	0.0054	0.0007	0.0085	0.0169*	0.0350***	0.0155	0.0193***	0.0027*	0.0196***	0.0033**
PRICRE	0.0031***	0.0006*	0.0031***	0.0012***	0.0025***	0.0021***	0.0045***	0.0029***	0.0006**	0.0001*	0.0011***	0.0005**
Year control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table reports results from adding additional control variables to Equations (2.7) and (2.8), specifically variables to indicate Regulation Quality (Columns 1 to 4), Activities restrictions (Columns 5 to 8) and Capital account openness and bank ownership (Columns 9 to 12). Other model specifications remain unchanged; dummies year countries are included but not reported. The table reports the marginal impact of financial integration indicators and other determinants on the mean and variance of the inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$, respectively. The former is reported at the average, 25th, 50th, 75th, and 90th percentile levels; the change in the sign of the marginal effect across the percentiles illustrates the non-monotonic impact of financial integration on cost efficiency. The marginal effect of other determinants is only reported at the average value; a positive sign indicates the *Z* variables increase cost inefficiency. The significance levels are calculated based on the bootstrapping confidence intervals and standard errors produced from 1,000 replications. Significance level *10%; **5%, ***1%.

In the last set of robustness tests, the chapter addresses some arguments about the concept of financial integration. First, one may argue that CLAIM and FOR represent different aspects of financial integration. Both measures are now included in one model. The non-monotonic impact of both CLAIM and FOR is still observable (as seen in Panel A, Table 2.12). Lastly, a popular *de facto* measure, namely TOTAL, is used to proxy financial integration. TOTAL is the ratio of the sum of the gross stocks of foreign assets and liabilities to GDP, which is based on the External Wealth of Nations Database (Lane and Milesi-Ferretti, 2007). The result in Panel B (Table 2.12) also confirms the non-monotonic relationship between TOTAL and cost efficiency. However, the marginal impact of TOTAL on the inefficiency level is approximately 0.0001 across the percentiles, translating into an increase or decrease of total cost by 0.01%. The negligible impact of TOTAL probably originates from its definition, since it includes all types of foreign assets, liabilities, and capital flows, including portfolio equity, debt, derivatives, and foreign exchange reserves. As such, CLAIM and FOR are much better measures of financial integration in the banking sector.

Table 2.12: Robustness tests on the measurement of financial integration (for the impact of financial integration)

	Panel A: CLAIM and FOR			Panel B: TOTAL	
	The marginal impact			The marginal impact	
	on E(u) (1)	on V(u) (2)		on E(u) (1)	on V(u) (2)
CLAIM			TOTAL		
Average	-0.0057	-0.0009*	Average	-5.9E-05	6.29E-06
25th per.	-0.0084	-0.0028	25th per.	-8.8E-05*	-2.03E-05*
50th per.	-0.0033	-0.0011	50th per.	-3.0E-05	-3.94E-06
75th per.	-0.0008*	-0.0002*	75th per.	1.35E-05	1.29E-05
90th per.	0.0010*	0.0008	90th per.	6.39E-05*	5.62E-05*
FOR					
Average	-0.0019*	0.0015*			
25th per.	-0.0043	-0.0009			
50th per.	-0.005	0.0001			
75th per.	0.0018*	0.0011*			
90th per.	0.0041***	0.0032***			
CRERISK	-0.0127	0.0005*	CRERISK	-0.0144	-0.0021***
SIZE	-0.0059	-0.0087	SIZE	-0.0072***	-0.0045*
CAP	-0.0042	-0.0006*	CAP	-0.0027	-0.0006*
CON	0.0003*	-0.0004*	CON	-0.0012	0.0021***
IFL	0.0213***	0.0060**	IFL	0.0160***	0.0049***
PRICRE	0.0016***	0.0013***	PRICRE	0.0025***	0.0007
Year control	Yes	Yes	Year control	Yes	Yes

Panel A reports results from the inclusion of both CLAIM and FOR in Equations (2.7) and (2.8). Other model specifications remain unchanged. The table's description is similar to the above-reported ones. Significance level *10%; **5%, ***1%.

Panel B reports results from the inclusion of TOTAL- another *de facto* measure of financial integration in Equations (2.7) and (2.8). Other model specifications remain unchanged. The table's description is similar to the above-reported ones. Significance level *10%; **5%, ***1%.

2.6 CHAPTER SUMMARIES

This chapter explored how financial integration has affected bank cost efficiency by applying the non-monotonic stochastic frontier model developed by Wang (2002) on a sample of commercial banks from nine East Asian countries over the period 1997–2014. The results can be summarised as follows. The marginal effect of the two financial indicators of integration (measured via the ratio of the foreign claims to GDP and the percentage of foreign banks) on the mean of the inefficiency term is non-monotonic. In other words, financial integration initially contributes to the improvement in cost efficiency, but eventually this reverses and financial integration reduces bank cost efficiency. The models suggest these turning points occur when more than 40% of banks are foreign and the foreign claims of international banks exceed 100% of GDP. In the sub-sample of low-integration countries, the turning point of the foreign banks ratio is 40% and the foreign claims ratio is 55%.

The change in the sign of the marginal effect of financial integration across its level has important policy implications. The revision by policy makers, such as the IMF, about the need for full capital financial liberalization would seem to be justified – crudely put, financial integration is a good thing but only up to a point and, increasingly, multinational organisations such as the IMF recognise this. As such, the chapter's results provide robust empirical evidence to support their more nuanced policy stance since the 1990s. This is relevant to Asia, as it increasingly becomes more financially and economically integrated. Policy makers should be aware that an 'optimal' level of financial integration exists. For example, policy makers in Malaysia and Indonesia should take a cautious approach in moving forward with further financial integration in terms of foreign bank penetration, as the current levels of FOR in these countries are quite close to the 'optimal' level of 40% (as reported by this study). On the other hand,

further integration should be beneficial for countries such as China, Vietnam, Thailand, and the Philippines, as their current ratios of foreign bank penetration are well below the 40% ‘optimum’.

Another important result from the chapter is that financial integration increases the variance of the inefficiency term. Higher financial integration is associated with greater cost performance variability. This is because banks are operating in more flexible and open financial systems.

Overall, this chapter provides consistent and robust evidence of a non-monotonic impact of financial integration on bank cost efficiency. This has implications for others wishing to model this relationship and for policy, as outlined above.

APPENDIX A1: ROBUSTNESS TESTS ON THE NON-MONOTONIC IMPACT OF CREDIT RISK ON BANK COST EFFICIENCY

Table A1: Sub-sampling robustness tests (for the impact of credit risk)

Statistics	Low-group countries				The Asian financial crisis period (1997–2006)				The global financial crisis period (2007–2014)			
	Model 1 (CLAIM)		Model 2 (FOR)		Model 1 (CLAIM)		Model 2 (FOR)		Model 1 (CLAIM)		Model 2 (FOR)	
	The marginal impact		The marginal impact		The marginal impact		The marginal impact		The marginal impact		The marginal impact	
	on E(u)	on V(u)	on E(u)	on V(u)	on E(u)	on V(u)	on E(u)	on V(u)	on V(u)	on V(u)	on E(u)	on V(u)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CRERISK												
Average	-0.018***	-0.001	-0.018***	0.005***	-0.007	0.000	0.019***	-0.005	-0.019**	0.004	-0.011	0.004
25th per.	-0.032***	-0.002***	-0.023***	-0.009***	-0.010*	-0.004	-0.019***	-0.008***	-0.040***	-0.001	-0.024	0.000
50th per.	-0.015***	-0.001	-0.009***	-0.003***	-0.001	0.000	-0.006***	-0.002***	-0.014*	0.000	-0.010	0.001
75th per.	-0.007***	0.000	-0.003	-0.001	0.003**	0.002***	-0.001	0.001	-0.004	0.002	-0.003	0.003
90th per.	-0.003***	0.001	0.001	0.001	0.007***	0.005***	0.003	0.003*	0.005	0.006*	0.004	0.006*

This table reports results from several robustness tests including the modelling on the sample of low-group countries (Columns 1 to 4) and the Asian (Columns 5 to 8) and the global financial crisis (Columns 9 to 12). The table reports the marginal impact of credit risk (CRERISK) on the mean and variance of the inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$ at the average, 25th, 50th, 75th, and 90th percentile levels. Other descriptions are similar to Table 2.10's. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A2: Robustness tests with regulations and policies control variables (for the impact of credit risk)

	Regulation quality				Activities restrictions				Capital account openness and bank ownership			
	Model 1 (CLAIM)		Model 2 (FOR)		Model 1 (CLAIM)		Model 2 (FOR)		Model 1 (CLAIM)		Model 2 (FOR)	
	The marginal impact		The marginal impact		The marginal impact		The marginal impact		The marginal impact		The marginal impact	
	on E(u)	on V(u)	on E(u)	on V(u)	on E(u)	on V(u)	on V(u)	on V(u)	on E(u)	on V(u)	on E(u)	on V(u)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CRERISK												
Average	-0.0103***	0.0025*	-0.0077**	0.0033*	0.0025	0.0034*	0.0037***	0.0032**	-0.0240***	-0.0014	-0.0244***	-0.0017
25th per.	-0.0261***	-0.0015*	-0.0190**	-0.0012	-0.0014	0.0006	-0.0025*	0.0012*	-0.0395***	-0.0071***	-0.0393***	-0.0072***
50th per.	-0.0029	0.0001	-0.0006	0.0006	0.0024	0.0013	0.0035***	0.0024**	-0.0140***	-0.0031**	-0.0137***	-0.0031***
75th per.	0.0028	0.0022***	0.0035*	0.0027***	0.0038*	0.0026*	0.0049***	0.0034**	-0.0040**	-0.0005	-0.0042**	-0.0004
90th per.	0.0062**	0.0049***	0.0073***	0.0056***	0.0055**	0.0049***	0.0072**	0.0070***	0.0049***	0.0043***	0.0044**	0.0043***

This table reports results from adding additional control variables to Equations (2.7) and (2.8), specifically variables to indicate Regulation Quality (Columns 1 to 4), Activities restrictions (Columns 5 to 8), and Capital account openness and bank ownership (Columns 9 to 12). The table reports the marginal impact of credit risk (CRERISK) on the mean and variance of the inefficiency term, i.e. $E(u_{it})$ and $V(u_{it})$ at the average, 25th, 50th, 75th, and 90th percentile levels. Other descriptions are similar to Table 2.11's. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A3. Robustness tests on the measurement of financial integration (for the impact of credit risk)

	Panel A: CLAIM and FOR			Panel B: TOTAL	
	The marginal impact			The marginal impact	
	on E(u)	on V(u)		on E(u)	on V(u)
	(1)	(2)		(1)	(2)
CRERISK			CRERISK		
Average	-0.0127***	0.0005	Average	-0.014***	-0.002
25th per.	-0.0208**	-0.0061***	25th per.	-0.019**	-0.006***
50th per.	-0.0066	-0.0018*	50th per.	-0.009*	-0.003**
75th per.	0.0009	0.0010	75th per.	-0.002	0.000
90th per.	0.0073***	0.0056***	90th per.	0.004**	0.004*

Panel A reports results from the inclusion of both CLAIM and FOR in Equations (2.7) and (2.8). Other descriptions are similar to Table 2.12's. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

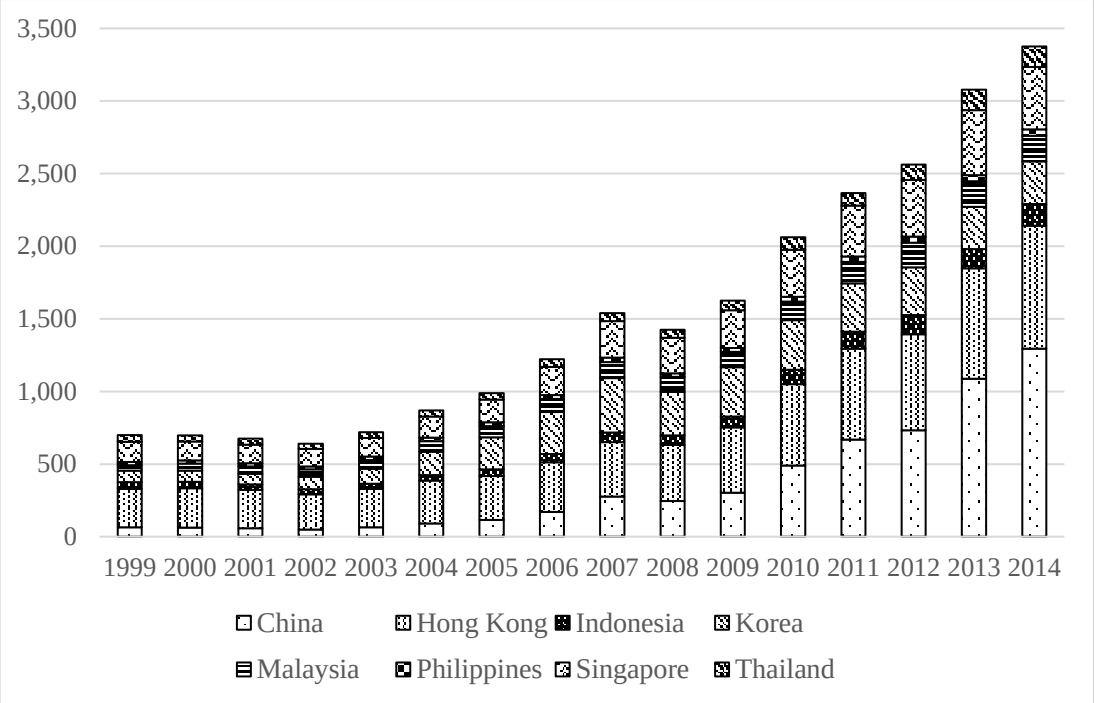
Panel B reports results from the inclusion of TOTAL – another *de facto* measure of financial integration in Equations (2.7) and (2.8). Other descriptions are similar to Table 2.12's. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

CHAPTER 3: LOANS FROM MY NEIGHBOURS: EAST ASIAN COMMERCIAL BANKS, FINANCIAL INTEGRATION, AND BANK DEFAULT RISK

3.1 INTRODUCTION

East Asia is an economically dynamic region of growing importance to the international financial system and the global economy. Unsurprisingly, East Asia has become increasingly integrated with the global financial system (World Bank, 2018; Asian Development Bank, 2018). The trend is apparent from the large increase in foreign banking claims to East Asia for the period 1999–2014, depicted in Figure 3.1. The trend also stands against the backdrop of the Asian financial crisis that led to high-profile bank defaults and a painful economic contraction in many East Asian economies (Asian Development Bank, 2008). Thus, the current development of financial integration in East Asia has attracted continued academic and policy interest in studying the benefits and costs of financial integration with regards to financial stability.

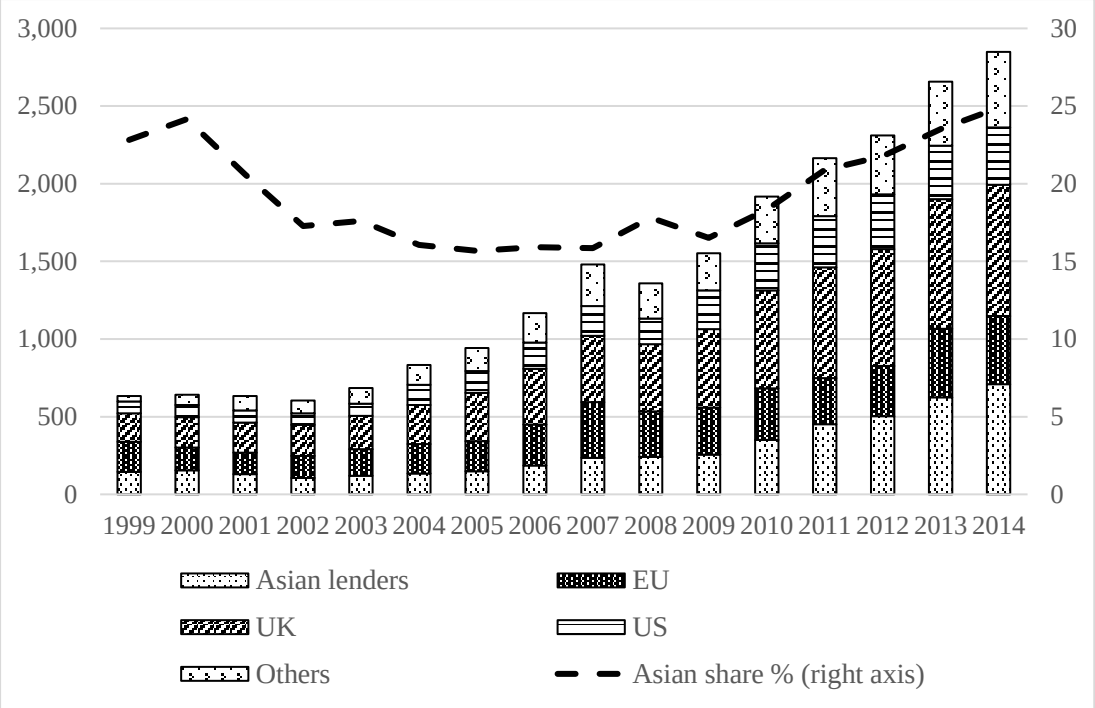
An earlier version of this chapter was presented at the Vietnam Symposium in Banking and Finance (VSBF 2019, Hanoi, Vietnam) and at the Asian Development Bank Institute (ADBI) and Singapore Management University Conference on Macroeconomic Stabilization in the Digital Age (2019, Singapore).



This figure reports the total foreign claims (in US$ billions) extended to each recipient country in the sample during 1999–2014. The source (lender) countries include 31 countries who report to BIS (see Appendix B1). Types of reporting banks include (i) domestic banks (controlled by parent entities with the same country code as the reporting country); (ii) banks located in the reporting country, but controlled by parents entities located in non-reporting countries; (iii) banks controlled by parent entities located in the reporting country but not consolidated by their parent. Source: Compiled from BIS Consolidated on Immediate Counterparty basis (CBS-IC), bank type "All excluding 4C banks, excluding domestic position".

Figure 3.1: Total foreign banking claims on each country in the sample

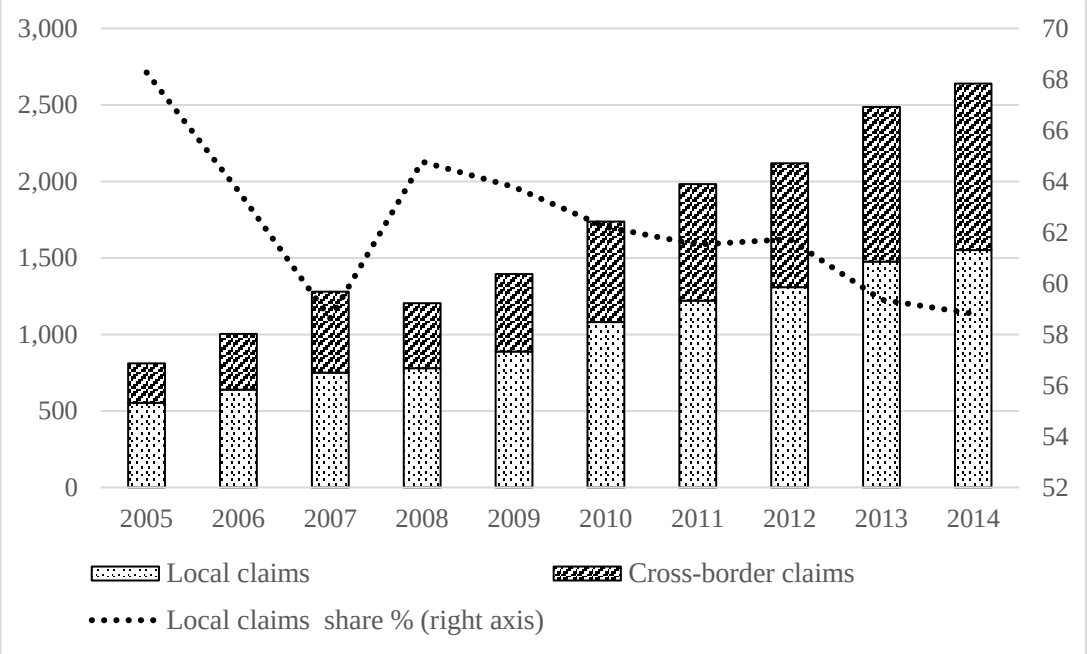
Further examination of the statistics of foreign banking claims to East Asia reveals two other interesting facts. When the source country of claims is considered, as seen in Figure 3.2, there is a steady growing share of foreign claims extended by Asian banks, especially after the global financial crisis. This fact, likely follows from efforts, at least in part, to promote intra-regional integration in East Asia (starting with the Chiang Mai Initiative in 2000, the Asian Bond Markets Initiative in 2003, and culminating with the formation of the ASEAN Economic Community in 2015) (Ananchotikul et al., 2015).



This figure reports the foreign claims (in US$ billions) extended to all sampled countries and broken down by lenders' nationality during 1999–2014. The source (lender) countries include 31 countries who report to BIS (see Appendix B1). Reporting Asian lenders include Australia, Chinese Taipei, Hong Kong, Japan, Singapore, and (South) Korea. Only one type of reporting bank is considered: domestic banks (controlled by parent entities with the same country code as the reporting country). Source: Compiled from BIS Consolidated on Immediate Counterparty basis (CBS-IC), bank type "Domestic banks, excluding domestic position".

Figure 3.2: The foreign banking claims on the sampled countries by lenders' nationality

Another decomposition of foreign banking claims is based on the methods of extension. International banks can extend claims locally through their branches and subsidiaries established in recipient countries; alternatively, they can extend claims across borders by financing and booking their claims from outside these recipient countries (García-Herrero and Martínez Pería, 2007). As seen in Figure 3.3, local claims account for the majority of claims. This fact represents efforts by international banks to obtain 'local' knowledge via affiliate presence. In short, these additional facts motivate a detailed examination about the impact of different forms of financial integration on financial stability.



This figure reports the foreign claims (in US$ billions) extended to all sampled countries and broken down by methods of extension during 2005–2014. The source (lender) countries is similar to CBS-IC; except for the three countries including Brazil, Mexico, Luxembourg do not report in the CBS-UR. (see Appendix B1). These source countries could extend claims either via their local affiliates set up at the recipients countries (local claims) or across border (cross-border claims). Only one type of reporting banks are considered: domestic banks (controlled by parent entities with the same country code as the reporting country). Source: Compiled from BIS Consolidated on Ultimate Risk basis (CBS-UR), bank type "Domestic banks, excluding domestic position".

Figure 3.3: The foreign banking claims on the sampled countries by methods of extension

Thus, this chapter investigates what impact financial integration has on bank default risk in recipient countries and explores whether that relationship is moderated by the *type* of financial integration. In the latter case, and as its title intimates, the chapter explores whether foreign banking claims from 'neighbours' have a preferential impact on bank default risk. Specifically, two definitions of 'neighbours' are adopted: (i) banks from other Asian countries and (ii) foreign banks' presence via a full affiliate office in the recipient countries.

More specifically, and considering East Asian countries as the foreign claims recipients, the first research question states: *"How does financial integration affect recipient country bank default risk?"* Based on the existing literature, this relationship is

ambiguous. Lower bank default risk could be derived from monitoring and competition channels. Specifically, banks in the recipient countries are subject to the external monitoring exercised by international banks (Allen et al., 2011). Furthermore, banks in the recipient countries are also under pressure to improve their risk management and credibility to compete with international banks in providing funds to domestic borrowers (Agénor, 2001). However, it may also be the case that international capital flows generate excessive liquidity in the recipient countries, which could aggravate bank agency problems, leading to higher bank risks (Dell'Ariccia and Marquez, 2006; Acharya and Naqvi, 2012). Empirical evidence on the relationship is relatively scant. Existing research focuses on the impact of financial liberalization (notably Cubillas and González, 2014) and the effect of foreign bank presence (such as Claessens et al., 2001; Wu et al., 2017) on bank risks. Closely related work by Dinger and Kaat (2017) reports that inflows of foreign capital lead to higher impaired loans. This contrasts with Karolyi et al. (2018), who show that cross-border banking flows lower bank systemic risk. This chapter contributes to the empirical evidence on the relationship between financial integration and bank default risk using a sample of commercial banks in East Asia, a dynamic and growing region that relies increasingly on foreign claims from international banks.

The study then decomposes the measure of total foreign claims based on lenders' nationality. The second research question explores the difference between the impact of the foreign claims extended by Asian neighbours and non-Asian lenders on bank default risk. Thus, the second research question states: *"Does regional lending affect recipient country bank default risk differently to non-regional lending?"* Evidence of information asymmetry associated with the distance between lenders and borrowers is well documented in the literature (Brennan and Cao, 1997; Petersen and Rajan, 2002; and Knyazeva and Knyazeva, 2012). Prior studies also specify the concept of 'distance' as

being either cultural and geographic distance (Detragiache et al., 2008) or institutional distance between home and host countries (Mian, 2006). Therefore, the *a priori* expectation is that Asian international banks possess an informational advantage due to the geographical, cultural, and institutional proximity with their regional borrowers. This informational advantage creates an effective discipline mechanism and a strong competitive pressure over banks in the recipient countries, thus leading to lower risk-taking behaviour. Although the rationale for expecting regional banking claims to lead to lower bank default risk relative to non-regional claims is highly intuitive, there is currently no research that has examined this possibility.

The third research question tests if the methods of claims extension affect bank default risk differently. This relates to the second definition of 'neighbours' – namely, the term applies when an international bank has a fully functioning affiliate in the recipient country. This leads to the third research question: *"Do local claims affect recipient country bank default risk differently to cross-border claims with no-local presence?"* Foreign claim extension via local affiliates involves foreign direct investment in the host country's financial sector (García-Herrero and Martínez Pería, 2007). This type of investment incorporates ownership, lessening the information asymmetry and facilitating closer borrower monitoring (Neuman, 2003). Additionally, the presence of foreign banks also engenders competition in the recipient countries' banking market, which is demonstrated to lower bank risk-taking (Faia and Ottaviano, 2017). *A priori*, it is reasonable to expect that local claims from foreign banks should lower bank default risk in the recipient countries. Again, despite this expectation being highly intuitive, there is no empirical evidence testing the differential impact of cross-border versus local claims of foreign banks on bank default risk. This study addresses this gap in the literature.

The chapter constructs an unbalanced sample of commercial banks from eight countries in East Asia (China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, and Thailand) during the period 1999–2014. Each research question is tested using a dynamic panel data model of bank default risk. The two-step system generalized method of moments (GMM) developed by Arellano and Bover (1995) and Blundell and Bond (1998) is used to estimate this dynamic relationship. The dependent variable, bank default risk, is measured by the z-score, which is interpreted as the number of standard deviations by which returns must decrease to wipe out all equity owned by the bank (Roy, 1952).

This chapter sources data to construct its measures of financial integration from the Consolidated Banking Statistics (CBS) published by the Bank for International Settlement (BIS). Data for the first two research questions rely on the Intermediate Counterparty (IC) version of CBS. To address the first research question, the chapter constructs the overall measure of financial integration from the total foreign claims that are extended by all international banks (regardless of their nationality and methods of extension) to the sampled East Asian countries. Actually, this measure is the variable CLAIM previously employed in Chapter 2. To address the second research question, the total foreign claims are decomposed into the foreign claims extended by international banks whose nationality are Asian and non-Asian. The classification, based on the nationality of international banks, captures geographic closeness and cultural and institutional similarity between lenders and borrowers. Data for the third question draw on the break-down of foreign claims into cross-border claims and local claims from the Ultimate Risk (UR) version of CBS.

The main result from this chapter is that financial integration (measured via the total foreign claims of international banks) lowers bank default risk in the recipient

countries. This effect is primarily driven by the foreign claims extended by Asian lenders and the foreign claims extended via local affiliates. The findings remain robust when an alternative measure of bank risk (i.e. profit volatility) is employed or a different sub-sampling strategy (i.e. domestic banks or low-financial-integration countries) is conducted. Overall, this chapter reports robust evidence that the foreign claims extended by Asian lenders and the foreign claims extended via local affiliates contribute to the stability of the banking system in the East Asian recipient countries.

The chapter contributes to the existing literature in several ways. The first research question sheds light on the debate about the impact of financial integration and international capital on financial stability. Research by Cubillas and González (2014) and Wu et al. (2017) confirm that financial liberalization and foreign bank presence increase bank risk-taking in emerging countries. Similarly, several empirical studies establish the connection between international capital flows, credit growth, and lower credit quality or even the incidence of financial crisis (e.g. Reinhart and Rogoff, 2008; Acharya and Naqvi, 2012; Dinger and Kaat, 2017). In contrast, this chapter focuses on the impact of financial integration measured via the foreign claims extended by international banks and documents a positive effect on banking stability (lower bank default risk) in the recipient countries. This finding complements Karolyi et al. (2018), who find that cross-border banking flows help to lower bank systemic risks at the country level.

The second and third research questions relate to the literature on the distance constraint between providers and recipients of funds. In the context of international equity portfolio investment, the theoretical model and empirical evidence of Brennan and Cao (1997) suggest that foreign investors are less informed about the foreign markets than the local investors, which could affect their investment returns. Similarly, foreign banks lending in poor countries face severe information asymmetry due to the

geographic, cultural, and institutional distance between home and host countries (Mian, 2006; Detragiache et al., 2008). In the bank loan market, Knyazeva and Knyazeva (2012) report higher loan spreads between distant borrowers and lenders due to the costs of gathering soft information. Evidence from these studies implies that information asymmetry decreases when the borrowers' and lenders' proximity increases. This chapter uses the context of foreign claims extended from international banks, taking the viewpoint of the recipient countries, to make the definition of 'closeness' or 'neighbours' more direct. Specifically, 'closeness' refers to the fact that foreign claims are extended by regional lenders or via local affiliates established in the recipient countries.

The findings are useful in guiding important policy decisions affecting the design of a financial integration strategy within East Asia, and potentially in other regions. To maintain the financial stability of their banking systems, these countries should favour either the foreign claims extended by Asian lenders or foreign claims extended via local branches of international banks established in their countries. The former option is synonymous with the promotion of intra-regional financial integration. This implication is meaningful because intra-regional finance still lags behind trade, both in terms of the level of integration and the benefits of risk-sharing (Ng and Yarcia, 2014). The latter option implies that where foreign claims come from outside East Asia, policy makers should encourage presence through local affiliates, as this has an equivalent impact.

The rest of the chapter proceeds as follows. Section 3.2 reviews the relevant literature and develops the hypotheses. Section 3.3 outlines the empirical methodology. Sections 3.4 and 3.5 present the descriptive and empirical findings. Section 3.6 concludes.

3.2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

The first research question examines the impact of financial integration (measured via the total foreign claims from international banks) on bank default risk in the recipient countries. The existing theoretical and empirical literature suggests that financial integration can both lower and increase bank default risk.

On the one hand, lower bank default risk could arise from different channels, including funding diversification, competition, monitoring, and regulation self-improvement. With regard to the first channel, domestic banks can be funded by either retail deposits or international interbank borrowing. The latter may serve as an alternative source of funding in the event of local shocks (Allen et al., 2011). Second, foreign capital could create healthy competition among the different providers of financing, leading to the threat of 'flight to quality' (Agénor, 2001). In other words, banks in the recipient countries are under pressure to improve their risk management and credibility to compete with international banks who provide another source of finance for domestic borrowers.

The third channel relates to the monitoring of international banks. East Asian borrowers received large volumes of foreign claims from international banks, especially after the global financial crisis (World Bank, 2018). The substantial exposure to the region encouraged international banks to monitor their interbank loans, contributing to the improved recipient country bank stability. Recent empirical evidence documenting this monitoring channel is provided by Karolyi et al. (2018). The authors attribute the stabilizing impact of cross-border banking flows to the oversight provided by lending banks located in countries with better regulatory quality relative to banks in recipient countries with weaker regulatory and supervisory systems.

The last channel leading to lower bank default risk relates to the improved prudential bank regulation and supervision implemented by the recipient countries on

their own accord. A theoretical framework of capital mobility and reform, developed by Gourinchas and Jeanne (2005), shows that the receipt of foreign capital may pressure policy makers in host countries to adopt better governance practices. These actions can also attract foreign lending and support policies to avoid capital flight. Similarly, international banking flows are greater and more beneficial for countries meeting certain 'thresholds' of macroeconomic and institutional quality (Kose et al., 2011; Claessens, 2017). In a similar vein, recipient countries are motivated to improve their own regulatory requirements to capitalise on the benefits of financial integration.

On the other hand, financial integration can increase recipient country bank default risk via excessive liquidity and regulation arbitrage. International capital inflows (as a result of capital account openness and financial liberalization) may generate excessive liquidity in the recipient countries (Dell'Ariccia and Marquez, 2006). Acharya and Naqvi (2012) further posit that this excessive liquidity aggravates bank agency problems, leading to the relaxation in lending standards, and higher bank risks. Houston et al. (2012) conjecture that banks tend to transfer funds to countries with fewer regulations. Consistent with this regulation arbitrage motive, Ongena et al. (2013) find that banks operating in countries with tighter bank restrictions and higher capital requirements tend to make riskier loans abroad. This behaviour has the potential to destabilize the recipient countries' financial system.

The sampled East Asia countries in this chapter are developed (Hong Kong, Singapore, and Korea) and emerging (Indonesia, Malaysia, China, Thailand, and the Philippines). The former group already have a developed regulatory system in place; the latter, induced by the lessons from the Asian financial crisis, also have formed an improved system to regulate international banking capital flows (Asian Development Bank, 2008). This helps to alleviate the concern over the regulation arbitrage and excess

liquidity. Therefore, Hypothesis 1 (H1) states: "*Financial integration significantly lowers bank default risk in the recipient countries.*"

The following two research questions address whether the impact of financial integration on bank default risk is moderated by the type of foreign claims. In this context, and more generally, it is worth observing that the empirical evidence on the relationship between financial integration and bank default risk is relatively scant. The existing literature mainly studies the relationship between financial liberalization or foreign bank presence and bank risks (such as Claessens et al., 2001; Cubillas and González, 2014; and Wu et al., 2017). Notably, Cubillas and González (2014) find that financial liberalization increases bank risk-taking in both developed and developing countries via improved competition and more risk-taking opportunities. Similarly, Wu et al. (2017) document that the risk of domestic banks increases with the presence of foreign banks in the emerging host economy. In contrast to the *de jure* indicator of financial liberalization (i.e. the capital account openness or the Index of Economic Freedom) used in Cubillas and González (2014) or the foreign bank penetration ratio used in Wu et al. (2017), this chapter measures financial integration via the total foreign claims extended by international banks, and this provides a new *de facto* approach to examine the impact of financial integration on bank risks.

Contrasting evidence from working papers directly examining the impact of international capital on recipient country bank risks highlights the need for further research. Dinger and Kaat (2017), using a sample of 11 countries in the Eurozone area, find that inflows of foreign capital (measured via a country's negative account balance) lead to higher loan-to-asset ratios and impaired loans. In contrast, Karolyi et al. (2018) document evidence that heightened cross-border banking flows lower bank systemic risks in 114 recipient countries. This chapter contributes to the current literature by

providing additional evidence on the impact of foreign claims from international banks on default risk at the individual bank level for a sample of East Asian banks.

More specifically, the second research question addresses whether the impact of financial integration on bank default risk differs due to the source countries of the foreign claims. International banks that extend claims to East Asia will seek to monitor and discipline the recipients of funds. However, informational disadvantages and higher monitoring costs mean that non-Asian international banks will exercise less effective monitoring power compared with their Asian counterparts. This is confirmed by several seminal studies, such as Brennan and Cao (1997), Petersen and Rajan (2002), and Knyazeva and Knyazeva (2012). These studies purport that lenders face greater information asymmetry and costly monitoring for distant borrowers. Large institutional, cultural, and geographic distances also heighten the loss of relationship lending between loan officers and management (Mian, 2006; Detragiache et al., 2008). Conversely, Asian international banks are informationally advantaged. The information advantage results from their familiarity with the cultural, legal, political, and economic environments of the recipient countries (Mian, 2006; Claessens and Van Horen 2014b). In addition to the regional specific knowledge, the information advantage is inherent to the local business relationship (Buch et al., 2012).[27]

Information advantage allows Asian lenders to do a better job of monitoring claims extended to regional borrowers. Furthermore, regional knowledge enables Asian lenders to compete better with banks in the recipient countries as providers of finance. Therefore, the benefit of the monitoring and competition channel in lowering bank

[27] To explain, Asian international banks follow the footsteps of domestic corporate customers going abroad to set up their foreign branches (Molyneux et al., 2013). Due to the lending relationship set up in home countries, Asian international banks have the informational advantage to serve these customers in new host markets. This informational advantage become greater when the trade and FDI linkage within the region is increasingly strengthened (Asian Development Bank, 2018).

default risk outlined in the first hypothesis becomes stronger in the case of Asian claims. In other words, the receipt of Asian claims is expected to lead to lower bank default risk. Hence, Hypothesis 2 (H2) states: "*Foreign claims extended by Asian banks, as distinct from claims extended by non-Asian banks, significantly lower bank default risk in the recipient countries."*

The third research question aims to test whether the impact of financial integration on bank default risk is different across methods of extension, namely local claims and cross-border claims. Neumann (2003) argues that portfolio debt flows (relative to equity flows and FDI) do not incorporate ownership and thus augment manager control, increasing the severity of information asymmetry. This also holds true in the context of local claims and cross-border claims; the former involves some forms of FDI in the host country's financial sector, while the latter does not (García-Herrero and Martínez Pería, 2007). In short, the asymmetric information is more pronounced for cross-border claims. Therefore, the monitoring and discipline of international banks over cross-border claims will be less effective, meaning that banks in recipient countries are likely to take on more risks than they might otherwise.

If international banks set up their affiliates to extend their claims to the recipient countries, there are additional benefits arising from the competition between domestic and foreign banks. Claessens et al. (2001) empirically show that multinational banks stimulate healthy competition among local banks in host countries. The dynamic multinational banking model of Faia and Ottaviano (2017) specifically links tougher local competition from global bank entry in retail banking to less risk-taking for the host banking system. Following this line of reasoning, the *a priori* expectation is that claims extended via local affiliates will lower recipient country bank default risk in the recipient countries. Thus, Hypothesis 3 (H3) states: "*Foreign claims extended via local affiliates*

of international banks, as distinct from cross-border claims, significantly lower recipient country bank default risk."

As previously noted, there is limited empirical evidence on the impact of foreign banking claims on recipient country bank default risk. Moreover, there is no study testing the differential impact of different types of foreign banking claims on bank default risk. Therefore, Chapter 3 addresses this gap in the literature.

3.3 METHODOLOGY, VARIABLES, AND DATA

3.3.1 Model Specification

The chapter adopts a dynamic specification to model the determinants of bank default risk (as specified in Equation 3.1). The dynamic setting is appropriate since Berger et al. (2000) argue that the risk-return profile of banks shows a tendency to persist over time, reflecting impediments to market competition and information opacity.

$$RISK_{ijt} = \beta_0 RISK_{ijt-q} + \beta_1 INTEG_{jt} + \beta_k BANK^k{}_{ijt} + \beta_m COUNTRY^m{}_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt} \quad (3.1)$$

In this specification, the bank default risk of bank *i* in country *j* at year *t* is written as a function of its past level ($RISK_{ijt-q}$, with *q* being lag length), financial integration (INTEG), a vector of *k* bank-level variables reflecting the characteristics of each bank *i* (BANK), and a vector of *m* variables reflecting the macroeconomic condition relevant to all banks, including bank regulation and supervision for any given country *j* (COUNTRY). θ_i is the bank-specific fixed effect to control for unobserved factors that do not change over time for each bank. γ_j and μ_t are the country and time dummies, respectively; ε_{ijt} is the error term. All explanatory variables enter the estimation of equations at the contemporaneous level based on the assumption that banks revise their targets during the estimation period (measured in years) in response to changes in their financial health as well as macroeconomic conditions.

To appropriately specify the lag order (q) in Equation 3.1, the moment selection criteria for GMM models developed by Andrews and Lu (2001) are employed. Specifically, the first-order dynamic panel (q=1) is the preferred model because it has the smaller Bayesian information criterion (BIC); the BIC value for the first- and second-order panel model are -261.917 and -240.518, respectively.[28] The first-order dynamic model of bank default risk is specified as in Equation 3.2. This specification is also in line with prior studies, such as Cubillas and González (2014), Agoraki et al. (2011), and Noman et al. (2018).

$$RISK_{ijt} = \beta_0 RISK_{ijt-1} + \beta_1 INTEG_{jt} + \beta_k BANK^k{}_{ijt} + \beta_m COUNTRY^m{}_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt} \quad (3.2)$$

3.3.2 Estimation Method

The chapter employs the two-step system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) with finite-sample corrected standard errors as proposed by Windmeijer (2005). Arellano and Bover (1995) and Blundell and Bond (1998) suggest employing the lagged first differences of the explanatory variables as instruments for the equation in levels and the lagged values of the explanatory variables in levels as instruments for the equation in differences.

The system GMM helps to address several econometric issues. Specifically, the GMM provides an unbiased estimator for the dynamic panel data model with the presence of bank fixed effect. Due to the correlation between the fixed effects and the lagged dependent variable, the pooled ordinary least squares (OLS) estimator is upward biased and inconsistent. The fixed effect (FE) method usually provides a downward-biased estimator following Nickell's (1981) finite-sample bias. More importantly, the GMM accommodates for possible endogeneity between bank default risk and other

[28] Additionally, in the second-order dynamic panel model, the signs of the lagged dependent variable are counter-intuitive: positive for the first lag, but negative for the second lag.

covariates in the model, which could affect the interpretation of the empirical results. For instance, contemporaneous bank-level regressors ($BANK_{ijt}$) are treated as being endogenous due to their simultaneous relationship with bank default risk. Among country-level regressors, financial integration ($INTEG_{jt}$) and bank regulation and supervision variables are treated as being predetermined variables. To explain, a lower bank default risk (i.e. a stable financial system) in the recipient countries would attract higher foreign claims extended by international banks (Karolyi et al., 2018). Similarly, regulators could change their regulation and supervision to discipline bank risk-taking behaviour (Agoraki et al., 2011; Noman et al., 2018). Finally, other macroeconomic variables, time dummies, and country dummies are treated as exogenous variables.

Before running the system GMM, a Fisher test developed by Maddala and Wu (1999) is used to check for the time series stationarity (T=17 years). The test is based on the augmented Dickey-Fuller test and could be used for unbalanced panel data. Additionally, the Durbin-Wu-Hausman (DWH) test for endogeneity is conducted to confirm the suspicion that bank-level control variables are endogenous.

After running the system GMM, some post-diagnostic tests are also performed to make sure that the model is well specified and produces a consistent estimator. First, the second-order (i.e. the AR(2)) Arellano-Bond autocorrelation test is used to detect the serial correlation of the residuals in the differenced equation. The AR(2) test has the null hypothesis of no autocorrelation.[29] Second, the Hansen J-statistics tests the over-identification and validity of the instruments under the null hypothesis that the 'instruments as a group are exogenous'. Third, the difference-in-Hansen test is also reported. This test is important but not often reported in publications (Roodman, 2009).

[29] By construction, the test for the first-order correlation (i.e. AR(1) process) in first differences usually rejects the null hypothesis. The expectation is that the AR(2) should be insignificant.

While the Hansen J-statistics tests for the joint validity of the full instrument set, the difference-in-Hansen checks the validity of the subset of instruments (specifically, the validity of differenced instruments for levels equation, and other sets of instruments for endogenous, predetermined, and exogenous explanatory variables).

3.3.3 Variables and Data

3.3.3.1 Bank default risk

To measure bank default risk, the distance to default (z-score) is used. Z-score = (ROA+ CAP)/(Std.ROA), where ROA is the rate of return on assets, CAP is the equity capital to asset ratio, and Std.ROA is the standard deviation of ROA (Roy, 1952). To calculate the standard deviation of ROA, the three-consecutive-year moving window (i.e. year t-2, t-1, and t) rather than the full sample period is used.[30] By its construction, Z-score is interpreted as the number of standard deviations by which returns must decrease to wipe out all equity owned by the bank; Z-score can be viewed as the inverse of the probability of bank failure (Roy, 1952; Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010). This means that a higher value of the Z-score suggests a lower exposure to default risk. As the distribution of the Z-score is highly skewed, following Laeven and Levine (2009), the natural logarithm of the Z-score is taken (LN(zscore)).

3.3.3.2 Financial integration measures and data

To address the first research question and H1, an overall measure of financial integration is constructed based on the foreign claims extended by international banks to

[30] The optimal length of ROA standard deviation's window is not well defined in the literature. Li et al. (2017) demonstrated the use of four- or five-year rolling window for New Zealand's banks and suggested this window is long enough to capture change in bank risks. Bouvartier et al. (2018) report that the three-year rolling window is the most popular option in the literature; furthermore, the three-year window outperforms the five-year one for the US and EU sample. Unfortunately, there has not been any discussion for the specific sample of Asian banks. The chapter follows Noman et al. (2018), which examines the relationship between bank regulation and default risk in ASEAN countries, and uses the three-year rolling window.

the sampled (recipient) countries. Similar to Chapter 2, the chapter sourced these statistics from the CBS-IC and retained the computation procedure as described in Section 2.3.3.[31] As these claims are extended by all lenders regardless of their nationality or methods of extension, the obtained value of claims after all these steps is regarded as the total foreign claims. The total foreign claims value is either scaled by the GDP of the corresponding sampled countries to construct the variable CLAIM (previously employed in Chapter 2) or transformed by taking the natural logarithm to construct an alternative measure of LN(claim). In short, both measures (CLAIM and LN(claim)) proxy for the total foreign claims on the sampled countries, which are extended by all lenders regardless of their nationality and methods of extension. Thus CLAIM and LN(claim) provide the baseline measure of $INTEG_{jt}$ in Equation 3.2.

Question 2 and H2 test whether the source country of foreign claims matters in the impact of financial integration on bank default risk. To compute the foreign claims extended by Asian banks (or Asian claims, for short) and the foreign claims extended by non-Asian banks (or non-Asian claims, for short), the total foreign claims measure is classified by the nationality of the lenders.[32] These statistics are then scaled by the GDP of the sampled countries (to construct ASIAN and NON_ASIAN, respectively) or transformed in a natural logarithm (to construct LN(asian) and LN(non_asian), respectively). Thus, these measures are alternative definitions of $INTEG_{jt}$ in Equation 3.2. The break-down by nationality reflects the difference not only in geographic location

[31] Adding to the overall description provided in Section 2.3.3, Appendix B1 presents some caveats, which are helpful to further understand the structure of CBS with regard to its various reporting bases and types of reporting banks.

[32] The list of BIS-reporting countries is provided in Appendix B2. Based on the nationality of reporting banks, Asian source countries include Australia, Chinese Taipei, Hong Kong SAR, India, Japan, (South) Korea, and Singapore. Non-Asian lenders mainly include European and North American advanced countries, such as the US, UK, Germany, France, etc.

but also in the source country characteristics, including culture and institutional quality (see Section 3.2).

Question 3 and H3 examine the variation in the relationship between financial integration and bank default risk due to the difference in methods of extension of the foreign claims. The foreign claims could be classified as cross-border claims (i.e. claims extended from the banks' headquarters and booked outside the recipient countries) or local claims (i.e. claims extended locally by international banks through the banks' branches and subsidiaries in the recipient countries). The data for this break-down are sourced from the CBS-UR rather than the CBS-IC, as the latter does not provide a clear-cut distinction between cross-border claims and local claims.[33] In a similar approach to earlier, measures of cross-border claims and local claims are scaled by the GDP of the sampled countries (to obtain CROSS and LOCAL, respectively) or transformed in a natural logarithm (to obtain LN(cross) and LN(local), respectively). These provide the final definitions of $INTEG_{jt}$ in Equation 3.2.

The difference in the available time periods and reporting basis between CBS-IC and CBS-UR prevents the analysis of local claims and Asian claims in a full parallel fashion. However, there is one scenario when local claims and Asian claims measure the same thing, which is when the majority of foreign affiliates/branches in the sampled countries are owned by Asian banks. To prove this is not the case, the database from Claessens and Van Horen (2015) on bank ownership is employed to examine the origin

[33] The CBS-IC reports the break-down of foreign claims into 'international claims' and 'local claims in local currency', in which international claims include both cross-border claims and local claim in foreign currency. In contrast, the CBS-UR separately reports cross-border claims and local claims. There are differences in the reporting basis of CBS-IC and CBS-UR. While CBS-IC looks at the immediate relationship between borrowers and lenders, CBS-UR tracks the counterparty who is ultimately responsible for servicing any outstanding obligations in the event of a default by the immediate borrower (Bank for International Settlement, 2015). Furthermore, CBS-UR is only available since 2005, while CBS-IC is available since the 1980s.

of foreign banks in the sampled East Asian countries. First, the total number of foreign banks in these countries is computed. Then, the number of foreign banks owned by Asian BIS-reporting countries is calculated. In Korea, there are no foreign banks with origin from Asian BIS-reporting countries. The ratio of Asian foreign banks to total foreign banks varies among the rest of the group (as reported in Appendix B3). For instance, in Thailand, Indonesia, and China, nearly 50% of their foreign banks are Asian foreign banks, while in Hong Kong and Singapore, this figure is around 23%. In short, the data presented in Appendix B3 provide evidence that the two measures 'local claims' and 'Asian claims' are distinctive but related measures of 'closeness' or 'neighbours'.

3.3.3.3 Control variables

In line with the existing literature on the determinants of bank risks (Laeven and Levine, 2009; Demirgüç-Kunt and Huizinga, 2010; and Beck et al., 2013), standard explanatory variables are included in Equation 3.2. The commonly used bank-level control variables include natural logarithm of total assets (SIZE), equity to total assets ratio (CAP), ratio of non-performing loans to gross loans to proxy for credit risk (CRERISK), ratio of non-interest operating expenses to total assets to proxy for cost efficiency (COST), the share of non-interest income to total income to proxy for income diversification (INC_DIV), the ratio of demand deposits to total deposits to proxy for bank charter value[34] (CHARTER), and a dummy variable to proxy for the foreign and domestic ownership of a bank (ODUM). Market concentration (CON), measured as the assets of the three largest banks to the total assets of all commercial banks in a country, is also included. Bank concentration may have a positive or a negative association with bank risk. In accordance with the 'competition-stability' hypothesis, the risk of bank

[34] Charter value reflects future economic rents that banks obtain from privileged access to markets protected from competition (Goyal, 2005).

insolvency increases in more concentrated markets (Boyd and De Nicolo, 2005). However, as suggested by the 'competition-fragility' hypothesis (Beck et al., 2006), more intensive competition leads to lower net interest margins, eroding a major source of bank profits and inducing more risky behaviour. This translates into less concentrated banking systems being associated with bank behaviour that is more risk-taking.

In addition to bank-level control variables and a competition variable, consistent with cross-country studies, such as Demirgüç-Kunt and Huizinga (2010), Agoraki et al. (2011), and Wu et al. (2017), the model also includes the GDP growth rate (GDP), the inflation rate (IFL) and the interest rates (INT) to capture the impact of macroeconomic conditions on financial stability, as well as the level of financial development (PRICE) measured as the ratio of private sector credit to GDP, and a dummy to proxy for a bank crisis (CRISIS). Based on the deposit insurance database from Demirgüç-Kunt et al. (2014), a dummy variable is constructed to indicate the existence of an explicit deposit insurance scheme in a country (INS). In theory, deposit insurance promotes financial intermediation and reduces the spill-over effects of bank runs by providing a safety net for depositors. However, empirical work by Laeven and Levine (2009) shows that the existence of deposit insurance coverage schemes reduces market discipline and encourages banks to take excessive risks (moral hazard). Finally, the model includes measures of bank regulation and supervision as other important determinants of bank risk (Laeven and Levine, 2009; Agoraki et al., 2011; and Beck et al., 2013). Three categories of bank regulation and supervision variables from Barth et al. (2013a) are included to proxy for (i) the restrictions on bank activities (ACT), (ii) the power of supervisory authorities to intervene in banks' structure and operation (SUP), and (iii) the extent to

which banks are exposed to private monitoring and public supervision (PRIMON).[35] The definitions and construction details for all variables are provided in Table 3.1.

Table 3.1: Definition and specification of variables

Variables	Definition	Sources
Dependent variable		
LN(zscore)	Default risk = Natural logarithm of bank Z-score. Z-score = [ROA+ (Equity/total assets)]/ [Std. (ROA)]. The Std. (ROA) is calculated over a three-year rolling window.	Bankscope and author's calculation
Bank-level variables		
SIZE	Natural logarithm of total assets	Bankscope and author's calculation
CAP	Equity ratio = total equity/ total assets (%)	Bankscope and author's calculation
INC_DIV	Income diversification = (non-interest income/ total income) (%)	Bankscope and author's calculation
COST	Overhead cost = Total non-interest operating expenses/total assets (%)	Bankscope and author's calculation
CHARTER	Charter value = customer demand deposits/ total assets (%)	Bankscope and author's calculation
CRERISK	Credit risk = Non-performing Loans / Gross loans (%)	Bankscope and author's calculation
ROA	Bank profitability= return on assets (%)	Bankscope
ROA_VOL	Profitability volatility= Standard deviation of ROA calculated over a three-year rolling window.	Bankscope and author's calculation
CON	Market concentration = Top 3 largest banks assets/ total banks assets (%)	Bankscope and author's calculation
ODUM	Foreign ownership equals 1, otherwise	Claessens and Van Horen (2015)

[35] A fourth category to proxy for the stringency of capital adequacy that is often referred to in the literature is capital regulation. This measure is not included in this study due to the relevant data being unavailable for most of the sampled countries. The variables' construction follows Beck et al. (2006) and Houston et al. (2012). There are four rounds of the World Bank survey for regulation and supervision published in 1999, 2002, 2006, and 2011. The 1999 survey is used for the period 1999–2001; the 2002 survey is used for 2002–2005; the 2006 survey is used for 2006–2010; and the 2011 survey is used for 2011–2014.

Financial integration variables		
CLAIM	Foreign claims extended by international banks/ GDP (%)	BIS CBS-IC
LN(claim)	Natural logarithm of foreign claims extended by international banks	BIS CBS-IC
ASIAN	Foreign claims extended by Asian international banks/ GDP (%)	BIS CBS-IC
NON_ASIAN	Foreign claims extended by non-Asian international banks/ GDP (%)	BIS CBS-IC
LN(asian)	Natural logarithm of foreign claims extended by Asian international banks	BIS CBS-IC
LN(non_asian)	Natural logarithm of foreign claims extended by non-Asian international banks	BIS CBS-IC
CROSS	Foreign claims extended across border by international banks/GDP (%)	BIS CBS-UR
LOCAL	Foreign claims extended via local affiliates of international banks/GDP (%)	BIS CBS-UR
LN(cross)	Natural logarithm of foreign claims extended across border by international banks	BIS CBS-UR
LN(local)	Natural logarithm of Foreign claims extended via local affiliates of international banks	BIS CBS-UR
Country-level control variables		
IFL	Inflation rate = Annual % change of average consumer price index (%)	Global Financial Development (GFD)
GDP	GDP growth rate = Annual % change of GDP (%)	GFD
PRICRE	Private credit to GDP = Bank credit to private sector/ GDP (%)	GFD
INT	Real interest rate (%)	World Development Indicator (WDI)
CRISIS	Dummy variable that takes a value of 1 for the year of the financial crisis	Laeven and Valencia (2012)
INS	Dummy variable to proxy for the deposit insurance coverage of a country. INS equals 1 when the country has explicit deposit insurance and other wise	Demirgüç-Kunt et al. (2014)
ACT	Overall restrictions on banking activities index measures the degree to which banks are allowed to engage in securities, insurance, real estate investment, and ownership of non-financial firms. Higher value indicates more restrictiveness.	Barth et al. (2013a)
SUP	Supervisory power index measures whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. Higher value denotes that supervisory agencies are authorised more oversight power.	Barth et al. (2013a)

PRIMON	Private monitoring index measures the degree of private monitoring which requires banks to release accurate and comprehensive information to the public. Higher value indicates greater regulatory empowerment of the monitoring of banks by private investors.	Barth et al. (2013a)

3.3.4 Bank Sample

The study examines an unbalanced sample of 2,280 commercial bank-year observations (or 393 banks) from eight countries in East Asia (China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, Singapore, and Thailand) over the period 1999–2014. Bank-level data are obtained from Bankscope. Banks with less than three consecutive years of available financial data for all bank-specific variables are excluded. All M&As and bank failures during the sample period are accounted for in the dataset so that both active and inactive banks are included to avoid survivorship bias.[36] The data are drawn from unconsolidated statements to reduce aggregation bias in the results (consolidated data are used if unconsolidated statements are unavailable). All bank-level data are winsorized at the top and bottom 0.5^{th} percentile.

3.4 DESCRIPTIVE ANALYSIS

Table 3.2 reports the descriptive statistics of all variables included in the regression. The LN(zscore) of the sampled commercial banks has a mean value of 3.648 and a standard deviation of 1.226. The wide range of LN(zscore) (ranging from -2.37 to 7.89) highlights the substantial variation on the level of default risk across banks in the sampled period.

With regard to the financial integration variables, the ratio of total foreign claims to GDP (CLAIM) has a mean value of 28.1% and a standard deviation of 38.2%. The

[36] Additionally, 10 negative observations of Z-score are dropped so that the natural logarithm of the variable is defined. Active banks make up 91.49% of the sample; 8.17% of banks in the sample are dissolved; 0.04% of banks are in bankruptcy; and 0.21% of sampled banks are in liquidation.

wide range of CLAIM partly reflects the different levels of financial integration among the sampled countries, as previously described in Section 2.4.

Table 3.2: Descriptive Statistics

	Mean	Std.	Min	Max	N
LN(zscore)	3.648	1.226	-2.377	7.895	2,280
CAP (%)	10.275	7.264	1.520	81.300	2,280
ROA (%)	1.118	1.134	-8.970	8.840	2,280
ROA_VOL	0.611	1.592	0.012	17.423	2,280
CRERISK(%)	5.400	9.233	0.010	70.780	2,280
INC_IV (%)	14.122	11.064	0.100	85.057	2,280
COST (%)	1.942	1.600	0.050	23.423	2,280
CHARTER (%)	33.983	26.322	0.153	100.000	2,280
CON (%)	44.734	10.018	29.789	94.407	2,280
IFL (%)	4.145	3.209	-3.953	20.489	2,280
GDP (%)	12.934	10.453	-13.044	47.368	2,280
PRICRE (%)	91.607	46.601	19.909	233.663	2,280
INS	0.514	0.500	0.000	1.000	2,280
INT (%)	3.068	3.521	-3.903	13.347	2,280
ACT	8.627	2.409	3.000	12.000	2,141
SUP	12.304	2.584	7.000	16.000	1,161
PRIMON	9.427	1.070	7.000	11.000	1,846
CLAIM (%) (*)	28.136	38.240	3.357	290.071	2,280
LN(claim)	11.854	1.137	9.937	14.074	2,280
ASIAN (%)	5.126	7.063	0.644	50.360	2,280
NON_ASIAN (%)	16.230	26.975	1.718	189.181	2,280
LN(asian)	10.111	1.095	8.021	12.217	2,280
LN(non_asian)	11.165	1.055	9.452	13.219	2,280
LOCAL (%)	14.388	27.132	1.446	186.572	1,710
CROSS (%)	8.035	7.915	1.761	50.262	1,710
LN(local)	11.201	1.039	8.842	13.206	1,710
LN(cross)	11.192	1.104	9.187	13.135	1,710

The table reports descriptive statistics for the variables used in the empirical analysis. There are 2,280 bank-year observations (about 393 banks) for eight sampled countries (including China, Hong Kong, Indonesia, Malaysia, Philippines, Korea, Singapore, and Thailand) during 1999–2014. For the definition and construction of the variables, see Table 3.1. Mean refers to the average value for each variable. Std. refers to standard deviation. Min and Max are the minimum and maximum observations for each variable in the sample. N refers to the number of observations.

(*): ASIAN and NON_ASIAN (similarly LOCAL and CROSS) do not add up to CLAIM. The deviation originates from the types of reporting banks from which the underlying statistics are aggregated. Specifically, in the case of CLAIM, there are three type of banks reporting to BIS, including (i) domestic banks (controlled by parent entities with the same country code as the reporting country); (ii) banks located in the reporting country, but controlled by parents entities located in non-reporting countries; (iii) banks controlled by parent entities located in the reporting country but not consolidated by their parent. In the case of ASIAN, NON_ASIAN, LOCAL and CROSS, reporting banks are only domestic banks. For further details, refer to Appendix B1.

Table 3.2 shows that NON_ASIAN with its mean value of 16.2% is higher than the mean value of ASIAN (5.1%). This is consistent with the observation that foreign claims on the sampled countries mostly come from non-Asian international banks, as depicted in Figure 3.2. LOCAL's mean value of 14.3% is higher than CROSS's value of 8%. This is also consistent with the fact that local claims account for the major shares of total claims, as depicted in Figure 3.3.

Table 3.3 reports the Pearson pairwise correlations. The correlation between Z-score and financial integration is divergent across the measures. Z-score has a positive and significant correlation with both foreign claims extended by Asian lenders (ASIAN) and foreign claims extended via local affiliates (LOCAL). Further, the correlations in Table 3.3 also show that different measures of financial integration (i.e. CLAIM, ASIAN, NON_ASIAN, CROSS, LOCAL) are highly correlated. Due to their construction, each measure refers to a component of the total foreign claims. Notably, the bank regulation and supervision variables (i.e. ACT, SUP, PRIMON) have a negative and significant correlation with each of the financial integration measures. This is consistent with the findings of Houston et al. (2012) that international banks tend to transfer a large proportion of funds to countries with fewer regulations (see Section 3.2). Overall, the bank-level variables and macroeconomic variables are found not to be highly correlated with each other, implying that the joint inclusion of these variables is unlikely to lead to concerns about multi-collinearity (confirmed by the low VIF statistics of all models run, reported in Table 3.4 below).

Table 3.3: The pairwise correlation among variables

	Z-score	CAP	CRERISK	INC_DIV	COST	CHARTER	CON	IFL	GDP	PRICRE	INT	CLAIM	ASIAN	NON_ASIAN	CROSS	LOCAL	ACT	SUP	PRIMON
Z-score	1.00																		
CAP	0.12**	1.00																	
CRERISK	-0.03	0.17**	1.00																
INC_DIV	0.01	0.22**	0.13**	1.00															
COST	-0.04**	0.19**	0.23**	0.11**	1.00														
CHARTER	0.00	-0.09**	-0.01	0.00	-0.25**	1.00													
CON	-0.01	0.01	0.06**	0.12**	-0.04**	0.30**	1.00												
IFL	-0.04**	0.12**	0.09**	-0.08**	0.32**	-0.15**	0.09**	1.00											
GDP	-0.04**	-0.10**	0.00	-0.14**	-0.04**	0.18**	0.02	0.28**	1.00										
PRICRE	0.06**	-0.22**	-0.25**	-0.10**	-0.54**	0.23**	-0.08**	-0.61	-0.10**	1.00									
INT	0.00	0.08**	0.14**	0.07**	0.15**	-0.14**	0.14**	0.04**	-0.43**	-0.16**	1.00								
CLAIM	0.02	0.10**	0.02	0.31**	-0.08**	-0.02	0.50**	-0.17**	-0.24**	0.25**	0.15**	1.00							
ASIAN	0.05**	0.15**	0.03	0.30**	-0.04	-0.04	0.62**	-0.11**	-0.26**	0.19**	0.18**	0.91**	1.00						
NON_ASIAN	0.00	0.08**	0.02	0.29**	-0.08**	0.01	0.51**	-0.15**	-0.21**	0.24**	0.16**	0.99**	0.89**	1.00					
CROSS	0.05	0.09**	-0.03	0.40**	-0.02	-0.11**	0.62**	-0.15**	-0.27**	0.18**	0.19**	0.96**	0.87**	0.95**	1.00				
LOCAL	0.03**	0.08**	-0.07**	0.33**	-0.09**	-0.11**	0.58**	-0.18**	-0.23**	0.31**	0.12**	0.99**	0.89**	0.98**	0.94**	1.00			
ACT	-0.06**	-0.17**	-0.16**	-0.41**	-0.22**	0.28**	-0.09**	0.17**	0.45**	0.14**	-0.40**	-0.55**	-0.49**	-0.52**	-0.64**	-0.56**	1.00		
SUP	-0.03**	0.17**	-0.07**	0.02	0.08**	-0.06**	-0.02	0.29**	0.29**	-0.30**	-0.26**	-0.05	-0.02	-0.07**	-0.19**	-0.15**	0.51**	1.0	
PRIMON	-0.07**	-0.18**	-0.25**	-0.24**	-0.26**	0.23**	-0.11**	-0.15**	0.16**	0.28**	-0.14**	-0.26**	-0.30**	-0.24**	-0.35**	-0.31**	0.36**	0.04	1.0

The table reports the Pearson rank correlation coefficients among variables. ** indicates statistical significance at the 5% level.

3.5 EMPIRICAL ANALYSIS

Section 3.5.1 first establishes the baseline result on the impact of financial integration on bank default risk and thus addresses H1 (see Section 3.2). The two following sections explore the variation of this impact that can be attributed to the source country (Asian claims versus non-Asian claims, as articulated in H2) and the methods of extension (cross-border claims versus local claims, as per H3). Finally, Section 3.5.4 presents some robustness tests.

3.5.1 The Impact of Financial Integration on Bank Default Risk

3.5.1.1 Validity of the system GMM estimators

Table 3.4 reports the system GMM estimates of Equation 3.2 to test H1. Several pre- and post-estimation tests are also reported at the end of this table.[37] With regard to pre-diagnostic tests, the DWH test for endogeneity confirms the endogenous relationship between bank-level covariates (including CAP, CRERISK, INC_DIV, COST, CHARTER, and CON) and the dependent variable.[38] Additionally, the VIFs value implies that the models are free from a multi-collinearity problem.

With regard to post-estimation tests, the AR(2) test is statistically insignificant, confirming the absence of the second-order serial correlation. As reported in Section 3.3.1, the one-year lag (i.e. L.LN(zscore)) is long enough to capture the persistency in

[37] With regard to the (unreported) unit root test, the null of non-stationary is rejected at the 1% level for all variables used in the regression and is rejected at the 5% level for financial integration variables in natural logarithm form (i.e. LN(Asian), LN(non-Asian) and LN(local) and LN(cross)). SIZE is dropped from the baseline regression due to its unit root. Nevertheless, the inclusion of SIZE in the regression does not change the result; the result is available upon request.

[38] The DWH test is conducted at the level equation and under the null hypothesis that the endogenous regressors may be actually treated as exogenous variables. The one-year lagged differences of the dependent variable and the suspicious regressors are used as instrumental variables.
As CAP is a component to compute bank default risk, the inclusion of CAP in the model could lead to the concern of endogeneity. Appendix B5 presents findings when CAP is excluded from the model. The results remain similar to the baseline's one.

bank default risk. Taking these results together, the second and further lags of the dependent variable are valid instruments for the GMM.

The high p-values of the Hansen J-statistics and the difference-in-Hansen tests suggest that the full set of instruments as well as each sub-set of instruments (i.e. for the level equation, the lagged dependent variable, the endogenous, pre-determined, and exogenous explanatory variables) are valid. As the two tests may be weakened by the proliferation of instruments (Roodman, 2009), the rule of thumb that the number of instruments is less than the number of groups (banks) is also maintained. This is obtained by restricting the number of lags in the instrument specification up to the second and third lags (for a detailed list of instruments, please refer to the note of Table 3.4).

The dynamic specification in the model is not rejected, given the significant effect of the lagged dependent variable across each of the models. The lagged dependent variable has its coefficient of 0.423 for model (1) and 0.425 for model (2). These coefficients from the GMM estimate are in between the range calculated by FE (0.26) and OLS methods (0.51) (both not reported). This additionally ensures the efficiency of the system GMM estimates (Roodman, 2006).

It is noteworthy that the number of observations used in the system GMM (836 observations) is substantially lower than the original bank-year observations (2,280 observations, as reported in Section 3.3.4). This is mostly due to the simultaneous inclusion of three regulation variables (i.e. ACT, SUP, PRIMON), which are not available for all observations. As a robustness check, two models, in which SUP (i.e. the variable with the lowest available observations) and both three variables are dropped from the regression, respectively, are reported in Appendix B4. The system GMM specification as well as the impact of financial integration on bank default risk remain similar to the ones reported in Table 3.4. However, the coefficient of the lagged

dependent variable is 0.53, which falls out of the (unreported) possible range between the FE and OLS estimates. This would be a sign of model misspecification, which is justifiable, as bank regulation and supervision have been found to be among the most important determinants of bank default risk (as in Laeven and Levine, 2009; Agoraki et al., 2011). Therefore, the chapter proceeds with the regression with the inclusion of all three regulation variables, as reported in Table 3.4.

Table 3.4: The impact of financial integration on bank distance to default

	(1)	(2)
L.LN(zscore)	0.423***	0.425***
	(0.04)	(0.04)
CLAIM	0.046*	
	(0.02)	
LN(claim)		1.924***
		(0.66)
CAP	0.063***	0.060***
	(0.02)	(0.02)
CRERISK	-0.004	-0.004
	(0.01)	(0.01)
INC_DIV	-0.024**	-0.021*
	(0.01)	(0.01)
COST	-0.112	-0.087
	(0.09)	(0.10)
CHARTER	0.001	-0.002
	(0.01)	(0.01)
CON	0.075**	0.052*
	(0.03)	(0.03)
IFL	-0.034	-0.029
	(0.03)	(0.03)
GDP	-0.037**	-0.041**
	(0.02)	(0.02)
PRICRE	-0.044**	-0.028**
	(0.02)	(0.01)
INS	-0.933*	-0.514
	(0.52)	(0.44)
INT	-0.049*	-0.061**
	(0.03)	(0.03)
ACT	0.163	0.291**
	(0.10)	(0.13)
SUP	0.219**	0.115
	(0.11)	(0.10)
PRIMON	0.639**	0.337*
	(0.26)	(0.18)
ODUM	0.015	0.020

	(0.10)	(0.11)
CRISIS	-1.389**	-1.741**
	(0.70)	(0.70)
Constant	-6.383*	-25.450***
	(3.58)	(8.78)
#Obs.	836	836
# Banks	202	202
# IV	100	100
AR(2) test (p value)	0.342	0.288
Hansen-J test (p value)	0.602	0.476
Diff-In-Hansen test (p value):		
GMM instruments for level equation	0.698	0.417
GMM instruments for the lagged dependent variable	0.696	0.619
GMM instruments for endogenous variables	0.486	0.186
GMM instruments for predetermined variables	0.275	0.192
IV instruments for exogenous variables	0.579	0.287
Mean (maximum) VIF	3.65 (6.63)	3.86 (6.72)
DWH test for endogeneity (p-value)	0.00	0.00

The table reports the impact of financial integration on bank default risk from Equation 3.2:

$$RISK_{ijt} = \beta_0 RISK_{ijt-1} + \boldsymbol{\beta_1 INTEG_{jt}} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt}$$

The dependent variable is the natural logarithm of Z-score to proxy for bank default risk. Financial integration is proxied via the ratio of foreign claims to GDP (CLAIM) or the natural logarithm of foreign claims (LN(claim)). For the definition and construction of other control variables, see Table 3.1. Bank FE, country and time dummies are included, but not reported to save space.

All models are estimated by the system GMM. For the dependent variable and endogenous bank-level control variables, their second and third lagged values are used as instruments in the transformed equation; the first lag of their differenced values are used as instruments in the level equation. For the predetermined variables (including financial integration and regulation variables), their first and second lagged values are used as instruments in the transformed equation; their differenced values are used as instruments in the level equation. For exogenous variables (including other country-level control variables, time and country dummies), their differenced values are used as instruments in the transformed equation; their level values are used as instruments in the level equation. The system GMM is run by the *xtabond2* Stata syntax written by Roodman (2006). *Collapse* option is used in specifying instruments for the endogenous and predetermined variables. As there are gaps in the sample panel, the forward orthogonal deviations transform (*orthogonal* option) is used instead of first differencing to maximise the sample size. *Twostep* along with the *robust* option are used to obtain the finite sample corrected two-step covariance matrix following Windmeijer (2005) correction. *Small* option is to adjust the estimates for small-sample and report t-statistics instead of z-statistics.

Insignificant value of AR(2) tests confirm the absence of the serial correlation in the second order. Similarly, insignificant value of Hansen J-statistics test and Difference-in-Hansen test ensures the validity of the instruments. The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3.5.1.2 The impact of financial integration on bank default risk

Table 3.4 shows that the coefficients of financial integration (measured by CLAIM and LN(claim), respectively, in models 1 and 2) are positive and significant. This implies that financial integration is associated with the increase in bank Z-score (or reduction in bank default risk) and is consistent with H1. With regard to the economic

impact, take Column 1 as an example, a 1-percentage-point increase in CLAIM is associated with an approximately 4.6% (0.046*100) increase in ZSCORE.[39] Overall, the evidence points to the benefit of financial integration in lowering individual bank default risk for the recipient countries. This result is consistent with the monitoring channel of international banks, which is found to drive the association between heightened cross-border banking flows and lower systemic risks (Karolyi et al., 2018). Further, the finding also supports the competition channel, which predicts that foreign banking claims would engender healthy competition among different providers of funds, thus leading to lower risk-taking behaviour (Agénor, 2001; Faia and Ottaviano, 2017). Overall, the results strongly support H1.

Not reported bank and year fixed effects capture a significant fraction of the overall explanatory power of Z-score. The only bank-level variables that have a significant impact on Z-score are equity capital ratio (CAP) and income diversification (INC_DIV). Banks with a lower level of equity capital to buffer against return volatility have higher risk of default. Similarly, due to the greater reliance on non-interest income, banks are exposed to more volatile activities or expand to risky non-traditional activities, reducing bank stability. The finding is congruent with the work by Demirgüç-Kunt and Huizinga (2010).

At the country level, the positive coefficient of CON implies that market concentration helps to lower bank default risk, which is in line with the 'competition-fragility' hypothesis postulated by Beck et al. (2006) (see Section 3.3.3.3). The negative

[39] As the sampled countries are different in their levels of financial integration, the interpretation is more meaningful in the context of specific countries. For instance, take China as an example, where a one-standard-deviation increase in CLAIM (from its mean level of 7% to 10%) is translated into an increase of 13% in Z-score. In the case of Singapore, a one-standard-deviation increase in CLAIM (from its mean level of 144% to 154%) is associated with a 52% increase in Z-score.

and significant coefficient on financial development (PRICRE) suggests that banks take more risks in more financially developed countries. It is easier for firms to switch from bank-based to market-based funding in more financially developed markets (Beck et al., 2013). Competitive pressure from stock market developments push banks to take more risks. Similarly, the negative and significant coefficient of economic growth (GDP) implies that banks take more risks in the period of economic expansion. Banks could relax their lending standards to satisfy the growing credit demand from the economy, likely leading to higher bank default risk (Dell'Ariccia and Marquez, 2006). The negative association between the interest rate (INT) and bank distance to default found for the sampled East Asian countries remains a puzzle. The result is not in line with the 'search for yield' motive, which predicts that the low (lending) interest rate induces banks to recklessly expand credit to generate more income (Rajan, 2006). All three categories of bank regulation and supervision are significantly and positively related to ZSCORE. Consistent with Agoraki et al. (2011) and Noman et al. (2018), banks in countries with stricter restrictions on bank activities (ACT), stronger private monitoring (PRIMON), and greater authority power (SUP) are characterized by a lower default risk profile. Finally, the negative bank crisis coefficient indicates that bank default risk is greater during periods of financial crisis.

The next two sections explore H2 and H3 to see if the above results are driven by 'neighbours' banks with information advantages, where the chapter takes two alternative definitions of 'neighbours' (see Section 3.1), namely regional banks or international banks with affiliate offices.

3.5.2 The Impact of Asian Claims and Non-Asian Claims on Bank Default Risk

Table 3.5 reports the impact of Asian claims (ASIAN) and non-Asian claims (NON_ASIAN). According to H2, foreign claims extended by Asian lenders should

significantly lower bank default risk in recipient countries. Based on the results reported in Columns 1 and 3 of Table 3.5, the significant and positive ASIAN and LN(Asian) coefficients provide evidence to support this hypothesis. In fact, the magnitude of the ASIAN coefficient is much larger than the CLAIM coefficient reported in Table 3.4. Given a 1-percentage-point increase in ASIAN, the coefficient in Column 1 of Table 3.5 predicts a 7.1% (0.071*100) increase in Z-score for the recipient country.

Consistent with H2, only the Asian claims contribute to the higher stability of banks in the recipient countries, as evidenced by the non-significant coefficients of NON_ASIAN and LN(non_asian) in Columns 2 and 4. The result supports the argument that the Asian claims are linked to lower information asymmetry, as regional banks possess information advantages, facilitating closer recipient country bank monitoring (Mian, 2006; Claessens and Van Horen, 2014b). Acharya and Naqvi (2012) posit that the influx of foreign capital creates excess liquidity in the recipient banking system, which induces bank risk-taking behaviour. However, this is not the case for the East Asian sampled countries. As seen in Figure 3.2, the level of Asian claims increases gradually over time. In other words, regional claim receipts do not lead to an excessive and sudden liquidity in the recipient countries' banking systems.

The impacts of other control variables are similar to the baseline result reported in Table 3.4, though some variables lose their explanatory power.

Table 3.5: The impact of Asian claims and non-Asian claims on bank distance to default

	(1)	(2)	(3)	(4)
L.LN(zscore)	0.460***	0.434***	0.439***	0.429***
	(0.04)	(0.04)	(0.04)	(0.05)
ASIAN	0.071**			
	(0.03)			
NON_ASIAN		0.013		
		(0.03)		
LN(asian)			0.824**	
			(0.38)	
LN(non_asian)				0.618
				(0.40)
CAP	0.052**	0.056***	0.053***	0.049**
	(0.02)	(0.02)	(0.02)	(0.02)
CRERISK	-0.005	-0.006	-0.006	-0.007
	(0.01)	(0.01)	(0.01)	(0.01)
INC_DIV	-0.014	-0.021**	-0.014	-0.025**
	(0.01)	(0.01)	(0.01)	(0.01)
COST	-0.089	-0.123	-0.086	-0.119
	(0.10)	(0.08)	(0.10)	(0.09)
CHARTER	-0.004	0.002	-0.004	0.002
	(0.01)	(0.01)	(0.01)	(0.01)
CON	0.016	0.047	0.032	0.061*
	(0.03)	(0.04)	(0.02)	(0.03)
IFL	-0.050	-0.041	-0.063*	-0.036
	(0.03)	(0.03)	(0.03)	(0.03)
GDP	-0.033**	-0.025	-0.028**	-0.028*
	(0.02)	(0.02)	(0.01)	(0.02)
PRICRE	-0.019	-0.017	-0.010	-0.018
	(0.01)	(0.02)	(0.01)	(0.01)
INS	-0.445	-0.580	-0.312	-0.324
	(0.45)	(0.50)	(0.44)	(0.45)
INT	-0.037	-0.034	-0.039	-0.041
	(0.02)	(0.03)	(0.02)	(0.03)
ACT	0.077	0.064	0.142	0.168*
	(0.06)	(0.08)	(0.09)	(0.09)
SUP	0.082	0.147	0.097	0.162
	(0.10)	(0.12)	(0.10)	(0.11)
PRIMON	0.212	0.378	0.202	0.373*
	(0.18)	(0.27)	(0.16)	(0.22)
ODUM	0.040	0.014	0.004	0.028
	(0.10)	(0.10)	(0.09)	(0.10)
CRISIS	-0.211	-0.631	-0.848	-1.480*
	(0.48)	(0.81)	(0.53)	(0.87)
Constant	0.246	-3.777	-10.069**	-16.984**
	(3.02)	(4.17)	(4.70)	(8.33)
#Obs.	836	836	836	836
# Banks	202	202	202	202

# IV	100	100	100	100
AR(2) test (p value)	0.308	0.397	0.347	0.381
Hansen-J test (p value)	0.643	0.655	0.665	0.37
Diff-In-Hansen test (p value):				
GMM instruments for level equation	0.492	0.761	0.697	0.276
GMM instruments for the lagged dependent var.	0.887	0.795	0.815	0.728
GMM instruments for endogenous var.	0.281	0.716	0.252	0.595
GMM instruments for predetermined var.	0.572	0.339	0.483	0.171
IV instruments for exogenous var.	0.330	0.665	0.375	0.201

The table reports the impact of different forms of financial integration on bank default risk. The total foreign claims are classified by lenders' nationality. In Columns 1 and 2, ASIAN and NON_ASIAN are the foreign claims extended by international banks whose nationality are Asian and non-Asian, respectively; these statistics are then scaled by GDP of the sampled countries. As a robust check, the natural logarithm of these statistics (i.e. (LN(asian) and LN(non_asian)) are constructed and presented in Columns 3 and 4. The dependent variable is the natural logarithm of Z-score to proxy for bank default risk. Other control variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3.5.3 The Impact of Local Claims and Cross-border Claims on Bank Default Risk

Table 3.6 reports the significant and positive coefficients of local claims regardless of its measures (i.e. LOCAL in Column 1 or LN(local) in Column 3, though in the latter case it is only marginally significant). The coefficients for cross-border claims are insignificant in both models reported in Columns 2 and 4. The result indicates that local claims extended via foreign affiliates rather than across borders help to lower recipient country bank default risk. In fact, the magnitude of the LOCAL coefficient is much larger than the CLAIM coefficient reported in Table 3.4. Given a 1-percentage-point increase in LOCAL, the coefficient in Column 1 predicts a 10.1% (0.101*100) increase in the Z-score for the recipient country. Overall, this finding strongly supports H3 and confirms the link between lower information asymmetry and local affiliates–based lending.

As seen in Figure 3.3, foreign affiliates based in the sampled countries account for a significant share of the total foreign claims. These foreign affiliates are funded primarily by local deposits (Cerutti, 2015). In addition, many economies in the East Asian

region have run persistent current account surpluses over the years (Didier et al., 2017). Taken together, the foreign capital sourced within the East Asian region is more stable, as the claims are originally sourced from domestic deposits and from countries with persistent capital account surpluses. These facts provide further evidence in favour of the positive association between local claims and bank stability.

Table 3.6: The impact of local claims and cross-border claims on bank distance to default

	(1)	(2)	(3)	(4)
L.LN(zscore)	0.464***	0.455***	0.445***	0.451***
	(0.06)	(0.06)	(0.06)	(0.06)
LOCAL	0.101**			
	(0.04)			
CROSS		0.046		
		(0.05)		
LN(local)			1.438*	
			(0.78)	
LN(cross)				0.213
				(0.54)
CAP	0.036*	0.033	0.039*	0.028
	(0.02)	(0.02)	(0.02)	(0.02)
CRERISK	0.009	0.007	0.008	0.006
	(0.02)	(0.02)	(0.02)	(0.02)
INC_DIV	-0.018*	-0.014	-0.015	-0.011
	(0.01)	(0.01)	(0.01)	(0.01)
COST	-0.132	-0.105	-0.111	-0.108
	(0.10)	(0.09)	(0.09)	(0.10)
CHARTER	-0.005	-0.006	-0.006	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)
CON	0.035	0.059	0.027	0.034
	(0.03)	(0.05)	(0.03)	(0.04)
IFL	0.005	-0.028	0.012	-0.041
	(0.04)	(0.04)	(0.04)	(0.04)
GDP	-0.042**	-0.031*	-0.039*	-0.024
	(0.02)	(0.02)	(0.02)	(0.02)
PRICRE	-0.052***	-0.036*	-0.025	-0.023
	(0.02)	(0.02)	(0.02)	(0.02)
INS	-0.499*	0.388	0.233	-0.496**
	(0.27)	(0.25)	(0.26)	(0.24)
INT	-0.041	-0.027	-0.033	-0.015
	(0.04)	(0.04)	(0.05)	(0.05)
ACT	-0.071	0.032	0.176	0.137
	(0.12)	(0.14)	(0.16)	(0.15)
SUP	0.360	0.322	0.318	0.337

	(0.25)	(0.25)	(0.33)	(0.30)
PRIMON	0.807	0.762	0.911	0.907
	(0.70)	(0.74)	(0.94)	(0.88)
ODUM	0.137	0.142	0.113	0.143
	(0.12)	(0.13)	(0.12)	(0.13)
Constant	-15.697*	-4.613	-22.26**	-7.781
	(8.53)	(6.40)	(10.91)	(8.64)
#Obs.	615	615	615	615
# Banks	156	156	156	156
# IV	80	80	80	80
AR(2) test (p value)	0.103	0.150	0.186	0.239
Hansen-J test (p value)	0.509	0.415	0.420	0.289
Diff-In-Hansen test (p value)				
GMM instruments for level equation	0.716	0.847	0.724	0.804
GMM instruments for the lagged dependent var.	0.583	0.523	0.387	0.575
GMM instruments for endogenous bank-level var.	0.228	0.492	0.130	0.159
GMM instruments for predetermined var.	0.884	0.536	0.829	0.357
IV instruments for exogenous var.	0.886	0.550	0.860	0.474

The table reports the impact of different forms of financial integration on bank default risk. The total foreign claims are classified by the methods of extension. In Columns 1 and 2, LOCAL and CROSS are the foreign claims extended by international banks via their foreign affiliates or across borders; these statistics are then scaled by GDP of the sampled countries. As a robust check, the natural logarithm of these statistics (i.e. (LN(local) and LN(cross)) are constructed and presented in Columns 3 and 4. The examination period is 2005–2014 due to the availability data. The dependent variable is the natural logarithm of Z-score to proxy for bank default risk. Other control variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

In short, the findings in Sections 3.5.2 and 3.5.3 complement and further elucidate the findings in Section 3.5.1. They show that the positive association between financial integration (measured via the total foreign claims) and Z-score is driven by claims extended by Asian banks and local claims, as distinct from non-Asian claims and cross-border claims, respectively. The policy implication of these results is discussed in Section 3.6. Prior to this, the robustness of the above results is further explored with alternative specifications of the models.

3.5.4 Robustness Tests

Several robustness tests are conducted. First, an alternative measure of bank risk, namely volatility in bank profit as measured by the standard deviation of ROA over the three-year window (ROA_VOL) is employed.[40] The result is reported in Table 3.7. As seen in Column 1, financial integration (CLAIM) helps to lower bank profit volatility (ROA_VOL). Consistent with the earlier findings, the effect is present when claims are extended by Asian lenders (ASIAN) or via local affiliates (LOCAL). This result reinforces the findings in Sections 3.5.2 and 3.5.3. Additionally, Table 3.7 also reports a positive association between higher rates of inflation, economic growth rates, and greater financial development and profit volatility (ROA_VOL). Bank regulation and supervision help to reduce profit volatility via effective private monitoring and supervisory power exercised by local authorities.

Table 3.7: The impact of financial integration on bank profit volatility

	(1)	(2)	(3)	(4)	(5)
L.ROA_VOL	0.391***	0.399***	0.397***	0.429***	0.431***
	(0.12)	(0.12)	(0.12)	(0.06)	(0.06)
CLAIM	-0.023**				
	(0.01)				
ASIAN		-0.031**			
		(0.01)			
NON_ASIAN			-0.020		
			(0.01)		
LOCAL				-0.026*	
				(0.02)	
CROSS					-0.000
					(0.01)
CAP	-0.007	-0.005	-0.006	0.001	0.003
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
CRERISK	-0.004	-0.002	-0.003	-0.020	-0.015
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
INC_DIV	0.012	0.010	0.012	0.001	-0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
COST	-0.035	-0.025	-0.028	0.014	0.011
	(0.05)	(0.04)	(0.05)	(0.03)	(0.03)

[40] The result is also unchanged when the measure is the natural logarithm of ROA_VOL. The result is provided in Appendix B6.

CHARTER	-0.003	-0.003	-0.002	0.000	0.002
	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
CON	-0.026*	-0.005	-0.022	0.006	0.006
	(0.02)	(0.01)	(0.02)	(0.01)	(0.01)
IFL	0.063**	0.054*	0.060*	-0.011	0.003
	(0.03)	(0.03)	(0.03)	(0.02)	(0.01)
GDP	0.031***	0.023**	0.026***	0.011**	0.007
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
PRICRE	0.029**	0.016**	0.020**	0.018**	0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
INS	0.390	0.190	0.255	-0.038	-0.077
	(0.25)	(0.19)	(0.21)	(0.14)	(0.10)
INT	0.001	-0.004	-0.005	-0.005	-0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ACT	-0.079	-0.036	-0.053	-0.017	-0.023
	(0.05)	(0.04)	(0.05)	(0.04)	(0.03)
SUP	-0.141***	-0.081*	-0.129**	-0.235**	-0.167**
	(0.05)	(0.05)	(0.06)	(0.11)	(0.07)
PRIMON	-0.310**	-0.165*	-0.238*	-0.568**	-0.399**
	(0.12)	(0.09)	(0.12)	(0.28)	(0.20)
ODUM	-0.078	-0.068	-0.087	-0.062	-0.045
	(0.12)	(0.10)	(0.11)	(0.07)	(0.06)
CRISIS	0.622	0.134	0.516		
	(0.49)	(0.35)	(0.50)		
Constant	2.364*	0.520	2.248	7.647**	3.197*
	(1.34)	(1.24)	(1.65)	(3.86)	(1.71)
#Obs.	836	836	836	615	615
# Banks	202	202	202	156	156
# IV	100	100	100	80	80
AR(2) test (p value)	0.844	0.719	0.946	0.840	0.758
Hansen-J test (p value)	0.460	0.764	0.454	0.711	0.654
Diff-In-Hansen test for level equation (p value)	0.591	0.577	0.192	0.807	0.589

The table reports the impact of financial integration on bank profit volatility (ROA_VOL). Financial integration is measured by the ratio of total foreign claims to GDP (CLAIM); ASIAN and NON_ASIAN (the foreign claims extended by international banks whose nationality are Asian and non-Asian, respectively); LOCAL and CROSS (the foreign claims extended by international banks via their foreign affiliates or across borders). Other control variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Second, a sub-sample of the low-integration group of countries is utilised to ensure that the original analysis was not biased by the presence of financial centres (i.e. Hong Kong and Singapore). The low-financial-integration sub-sampling is reported in Table 3.8. Again, the results are fully consistent with the previous results and H1, H2, and H3. In fact, the impact of financial integration on bank default risk becomes stronger in this sub-sampling, as the magnitude of the CLAIM, ASIAN, and LOCAL coefficients

are higher than their baseline's. This implies that countries with a lower level of financial integration are benefiting more from the receipt of foreign banking claims. This further supports the evidence documented in Chapter 2 that financial integration is more beneficial (in terms of efficiency improvement) for the low-integration group of countries (see Section 2.5.3).

Table 3.8: Low-financial-integration countries sub-sampling

	(1)	(2)	(3)	(4)	(5)
L.LN(zscore)	0.421***	0.464***	0.433***	0.465***	0.463***
	(0.05)	(0.04)	(0.05)	(0.06)	(0.06)
CLAIM	0.065**				
	(0.03)				
ASIAN		0.073**			
		(0.03)			
NON_ASIAN			0.018		
			(0.05)		
LOCAL				0.132***	
				(0.04)	
CROSS					0.062
					(0.05)
CAP	0.060***	0.046**	0.056***	0.023	0.023
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
CRERISK	-0.006	-0.006	-0.009	0.000	0.003
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
INC_DIV	-0.023*	-0.012	-0.017	-0.014	-0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COST	-0.132	-0.107	-0.111	-0.077	-0.057
	(0.10)	(0.10)	(0.08)	(0.10)	(0.09)
CHARTER	0.003	0.002	0.000	0.001	-0.006
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CON	0.066*	0.022	0.024	0.021	0.081**
	(0.04)	(0.03)	(0.04)	(0.03)	(0.04)
IFL	-0.050	-0.054	-0.073**	0.025	-0.026
	(0.03)	(0.03)	(0.03)	(0.05)	(0.05)
GDP	-0.035**	-0.032*	-0.023	-0.038*	-0.040**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
PRICRE	-0.050**	-0.026	-0.017	-0.067***	-0.048*
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
INS	-0.662	-0.435	-0.301	0.712*	0.515
	(0.58)	(0.55)	(0.54)	(0.40)	(0.38)
INT	-0.055*	-0.055*	-0.043	-0.033	-0.051
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
ACT	0.221*	0.055	0.027		
	(0.13)	(0.09)	(0.13)		
SUP	0.171	0.077	0.105	0.482*	0.313

	(0.12)	(0.12)	(0.11)	(0.25)	(0.27)
PRIMON	0.623**	0.287	0.230	1.275**	0.756
	(0.28)	(0.21)	(0.26)	(0.64)	(0.70)
ODUM	-0.082	-0.076	-0.071	0.069	0.089
	(0.11)	(0.11)	(0.10)	(0.13)	(0.12)
CRISIS	-1.256*	-0.141	-0.044		
	(0.71)	(0.50)	(0.88)		
Constant	-5.482	-0.040	-0.480	-17.275*	-11.552
	(3.86)	(3.06)	(4.36)	(9.18)	(10.78)
#Obs.	796	796	796	575	575
# Banks	188	188	188	142	142
# IV	98	98	98	78	78
AR(2) test (p value)	0.398	0.432	0.466	0.116	0.155
Hansen-J test (p value)	0.438	0.444	0.364	0.314	0.199
Diff-In-Hansen test for level equation (p value)	0.396	0.502	0.638	0.288	0.487

This table reports the impact of financial integration on bank distance to default on the sample of countries with a low level of financial integration (i.e. the whole sample excludes Hong Kong and Singapore). Financial integration is measured by the ratio of total foreign claims to GDP (CLAIM); ASIAN and NON_ASIAN (the foreign claims extended by international banks whose nationality are Asian and non-Asian, respectively); LOCAL and CROSS (the foreign claims extended by international banks via their foreign affiliates or across borders). In Columns 4 and 5, ACT is dropped because of collinearity. Other variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Third, only domestic banks are sampled to ensure that the prior findings are not driven by the entry (or presence) of foreign banks in the recipient countries. The is a real concern, as foreign banks own better risk management, thus having a lower level of default risk (Wu et al., 2017). Their entry or presence would thus lower the overall risk of banks, but this does not necessarily mean that domestic bank risk management improves. To address this concern, regression on only domestic banks are run. The domestic sub-sampling is reported in Table 3.9. Overall, the main findings remain qualitatively unchanged from the baseline results. Financial integration measures, such as CLAIM, ASIAN, and LOCAL, are positively associated with bank distance to default. More interestingly, the coefficients of CLAIM and ASIAN are marginally significant while LOCAL is highly significant and large. The result further implies that the local claims induce the strongest response from the domestic banks. This is sensible since the

foreign affiliates of international banks established in host countries would directly compete with the domestic banks in the local markets for extending loans and raising deposits. Additionally, higher bank costs are associated with higher default risk in the domestic banks' sampling.

Table 3.9: Domestic banks sub-sampling

	(1)	(2)	(3)	(4)	(5)
L.LN(zscore)	0.426***	0.451***	0.424***	0.404***	0.416***
	(0.05)	(0.05)	(0.06)	(0.07)	(0.08)
CLAIM	0.041*				
	(0.02)				
ASIAN		0.062*			
		(0.04)			
NON_ASIAN			0.027		
			(0.04)		
LOCAL				0.150***	
				(0.05)	
CROSS					0.065
					(0.07)
CAP	0.049	0.042	0.046	0.013	0.016
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
CRERISK	-0.009	-0.006	-0.014	0.019	0.001
	(0.02)	(0.02)	(0.01)	(0.03)	(0.03)
INC_DIV	-0.022*	-0.020	-0.021	-0.019*	-0.011
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
COST	-0.183*	-0.161	-0.170*	-0.100	-0.061
	(0.10)	(0.11)	(0.10)	(0.08)	(0.10)
CHARTER	-0.000	-0.001	0.001	0.010	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CON	0.032	-0.006	0.024	-0.024	0.005
	(0.04)	(0.03)	(0.05)	(0.04)	(0.05)
IFL	-0.038	-0.036	-0.034	0.075	-0.002
	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)
GDP	-0.018	-0.015	-0.007	-0.024	-0.008
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
PRICRE	-0.031	-0.014	-0.011	-0.071***	-0.043*
	(0.02)	(0.01)	(0.02)	(0.03)	(0.03)
INS	-0.717	-0.310	-0.405	0.014	0.002
	(0.81)	(0.76)	(0.85)	(0.40)	(0.46)
INT	-0.005	0.004	0.010	0.040	0.044
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
ACT	0.148*	-0.016	-0.024	-0.142	0.011
	(0.08)	(0.07)	(0.09)	(0.21)	(0.28)
SUP	0.228	0.250***	0.187	0.601**	0.210**
	(0.14)	(0.09)	(0.16)	(0.27)	(0.10)
PRIMON	0.341	0.059	0.206	1.079	0.912

	(0.31)	(0.24)	(0.35)	(0.80)	(0.97)
CRISIS	-0.752	0.198	-0.463		
	(0.87)	(0.79)	(1.11)		
Constant	-2.032	2.411	-1.400	-22.050**	-4.819
	(3.62)	(3.57)	(4.74)	(8.63)	(8.34)
#Obs.	521	521	521	366	366
# Banks	142	142	142	99	99
# IV	99	99	99	79	79
AR(2) test (p value)	0.799	0.854	0.818	0.263	0.194
Hansen-J test (p value)	0.852	0.891	0.813	0.447	0.273
Diff-In-Hansen test for level equation (p value)	0.710	0.695	0.664	0.133	0.223

This table reports the impact of financial integration on bank distance to default on the sample of domestic banks (ODUM=0). Financial integration is measured by the ratio of total foreign claims to GDP (CLAIM); ASIAN and NON_ASIAN (the foreign claims extended by international banks whose nationality are Asian and non-Asian, respectively); LOCAL and CROSS (the foreign claims extended by international banks via their foreign affiliates or across borders). Other variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

3.6 CHAPTER SUMMARIES

The chapter considers a country receiving foreign claims from international banks to examine the impact of financial integration on its bank default risk. The key finding is that financial integration lowers recipient countries' bank default risk. The result is primarily driven by the foreign claims extended by Asian lenders and the foreign claims extended via local affiliates. The findings remain robust when an alternative measure of bank risk (i.e. profit volatility) is employed or a different sub-sampling strategy is conducted. Overall, the result provides empirical support for the positive effect of financial integration and international banking capital on bank stability.

From a practical perspective, the findings suggest some preference about the forms of financial integration may be beneficial for East Asian recipient countries. Specifically, these countries should favour either the foreign claims extended by Asian lenders or foreign claims extended via local branches of international banks established in their countries. The former is synonymous with the promotion of intra-regional financial integration. This implication is meaningful because intra-regional finance still

lags behind trade, both in terms of the level of integration and the benefits of risk-sharing (Ng and Yarcia, 2014). The latter implies that where foreign claims come from outside East Asia, policy makers should encourage presence through local affiliates, as this has an equivalent impact. These two options of the 'neighbouring' foreign claims are complementary, providing recipient countries' policy makers with flexibility in their choice of preferred form of financial integration.

APPENDIX B1: SOME CAVEATS ABOUT BIS CONSOLIDATED BANKING STATISTICS (CBS)

CBS provides the credit exposures (termed as 'foreign claims') of banks headquartered in 31 BIS-reporting (source) countries to over 200 counterparties (recipient) countries on bilateral basis. CBS are structured on the nationality (not the location) of reporting banks.

Take Singapore as an example of a country reporting to BIS. There are four types of reporting banks located in Singapore:

(i) domestic banks (controlled by parent entities with the same country code as the reporting country), for instance: OCBC Bank, United Overseas Bank, etc.;
(ii) banks located in the reporting country, but controlled by parent entities located in non-reporting countries, for instance: an affiliate of Bank of China (China has not reported to BIS);
(iii) banks located in the reporting country, but controlled by parent entities located in reporting countries; for instance: an affiliate of HSBC (UK has reported to BIS);
(iv) banks controlled by parent entities located in the reporting country but not consolidated by their parent.

These reporting banks will report their claims extended to counterparties in a recipient country (i.e. the sampled East Asia). In the case of the total foreign claims data (to construct CLAIM), three types of reporting banks, including (i), (ii), and (iv) are considered. The third category banks are excluded, as the affiliates of HSBC will be consolidated by their parent bank in the UK and reported under the UK's foreign claims.

When foreign claims are broken down by lenders' nationality (to construct ASIAN and NON_ASIAN), only the first type of reporting bank (i.e. domestic banks) is considered. This is to clarify that the affiliates of distant international banks set up in Singapore (such as an affiliate of HSBC in Singapore) are not considered to construct Asian claims. The claims extended by an affiliate of HSBC in Singapore will later be

consolidated by their parent bank HSBC (UK); the claims then become non-Asian claims.

When foreign claims are broken down by methods of extension (to construct LOCAL and CROSS), only the first type of reporting bank (i.e. domestic banks) is considered. Specifically, United Overseas Bank (Singapore) sets up its branch in China and extends claims to counterparties in China via this branch; this is the case of local claims. Alternatively, United Overseas Bank (Singapore) books its claims outside China (by either extending from its head office in Singapore or from its branch located in another country); this is the case of cross-border claims.

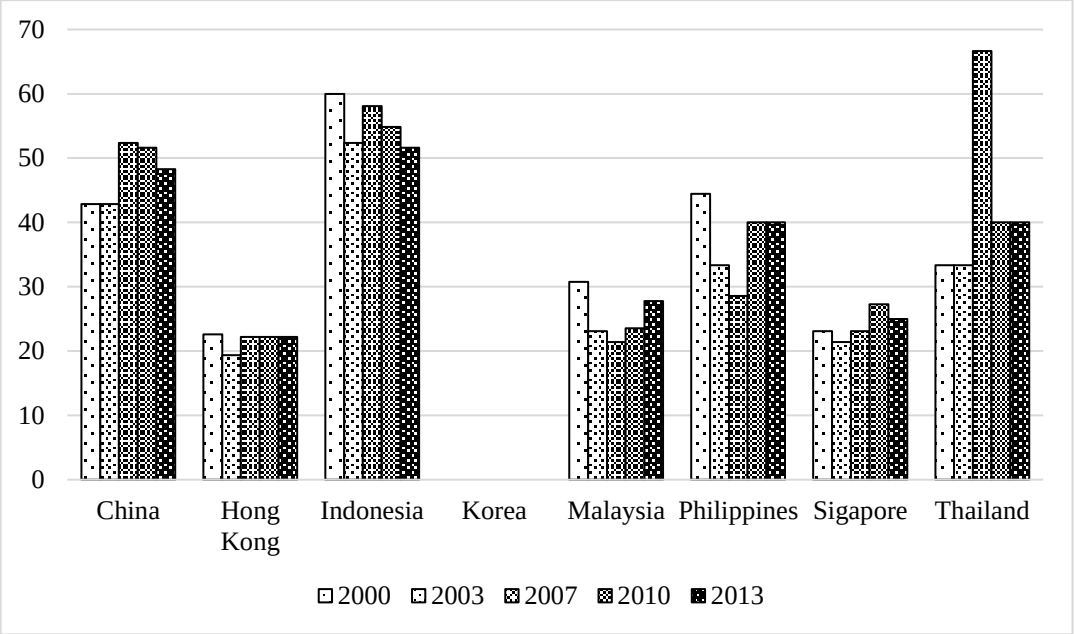
With regard to the reporting basis of Immediate Counterparty (IC) and Ultimate Risk (UR), the former considers parties directly involved in lending contracts, while the latter takes into account the credit risk transferring from one counterparty to another via collaterals or guarantees. For example, a Singapore bank extends a loan to a company in China and the loan is guaranteed by a Hong Kong bank. On an IC basis, the Singapore bank would report the loan as a claim on China. On a UR basis, the loan would be reported as a claim on Hong Kong instead. Further, it is worth noting that there are differences of when and which countries report both IC and UR, as outlined in Appendix B2.

APPENDIX B2: LISTS OF BIS-REPORTING COUNTRIES

Country	Asian lenders	Consolidated Banking Statistics (CBS)	
		Immediate Counterparty (IC)	Ultimate Risk (UR)
Australia	v	Q4 2003	Q4 2004
Austria		Q4 1983	Q4 2005
Belgium		Q4 1983	Q4 2004
Brazil		Q4 2002	...
Canada		Q4 1983	Q1 2005
Chile		Q4 2002	Q4 2004
Chinese Taipei	v	Q4 2000	Q4 2004
Denmark		Q4 1983	...
Finland		Q4 1985	Q1 2005
France		Q4 1983	Q4 2004
Germany		Q4 1983	Q4 2004
Greece		Q4 2003	Q4 2004
Hong Kong SAR	v	Q4 1997	Q3 2015
India	v	Q4 2001	Q1 2005
Ireland		Q4 1983	Q4 2004
Italy		Q4 1983	Q3 2004
Japan	v	Q4 1983	Q4 2004
(South) Korea	v	Q4 2011	Q4 2013
Luxembourg		Q4 1983	...
Mexico		Q4 2003	...
Netherlands		Q4 1983	Q4 2004
Norway		Q2 1994	Q4 2004
Portugal		Q4 1999	Q4 2004
Singapore	v	Q4 2000	Q1 2005
Spain		Q4 1985	Q2 2005
Sweden		Q4 1983	Q2 2005
Switzerland		Q4 1983	Q2 2005
Turkey		Q4 2000	Q4 2004
United Kingdom		Q4 1983	Q4 2004
United States		Q4 1983	Q4 2004

Source: https://www.bis.org/statistics/rep_countries.htm

APPENDIX B3: THE RATIO OF ASIAN FOREIGN BANKS TO TOTAL FOREIGN BANKS IN THE EAST ASIAN SAMPLED COUNTRIES (%)



This figure presents the ratio of Asian foreign banks to total foreign banks in East Asian countries (%). The denominator is the total number of foreign banks in these sampled countries. The numerator is the number of foreign banks owned by Asian BIS-reporting countries. Source: Compiled from Claessens and Van Horen (2015).

APPENDIX B4: MODEL SPECIFICATION WITHOUT REGULATION AND SUPERVISION VARIABLES

	(1)	(2)
L.LN(zscore)	0.533***	0.531***
	(0.04)	(0.04)
CLAIM	0.016**	0.012*
	(0.01)	(0.01)
CAP	0.045***	0.038**
	(0.02)	(0.02)
CRERISK	-0.004	0.000
	(0.01)	(0.01)
INC_DIV	-0.010	-0.007
	(0.01)	(0.01)
COST	-0.108	0.050
	(0.12)	(0.12)
CHARTER	0.007	0.003
	(0.00)	(0.01)
CON	-0.018	0.010
	(0.01)	(0.01)
IFL	-0.030*	-0.002
	(0.02)	(0.01)
GDP	-0.013**	0.026**
	(0.01)	(0.01)
PRICRE	-0.000	0.003
	(0.01)	(0.00)
INS	0.274*	-0.083
	(0.16)	(0.14)
INT	-0.013	0.007
	(0.02)	(0.01)
ACT	0.117**	
	(0.06)	
PRIMON	-0.053	
	(0.06)	
ODUM	-0.020	0.100
	(0.09)	(0.10)
CRISIS	0.287	0.260
	(0.23)	(0.23)
Constant	-0.102	-2.652**
	(1.19)	(1.15)
#Obs.	1425	1740
# Banks	349	393
# IV	97	91
AR(2) test (p value)	0.333	0.188
Hansen-J test (p value)	0.772	0.164
Diff-In-Hansen test (p value):		
GMM instruments for level	0.97	0.712
GMM instruments for the lagged dependent variable	0.816	0.344
GMM instruments for endogenous bank-level variables	0.346	0.106

GMM instruments for predetermined variables	0.727	0.634
IV instruments for exogenous variables	0.708	0.216

This table reports the robustness to Table 3.4. To maintain the number of bank sample observations, SUP (with the lowest number of available observations), then all regulation variables (ACT, SUP, and PRIMON) are dropped. Other variables and the system GMM specification remain unchanged from the baseline model. The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX B5: MODELS WITHOUT CAPITAL RATIO (CAP)

	(1)	(2)	(3)	(4)	(5)
L.LN(zscore)	0.498***	0.536***	0.506***	0.499***	0.494***
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)
CLAIM	0.042*				
	(0.03)				
ASIAN		0.086***			
		(0.03)			
NON_ASIAN			-0.005		
			(0.03)		
LOCAL				0.113***	
				(0.04)	
CROSS					0.040
					(0.05)
Control variables	Yes	Yes	Yes	Yes	Yes
#Obs.	836	836	836	615	615
# Banks	202	202	202	156	156
# IV	97	97	97	77	77
AR(2) test	0.384	0.347	0.469	0.113	0.161
Hansen-J test	0.247	0.605	0.47	0.627	0.425
Diff-In-Hansen test for GMM instruments	0.248	0.427	0.581	0.863	0.823

This table reports the robustness test on the exclusion of capital ratio (CAP) from the model. Other variables definition and the system GMM specification remain unchanged (as reported in Table 3.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX B6: TAKING NATURAL LOGARITHM OF PROFIT VOLATILITY

	(1)	(2)	(3)	(4)	(5)
L.lnROA_vol	0.463***	0.484***	0.493***	0.420***	0.433***
	(0.07)	(0.06)	(0.07)	(0.05)	(0.06)
CLAIM	-0.035*				
	(0.02)				
ASIAN		-0.060**			
		(0.03)			
NON_ASIAN			-0.037		
			(0.03)		
LOCAL				-0.092***	
				(0.03)	
CROSS					-0.020
					(0.04)
Control variables	Yes	Yes	Yes	Yes	Yes
#Obs.	836	836	836	615	615
# Banks	202	202	202	156	156
# IV	100	100	100	80	80
AR(2) test	0.101	0.122	0.112	0.161	0.183
Hansen test	0.28	0.402	0.226	0.378	0.191
Diff-in-Hansen test for GMM instruments	0.635	0.951	0.682	0.34	0.153

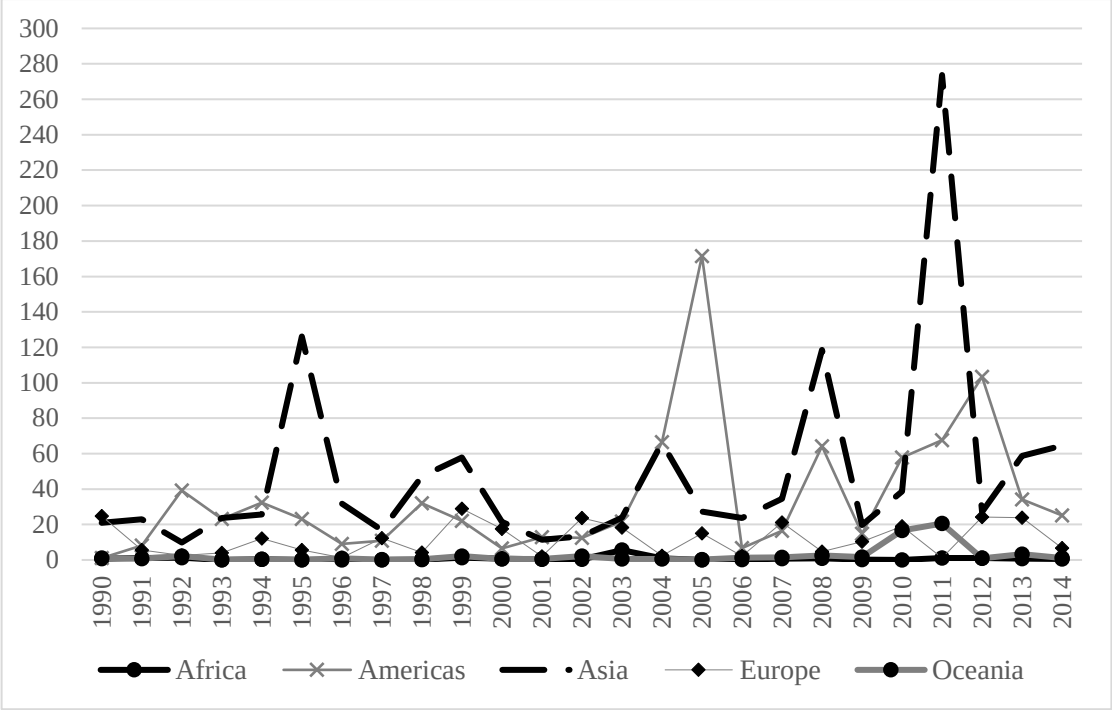
This table takes the natural logarithm of profit volatility (i.e. LN(ROA_VOL)) rather than taking the standard deviation of profitability (i.e. ROA_VOL) as in Table 3.7. Other variables definition and the system GMM specification remain unchanged (as reported in Table 3.7). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

CHAPTER 4: THE IMPACT OF NATURAL DISASTERS ON BANK PERFORMANCE AND THE MODERATING ROLE OF FINANCIAL INTEGRATION

4.1 INTRODUCTION

Asia has been one of the most disaster-prone regions in the world, as measured by total economic damage reported in Figure 4.1. The region has been affected by numerous destructive natural disasters during the last few decades. Examples include the Indian Ocean tsunami in 2004, the Sichuan earthquake in 2008, and the Haiyan cyclone in 2013. These disasters have had large economic and social impacts on the affected countries. Over the past 20 years, Asia has borne almost half of the estimated global economic cost of natural disasters, roughly $53 billion annually (Asian Development Bank, 2014). Within East Asia, Indonesia, China, and the Philippines stand out as highly vulnerable to disasters (Noy, 2015). This is particularly concerning because there is now evidence that climate change is altering the frequency and severity of natural hazards. According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Intergovernmental Panel on Climate Change, 2014), more frequent and intense heat waves and an increase in heavy rain events are expected in Asia. If realised, these projections herald severe consequences for East Asia because climate change will increase the region's vulnerability to natural disasters.

An earlier version of this chapter was presented at the New Zealand Finance Colloquium (Lincoln University, Christchurch, New Zealand, 2019).



(Source: Compiled from EM-DAT)

Figure 4.1: Total economic damage of natural disasters (in US$ billions) per continent during 1990–2014

The purpose of this chapter is to assess the potential impact of natural disasters on banks in East Asia. The findings of this study are critical to the East Asian countries because banks provide an important source of finance for the post-disaster recovery process. Bank deposits serve as an *ex-ante* source for disaster mitigation; deposits can be withdrawn once the natural disaster strikes to repair and rebuild the damages caused by the disaster (Skidmore, 2001). Further, with credit supply in the form of outright lending or additional credit commitments, banks are better able than markets and insurance providers to cater for firms' preferences around financial flexibility (Gorbenko and Strebulaev, 2010; Bos and Li, 2017). Indeed, in developing countries, where insurance coverage is non-existent or deficient, the role of banks in the reconstruction process becomes more important (Nguyen and Wilson, 2018). However, if banks are strongly affected by disasters (perhaps as a result of the magnitude of the disaster or its geographical concentration), the role of banks in the reconstruction process could be

limited. Given the importance of banking to the economy, this chapter assesses the impact of disasters on various aspects of bank performance.

Foreign capital is another possible source of finance for ex-post recovery (Noy, 2009). Historically, inflows of remittances and foreign aid have played an important role in supporting the recovery process, while private foreign capital (such as bank lending and equity) seems to experience 'capital flight' following natural disasters (Yang, 2008; David, 2011). Evidence of private foreign capital withdrawal post-disasters contrasts with the fact that foreign banking claims on East Asia have been growing substantially during 1999–2014 (as shown by Figure 3.1). Hence, there is an outstanding question concerning the moderating role of foreign banking capital on commercial bank performance following a natural disaster

This chapter examines the impact of natural disasters on a broad range of bank performance measures. Further, it investigates the moderating effect of financial integration on the relationship between natural disasters and bank performance. Finally, it explores whether the moderating role of financial integration varies by the type of integration. Chapter 3 showed that foreign banking claims from 'neighbours' have a beneficial (i.e. lowered) impact on bank default risk. This chapter re-investigates this effect more broadly in the context of natural disasters and bank performance.

Specifically, first the chapter asks: "*How do natural disasters affect various measures of bank performance, namely deposits ratio, liquidity, credit risk, profitability, and default risk?"* Cross-country analyses are rare in the existing literature addressing this question.[42] Discernible prior studies include Klomp (2014) and Brei et al. (2019),

[42] Most studies focus on the response of banks around an event window for a specific disaster in one country. For example, Garmaise and Moskowitz (2009) study the impact of earthquakes in California (US); Berg and Schrader (2012) study volcanic eruption in Ecuador; Hosono et al. (2016) study the 1995 Kobe earthquake; and Nguyen and Wilson (2018) study the 2004 Indian Ocean tsunami in Thailand. These studies generally document the limited access to bank credit and credit contraction in the affected areas

both of which examine the country-level impact of disasters on the aggregated measures of bank performance. Studying the impact of large-scale world-wide natural disasters on financial stability during the period 1997–2010, Klomp (2014) documents the increase in the likelihood of a bank's default. Unfortunately, the study neither provides the specific evidence for the East Asian region, nor controls for the impact of the Asian financial crisis. Furthermore, Klomp (2014) only focuses on the impact of disasters on bank default risk while other studies (such as Collier et al. 2013, Noth and Schüwer 2018, and Brei et al. 2019) demonstrate the realized impact of disasters on other aspects of bank performance. For instance, investigating the impact of hurricanes on the East Caribbean banking industry during the period 2001–2012, Brei et al. (2019) report a reduction in the deposits ratio as well as the other liabilities ratio, suggesting a negative funding shock to banks. Therefore, it is worth investigating the impact of disasters on various aspects of banks performance in addition to stability. In short, this chapter augments prior studies by examining the impact of all disaster events on various measures of bank-level performance in the disaster-prone region of East Asia during 1999–2014, the period following the Asian financial crisis.

Second, the chapter explores the moderating role of financial integration and asks: "*How does financial integration moderate the impact of natural disasters on bank performance?"* The literature provides opposing predictions on the moderating role of financial integration on the relationship between natural disasters and bank performance. On the one hand, foreign capital could help to ease financial constraints in host economies by providing access to alternative sources of external financing and

following disasters. In contrast, Schüwer et al. (2018) find that independent banks located in the affected areas by Hurricane Katrina in 2005 increase their risk-based capital ratios and new lending to affected firms. Similarly, studying the impact of the 2013 Elbe flooding in Germany, Koetter et al. (2019) report that the credit supply increases among local banks that provide recovery lending to affected customers.

compensating for the volatility of domestic credit (Allen et al., 2011). On the other hand, the likelihood of associated international capital outflows (Yang, 2008; David, 2011) could amplify the impact of disasters on banks. Given these opposing predictions, establishing which of the effects dominates is an empirical question of interest to academic researchers and policy makers alike. To date, there are no empirical studies that examine the moderating role of financial integration on the relationship between natural disasters and bank performance. This chapter addresses that gap in the literature by using the ratio of the foreign claims of international banks to GDP to proxy for the level of financial integration (the same measure of CLAIM employed in Chapters 2 and 3), and then investigates the significance of the interactions between financial integration and natural disasters.

The third research question states: "*Do the foreign claims from 'neighbours' moderate the impact of natural disasters on bank performance differently from more distant sources of capital?"* Since natural disasters may destroy information on borrowers and collateral values, lending could be more resilient in the case of lenders who possess informational advantages (Chavaz, 2014; Cortés and Strahan, 2017). Chapter 3 confirmed that types of financial integration differ on their information asymmetry. This chapter decomposes the measure of the total foreign claims based on lenders' nationality and methods of extension to investigate the moderating role of each type of financial integration on banks performance following natural disasters. Consistent with Chapter 3, this chapter repeats two definitions of 'neighbours' lenders: (i) banks from other Asian countries and (ii) foreign bank presence via a full affiliate office in the recipient countries. Due to its close proximity to borrowers, Asian (regional) foreign banks face less information asymmetry than non-Asian (distant) lenders (Mian, 2006; Claessens and Van Horen, 2014b). Further, in comparison with cross-border claims, the

local claims extended via an affiliate presence involve some forms of foreign direct investment in the host country's financial sector (García-Herrero and Martínez Pería, 2007), which serves as a way to acquire 'local' knowledge. The informational advantages predict that Asian and local claims are more resilient during natural disasters than their counterparts. This advantage helps to alleviate the consequences of disasters. Despite this expectation being highly intuitive, there is no empirical evidence testing the differential impact of these types of foreign banking claims in the context of natural disasters. The chapter addresses this gap in the literature.

The chapter constructs an unbalanced sample of commercial banks from seven countries in East Asia (China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, and Thailand) during the period 1999–2014. A dynamic panel data model of bank performance ratios is constructed to reveal the short-term and contemporaneous response of banks toward disasters. The two-step system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) is used to estimate this dynamic relationship. Data for disaster damage are sourced from the Emergency Events Database (EM-DAT). The ratio between the total economic loss caused by all natural disasters in a particular country and a given year to the country's previous year GDP is constructed to proxy for the magnitude of damage of each disaster. As in Chapter 3, data are sourced from the CBS report published by BIS to construct the financial integration measures. Specifically, to address question 1 and 2, the chapter constructs the overall measure of financial integration based on the total foreign banking claims data. To address question 3, the chapter proxies different types of financial integration via the components of foreign bank claims classified by lenders' nationality and methods of extension.

The chapter finds that natural disasters significantly lower bank deposits ratio. However, bank liquidity, credit risk, profitability, and default risk are not affected by

disasters. With regard to the moderating role of financial integration, the total foreign banking claims help to alleviate the decline in bank deposits in the aftermath of disasters. These results indicate that bank deposits and foreign banking claims serve as sources of funds for post-disaster recovery. Together with other sources, such as bank credit, government support, remittance, and foreign aid, they provide multiple channels for households and firms to obtain immediate access to finance, which is critically important to their disaster recovery.

The moderating role of financial integration is present in the case of foreign claims extended by Asian lenders (but not in the case of non-Asian counterparts). The moderating role is not present in either local claims or cross-border claims. These results highlight the resilience of 'neighbouring' claims extended by Asian lenders during local shocks, and provide rigorous evidence (in addition to that provided in Chapter 3) to support intra-regional financial integration.

The rest of this chapter is structured as follows. Section 4.2 reviews the related literature and introduces our hypotheses. The methodology is presented in Section 4.3. Sections 4.4 and 4.5 present the descriptive and empirical results, respectively. Section 4.6 provides the conclusion and implications.

4.2 LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

With regard to the first research question, the existing literature generally confirms the negative impact of disasters on various aspects of bank performance. One potential impact of disasters is the lowering of deposits ratios and bank liquidity. In an investigation of how people cope with unexpected losses caused by the 1995 Hanshin-Awaji earthquake, Sawada and Shimizutani (2008) conclude that dis-savings were utilized to compensate for the loss to assets, while borrowing was used extensively to repair damage to housing. Given this household response, tightening bank liquidity is

expected in the aftermath of disasters. This argument has been empirically validated for the case of commercial banks in the Eastern Caribbean islands. Following hurricane strikes, these banks faced deposits withdrawal and experienced a negative funding shock (Brei et al., 2019).

Natural disasters could also increase bank credit risk due to the deterioration in the payment capabilities of affected borrowers (Klomp, 2014). The shortage of funding and the increase in credit losses would reduce profitability. As empirically shown by Noth and Schüwer (2018), the occurrence of natural disasters in the US during 1994–2012 is associated with a higher non-performing assets ratio and lower profitability for two years following a natural disaster.

More seriously, natural disasters could affect bank stability. Using a simulation approach, Collier et al. (2013) find that natural catastrophes could become a systemic risk because of declining capital ratios, reduction in equity, and decrease in loan origination immediately following a disaster. An empirical cross-country analysis by Klomp (2014) suggests that large-scale natural disasters increase the likelihood of a bank's default in emerging countries during the examined period of 1997–2010. Additionally, Brei et al. (2019) also report the significant decline in bank distance to default as a consequence of hurricane strikes on the East Caribbean islands. As noted in Section 4.1 (see also Figure 4.1 and Noy, 2015), East Asia is a disaster-prone area. Based on this and the preceding discussion, Hypothesis 1 (H1) states: "*Natural disasters negatively affect bank performance measures such as deposits ratio, liquidity, credit risk, profitability, and default risk".*

The second question examines the moderating role of financial integration on the relationship between disasters and bank performance. On the one hand, generally, foreign capital can ease financial constraints in host economies by providing access to alternative

sources of external financing and compensating for the volatility of domestic credit (Allen et al., 2011). Additionally, the lending behaviour of foreign banks has been shown to be more resilient during local shocks (De Haas and Van Lelyveld, 2006; Arena et al., 2006), as they have access to liquidity and capital injections from their parent banks (Cetorelli and Goldberg, 2012). Therefore, in the aftermath of natural disasters, at the country level, the availability of foreign funds helps to speed up the replenishment of capital stock, allowing countries to quickly respond to the shocks (Noy, 2009; Felbermayr and Gröschl, 2014). From a bank's perspective, it can increase its international borrowings to meet the increase in credit demand and disaster relief.

On the other hand, a likelihood of severe outflows of international capital, especially banking flows, after a disaster can exacerbate the adverse impact of disasters on bank performance. Empirical evidence establishing the volatile response of international banking flows towards exogenous shocks includes findings that bank lending flows are more volatile than equity and FDI flows during financial shocks (Levchenko and Mauro, 2007; Eichengreen et al., 2018). In the aftermath of natural disasters, Yang (2008) and David (2011) consistently find that private flows (such as bank lending and equity) seem to experience 'capital flight' in contrast to the inflows of foreign aid and remittances.

However, no study has directly examined how foreign capital moderates the impact of disasters on bank performance. Noy (2009) finds that capital account openness moderates the impact of natural disasters on economic growth. The results show that countries with a less open capital account are better able to endure natural disasters (Noy, 2009). This follows from the fact that countries with capital account restrictions are less vulnerable to 'capital flight' following a natural disaster event.

Given these findings, it is clear that there are two competing arguments for the moderating effect of foreign capital on bank performance. On balance, considering the weight of the empirical and theoretical literature, Hypothesis 2 (H2) states: *"Greater financial integration alleviates the consequences of natural disasters on bank performance."*

The third question investigates the moderating role of each type of financial integration. The occurrence of natural disasters may destroy information on borrowers and collateral values. Banks that have an advantage in generating tacit information can process this soft information so that they can better distinguish between good and bad credit prospects following a disaster, and can therefore maintain or even increase their lending to (selected) affected customers. Several studies, such as Chavaz (2014) and Cortés and Strahan (2017), conclude that this informational advantage belongs to the local and small banks. As explained in Chapter 3, the informational advantage arguably belongs to the 'neighbours' foreign banks, which could be either (i) banks from other Asian countries or (ii) foreign bank presence via a full affiliate office in the recipient countries. In the former case, the information advantage of regional lenders results from their familiarity with the cultural, legal, political, and economic environments of the recipient countries (Mian, 2006; Claessens and Van Horen, 2014b). In addition to regional specific knowledge, the information advantage is inherent to the local business relationship (Buch et al., 2012) since Asian international banks follow the footsteps of domestic corporate customers going abroad to set up their foreign branches (Molyneux et al., 2013). In the latter case, the local claims extended via an affiliate presence of an international bank involves some form of foreign direct investment in the host country's financial sector (García-Herrero and Martínez Pería, 2007), which could be synonymous with 'local' knowledge acquisition. Additionally, the local claims are funded primarily

by local deposits (Cerutti, 2015); hence, the local claims could be less volatile than cross-border counterparts. In short, the Asian claims and local claims are expected to be more resilient during natural disasters. Accordingly, the two following hypotheses are developed. Hypothesis 3 (H3) states: "*Foreign claims extended by Asian lenders, as distinct from non-Asian lenders, alleviate the consequences of natural disasters on bank performance*", and Hypothesis 4 (H4) states: "*Foreign claims extended via local affiliates of international banks, as distinct from cross-border claims, alleviate the consequences of natural disasters on bank performance*."

4.3 METHODOLOGY, VARIABLES, AND DATA

4.3.1 Model Specification

Consistent with Chapter 3, this chapter develops a dynamic panel model to examine the impact of natural disasters on bank performance (H1) as given by Equation (4.1). The dynamic panel data model is estimated to examine the impact of disasters on economic growth (Noy, 2009; McDermott et al., 2013) and on the performance of financial institutions (Klomp, 2014 and 2018).

$$Y_{ijt} = \beta_0 Y_{ijt-1} + \beta_1 DAMAGE_{jt} + \beta_2 INTEG_{jt} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt} \quad (4.1)$$

In this specification, Y_{ijt} is the dependent variable (DEPO deposits ratio, LIQ liquidity, CRERISK credit risk, ROA profitability, and LN(zscore) distance to default) for bank *i* in country *j* at time *t*. Y_{ijt} is written as a function of its past level (Y_{ijt-1}), disaster damage (DAMAGE), financial integration (INTEG), a vector of *k* bank-level variables reflecting the characteristics of each bank *i* (BANK), and a vector of *m* country-level variables reflecting the macroeconomic condition relevant to all banks including bank regulation and supervision for any given country *j* (COUNTRY). θ_i is the bank-specific fixed effect to control for unobserved factors that do not change over time for each bank. γ_j and μ_t are the country- and time- dummy variables, respectively; ε_{ijt} is the

error term. The coefficient of interest is β_1 reflecting the relation between bank response and contemporaneous shocks from disasters occurring in year *t*.

Another popular method is the distributed lags models (as employed in Noth and Schüwer, 2018, and Brei et al., 2019), in which several lags of disaster damage are included in the model. The distributed lag model aims to account for the lagged effect of disasters and the fact that it might take time until banks experience the entire effect. With the design of the dynamic panel data (shown in Equation 4.1), the lagged dependent variable already contains the entire history of other independent variables, including the impact of past disasters. Additionally, the distributed lags model only includes several lags of disaster impact, so that it is not possible to examine the moderating role of other factors (such as financial integration) on the impact of disasters on bank performance. Therefore, the chapter intentionally uses the dynamic panel data model to investigate the three research questions.

To study the moderating role of financial integration on the relationship between natural disasters and bank performance (H2), the chapter retains the model and variables specification in Equation (4.1), and includes the interaction term created by multiplying the measures of financial integration and disasters impact:

$$Y_{ijt} = \beta_0 Y_{ijt-1} + \beta_1 DAMAGE_{jt} + \beta_2 INTEG_{jt} + \beta_3 DAMAGE_{jt} * INTEG_{jt} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt} \quad (4.2)$$

To test H3 and H4, Equation (4.2) is estimated with the specific measure for each type of foreign banking claim replacing the aggregate measure INTEG (i.e. ASIAN, NON_ASIAN, LOCAL, and CROSS as previously employed in Chapter 3).

4.3.2 Estimation Method

The empirical analysis employs the two-step system GMM developed by Arellano and Bover (1995) and Blundell and Bond (1998) with finite-sample corrected standard errors as proposed by Windmeijer (2005). The specification about the variables' exogeneity remains unchanged from Chapter 3. For instance, contemporaneous bank-level regressors ($BANK_{ijt}$) are treated as being endogenous. Financial integration ($INTEG_{jt}$) and bank regulation and supervision variables are treated as being predetermined. Disaster damage ($DAMAGE_{jt}$) is treated as an exogenous variable, as the occurrence of natural disasters are exogenous shocks to bank performance. Finally, other macroeconomic variables, time dummies, and country dummies are treated as exogenous variables.

The same procedure of pre- and post-tests is carried out as in the previous chapter. These tests include a Fisher test for the time series stationarity, the Durbin-Wu-Hausman (DWH) test for endogeneity of bank-level control variables, the second-order Arellano-Bond (i.e. the AR(2)) autocorrelation test, the Hansen J-statistics test for the joint validity of the full instrument set, and the difference-in-Hansen test for the validity of the subset of instruments.

4.3.3 Variables and Data

4.3.3.1 Disaster damage's measure and data

Data for disaster damage are sourced from EM-DAT, which are collected by the Centre for Research on the Epidemiology of Disasters (CRED).[43] The EM-DAT database

[43] The EM-DAT database distinguishes between four broad groups of natural disasters: (1) hydrological disasters, including floods and wet mass movements; (2) meteorological disasters concerning storms and hurricanes; (3) geophysical disasters, including earthquakes, tsunamis, and volcanic eruptions; and (4) climatic disasters, including extreme temperatures, droughts, and wildfires. The inclusion criteria for the events dataset is that 10 or more people were killed, 100 or more people were affected, an official state of emergency was declared, or a call for international assistance was made.

has a world-wide coverage; the earliest events were reported from 1900. This explains why it has been the most popular source of data for disaster damage to date in the literature (Noy, 2009).

The EM-DAT database publishes three measures of disaster damage, which could serve as proxies for the magnitude of the disaster. They are (i) the number of people killed, (ii) the number of affected population, and (iii) the amount of direct damage (measured in US dollars). The chapter uses the last measure, specifically the economic loss caused by all disaster events. When damages from all events are aggregated, the measure could reflect both the magnitude and the frequency of disasters.[44] The economic loss, then, is aggregated at the country level and annual level. Finally, following Noy (2009), the disaster damage variable (DAMAGE) is constructed as the ratio of the total economic loss to the country's prior-year GDP. In short, DAMAGE represents the total economic loss caused by all disasters in a particular country, in a given year, and scaled by the country's prior-year GDP.

It is noteworthy that the EM-DAT database suffers from measurement errors and endogeneity concerns. The database does not provide the full universe of disaster events (Felbermayr and Gröschl, 2014); this could be due to the poor technology available to collect and record information about disaster events (Cavallo et al., 2013). Therefore, the measurement error is more pronounced in the earlier years of data availability. As the chapter samples disasters since 1999, this concern is alleviated. Besides, the ex-post measure of economic loss could be endogenous to other country control variables, such

[44] Some papers only sample large-scale events, but the threshold to define the 'large' magnitude is quite subjective. For instance, Klomp (2014) defines a large-scale event as one in which economic loss is greater than 1% GDP or 0.5% banking assets size. Cavallo et al. (2013) define a 'large' disaster with its damage, measured in terms of people killed as a share of population, being two standard deviations greater than the world pooled mean for the sampled period. Thus, to avoid the subjectivity in defining large-scale disasters, the chapter samples all events reported by the EM-DAT database.

as inflation or economic growth (Noy, 2009; Klomp, 2014). The chapter employs the system GMM, which uses the valid internal instrument variables, and could relieve this endogeneity concern.[45]

4.3.3.2 Financial integration variables

Similar to Chapter 2 and 3, this chapter sources data to construct financial integration measures from the CBS report published by the BIS. To address research questions 1 and 2 (as well as H1 and H2), the chapter sources data on the foreign claims extended by international banks to the sampled (recipient) countries from the CBS-IC. This statistic is then scaled by the GDP of the corresponding sampled countries to construct the overall measure of financial integration (CLAIM). CLAIM was previously employed in Chapter 2 and 3 (see Section 2.3.3 and 3.3.3).

To test H3, the moderating role of the foreign claims classified by lenders' nationality, the chapter draws on data on the Asian claims and non-Asian claims from the CBS-IC report. H4 investigates the foreign claims broken down by the methods of extension using data for local claims and cross-border claims sourced from the CBS-UR. These statistics are then scaled by the GDP of the sampled countries to construct variables, namely ASIAN, NON_ASIAN, LOCAL, and CROSS, respectively (see Section 3.3.3).

4.3.3.3 Bank-level variables

The chapter examines the impact of natural disasters on several aspects of bank performance, specifically deposits ratio (DEPO), liquidity (LIQ), credit risk (CRE),

[45] An absolute solution to the endogeneity concern is using an index of disaster intensity, which is constructed from the physical characteristics of the disaster. A notable example is the Ifo Geological and Meteorological Events (Ifo-GAME) database of disaster events (including earthquakes, volcanic eruptions, storms, floods, droughts, and extreme temperature) and their physical intensities index. However, the data are only publicly updated to 2010. Moreover, the aggregated disaster index at country and year level only represents the physical magnitude of the single largest event of each type of disaster (not for all disasters).

profitability (ROA), and default risk (LN(zscore)). In line with the existing literature on the determinants of bank risks and profitability (such as Athanasoglou et al., 2008; Laeven and Levine, 2009; Ghosh, 2015; and Brei et al., 2019), standard explanatory variables are included in Equation (4.2). For instance, Athanasoglou et al. (2008) found that higher capitalization, lower credit risk, higher operating efficiency, and lower market concentration are associated with higher banks profitability. Additionally, macro-economic factors such as inflation rate and interest rate positively affect banks profitability. Findings from Ghosh (2015) suggest several internal determinants of bank credit risks such as bank size, capitalization, cost efficiency, loans to assets ratio, and income diversification. Laeven and Levine (2009) emphasize the importance of controlling for deposit insurance coverage as well as bank regulation and supervision scheme on studying determinants of banks default risks. Table 4.1 provides the detailed definitions and construction of all variables.[46]

[46] Some banks may have insurance (and/or re-insurance) contracts to protect their business against the adverse impact of natural disasters. As data on the bank-level insurance coverage are not available, the paper could not directly control for the potential mitigating effect of insurance on the relationship between disasters and bank performance. Besides, GDP per capital is often included in the economic growth and natural disaster literature (Felbermayr and Gröschl, 2014) since this variable proxies for economic development and is highly correlated to the country-level insurance penetration data and government spending, which could affect the ex-post recovery process. However, the chapter could not include this variable (in the form of natural logarithm of GDP per capital), as the variable contains unit roots in its time series. The chapter attempts to control for GDP per capita by using the country dummies in the regression.

Table 4.1: Definition and specification of variables

Variables	Definition	Data Source
Dependent Variable		
DEPO	Deposits ratio = total customers deposits/ total assets (%)	Bankscope and author's calculation
ROA	Profitability = Net Income/ Total assets (%)	Bankscope
CRERISK	Credit risk = Non-performing loans/ Gross loans (%)	Bankscope
LIQ	Liquidity = Liquid assets/deposits and short-term funding (%)	Bankscope
LN(zscore)	Natural logarithm of bank Z-SCORE. Z-SCORE is equal to [ROA+ (Total Equity/Total assets)]/ [Std. (ROA)]. The Std. (ROA) is calculated over a three-year rolling window.	Bankscope and author's calculation
Bank-level control variables		
SIZE	Natural logarithm of total assets	Bankscope and author's calculation
CAP	Equity ratio = total equity/ total assets (%)	Bankscope and author's calculation
INC_DIV	Income diversification = (non-interest income/ total income) (%)	Bankscope and author's calculation
COST	Overhead cost = Total non-interest operating expenses/total assets (%)	Bankscope and author's calculation
CHARTER	Charter value = Customer demand deposit/ total assets (%)	Bankscope and author's calculation
LOANS	Loans to assets = gross loans/ total assets (%)	Bankscope and author's calculation
CON	Market concentration = Top 3 largest banks assets/ total banks assets (%)	Bankscope and author's calculation
ODUM	Foreign ownership equals 1, otherwise	Claessens and Van Horen (2015)
Variables of interest		
DAMAGE	Economic loss caused by all disasters = Economic losses of all events in one country in a given year/ a counry's last year GDP	EM-DAT
CLAIM	Foreign claims of international banks to GDP of a country (%)	BIS CBS-IC
ASIAN	Foreign claims extended by international banks in Asia/ GDP (%)	BIS CBS-IC

NON_ASIAN	Foreign claims extended by international banks in non-Asian countries/ GDP(%)	BIS CBS-IC
CROSS	Foreign claims extended across border by international banks/GDP (%)	BIS CBS-UR
LOCAL	Foreign claims extended via foreign branches of international banks/GDP (%)	BIS CBS-UR
Country control variables		
IFL	Inflation rate = Annual % change of average consumer price index (%)	Global Financial Development (GFD)
GDP	GDP growth rate = Annual % change of GDP (%)	GFD
PRICRE	Private credit to GDP =Bank credit to private sector/ GDP (%)	GFD
INT	Real interest rate (%)	World Development Indicator (WDI)
CRISIS	Dummy variable that takes a value of 1 for the year of the financial crisis	Laeven and Valencia (2012)
INS	Dummy to proxy for the deposit insurance coverage of a country. INS takes a value of 1 when the country has explicit deposit insurance and 0 otherwise	Demirgüç-Kunt et al. (2014)
ACT	Overall restrictions on banking activities index measures the degree to which banks are allowed to engage in securities, insurance, real estate investment, and ownership of non-financial firms. Higher value indicates more restrictiveness.	Barth et al. (2013a)
SUP	Supervisory power index measures if the supervisory authorities have the authority to take specific actions to prevent and correct problems. Higher value denotes that supervisory agencies are authorised more oversight power.	Barth et al. (2013a)
PRIMON	Private monitoring index measures the degree of private monitoring which requires banks to release accurate and comprehensive information to the public. Higher value indicates greater regulatory empowerment of the monitoring of banks by private investors.	Barth et al. (2013a)

4.3.4 Bank Sample

The sample of banks and countries is similar to Chapter 3's, except that Singapore is excluded due to no recorded natural disasters. The final (unbalanced) sample contains 2,219 commercial bank-year observations (379 banks) from seven countries in East Asia

(China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, and Thailand) over the period 1999–2014. Other procedures to obtain and clean the financial data remain unchanged from Chapter 3 (see Section 3.3.4).

4.4 DESCRIPTIVE ANALYSIS

Table 4.2 reports the descriptive statistics of all variables included in the regression. The measures of bank performance LN(zscore), CRERISK, LIQ, ROA, and DEPO report a wide range of values, highlighting the substantial variation in performance across banks in the sampled period.

Table 4.2: Descriptive statistics

	Mean	Std.	Min	Max	N
LN(zscore)	3.642	1.228	-2.377	7.895	2,219
LIQ (%)	31.197	22.592	4.230	133.590	2,219
CRERISK (%)	5.399	9.171	0.010	70.780	2,219
ROA (%)	1.115	1.132	-8.970	8.840	2,219
DEPO (%)	69.547	15.732	14.374	93.270	2,219
CAP (%)	10.204	7.214	1.520	81.300	2,219
INC_DIV (%)	13.722	10.456	0.100	69.444	2,219
COST (%)	1.962	1.614	0.050	23.423	2,219
CHARTER	32.692	24.891	0.153	100.000	2,219
LOANS (%)	53.927	16.407	0.493	99.210	2,219
CON (%)	43.599	7.274	29.789	78.151	2,219
IFL (%)	4.204	3.218	-3.953	20.489	2,219
GDP(%)	13.068	10.443	-13.044	47.368	2,219
PRICRE (%)	91.278	47.153	19.909	233.663	2,219
INT (%)	3.016	3.524	-3.903	13.347	2,219
ACT	8.687	2.416	3.000	12.000	2,080
SUP	12.261	2.612	7.000	16.000	1,126
PRIMON	9.437	1.085	7.000	11.000	1,785
DAMAGE (%)	0.464	1.521	0.000	17.053	2,219
CLAIM (%)	25.043	33.933	3.357	290.071	2,219
ASIAN (%)	4.431	0.644	5.762	50.360	2,219
NON_ASIAN	14.148	1.718	24.155	189.181	2,219
LOCAL (%)	13.071	1.446	25.906	186.572	1,673
CROSS (%)	7.443	1.761	6.891	50.262	1,673

The table reports descriptive statistics for the variables used in the empirical analysis. There are 2,219 bank-year observations (about 379 banks) for seven sampled countries (including China, Hong Kong, Indonesia, Malaysia, the Philippines, Korea, and Thailand) during 1999–2014. For the definition and construction of the variables, see Table 4.1.

The ratio of disaster loss to GDP (DAMAGE) has a mean of 0.46 and standard deviation of 1.52. Figure 4.2 is the scatter plot between the number of disasters (i.e. a proxy of frequency) and the disasters damage (i.e. a proxy of magnitude). Taken together, it is clear that the majority of events have a small-scale impact, with economic losses being lower than 1% GDP. Figure 4.3 graphs DAMAGE for each sampled country. China, Indonesia, the Philippines, and Thailand experienced more damaging disasters, while Korea, Hong Kong, and Malaysia suffered losses to a lesser extent.

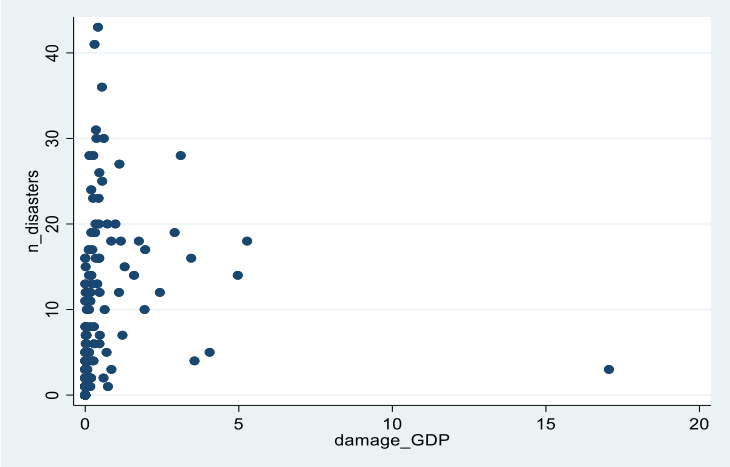


Figure 4.2: Frequency and magnitude of the sampled disasters in East Asia during 1999–2014

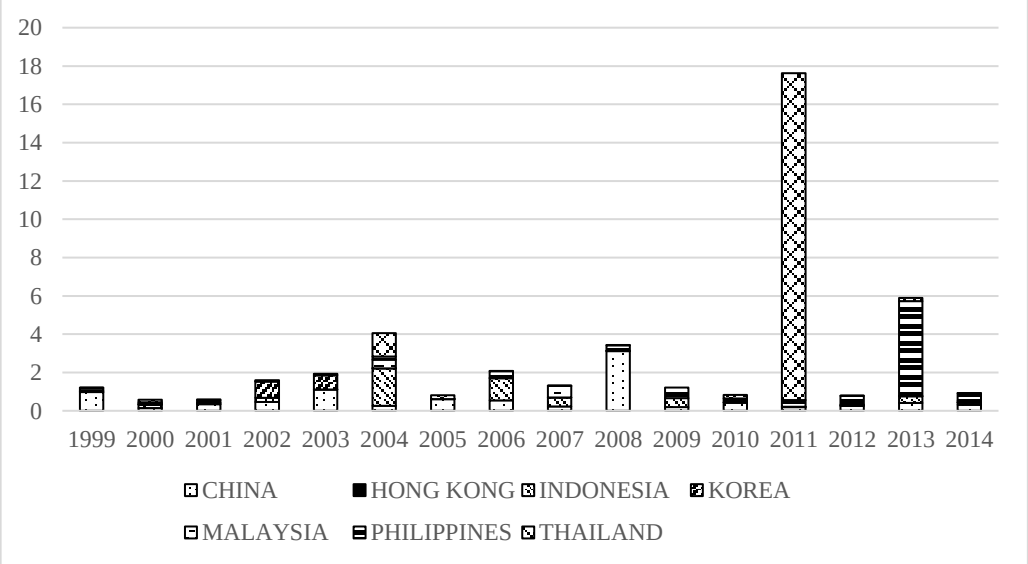


Figure 4.3: Disasters damage (DAMAGE) (%) for each country in the sample

Table 4.3 reports the Pearson pairwise correlation coefficients. DAMAGE is negatively correlated with deposits ratio (DEPO), liquidity (LIQ), and charter value (CHARTER). The negative association is early evidence that deposit withdrawal and tightened liquidity are a consequence of disasters. DAMAGE is positively correlated with bank z-score, equity ratio (CAP), and loans to assets ratio (LOANS). The association may be evidence of an increase in equity capital to buffer against loss caused by disasters to protect bank stability and increase credit supply to support the recovery process. There is an insignificant correlation between DAMAGE and credit risk (CRERISK) and profitability (ROA). A formal examination of the impact of disasters is provided in the empirical analysis, below. Overall, the bank-level variables and macroeconomic variables are found not to be highly correlated with each other, implying that the joint inclusion of these variables is unlikely to lead to concerns about multi-collinearity (confirmed by low VIF statistics of all models run, as reported at Table 4.4 below).

Table 4.3: The pairwise correlation among variables

	Z-score	LIQ	CRERISK	ROA	DEPO	CAP	INC_DIV	COST	CHARTER	LOANS	CON	DAMAGE	CLAIM	IFL	GDP	PRICRE	INT	ACT	SUP	PRIMON
Z-score	1.00																			
LIQ	-0.02	1.00																		
CRERISK	-0.23**	0.17**	1.00																	
ROA	0.11**	0.14**	-0.17**	1.00																
DEPO	-0.01	-0.27**	-0.07**	-0.03	1.00															
CAP	0.15**	0.42**	0.18**	0.20**	-0.46**	1.00														
INC_DIV	-0.03	0.25**	0.15**	0.16**	-0.23**	0.25**	1.00													
COST	-0.18**	0.07**	0.23**	0.03	0.05**	0.21**	0.11**	1.00												
CHARTER	0.09**	0.14**	-0.02	0.04**	0.09**	-0.13**	-0.08**	-0.25**	1.00											
LOANS	-0.01	-0.57**	-0.06**	0.00	0.01	0.00	-0.21**	0.12**	-0.21**	1.00										
CON	-0.12**	0.08**	0.09**	0.02	0.17**	-0.03	-0.05**	0.00	0.16**	-0.04**	1.00									
DAMAGE	0.05**	-0.07**	-0.04	-0.04	-0.14**	0.05**	0.03	-0.05	-0.11**	0.09**	-0.03	1.00								
CLAIM	0.01**	0.13**	0.00	0.03	-0.06**	0.09**	0.26**	-0.06**	-0.20**	-0.08	0.29**	0.05**	1.00							
IFL	-0.16**	0.18**	0.07**	0.18**	0.11**	0.15**	-0.08**	0.30**	-0.12**	-0.03**	0.22**	-0.06**	-0.14**	1.00						
GDP	-0.07**	0.07**	-0.01	0.06**	0.12**	-0.09**	-0.14**	-0.06**	0.22**	-0.11	0.09**	-0.01	-0.23**	0.26**	1.00					
PRICRE	0.19**	-0.18**	-0.26**	-0.19**	-0.09**	-0.24**	-0.11**	-0.54**	0.24**	0.01**	-0.14**	0.15**	0.27**	-0.61**	-0.10**	1.00				
INT	-0.05**	0.02	0.12*	-0.01	-0.01	0.08**	0.06**	0.15**	-0.18**	0.01	0.11**	-0.10**	0.11**	0.05**	-0.43**	-0.17**	1.00			
ACT	-0.03	-0.06**	-0.16**	-0.01	0.11**	-0.16**	-0.42**	-0.24**	0.36**	0.04	0.02	-0.03	-0.55**	0.16**	0.45**	0.14**	-0.40**	1.00		
SUP	0.00	0.17**	-0.07**	0.14**	0.00	0.19**	-0.02	0.10**	-0.11**	0.00	-0.15**	0.02	-0.12**	0.31**	0.31**	-0.32**	-0.28**	0.52**	1.00	
PRIMON	0.00	-0.22**	-0.26**	-0.15**	-0.01	-0.19**	-0.24**	-0.26**	0.27**	0.25**	-0.12**	0.02	-0.27**	-0.15**	0.16**	0.29**	-0.13**	0.37**	0.04	1.00

The table reports the Pearson rank correlation coefficients among variables. ** indicates statistical significance at the 5% level.

4.5 EMPIRICAL ANALYSIS

4.5.1 Impact of Natural Disasters on Bank Performance Ratios

Table 4.4 reports the impact of natural disasters on various measures of bank performance to test H1. Several pre- and post-estimation tests are also reported at the end of this table.[47] With regard to pre-diagnostic tests, the DWH test for endogeneity confirms the endogenous relationship between bank-level covariates and the dependent variable. With regard to the post-estimation tests, the AR(2) test is statistically insignificant, confirming the absence of the second-order serial correlation. The high p-values reported for the Hansen J-statistics and the difference-in-Hansen tests suggest that the full set of instruments as well as each subset of instruments are valid (for a detailed list of instruments, please refer to the note in Table 4.4).[48]

Moving to the impact of disasters on bank performance, as seen in Column 1 of Table 4.4, disasters significantly lower deposits ratio. The result is consistent with evidence of deposit withdrawal in the small Eastern Caribbean islands following disasters reported by Brei et al. (2019). The finding implies that depositors in East Asian countries withdraw cash from banks to cope with losses. Skidmore (2001) reports that there is a higher propensity to save money in disaster-vulnerable countries. This is certainly the case for the sample of East Asian countries in this study; many of which have experienced substantial losses from disasters (as shown in Figure 4.1). Deposit withdrawals triggered by catastrophic events is a form of self-insurance and is essential in countries where the

[47] With regard to the (unreported) unit root test, the null of non-stationary is rejected at the 1% level for all variables used in the baseline regression. SIZE is dropped from the regression due to the presence of a unit root.

[48] In the case of liquidity (LIQ), credit risks (CRERISK), profitability (ROA), and default risk (LN(zscore)) being the dependent variable, regulation and financial integration are treated as pre-determined variables (this is similar to Chapter 3). However, in the case of deposits ratio (DEPO) in the first column, the Hansen test and difference-in-Hansen test indicate that regulation and financial integration should be treated as an exogenous variable. Appendix C1 reports the results when these variables are treated as pre-determined ones. In this specification, the Hansen test and the difference-in-Hansen test are both lower, while the number of instruments is higher than the baseline. All other results are quantitatively similar. Therefore, the baseline results report when these variables are treated as exogenous.

insurance markets cannot provide a sufficient level of protection against possible disaster losses (Nguyen and Wilson, 2018). In terms of economic impact, a 1-percentage-point increase in DAMAGE is associated with a 0.7-percentage-point decrease in deposits ratio.[49]

Columns 2 to 5 of Table 4.4 report no significant impact of disasters on liquidity (LIQ), credit risk (CRERISK), profitability (ROA), and default risk (LN(zscore)).[50] This is contrary to the prior evidence of a lower profitability and credit quality in the US sample (Noth and Schüwer, 2018), a tightened liquidity in the Caribbean sample (Brei et al., 2019), and a higher bank default risk in the world-wide sample (Klomp, 2014). This result should be interpreted with caution. In the context of the dynamic model, the result indicates that these ratios do not show a *contemporaneous* response toward natural disasters.[51] Furthermore, the regression approach provides an assessment of an overall condition, i.e. central tendency or 'on average'. In this sense, the negative impact will not be detected unless all banks (or a large number of them) are impacted.

The specific context of the East Asian sample could partly explain this result. As seen in Figure 4.2, the majority of disasters have a small-scale impact, with DAMAGE

[49] The interpretation is more meaningful in the context of specific disasters. For instance, the Sichuan earthquake in 2008 (China) with reported DAMAGE of 3.1% GDP is associated with a 2.17-percentage-point reduction in the deposits ratio. The Haiyan cyclone in 2013 (the Philippines) with DAMAGE of 4.9% results in a reduction of 3.5 percentage points in the deposits ratio. The 2011 flooding in Thailand with resulting DAMAGE of 17% leads to a reduction of 12.7 percentage points in the deposits ratio.

[50] As CAP and ROA are components to compute bank default risk. The inclusion of these two variables in the model of bank default risk could lead to the concern of endogeneity. Appendix C2 provides the result when these two variables are excluded from the regression; the finding remains unchanged.

[51] It could be a case of delayed impact as it may take time for a bank to experience the full impact of disaster damage. Though not central to the chapter's analysis, the chapter further investigates the one-year lagged impact of disasters on bank performance in Appendix C3. As seen in Panel A, the finding is robust in the case of credit risk, profitability, and stability; these measures do not response both to the contemporaneous as well as one-year lagged impact of disasters. The response of deposits ratio toward the contemporaneous impact of disasters remains unchanged. More interestingly, in the period following disasters, deposits ratio rebounds; this finding suggests that households may deposit their insurance payment, aid, or remittances into banks, leading to an increase in bank deposits. Due to deposits growth or the extension of recovery loans, banks liquidity declines in this period; this finding also confirms the evidence of the delayed impact of disasters on bank liquidity.

being lower than 1% GDP. The statistically insignificant impact of DAMAGE reported in Table 4.4 may be attributed to the small scale of the disasters not affecting the *majority* of the sampled banks. Klomp (2014) also reports an insignificant impact of disasters on bank default risk in his robustness test when all disaster events (regardless of magnitude) are sampled. Additionally, with regard to the frequency of disasters, if there are few large-scale events recorded for the sampled countries, disasters are also not likely to affect the majority of the sampled banks.[52]

The Asian banking system has undergone important reforms following the Asian financial crisis (Asian Development Bank, 2008). Examining the period of 1999–2014, the chapter possibly captures the positive impact of these reforms via the banking system's resilience against disasters. Additionally, Chapter 2 and Chapter 3 find that financial integration has helped to improve bank cost efficiency and lower distance to default. This improvement would also contribute to the resilience of the sampled commercial banks.

Natural disasters result in spatially correlated losses if a bank's lending portfolio is geographically and economically concentrated (Brei et al., 2019). It has been shown that banks that belong to a geographically diversified banking group are better able to withstand the adverse impact of disasters (Koetter et al., 2019). Thus, the insignificant impact of disasters on several bank ratios may be due to bank lending diversification (by sectors and regions) and its contribution to the resilience of the majority of East Asian

[52] Providing the impact of large-scale disasters on bank performance ratios, Appendix C4 confirms this argument. When only large-scale events (i.e. events with economic loss being greater either than 1% GDP or 0.5% banking assets size, in line with Klomp's (2014) definition) are sampled, the number of disasters falls from 1,319 events to 26 events over the period of 1999–2014. The robustness result is quantitatively similar to the baseline one reported in Table 4.4, in which only the deposits ratio is significantly and adversely affected.

commercial banks against the impact of natural disasters. Overall, H1 is accepted for the deposits ratio only.

Table 4.4: Impact of disasters on bank performance ratios

	(1)	(2)	(3)	(4)	(5)
	DEPO	LIQ	CRERISK	ROA	LN (zscore)
L.Y	0.694***	0.443***	0.683***	0.303***	0.408***
	(0.06)	(0.10)	(0.10)	(0.07)	(0.05)
DAMAGE	-0.720**	-0.207	-0.171	0.060	0.034
	(0.28)	(0.35)	(0.15)	(0.04)	(0.03)
CLAIM	-0.195	-0.237	-0.122	0.072**	0.079***
	(0.21)	(0.27)	(0.14)	(0.03)	(0.03)
CAP	0.197*	0.582**	-0.218*	0.018	0.061***
	(0.12)	(0.27)	(0.13)	(0.02)	(0.02)
CRERISK	0.108*	0.229*		-0.004	-0.005
	(0.06)	(0.13)		(0.01)	(0.01)
INC_DIV	-0.079	0.199	0.192*	0.008	-0.023*
	(0.10)	(0.15)	(0.11)	(0.01)	(0.01)
COST	-0.579	-0.033	-0.021	-0.131	-0.167**
	(0.72)	(1.06)	(0.34)	(0.15)	(0.08)
ROA	2.414**	-0.438	0.749		0.105
	(1.00)	(1.83)	(0.79)		(0.10)
LOANS	0.013	-0.638***	0.115**	0.012	
	(0.07)	(0.18)	(0.05)	(0.01)	
CHARTER			0.113**	0.007	0.006
			(0.05)	(0.02)	(0.01)
CON	-0.606	-0.254	-0.242	0.131*	0.087*
	(0.44)	(0.37)	(0.22)	(0.07)	(0.05)
IFL	-0.055	0.643	0.226	0.035	-0.025
	(0.24)	(0.47)	(0.18)	(0.04)	(0.04)
GDP	-0.090	0.359*	0.034	-0.009	-0.028*
	(0.09)	(0.19)	(0.08)	(0.02)	(0.02)
PRICRE	0.191	0.410*	0.035	-0.055*	-0.052**
	(0.12)	(0.23)	(0.10)	(0.03)	(0.02)
INT	-0.025	0.736**	0.136	-0.020	-0.041*
	(0.18)	(0.30)	(0.12)	(0.03)	(0.02)
INS	9.344***	8.890*	-0.178	-1.441*	-0.553
	(2.81)	(4.61)	(2.02)	(0.77)	(0.54)
ACT	0.592	1.798	-1.044	0.164	0.306**
	(1.32)	(1.48)	(0.80)	(0.15)	(0.15)
SUP	-0.627	-3.538**	0.705	0.193	0.139
	(0.57)	(1.46)	(0.48)	(0.15)	(0.12)
PRIMON	-3.862	-2.880	-0.188	0.728	0.790**
	(2.62)	(2.58)	(1.63)	(0.45)	(0.35)
ODUM	-3.645**	-0.868	-0.224	-0.160	-0.087
	(1.52)	(1.80)	(0.79)	(0.20)	(0.11)
CRISIS	5.849	12.165	6.968	-2.761*	-1.695*

	(8.09)	(7.91)	(5.05)	(1.49)	(1.01)
Constant	69.839	46.556	4.606	-12.158	-8.760
	(44.76)	(38.20)	(24.88)	(7.45)	(5.36)
#Obs.	810	810	810	810	810
# Banks	194	194	194	194	194
# IV	95	103	103	103	103
AR(2) test (p value)	0.196	0.876	0.168	0.101	0.504
Hansen-J test (p value)	0.653	0.164	0.862	0.494	0.465
Diff-In-Hansen test (p value):					
GMM instruments for level	0.620	0.161	0.742	0.763	0.368
GMM instruments for the lagged dependent var.	0.673	0.128	0.89	0.689	0.633
GMM instruments for endogenous bank-level var.	0.684	0.129	0.756	0.609	0.375
GMM (IV) instruments for regulation and financial integration var.	0.796	0.38	0.827	0.318	0.512
IV instruments for other exogenous var.	0.664	0.256	0.935	0.742	0.444
DWH endogeneity test	0.00	0.00	0.00	0.00	0.00
Mean VIFs (maximum)	2.23 (4.34)	2.23 (4.34)	2.24 (4.39)	2.25 (4.36)	2.24 (4.39)

The table reports the impact of disasters on various bank ratios as in Equation 4.1:

$$Y_{ijt} = \beta_0 Y_{ijt-1} + \beta_1 DAMAGE_{jt} + \beta_2 INTEG_{jt} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt}$$

The dependent variables are ratios of deposits (DEPO), liquidity (LIQ), credit risk (CRERISK), and distance to default (LN(zscore)). Disaster damage is proxied via the ratio of economic loss to a country's previous year GDP (DAMAGE). For the definition and construction of other control variables, see Table 4.1. Bank fixed effect, country and time dummies are included, but not reported to save space.

All models are estimated by the system GMM. For the dependent variable and endogenous bank-level control variables, their second and third lagged values are used as instruments in the transformed equation and the first lag of their differenced values are used as instruments in the level equation. Financial integration (CLAIM) and regulation variables (ACT, SUP and PRMON) are treated as pre-determined variables in all the cases except for deposits ratio (DEPO) in Column 1, where they are treated as exogenous variables. For these pre-determined variables, their first and second lagged values are used as instruments in the transformed equation; their differenced values are used as instruments in the level equation. Other variables (including disaster damage (DAMAGE) and other country-level control variables) are treated as exogenous ones. Accordingly, their differenced values are used as instruments in the transformed equation; their level values are used as instruments in the level equation. The system GMM is run by the *xtabond2* Stata syntax written by Roodman (2006). *Collapse* option are used in specifying instruments for the endogenous and predetermined variables. As there are gaps in the sample panel, the forward orthogonal deviations transform (*orthogonal* option) is used instead of first differencing to maximise the sample size. *Twostep* along with the *robust* option is used to obtain the finite sample corrected two-step covariance matrix following Windmeijer (2005) correction. *Small* option is to adjust the estimates for small-sample and report t-statistics instead of z-statistics.

Insignificant value of AR(2) tests confirm the absence of the serial correlation in the second order. Similarly, insignificant value of Hansen J-statistics test and difference-in-Hansen test ensures the validity of the instruments. The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

The impact of other determinants on deposits ratio (DEPO) are presented in Column 1. Specifically, banks operating in countries with explicit deposit insurance schemes (INS) and with higher equity ratio (CAP), higher profitability (ROA), and higher credit risk (CREISK) attract higher deposits. As seen from Column 2, a higher loans to assets ratio (LOANS) together with greater ability by supervisory agencies (SUP) to exercise oversight, results in lower bank liquidity (LIQ). Conversely, the combination of higher real interest rates (INT) and a greater equity ratio (CAP) improves bank liquidity. There is also marginal evidence that deposit insurance (INS) and economic growth (GDP) improve bank liquidity. The model estimated for bank credit risk (CRERISK) is reported in Column 3. Greater proportions of loans to assets (LOAN) and customer demand deposits to assets (CHARTER) significantly increase bank credit risk. There is also marginal evidence that higher equity ratio (CAP) reduces credit risk, whereas bank income diversification (INC_DIV) increases credit risk. The estimated model reported in Column 4 shows that greater financial integration (CLAIM) improves bank profitability (ROA). There is some evidence that private sector bank credit (PRICRE) and deposit insurance (INS) reduce bank profitability and greater market concentration (CON) increases bank return on assets. The results of other determinants on bank distance to default (LN(zscore)), reported in Column 5, are congruent to those reported in Chapter 3; notably, financial integration significantly lowers bank default risk.

4.5.2 The Moderating Role of Financial Integration and Its Components

Table 4.5 first establishes the baseline result on the moderating role of financial integration to address H2 (see Section 4.2). Tables 4.6 and 4.7 explore the variation of this moderating role that can be attributed to the lenders' nationality (Asian claims versus

non-Asian claims, as articulated in H3) and the methods of extension (local claims versus cross-border claims, as per H4).[53]

As seen in Table 4.5, the coefficient of the interaction term between CLAIM and DAMAGE is significant and positive, indicating that the total foreign banking claims help to alleviate the bank deposits decline during the aftermath of disasters.[54] The result implies that foreign banking claims serve as an alternative source of finance (in addition to bank deposits) to support the post-disaster recovery of households and firms. This implication seems to contradict the result of Noy (2009) in the context of economic growth. Noy (2009) reports that countries with a less open capital account are less vulnerable to 'capital flight' following disasters, and therefore better able to endure natural disasters. However, this is not true for the sampled East Asian countries in this study. This suggests that mild-impact disasters have not triggered foreign capital outflows from the sampled countries. Overall, the evidence strongly supports H2.

[53] In Table 4.5-4.7, the interaction terms are created by multiplying the measures of financial integration and disasters damage. To ease the concern of multi-collinearity, it is suggested that these variables should be demeaned before their relevant interaction terms are created. Either approach provides similar findings with the significance level of all the interaction terms being unchanged. The results from demeaning option is provided in Appendix C5.

[54] As seen in Panel B of Appendix C3, this finding also holds in the presence of the one-year lagged impact of disasters.

Table 4.5: The moderating of financial integration on the impact of disasters on the deposits ratio

	(1)
	DEPO
L.Y	0.699***
	(0.06)
DAMAGE	-6.739***
	(1.68)
CLAIM	-0.599**
	(0.26)
DAMAGE_CLAIM	0.243***
	(0.06)
CAP	0.232*
	(0.12)
CRERISK	0.122*
	(0.06)
INC_DIV	-0.070
	(0.10)
COST	-0.453
	(0.80)
ROA	2.694***
	(0.98)
LOANS	0.014
	(0.07)
CON	-0.896*
	(0.46)
IFL	-0.099
	(0.24)
GDP	-0.059
	(0.08)
PRICRE	0.354**
	(0.15)
INT	0.062
	(0.17)
INS	12.090***
	(3.24)
ACT	-0.888
	(1.48)
SUP	-0.505
	(0.52)
PRIMON	-6.539**
	(2.93)
ODUM	-3.680**
	(1.45)
CRISIS	15.690*
	(9.21)
Constant	106.444**
	(47.75)
#Obs.	810

# Banks	194
# IV	96
AR(2) test (p value)	0.191
Hansen-J test (p value)	0.738
Diff-In-Hansen test (p value):	
GMM instruments for level	0.816
GMM instruments for the lagged dependent variable	0.791
GMM instruments for endogenous bank-level variables	0.717
IV instruments for regulation and financial integration	0.905
IV instruments for other exogenous variables	0.751

The table reports the moderating role of financial integration (CLAIM) on the impact of disasters on bank deposits ratio as in Equation 4.2:

$$Y_{ijt} = \beta_0 Y_{ijt-1} + \beta_1 DAMAGE_{jt} + \beta_2 INTEG_{jt} + \beta_3 DAMAGE_{it} * INTEG_{jt} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt}$$

The dependent variables is the ratio of customers deposits to total assets (DEPO). Disaster damage is proxied via the ratio of economic loss to a country's last year GDP (DAMAGE). Other variables and the system GMM specification remain unchanged (as reported in Table 4.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4.6 reports evidence of the moderating effect of foreign claims extended by Asian and non-Asian lenders. The significant negative coefficient for ASIAN reported in Column 1 shows that Asian claims significantly lower bank deposits ratio. However, there is no relationship for non-Asian claims (Column 3). This is feasible, as banks could source their funds via inter-bank borrowing from Asian foreign banks in addition to retail deposits. This finding also reinforces the argument (postulated in Section 3.2) that competition pressure is more pronounced when foreign claims are extended from regional Asian lenders compared with the distant non-Asian counterparts. Column 2 of Table 4.6 reports evidence of the moderating impact of ASIAN claims on the impact of natural disasters (H3). The coefficient for the interaction term between ASIAN and DAMAGE is significant and positive. This is in contrast to the insignificance of non-Asian claims reported in Column 4. The significant Asian interaction term suggests that Asian claims help to alleviate the decline in bank deposits ratio following disasters. The result lends support to H3 and favours the 'neighbouring' claims extended by the Asian lenders.

Table 4.6: The moderation of Asian and non-Asian claims

	(1)	(2)	(3)	(4)
	DEPO	DEPO	DEPO	DEPO
L.Y	0.717***	0.709***	0.694***	0.695***
	(0.06)	(0.06)	(0.07)	(0.07)
DAMAGE	-1.075***	-3.725**	-0.552***	-1.573
	(0.31)	(1.53)	(0.21)	(0.98)
ASIAN	-0.809***	-0.698**		
	(0.30)	(0.29)		
DAMAGE_ASIAN		0.294*		
		(0.16)		
NON_ASIAN			0.229	0.061
			(0.32)	(0.44)
DAMAGE_NONASIAN				0.121
				(0.11)
CAP	0.210*	0.196*	0.188	-0.181
	(0.11)	(0.12)	(0.12)	(0.12)
CRERISK	0.104	0.100	0.132**	0.138**
	(0.07)	(0.07)	(0.07)	(0.07)
INC_DIV	-0.079	-0.070	-0.130	-0.128
	(0.09)	(0.08)	(0.10)	(0.10)
COST	-0.618	-0.672	-0.696	-0.632
	(0.65)	(0.65)	(0.72)	(0.74)
ROA	2.413**	2.437**	2.162**	2.037**
	(1.01)	(1.01)	(1.00)	(0.97)
LOANS	0.000	-0.007	0.012	0.020
	(0.07)	(0.07)	(0.07)	(0.07)
CON	-0.595*	-0.538	-0.134	-0.139
	(0.34)	(0.33)	(0.43)	(0.47)
IFL	-0.090	-0.191	0.059	0.090
	(0.22)	(0.23)	(0.26)	(0.26)
GDP	-0.084	-0.106	-0.123	-0.126
	(0.08)	(0.08)	(0.08)	(0.08)
PRICRE	0.230***	0.184***	0.025	0.047
	(0.06)	(0.06)	(0.11)	(0.13)
INT	0.046	0.005	-0.017	-0.027
	(0.16)	(0.16)	(0.17)	(0.16)
INS	10.292***	9.809***	8.186***	7.693***
	(2.26)	(2.18)	(2.09)	(2.09)
ACT	0.759	0.672	1.964*	1.697
	(0.89)	(0.90)	(1.16)	(1.28)
SUP	-0.332	-0.202	-0.329	-0.296
	(0.49)	(0.48)	(0.56)	(0.57)
PRIMON	-4.321**	-3.862**	-1.153	-1.446
	(1.94)	(1.86)	(2.33)	(2.63)
ODUM	-3.509**	-3.859***	-3.569**	-3.582**
	(1.38)	(1.44)	(1.54)	(1.49)
CRISIS	5.219	5.455	-4.034	-2.843
	(5.57)	(5.63)	(8.19)	(9.51)

Constant	62.440*	61.556*	20.276	23.182
	(35.15)	(34.71)	(45.35)	(50.33)
#Obs.	810	810	810	810
# Banks	194	194	194	194
# IV	95	96	95	96
AR(2) test (p value)	0.184	0.172	0.107	0.120
Hansen-J test (p value)	0.648	0.665	0.628	0.590
Diff-In-Hansen test (p value):				
GMM instruments for level	0.747	0.804	0.605	0.674
GMM instruments for the lagged dependent var.	0.453	0.510	0.550	0.527
GMM instruments for endogenous bank-level var.	0.73	0.869	0.637	0.626
IV instruments for regulation and financial integration var.	0.768	0.664	0.945	0.874
IV instruments for other exogenous var.	0.761	0.791	0.625	0.521

This table reports the moderating role of Asian claims (ASIAN) and non-Asian claims (NON_ASIAN) on the impact of disasters on bank deposits ratio (DEPO). Other variables and the system GMM model specification remain unchanged from Table 4.4. The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4.7 reports the result when the total foreign banking claims are classified into local claims and cross-border claims. Comparing the coefficients for LOCAL and CROSS in Columns 1 and 3, local claims significantly lower the bank deposits ratio, while cross-border claims do not. This again reinforces the argument (presented in Section 3.2) that local claims exert higher competitive pressure than cross-border claims. The coefficient for the interaction term between LOCAL and DAMAGE reported in Column 2 is positive as expected; however, the standard error is quite large, making the coefficient insignificant. This could be due to the lack of variation in the response of local claims to natural disasters. The coefficient of the interaction term between CROSS and DAMAGE given in Column 4 is also insignificant. Overall, the evidence on the moderating role of both local and cross-border claims is unclear, leading to the rejection of H4.

Table 4.7: The moderation of local claims and cross-border claims

	(1)	(2)	(3)	(4)
	DEPO	DEPO	DEPO	DEPO
L.Y	0.726***	0.725***	0.678***	0.684***
	(0.11)	(0.11)	(0.09)	(0.09)
DAMAGE	-0.972*	-3.782*	-0.529	-0.765
	(0.52)	(2.10)	(0.45)	(3.59)
LOCAL	-0.787*	-0.971**		
	(0.45)	(0.48)		
DAMAGE_LOCAL		0.189		
		(0.14)		
CROSS			-0.084	-0.196
			(0.43)	(0.41)
DAMAGE_CROSS				0.026
				(0.61)
CAP	0.284*	0.288*	0.246	0.255
	(0.15)	(0.15)	(0.16)	(0.16)
CRERISK	0.081	0.082	0.140	0.126
	(0.14)	(0.13)	(0.17)	(0.16)
INC_DIV	0.037	0.038	-0.048	-0.035
	(0.13)	(0.13)	(0.13)	(0.14)
COST	-0.284	-0.330	-0.515	-0.518
	(0.85)	(0.85)	(0.82)	(0.87)
ROA	1.588	1.614	1.495	1.392
	(1.51)	(1.52)	(1.41)	(1.43)
LOANS	0.077	0.078	0.057	0.060
	(0.12)	(0.12)	(0.12)	(0.12)
CON	-0.820	-0.750	-0.408	-0.538
	(0.54)	(0.51)	(0.53)	(0.60)
IFL	-0.371	-0.389	-0.156	-0.159
	(0.28)	(0.28)	(0.30)	(0.31)
GDP	0.087	0.055	-0.038	-0.048
	(0.12)	(0.13)	(0.09)	(0.13)
PRICRE	0.348*	0.357*	0.150	0.146
	(0.19)	(0.19)	(0.13)	(0.14)
INT	0.341	0.303	0.023	0.021
	(0.44)	(0.43)	(0.35)	(0.41)
INS	8.883	8.379	8.978	9.697
	(6.35)	(5.85)	(6.05)	(6.41)
SUP	0.336	0.524	-0.354	0.068
	(3.16)	(2.91)	(2.60)	(3.17)
PRIMON	-3.307	-3.240	-3.710	-3.237
	(7.22)	(6.80)	(6.12)	(6.51)
ODUM	-2.785	-2.886*	-2.934	-2.832
	(1.74)	(1.74)	(1.81)	(1.75)
Constant	153.036**	170.570**	50.412	57.369
	(69.21)	(74.43)	(39.56)	(41.44)
#Obs.	589	589	589	589
# Banks	148	148	148	148

# IV	74	75	74	75
AR(2) test (p value)	0.208	0.209	0.179	0.18
Hansen-J test (p value)	0.656	0.674	0.555	0.552
Diff-In-Hansen test (p value):				
GMM instruments for level	0.883	0.888	0.789	0.868
GMM instruments for the lagged dependent var.	0.515	0.543	0.339	0.317
GMM instruments for endogenous bank-level var.	0.966	0.970	0.931	0.941
IV instruments for regulation and financial integration var.	0.591	0.802	0.573	0.570
IV instruments for other exogenous var.	0.919	0.94	0.812	0.809

This table reports the moderating role of local claims (LOCAL) and cross-border claims (CROSS) on the impact of disasters on bank deposits ratio (DEPO). The examined period is 2005–2014. Other variables and the system GMM model specification remain unchanged from Table 4.4; ACT and CRISIS is dropped due to collinearity. The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

4.6 CHAPTER SUMMARIES

The chapter adds to the literature on the impact of natural disasters on bank-level performance using cross-country evidence from East Asia. Specifically, natural disasters significantly lower the bank deposits ratio, suggesting that depositors withdraw cash from banks to cope with disaster losses. However, bank liquidity, credit risk, profitability, and default risk are not affected by disasters. A conservative interpretation of disaster insignificance in the context of the dynamic panel data model is that bank liquidity, credit risk, profitability, and default risk are not *contemporaneously* related to natural disasters. This may be explained by the small-scale damages of most disasters, the resilience, and the lending diversification of the sampled banks.

With regard to the moderating role of financial integration, total foreign banking claims help to alleviate the bank deposits decline in the aftermath of disasters. The moderating role of financial integration is found to be present in the case of foreign claims extended by Asian lenders (but not for non-Asian lenders). There is no evidence of a moderating role for either local claims or cross-border claims. This may be due to the lack of variation in the response of these types of claims to disasters.

The chapter has implications in terms of managing the impact of natural disasters on banks in the context of financial integration. The results highlight that bank deposits and foreign banking claims (specifically Asian claims) serve as sources of funds to support the post-disaster recovery. Together with other sources, such as bank credit, government support, remittance, and foreign aid, these provide multiple channels for households and firms to obtain the relatively immediate access to finance, which is fundamentally important for disaster recovery.

As the occurrence of natural disasters may destroy information on borrowers and collateral values, information advantage is crucial for lenders to maintain their credit supply. This makes disasters a special context to test the preference of the two definitions of 'neighbours' banking, which may have this informational advantage, i.e. being either (i) banks from other Asian countries or (ii) a foreign banks presence via a full affiliate office in the recipient countries. The results highlight the resilience of the foreign claims extended by Asian lenders in the event of local shocks, which is not present for the case of the foreign claims extended via local affiliates of foreign banks. This further supports the evidence documented in Chapter 3 of support for intra-regional financial integration in East Asia.

APPENDIX C1: ROBUSTNESS TO TABLE 4.4- DEPOSITS RATIO

(Regulation and financial integration variables are treated as pre-determined variables)

	(1)
	DEPO
L.Y	0.697***
	(0.05)
DAMAGE	-0.957***
	(0.28)
CLAIM	-0.298
	(0.21)
CAP	0.187*
	(0.11)
CRERISK	0.066
	(0.06)
INC_DIV	0.003
	(0.09)
COST	-0.279
	(0.61)
ROA	1.757*
	(1.01)
LOANS	0.026
	(0.07)
CON	-0.904**
	(0.38)
IFL	-0.257
	(0.23)
GDP	-0.111
	(0.09)
PRICRE	0.225
	(0.14)
INS	-0.127
	(0.18)
INT	8.935**
	(3.84)
ACT	-0.454
	(1.18)
SUP	-0.098
	(0.78)
PRIMON	-5.655**
	(2.31)
ODUM	-3.601***
	(1.31)

CRISIS	11.313
	(7.31)
Constant	104.023***
	(37.16)
#Obs.	810
# Banks	194
# IV	103
AR(2) test (p value)	0.190
Hansen-J test (p value)	0.588
Diff-In-Hansen test (p value):	
GMM instruments for level	0.939
GMM instruments for the lagged dependent variable	0.588
GMM instruments for endogenous bank-level variables	0.815
GMM instruments for regulation and financial integration variables	0.779
IV instruments for exogenous variables	0.513

This table reports the impact of disasters on bank deposits ratio when regulation and financial integration variables are treated as predetermined variables to evoke their GMM-style instrument in the system GMM. Other variable definitions and model specification remain unchanged from Table 4.4.

APPENDIX C2: EXCLUSION OF CAPITAL RATIO AND PROFITABILITY FROM THE MODEL OF BANK DEFAULT RISK

	(1)
L.LN(zscore)	0.490***
	(0.05)
CLAIM	0.069**
	(0.03)
DAMAGE	0.022
	(0.03)
Other control variables	Yes
No. of obs	810
No. of banks	194
No. of IV	97
AR(2) test	0.404
Hansen test	0.189
Diff-in-Hansen test for GMM instrument	0.159

This table presents finding when capital ratio (CAP) and profitability (ROA) are excluded from the regression of bank default risk to ease the concern of endogeneity. Other variables and the system GMM specification remain unchanged (as reported in Table 4.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX C3: THE LAGGED EFFECT OF DISASTERS DAMAGE

Panel A: The one-year lagged impact of disasters on bank performance

	(1) DEPO	(2) LIQ	(3) CRERISK	(4) ROA	(5) LN(zscore)
L.Y	0.719***	0.446***	0.681***	0.304***	0.411***
	(0.06)	(0.10)	(0.09)	(0.07)	(0.05)
DAMAGE	-0.830***	-0.330	-0.167	0.040	0.029
	(0.27)	(0.34)	(0.16)	(0.04)	(0.03)
L.DAMAGE	0.710**	-0.458*	-0.021	-0.014	0.007
	(0.33)	(0.28)	(0.11)	(0.03)	(0.03)
CLAIM	-0.045	-0.391	-0.099	0.053	0.071**
	(0.20)	(0.25)	(0.18)	(0.03)	(0.03)
CAP	-0.221**	0.617**	-0.210*	0.021	0.061***
	(0.11)	(0.27)	(0.12)	(0.02)	(0.02)
CRERISK	0.096	0.226*		-0.006	-0.006
	(0.06)	(0.13)		(0.01)	(0.01)
INC_DIV	-0.094	0.195	0.192*	0.010	-0.025*
	(0.09)	(0.15)	(0.11)	(0.01)	(0.01)
COST	-0.549	-0.009	-0.032	-0.139	-0.180**
	(0.68)	(1.03)	(0.33)	(0.14)	(0.08)
ROA	2.148**	-0.467	0.690		0.109
	(0.97)	(1.82)	(0.82)		(0.10)
LOANS			0.113**	0.010	0.006
			(0.05)	(0.02)	(0.01)
CHARTER	0.002	-0.643***	0.114**	0.012	
	(0.06)	(0.17)	(0.05)	(0.01)	
CON	-0.486	-0.445	-0.220	0.085	0.077
	(0.41)	(0.34)	(0.26)	(0.08)	(0.05)
IFL	-0.218	0.731	0.247	0.023	-0.032
	(0.23)	(0.48)	(0.18)	(0.04)	(0.03)
GDP	-0.134	0.369*	0.031	-0.007	-0.028*
	(0.09)	(0.19)	(0.07)	(0.02)	(0.02)
PRICRE	0.126	0.462**	0.021	-0.044	-0.051**
	(0.13)	(0.22)	(0.12)	(0.03)	(0.02)
INT	-0.031	0.706**	0.136	-0.016	-0.044*
	(0.16)	(0.29)	(0.12)	(0.02)	(0.02)
INS	9.754***	8.374*	-0.470	-1.197	-0.584
	(2.37)	(4.53)	(2.05)	(0.79)	(0.56)
ACT	1.586	0.613	-0.983	0.064	0.257
	(1.31)	(1.56)	(1.01)	(0.15)	(0.16)
SUP	-0.904**	-3.020**	0.743	0.189	0.153
	(0.44)	(1.44)	(0.50)	(0.15)	(0.12)
PRIMON	-2.940	-4.048	-0.082	0.477	0.749**
	(2.53)	(2.57)	(1.86)	(0.46)	(0.38)

ODUM	-3.179**	-1.125	-0.230	-0.191	-0.091
	(1.36)	(1.80)	(0.78)	(0.19)	(0.11)
CRISIS	3.303	16.383**	6.481	-1.882	-1.440
	(7.77)	(7.42)	(5.53)	(1.54)	(1.07)
Constant	52.832	70.209*	3.053	-7.647	-7.573
	(43.12)	(36.52)	(28.22)	(7.56)	(5.64)
No. of obs	810	810	810	810	810
No. of banks	194	194	194	194	194
No. of IV	96	104	104	104	104
AR(2) test	0.393	0.827	0.163	0.119	0.561
Hansen test	0.681	0.197	0.884	0.517	0.45
Diff-in-Hansen test for GMM IV.	0.792	0.144	0.761	0.742	0.377

This table presents the one-year lagged impact of disasters damage on various measures of banks performance. The model is presented as follows: $Y_{ijt} = \beta_0 Y_{ijt-1} + \beta_1 DAMAGE_{jt} + \boldsymbol{\beta_2 L.DAMAGE_{jt}} + \beta_3 INTEG_{jt} + \beta_k BANK^k_{ijt} + \beta_m COUNTRY^m_{jt} + \theta_i + \gamma_j + \mu_t + \varepsilon_{ijt}$
Other variables and the system GMM specification remain unchanged (as reported in Table 4.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel B: The moderation of financial integration

	(1) DEPO	(2) DEPO	(3) LIQ	(4) LIQ
L.Y	0.720***	0.730***	0.439***	0.441***
	(0.06)	(0.06)	(0.09)	(0.09)
DAMAGE	-5.619***	-0.577**	-0.876	-0.411
	(2.12)	(0.25)	(2.94)	(0.33)
L.DAMAGE	-0.579	2.208*	2.156	1.479
	(1.64)	(1.15)	(3.37)	(2.71)
CLAIM	-0.375	0.232	-0.358	-0.381
	(0.31)	(0.15)	(0.40)	(0.27)
DAMAGE#CLAIM	0.199**		0.021	
	(0.08)		(0.12)	
L.DAMAGE#CLAIM	0.040	-0.048	-0.095	-0.071
	(0.06)	(0.04)	(0.12)	(0.10)
Other control variables	Yes	Yes	Yes	Yes
No. of obs	810	810	810	810
No. of banks	194	194	194	194
No. of IV	98	97	106	105
AR(2) test	0.25	0.417	0.827	0.816
Hansen test	0.751	0.531	0.201	0.208
Diff-in-Hansen test for GMM instruments	0.859	0.800	0.138	0.148

This table reports the moderation of CLAIM on the one-year lagged impact of disasters on bank deposits ratio and liquidity. The interaction terms are created by multiplying the measures of integration and one-year lagged impact of disasters. Other variables and the system GMM specification remain unchanged (as reported in Table 4.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX C4: IMPACT OF LARGE-SCALE DISASTERS ON BANK PERFORMANCE RATIOS

	(1)	(3)	(4)	(5)	(2)
	DEPO	LIQ	CRERISK	ROA	LN(zscore)
L.Y	0.694***	0.443***	0.683***	0.305***	0.407***
	(0.06)	(0.10)	(0.10)	(0.08)	(0.05)
DAMAGE	-0.781**	-0.226	-0.169	0.057	0.039
	(0.30)	(0.36)	(0.15)	(0.04)	(0.03)
CLAIM	-0.230	-0.232	-0.122	0.066**	0.082***
	(0.22)	(0.28)	(0.14)	(0.03)	(0.03)
CAP	-0.199*	0.583**	-0.221*	0.016	0.061***
	(0.12)	(0.26)	(0.13)	(0.02)	(0.02)
CRERISK	0.107	0.230*		-0.005	-0.005
	(0.06)	(0.13)		(0.01)	(0.01)
INC_DIV	-0.077	0.196	0.192*	0.009	-0.024*
	(0.10)	(0.15)	(0.11)	(0.01)	(0.01)
COST	-0.579	-0.002	-0.030	-0.104	-0.170**
	(0.72)	(1.07)	(0.34)	(0.15)	(0.09)
ROA	2.426**	-0.451	0.745		0.103
	(1.01)	(1.82)	(0.78)		(0.10)
LOANS	0.013	-0.640***	0.117**	0.009	
	(0.07)	(0.18)	(0.05)	(0.01)	
CHARTER			0.114**	0.004	0.006
			(0.05)	(0.02)	(0.01)
CON	-0.660	-0.247	-0.237	0.112	0.092*
	(0.45)	(0.38)	(0.22)	(0.07)	(0.05)
IFL	-0.065	0.655	0.230	0.033	-0.024
	(0.24)	(0.47)	(0.18)	(0.04)	(0.04)
GDP	-0.090	0.356*	0.036	-0.003	-0.028*
	(0.09)	(0.18)	(0.07)	(0.02)	(0.02)
PRICRE	0.210	0.404*	0.036	-0.045*	-0.054**
	(0.13)	(0.23)	(0.10)	(0.03)	(0.02)
INT	-0.022	0.730**	0.141	-0.011	-0.042*
	(0.18)	(0.29)	(0.12)	(0.03)	(0.02)
INS	9.784***	8.836*	-0.168	-1.183	-0.599
	(2.96)	(4.65)	(1.94)	(0.74)	(0.54)
ACT	0.446	1.740	-1.029	0.162	0.318**
	(1.37)	(1.48)	(0.80)	(0.15)	(0.15)
SUP	-0.655	-3.492**	0.689	0.132	0.144
	(0.58)	(1.44)	(0.47)	(0.14)	(0.12)
PRIMON	-4.256	-2.835	-0.184	0.612	0.828**
	(2.74)	(2.63)	(1.62)	(0.43)	(0.36)
ODUM	-3.637**	-0.855	-0.216	-0.126	-0.085
	(1.50)	(1.80)	(0.79)	(0.20)	(0.11)
CRISIS	7.147	12.095	6.924	-2.406*	-1.810*
	(8.46)	(8.14)	(5.03)	(1.43)	(1.02)

Constant	76.020	46.703	3.992	-10.236	-9.348*
	(46.46)	(39.49)	(24.86)	(7.01)	(5.40)
#Obs.	810	810	810	810	810
# Banks	194	194	194	194	194
# IV	95	103	103	103	103
AR(2) test (p value)	0.195	0.88	0.166	0.193	0.519
Hansen-J test (p value)	0.640	0.167	0.855	0.307	0.472
Diff-In-Hansen test for level equation (p value):	0.607	0.164	0.737	0.698	0.368

This table reports the impact of large-scale disasters on bank performance measures. A large-scale disaster is an event in which economic loss is greater than 1% of GDP or 0.5% of the banking assets size. Other variables and the system GMM specification remain unchanged (as reported in Table 4.4). The robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX C5: DEMEANING VARIABLES BEFORE CREATING INTERACTION TERMS

Panel A: The moderation of CLAIM on the impact of disasters on deposits

	(1)	(2)
L.DEPO	0.694***	0.722***
	(0.06)	(0.06)
DAMAGE_de	-0.720**	-0.181
	(0.28)	(0.32)
CLAIM_de	-0.195	-0.133
	(0.21)	(0.19)
DAM#CLAIM_de		0.404***
		(0.14)

Panel B: The moderation of Asian and non_Asian claims

	(1)	(2)	(3)	(4)
L.DEPO	0.717***	0.715***	0.694***	0.685***
	(0.06)	(0.06)	(0.07)	(0.07)
DAMAGE_de	-1.075***	-1.246*	-0.552***	-0.522**
	(0.31)	(0.68)	(0.21)	(0.22)
ASIAN_de	-0.809***	-0.970		
	(0.30)	(0.59)		
DAM#ASIAN_de		0.077*		
		(0.04)		
NON_ASIAN_de			0.229	0.318
			(0.32)	(0.30)
DAM#NONASIAN_de				0.244
				(0.16)

Panel C: The moderation of local and cross-border claims

	(1)	(2)	(3)	(4)
L.DEPO	0.726***	0.723***	0.678***	0.700***
	(0.11)	(0.10)	(0.09)	(0.09)
DAMAGE_de	-0.972*	-0.409	-0.529	-0.794
	(0.52)	(0.60)	(0.45)	(0.49)
LOCAL_de	-0.787*	-0.466		
	(0.45)	(0.48)		
DAM#LOCAL_ de		0.279		
		(0.23)		
CROSS_de			-0.084	-0.266
			(0.43)	(0.44)
DAM#CROSS_de				-1.009
				(0.75)

CHAPTER 5: CONCLUSION

This chapter first summarises key findings, contributions, and limitations of the three essays, then it highlights their practical implications and outlines potential avenues for future studies.

5.1 KEY FINDINGS, CONTRIBUTIONS, AND LIMITATIONS

The thesis comprises three empirical essays to examine the impact of financial integration on the banking sector, with a focus on the level and type of financial integration. The first essay, presented in Chapter 2, explores how financial integration affects bank cost efficiency. Sampling commercial banks from nine East Asian countries over the period 1997–2014, this essay consistently reports the non-monotonic impact of financial integration on bank cost efficiency. Specifically, financial integration initially contributes to the improvement in cost efficiency, but eventually this reverses and financial integration reduces bank cost efficiency. Turning points of the non-monotonicity occur when more than 40% of banks are foreign and the foreign claims of international banks exceed 100% of GDP. In the sub-sample of low-integration countries, the turning point of the foreign banks ratio is 40% and the foreign banking claims ratio is 55%.

With regard to academic contribution, Chapter 2 is the first study to apply the non-monotonic efficiency effect model developed by Wang (2002) to the relationship between financial integration and bank cost efficiency. Hitherto, this relationship was assumed to be accurately captured by monotonic efficiency effect models. Indeed, the model's unique ability of modelling a non-monotonic relationship provides new insight into the existing relationship between variables, which is informative for the purpose of policy analysis. These examples are the non-monotonic impact of financial integration and credit risk on bank cost efficiency (presented in Section 2.5.2.1 and 2.5.2.2,

respectively) as well as the impact of regulation on both the level and the variance of inefficiency (as presented in Section 2.5.4).

However, one limitation of Wang's (2002) model should be acknowledged. Existing models analysing the determinants of the inefficiency term, including Wang (2002) as well as the most popular model of Battesse and Coelli (1995), suffer from this limitation. Specifically, these models confound the time-invariant unobserved heterogeneity and inefficiency terms. Accordingly, the estimated inefficiency captures the effect of bank-specific heterogeneity in addition to inefficiency; in other words, the estimated inefficiency would be higher than the true inefficiency (Chen et al., 2014). Several studies, such as Goddard et al (2014), Chen et al. (2014), and Belotti and Ilardi (2018), have attempted to disentangle the heterogeneity and inefficiency effect. However, due to the complexity of the SFA and ML methods, to date no model can estimate both the true inefficiency term and the determinants of inefficiency in a single-step procedure. As a non-monotonic efficiency effect model would provide new insight into the existing relationship, further development of the SFA framework which accommodates both the true modelling of the inefficiency term and its determinants in a panel data context is needed.

Presented in Chapter 3, the second essay investigates the impact of financial integration on recipient country bank default risk and, critically, whether that relationship is moderated by the *type* of financial integration. Findings from the dynamic system GMM show that financial integration lowers bank default risk in the recipient countries. The impact is primarily driven by the foreign claims extended by Asian lenders and the foreign claims extended via local affiliates. This result confirms the preferential impact of foreign banking claims from 'neighbours', namely either banks from other Asian countries or foreign bank presence via a full affiliate office in the recipient countries.

These ‘neighbouring’ lenders possess informational advantages and assert competitive pressure, resulting in the effective monitoring and disciplining of the loan relationship.

The second essay is the first study to decompose the measure of total foreign claims based on lenders’ nationality and methods of extension in the context of bank default risk. By doing so, the essay sheds light on the existing limited and conflicting results (i.e. Dinger and Kaat 2017; Karolyi et al. 2018) in the literature as to whether financial integration has a positive or negative effect on bank default risk. Furthermore, this essay makes the definition of ‘closeness’ or ‘neighbours’ more specific from the viewpoint of the recipient countries, directly contributing to the literature on the distance constraint between providers and users of funds (i.e. Brennan and Cao, 1997; Petersen and Rajan, 2002; and Knyazeva and Knyazeva, 2012).

The employment of the BIS CBS database has revealed the latest development and changes in the nature of financial integration in East Asia, particularly in terms of lenders’ nationality and methods of claims extension. However, as the database was originally designed with a lender perspective in mind, it is subject to some limitations. First, China has recently emerged as an important financial hub (in addition to Hong Kong, Japan, and Singapore), channelling funds both inter- and intra-regionally (Asian Development Bank, 2018). The majority of Asian countries, including China, have not reported their foreign claims to BIS CBS. Therefore, the analysis so far might under-estimate the value of foreign claims with intra-regional origin. An increase in the number of emerging Asian lenders reporting to BIS in the future would facilitate better monitoring of intra-regional claims, as well as their impact on the bank stability of the recipient countries. Second, the data to construct the measures of total foreign claims, its decomposition by lenders’ nationality, and methods of extension rely on different reporting bases (see Appendix B1). This prevents comparative and parallel analysis of

these measures. Therefore, if data on lenders' nationality could be broken down further by their methods of extension (i.e. Asian claims extended locally or across border), or vice versa, a more detailed analysis could be provided. In short, this calls for improving the scope of data collection and harmonization of reporting basis so that BIS CBS could closely capture changes in the international banking markets.

Presented in Chapter 4, and motivated by the devastating impact of natural disasters, the third essay analyses the impact of natural disasters on several measures of commercial bank performance and how financial integration moderates this relationship. By doing so, this essay contributes to the limited cross-country literature on the impact of natural disasters with evidence from East Asia. Specifically, the essay finds that natural disasters significantly lower the deposits ratio but have no contemporaneous relationship with liquidity, credit risk, profitability, and default risk. The resilience of the sampled East Asian banking system would partly follow from the financial reforms and regulation improvement after the Asian financial crisis as well as the efficiency and stability benefits obtained from financial integration (as found in the first two essays).

The third essay is also the first study to examine the moderating role of financial integration on the relationship between natural disasters and bank performance. The essay shows that foreign banking claims, specifically those extended by regional Asian lenders, help to alleviate the deposits decline in the aftermath of natural disasters. The results highlight the role of commercial bank deposits and foreign banking claims as sources of finance for post-disaster recovery. Together with other sources, such as bank credit, government support, remittance, and foreign aid, these provide multiple channels for households and firms to obtain a relatively immediate access to finance, which is fundamentally important for disaster recovery.

Some words about the limitations of the final essay are warranted. Due to data limitation, this essay could not track the specific locations of banks and match these to the affected areas by disaster events for the sampled banks. Therefore, the essay could not employ other estimation techniques, such as difference-in-difference (as employed in Nguyen and Wilson, 2018; Schüwer et al., 2018), to compare the response of affected and unaffected banks around the event window of a disaster. The availability of such geographically defined data would allow the analysis to test if a bank's financial condition is significantly different after a disaster in a much more precise manner.

5.2 PRACTICAL IMPLICATIONS AND FURTHER STUDIES

The thesis is motivated to address the long-standing policy question of "*How can a country maximize the benefits and mitigate the costs of financial integration?"* By incorporating the latest trend of reversal and regionalization, as well as the emerging role of the East Asian region in the international banking landscape, the thesis suggests that policy makers need to find their answers by considering the level of financial integration and the type of financial integration.

More specifically, the first essay (Chapter 2) helps policy makers to decide on the degree to which their countries should become financially integrated. The non-monotonic impact of financial integration on bank cost efficiency implies that financial integration is a good thing, but only up to a point. In the financial globalization context, this essay provides empirical evidence to support more nuanced policy toward the full capital financial liberalization adopted by some multinational organisations, such as the IMF. Being specific to the context of ongoing further and deeper financial integration in East Asia, policy makers should be aware that an 'optimal' level of financial integration exists. Some countries with their level of integration being close to or above the optimal point are recommended to take a cautious approach toward further connectedness. Others,

notably China, Vietnam, Thailand, and the Philippines, would benefit from additional financial integration.

The second essay (Chapter 3) helps policy makers to design their countries' integration policy. To maintain or improve the financial stability of their banking systems, they should favour either the foreign claims extended by Asian lenders or foreign claims extended via local branches of international banks established in their countries. The former option is synonymous with the promotion of intra-regional financial integration. The latter option implies that where foreign claims come from outside East Asia, policy makers should encourage presence through local affiliates, as this has an equivalent impact. In short, these two options of 'neighbouring' foreign claims are complementary, providing recipient countries' policy makers with flexibility in their choice of preferred form of financial integration.

The third essay (Chapter 4) further highlights the differential impact of different types of financial integration in the context of natural disasters. The essay confirms the resilience of the foreign banking claims extended by Asian lenders in the event of local shocks, which is not present for the case of local claims. Accordingly, policy makers in East Asia have additional evidence to support intra-regional financial integration; this recommendation is also robust during the episodes of local shocks.

Overall, the thesis generally points to the beneficial impacts of financial integration in terms of bank efficiency and stability. Furthermore, the thesis emphasizes the importance of considering the level and nature of financial integration to obtain such benefits. As there have not been many existing studies specifically focusing on the level and forms of financial integration, further studies could be conducted following these two avenues. For example, future research could explore whether the non-monotonicity also holds in the relationship between financial integration and bank profit efficiency.

Further, the differential impact of foreign banking claims on bank stability classified by the sectors funded in the recipient countries (i.e. financial institutions, government, private sector) is also worthy of examination. These studies would develop the current understanding of the impact of the level and nature of financial integration on the performance of the banking sector.

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