Bank Business Models in Southeast and East Asia: -
Implications for Stability

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ABSTRACT

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Bank Business Models in Southeast and East Asia:-
Implications for Stability

This research aims to understand the effect of business models in the Asian banking industry during the most recent financial crisis, and to identify effective banking business models for the post-crisis landscape. This research was based on observations about the importance of the bank business model for reaching bank stability, as well as a lack of research that focuses on Southeast and East Asia. Its main originality is in the application of existing stability models to banks in Asia, which has rarely been tested. The research uses an econometric approach, with several methods selected (including pooled OLS, robust fixed effects, and time fixed effects) on base models. Three hypotheses were posed, tested conditions of bank stability related to diversification strategy, use of interest and non-interest income, and strength of the bank balance sheet indicators. Bank performance was modelled using seven indicators grouped in three categories (Stability, Performance, and Stock returns). The outcome of testing variables was mixed. Diversification was shown to have a nonlinear effect on bank outcomes in most cases. However, excessive diversification could be harmful. Similar results were found for the effect of Interest and Non-interest income on the indicator outcomes. The third test showed that the Cost-to-income ratio and Total assets were key balance sheet indicators, but other variables tested were not significant. Overall, the findings of the research imply that banks do need to consider their business models, since these do affect performance of the bank in economic crisis situations and overall bank stability. Also, it can be concluded that the traditional relationship banking with strong balance sheet and effective risk management system is the most appropriate model in Southeast and East Asia.
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Chapter 1: Introduction

1.1 Research Background
The worldwide financial crisis of 2007-2009 was a devastating financial blow that was felt around the world. This crisis was brought on by a gradual failure of the subprime mortgage market in the United States, but it rapidly spread around the world, first to countries with substantial financial ties to the US and then further into global financial markets (Brunnermeier, 2009). The collapse of the subprime market, however, was only the most visible cause of collapse. Instead, various mechanisms included a multiple economy stream of slow bank runs and capital flight across economies (Obstfeld et al., 2009). The crisis should not have come as a surprise in the way that it did. During the period in which off balance sheet (OBS), originate and distribute, and transaction-based banking models were becoming more common in the late 1990s and early 2000s, they were already known to be more risky than traditional commercial and investment banking models (Berndt & Gupta, 2008; Brunnermeier, 2009). The root cause of the economic collapse associated with this crisis was the manufacture of tail risk and increasing size and complexity of financial institutions (Acharya, Cooley, Richardson & Walter, 2009b). This suggests that the failure of the banking system cannot be attributed to a single event, but is instead related to the cumulative impact of banking deregulation and increasingly riskier banking business models created in profit-seeking exercise over decades.

The impact of the US financial crisis on Asia was at first limited. India, China, and Japan, which as major commercial suppliers to Western economies are typically procyclical, felt the effects of the crisis immediately through reduced economic output and export demand (Fidmuc & Korhonen, 2010). However, other Asian economies, which are countercyclical, felt delayed effects from the economic crisis (Fidmuc & Korhonen, 2010). By 2010, Asian banks had withdrawn from international positions, with international holdings falling from 15% to 8% (Schoenmaker, 2011). Bank regulators did not, as they did in many Western economies, reject re-regulation of the banking industry (Bernanke, 2009). Instead, they tightened regulation of the banking sector in order to limit effects on the financial markets (Bernanke, 2009). Furthermore, banks in many Asian countries did not further exacerbate the economic damage of the
crisis by tightening liquidity, reducing the economic slowdown effects felt in many Western countries (Bernanke, 2009). Regardless, there were some substantial effects of the banking crisis on the real economy.

Thailand first felt the impact of the crisis in 2009, with a fall of approximately USD$10.5 billion in GDP (World Bank, 2012). However, it has continued to show strong performance compared to other developing and developed countries. The World Bank (2013a) reports that Thailand is now classified in the top ranks of developing countries as an upper middle-income economy. Despite repeated challenges following the 2007 economic crisis, the 2010 political crisis, and the 2011 floods, Thailand’s economy has begun to rebound (World Bank, 2013a). GDP growth in 2012 was reported at 6.4%, with an estimated 5% growth expected in 2013 (World Bank, 2013a). Thailand has also made significant strides in poverty reduction, with poverty rates at 13.2% as of 2011 (World Bank, 2013a). As a result, Thailand’s banking system has also begun to change rapidly. A recent report indicates that Thai banks are likely to begin reaching into the regional and international market in the near future, using merger and acquisition (M&A) strategies to expand international market penetration (The Nation, 2013). Changing business conditions and conditions of banking competition across the Asia Pacific region are also likely to challenge existing business strategies (PWC, 2013). PWC’s (2013) report on M&A in the banking sector reports that banks from countries with established (and saturated) banking markets, such as Japan, are likely to use M&A to move into Southeast Asian markets (including Thailand and others), bringing new services and business models in their quest for new markets. This raises the question of what effects these new business models may have on bank stability, profitability, and riskiness.

Despite the relatively light impact of the financial crisis to Thailand and many other (though not all) Asian countries, the fact remains that the financial crisis was known to be a possibility given the existing understanding of bank business models and their risk profiles. Following the 2007-2009 financial crisis, as well as the earlier 1997-1998 financial crisis, there is a clear impetus to improve bank stability in the Southeast and East Asia region. However, in order to achieve improved bank stability, it is necessary to understand what factors affect bank stability in the first place. This is particularly important given the rapid growth in the region. In 2012, developing Asian economies
grew at a rate of 6.6%, faster than any other region in the world (Global Finance, 2013). The average growth rate since 2003 has been 8.8%. However, there is little information about banking, bank stability, and its role in economic growth in this region. Few studies focus specifically on Southeast and East Asia, and typically include them only as global analysis or do not include them at all. This is particularly unfortunate given the importance of growth in the region. This dissertation seeks to fill a small piece of this requirement by identifying resilient bank business models for the current market and regulatory environment in Southeast and East Asia. As a personal motivation, the researcher of this study is from the Southeast and East Asia region and intends to continue her career in the region. Thus, she has a personal interest in the region and in providing improved economic and banking information about the region.

1.2 Research Aim, Question, and Hypothesis

The aim of this research is to understand implication of various banking business models towards past financial crises and to identify effective banking business models for the post-banking crisis landscape in Southeast and East Asia. The aim of the research is formulated into a single research question, which is what are effective banking business models for Southeast and East Asian banks to cope with possible financial instability?

A full description of the theoretical basis of the hypotheses tested is included in Section 3.4. Briefly, however, the first hypothesis is based on the positive impact of diversification of income sources (including interest and non-interest income) on bank stability, as explored by previous authors (Bernt & Gupta, 2008; Carbó & Rodriguez, 2007; Demirgüç-Kunt & Huizinga, 2010; Lepetit, et al, 2008; Lozano-Vivas & Pasiouras, 2008; Stiroh, 2004). This hypothesis is stated as:

**H1: Under current banking conditions in Southeast and East Asia, a risk diversification strategy that includes a majority proportion of interest sources of income and a minority of non-interest sources of income will be most effective.**

The second hypothesis focuses on the relative impact of interest-bearing income from relationship banking models and non-interest income, including any income derived
from transaction based income, originate-to-distribute (OTD) transactions, or others. Previous research has suggested that relationship banking reduces bank risk, though it does not necessarily increase income (Altunbas et al, 2011; Baele et al, 2010; Berger & Udell, 1995a; Berger, et al., 2009; Boots & Marine, 2008). Hypothesis 2 is stated as:

\[ H2: \text{Under current banking conditions in Southeast and East Asia, banks that rely on interest-bearing income from relationship banking will be more stable than those that rely on non-interest income (including transaction-based income and any other mechanisms that are not related to relationship banking).} \]

Hypothesis 3 focuses on banking management practices as a way of understanding bank stability. It is based on research that indicates that weak balance sheets, as well as other indicators like Capital ratios, are associated with increased risk (Brunnermeier, 2009; De Jonghe, 2010; Foos, et al., 2010; Seodarmono, et al., 2013 Vallascas & Keasey, 2012). Hypothesis 3 is stated as:

\[ H3: \text{Under current banking conditions in Southeast and East Asia, banks that maintain a strong balance sheet will be more stable than those with a weaker balance sheet.} \]

1.3 Research Contributions
The main importance of this research is that it serves as a basis for further academic exploration and analysis of the stability contributions of various bank business models. It is a contribution to a continuing and evolving conversation about how banks can best meet the needs of their customers, investors, and the economies in which they are embedded. Most early research on bank business models was descriptive in nature, detailing bank strategies rather than identifying their impact on earnings. A number of researchers have created categorization and classification strategies for bank business models, based on size, type of income streams, customer bases and main types of transactions, and level of institutional embeddedness (Beck, et al, 2000; Cavelaars & Passenier, 2012; Ferreira, et al., 2012; Singh, 2007). These classification models do not determine effects on stability, but instead strategic, tactical, and operational choices made by the bank. Other researchers have examined the impact of various aspects of the
bank business model on bank stability. These studies have routinely showed
correlations between various aspects of bank business models and stability (Altunbas et
al, 2011; Ayadi, et al., 2011; Baele, et al., 2010; Berger, et al., 2009; De Jonghe, 2010;
Navaretti, et al., 2010; Vallascas & Keasey, 2012). However, these studies still leave
gaps in knowledge surrounding the bank business model and its relation to stability.
First, most of these studies do not use a broad definition, either for business models or
stability. This means that findings derived from these studies are partial and do not offer
a broad-based view of the relationship. Second, few (if any) of these studies have
focused specifically on Southeast and East Asia as an economic region. Instead, most
are focused on European or US banking markets. This is a problem because Southeast
and East Asia are rapidly growing economic regions that have expanding banking
markets (Barreto, 2013). This leaves a gap in the academic research surrounding bank
stability in Southeast and East Asia, which may be only partially filled by theory. The
main contributions of this research are that it will focus on a broad-based view of both
bank business models and bank stability, and that it will examine only banks from 14
countries in Southeast and East Asia. The findings could also be useful by banking
policymakers and banks that are selecting business strategies.

1.4 Definition of Terms

**Capital ratio:** It is defined under regulatory requirements to a minimum holding of
capital assets compared to existing loans (Schaeck & Cihák, 2010).

**Cost-to-income ratio:** Non-interest costs, excluding bad and doubtful debt expense
divided by the total of net interest income and non-interest income (Tripe, n.d., p.4).

**Degree of total leverage (DTL):** The number relates a firm's operating and financial
leverage to its net income (Business Dictionary, 2013).

**Diversification:** Spreading a bank's assets (loans) over a wider assortment of quality
borrowers, to maintain or improve earning levels while maintaining the same level of

**Equity-to-asset ratio:** The proportion of total assets financed by the owner's equity
capital. It is the reciprocal of the debt-to-asset ratio.
Financial crisis: It involves the constriction of credit flows to businesses and households and a concomitant fall in demand for goods and services. This constriction of credit flows is most commonly seen from liquidity or production constraints (Jickling, 2009).

Financial instability: It occurs when shocks to the financial system interfere with information flows so that the financial system can no longer do its job of channelling funds to productive investment opportunities (Mishkin, 1999).

Interest income: The amount of money allocated as interest received by company investments (Business Dictionary, 2013).

Non-interest income: The money gained by financial institutions on investment transactions (Business Dictionary, 2013).

Non-performing loans: It is any loan in which interest and principal payments are more than 90 days overdue (Financial Dictionary, 2013).

Performing loans: A loan that is less than 90 days past due, has not been placed on nonaccrual, or is not in workout status (Financial Dictionary, 2013).

Profit before tax: A calculation of the company’s income versus expenses, with the exclusion of tax payments (Business Dictionary, 2013).

Profits-to-assets ratio (ROA): The return on assets (ROA) percentage shows how profitable a company's assets are in generating revenue (Financial Dictionary, 2013).

Profits-to-equity ratio (ROE): The rate of return on the ownership interest (shareholders’ equity) of the common stock owners (Financial Dictionary, 2013).

Stock returns: Return of publicly traded stock over time (retrieved from appropriate stock market reporting) (Kirkwood & Nahm, 2006).
**Stock volatility**: Standard deviation of stock returns calculated on an inter-day basis over time (Fuertes, Izzeldin & Kalatychou, 2009).

**Tier 1 Capital ratio**: Ratio of core capital (including common stock, retained earnings, and reserves) to total ownership equity (BIS, 1989).

**Total assets**: The sum of all assets of company, including cash, investments, furniture, fixtures, equipment, receivables, intangibles, and any other items of value owned by a person or a business entity (Financial Dictionary, 2013). From a banking perspective, the total assets primarily include the bank’s loans or investments.

**Turnovers**: The annual sales volume net of all discounts and sales taxes (Business Dictionary, 2013).

**Writedowns**: Reducing the book value of an asset if it is overstated compared to current market values (Financial Dictionary, 2013).
Chapter 2: Literature Review

2.1 Financial Intermediaries

2.1.1 Existence of Financial Intermediaries

The simplest of questions and the most fundamental matter regarding the financial intermediary is: what is the financial intermediary for? The existing empirical and theoretical research reveals two main reasons for the existence of financial intermediaries, which are the efficient allocation of capital and the creation of funding liquidity. However, the empirical research also questions the degree to which different forms of banking actually are associated with these outcomes.

2.1.1.1 Allocation of Capital

One of the core roles of the financial intermediary is allocation of capital efficiently between borrowers and lenders (Greenbaum & Thakor, 2007). An obvious approach for allocation of capital is direct borrowing and lending between parties in a financial system. However, as Diamond (1984) demonstrates, this is not actually the most efficient approach to the problem of capital allocation, since this transfers costs of monitoring of borrowers directly to the lenders (who may not have resources or information availability to efficiently perform this task). Instead, the financial intermediary assumes the task of monitoring the allocation of capital (servicing loans). Although it does assume some delegation costs associated with this task, there are also incentives to perform the task, such as interest rates, which are typically higher for borrowers than for savers, allowing the bank to benefit from their delegation activities. The use of diversified activities within the bank can reduce the delegation costs further. These costs are below the costs associated with direct monitoring, thus offering a benefit for financial intermediaries as well as borrowers and lenders. Consequently, Diamond (1984) claims that the financial intermediary is in theory a more effective approach to the capital allocation problem, because it reduces the costs of borrowing and increases the feasibility of monitoring borrowers.

While in theory the capital allocation provided by the financial intermediary is more effective than a direct or market-based system for lending, the empirical research does
not necessarily support this argument in all situations. Beck and Levine (2002) compare the performance of market-based (direct) and bank-based (intermediary) financial systems in expanding capital-heavy industries. They find that neither of these systems was better than the other in expanding growth within the target industries. Instead, they find that regulatory and legal provisions that determined the degree of market efficiency, contract enforcement and creditor protections were more important in the development of these industries than were the specific mode of capital allocation. It should be considered, however, that these industries comprise a relatively limited portion of any given economy, and the authors did not address any other types of markets. Additionally, these types of industries are not the only structures of industry that require investment. Smaller industries with lighter capital requirements (and therefore less direct borrowing power) may have different needs. However, smaller industries and smaller firms within a larger industry are unlikely to have access to market-based methods for transferring capital, even in cases where this is allowed in the regulatory regime. Another study finds that countries with active financial markets have faster movement of capital from declining industry and toward growing industries compared to countries with relatively stagnant financial markets (Pang & Wu, 2009). This suggests that financial markets play a significant role in the development of new industries and the transfer of capital between industries (Pang & Wu, 2009). However, this does not address the condition in which there are limited market-based capital facilities available and cases where there is little interest in market-based capital allocation (such as small firms). As such, while these findings are empirically interesting, they do not refute the idea that the financial intermediary plays a significant role in capital allocation and transfer of capital between borrowers and lenders.

Differences in capital allocation and transfer could influence how banks deal with risk, and thus their ideal business models. A panel study (1994 to 2008, n = 42 Asian countries) finds varied effects for bank capital on risk (Lee & Hsieh, 2013). This study finds that commercial banks had a slight negative relationship between bank capital and risk during the study period. Its second finding of importance is that banks in lower-middle income countries (especially developing countries) showed the highest negative relationship between bank capital and risk (Lee & Hsieh, 2013). This category, which includes many developing countries, thus had the strongest relationship between increased capital and lowered risk during this period (Lee & Hsieh, 2013). This has
implications for a number of Asian developing countries that fall into the lower middle-income category. The authors also perform a regional comparison, finding that Asian banks (including Middle and Eastern Asia) had the strongest negative relationship between capital and risk compared to all countries.

2.1.1.2 Creation of Liquidity
A second role of the financial intermediary is in the creation of liquidity or ability to efficiently buy and sell assets without constraints on capital or commodity supply flows (Greenbaum & Thakor, 2007). There are a number of roles that liquidity plays in the financial sector. For example, trading liquidity (or the ability of the trader to trade effectively) is based on the traders’ funding liquidity (or access to funds). This trading liquidity creates market liquidity for classes of assets that are being traded (Brunnermeier & Pedersen, 2009). This means there is a direct relationship between availability of liquid funds for trading and avoidance of a downward liquidity spiral. One recent theoretical study of the effect of financial intermediaries on the degree of liquidity in the market showed that, generally speaking, an increase in intermediary capital availability (such as bank deposits, which are available for lending, though this model does not specify the source of funds) increases the degree of liquidity in the market. This is particularly the case in a constrained intermediary market, where there are specific regulations regarding the bank’s role in the lending relationship. However, this relationship is not unassailable, as there are conditions in which financial intermediaries can actually destabilize the liquidity relationship. The authors state that if financial intermediaries become for some reason unwilling to lend (such as conditions during some periods of the most recent financial instability), then liquidity within the economy can be severely disrupted (Gromb & Vayanos, 2010). Thus, the financial intermediary can either increase or decrease liquidity within a market. The authors do not specifically draw a difference between different sources of funding for liquidity. However, they do find that funding with higher margin requirements is more illiquid. This suggests that increased cost of capital will decrease liquidity (Gromb & Vayanos, 2010). The authors suggest that sources of funds are not independent, but instead are likely to create market linkages (Gromb & Vayanos, 2010). Thus, the source of capital funding is not necessarily unimportant in this model, but neither is it easy to determine independent effects of different sources of capital on liquidity based on the model.
Other authors have had more insight into the effect of financial intermediaries on liquidity. Allen and Gale (2004) argue that financial intermediaries can create liquidity in multiple ways, governed by whether the intermediary can issue complete contingent contracts (where risk can be anticipated) or incomplete contracts and whether the markets they operate in are complete or incomplete. It is only in states with complete markets that contracts offered by the financial intermediary can be efficient (that is, can provide liquidity). The majority of financial intermediaries, including banks, can only offer incomplete contracts and thus cannot insure liquidity appropriately based on the risk potentials within the market. Because of this, Allen and Gale (2004) argue that regulating liquidity could be appropriate in a market with incomplete markets for aggregate risk or widespread market participation, in order to help promote the development of an efficient market. However, it is not necessarily helpful in a market that is aggregate-risk complete or limited in participation levels. The authors point out that this will not totally prevent bank runs or other market inefficiencies, which can still occur in efficient markets (Allen & Gale, 2004). There are also differences based on whether complete or incomplete contracts are used in the financial market (Allen & Gale, 2004). (Complete contracts spell out all potential conditions within the contract, whereas incomplete contracts rely on existing law and assumptions and only provide specifics where there are conditions that vary from these assumptions (Allen & Gale, 2004). The sophisticated, risk-complete market described above is in theory incentive-efficient if complete contracts are used, while it is constrained-efficient if there are incomplete contracts in use (Allen & Gale, 2004). Thus, the characteristics of the market and the extent of completeness determine the extent of efficiency in the market and the use of liquidity regulation.

There are a number of forms of financial intermediation instruments that can provide liquidity for uninformed agents (such as ordinary depositors to a bank) (Gorton & Pennacchi, 1990). These instruments, including government bonds and money market funds, hold in common the element of guaranteed (or near-guaranteed) liquidity that the bank account with associated depository insurance holds. Thus, even though the deposit account at a bank may be the most common instrument used to provide liquidity, it is not the only such instrument. Furthermore, Gorton and Pennacchi (1990) argue that even though depository insurance may promote moral hazard (or the assumption of excessive risk on the basis of the risk taker not bearing the full cost of failure), it is also
required to protect these uninformed agents (or depositors) and thus is required to ensure liquidity. Simply, the depository insurance system prevents the exploitation of depositors by informed agents (bankers and others with control over the financial intermediary).

One study finds that the role of financial intermediaries in creating liquidity is strongly procyclical in a marked to market environment. This is a particularly important finding given the recent financial crisis, which was exacerbated by the collapse of marked-to-market securities in a procyclical fashion. Adrian and Shin (2010) analyse bank balance sheets. They determine that the change in bank balance sheets in accordance with changes in the market (using mark to market valuation) resulted in such a rapid increase in balance sheet assets in some cases that the financial intermediaries had leverage that was significantly too low. This led to a surplus capital capacity, which the banks attempted to leverage by providing short-term loans and mortgages on increasingly good terms for borrowers (Adrian & Shin, 2010). The authors argue that this led to an eventual collapse of the credit cycle (the mortgage crisis) due to the growth of excess capacity. This finding is particularly relevant for the current study, where the goal is to determine a business model that prevents or reduces this type of procyclical behaviour.

2.1.1.3 Economic Growth
The creation of liquidity and capital allocation efficiency has implications for economic growth. Financial intermediation through banks, insurance firms and others has a strong effect on economic growth (Levine, Loayza & Beck, 2000). Levine et al. (2000) argue that the role of strong regulation of financial intermediaries, especially in areas like contract enforcement, accounting practices and creditor rights, are associated with different levels of financial development within different economies. They identify these differences as being some of the key factors in the difference in economic growth rates between countries, noting that these differences in legal and accounting systems affect the efficiency with which different economic systems can operate. The differences in economic growth can be attributed to the differences in liquidity and capital allocation caused by the differences in regulatory regimes and subsequently the approaches used by financial intermediaries to manage funds. However, while Levine et al.’s (2000) findings do suggest that regulation rather than bank business models are
implicated in effective liquidity provision and economic growth, evolution of new bank business models are in many cases the direct result of regulatory implementation. For example, it is well known that originate-to-distribute business models only emerged following deregulation in the United States and Europe in the 1990s and later (Altunbas, Manganelli & Marques-Ibanez, 2011; Berndt & Gupta, 2008; Brunnermeier, 2009). As such, bank business models are at least partially a consequence of regulation, and identifying effective business models is a necessary precondition for determining appropriate regulatory steps. Thus, these are not separate issues, but are interconnected.

There is still evidence that financial intermediaries are important for economic efficiency. Using a theoretical endogenous growth model, another group of researchers demonstrate that financial intermediaries increase economic production efficiency by reducing the tendency toward excessive accumulation of unproductive capital assets (Bencivenga & Smith, 1991). Bencivenga and Smith (1991) also show that capital liquidation is also generally reduced by the introduction of intermediaries, which result in a higher level of economic efficiency. However, recent studies of economic growth and the role of financial intermediaries do not support the strength of relationship between financial intermediaries and efficient capital allocation that was seen in previous studies (Rousseau & Wachtel, 2011). Rousseau and Wachtel (2011) examine the causes of this reduced impact of financial intermediaries on economic growth, finding that credit growth that was too rapid generated a credit crisis during their study period. This reduced the impact of financial intermediaries on growth. Although they do find that deregulation and financial market liberalization created conditions where this excessively rapid credit market development could occur, they are not directly related.

The empirical finding of this study is that financial intermediation no longer presents as strong an influence on economic growth as it has previously (Rousseau & Wachtel, 2011). The authors advance a number of reasons for this, including that the undirected market liberalization of the 1980s and 1990s reduced the efficiency of economic output because countries did not have trading partners in place and because of an increasing role of market-based funding (such as through stock markets or corporate bonds).

However, their most convincing explanation, and the one that finds the most support within the external analysis of recent conditions, suggests that the too-rapid growth of credit markets and the resultant increasing frequency and severity of financial crises has limited the impact of financial intermediaries on economic growth because it has, while
on the one hand facilitating growth, on the other hand been inhibiting it (Rousseau & Wachtel, 2011). This strongly suggests that the excessively rapid expansion of credit availability is actually detrimental to economic growth, the exact conditions observed in the collapse of the US subprime market and the subsequent general economic collapse (Brunnermeier, 2009).

2.1.2 Functions of the Bank

There are a number of different kinds of financial intermediaries, which vary depending on the regulatory regime and demand environment (Allen & Santomero, 2001). The main concern in this case is the bank, which facilitates borrowing and lending for general purposes based on transaction and depository activities (as discussed above) (Allen & Santomero, 2001). There are also mutual or cooperative financial intermediaries, such as credit unions (which provide collaborative lending and deposit, especially in the US) and building societies (which are oriented to mortgage lending, particularly in the Commonwealth countries) (Allen & Santomero, 2001). A third category of financial intermediaries includes insurance companies (which are focused on distribution of risk) and investment vehicles such as pensions and others (Allen & Santomero, 2001). In this research, the bank, which is one of the most common and standard types of financial intermediaries, is the focus.

In addition to the question of what financial intermediaries are, there is the question of what functions the bank provides. These can be understood as risk-based functions (traditional banking functions such as lending and deposits) and transaction-based functions (non-traditional functions such as originate-and-distribute activities and cash payment-and-collection services). Of these, the traditional banking functions are more closely related to the traditional financial intermediary roles of creation of liquidity and capital allocation as detailed above. In essence, financial institutions (as financial intermediaries) can be seen to reduce the frictions inherent in an imperfect market by increasing information and meeting differing capital requirements among borrowers and lenders. This is what accounts for both the presence of financial institutions within the market as well as the ways in which these institutions operate (Berger, Herring & Szego, 1995). The bank and its role in the credit market acts as what one group of researchers calls a financial accelerator, increasing the rate of exchange between asset
holders and investors. However, although this sounds like a largely positive activity, as Bernanke et al. (1999) point out, this also accelerates the rate of macroeconomic shocks and increases the volatility of the economy. Thus, the role of the bank is both positive and negative.

2.1.2.1 Traditional or Risk-Based Banking Functions

Traditional banking activities are often concerned with the provision of liquidity and allocation of capital. Traditional banking activities include depository activities as well as lending activities. That is, the bank acts to allocate funds from savers to those that require funding. Kashyap et al. (2002) see both lending and deposit activities as a single function, that of provision of liquid capital. They also observe that the liquid assets holdings of the banks are required to support both of these activities. Thus, in this respect the traditional activities of the banking sector can be seen to integrate both of the major functions of the financial intermediary, including liquidity and efficient capital allocation.

One of the most traditional forms of banking activity is relationship (or risk-based) lending. As Berger and Udell (1995) explain, relationship lending from banks to small and medium sized firms is one of the most important ways these firms accumulate funding for new capital investment, since they do not have access to other sources (such as equity markets or corporate bonds) that large firms can access. The banking relationship also provides increased information that reduces information asymmetries, in effect reducing unknown risk and increasing the certainty associated with the loan. Under Diamond’s (1984) understanding of the relationship of the financial intermediary and borrower, this is a reduction in the monitoring costs associated with the relationship. Thus, the bank performs capital allocation (providing small and medium businesses with funding) as well as liquidity improvement while at the same time reducing information asymmetry (Berger & Udell, 1995).

The efficiency associated with traditional relationship banking varies widely with the type of bank examined. One study of banks in China finds that state-owned banks showed that they were inefficient in capital allocation (Berger, Hasan & Zhou, 2009). In contrast, foreign-owned banks were efficient in capital allocation, and the degree of
efficiency increased with the rate of foreign ownership. Berger et al. (2009) argue that this finding is dependent on the banking regulatory environment, including banking regulations and other factors. Thus, this is a condition that is specific to China and is not likely to be duplicated exactly in other banking markets. Furthermore, there is some significant concern about this study, since Berger et al. (2009) do not, strictly speaking, identify the reasons for this difference in efficiency. For example, state-owned banks could be focused on priorities other than efficiency in its lending policies (such as lending to higher-risk borrowers with subsidised interest rates), which might be considered to be appropriate under the mandate of a state-owned bank to support economic growth rather than profits. Furthermore, the position of profit as the main goal of the bank is also likely to change depending on its ownership structure. Thus, simply stating that state-owned banks are inefficient compared to private banks, without exploring the reasons for this inefficiency, does not provide appropriate insight into the reasons for both inefficiency and efficiency among banks in the same regulatory regime. Regardless, it is worth considering that not all banks within a given market will be efficient, even though they are subject to the same rules and regulations.

One of the checks on the financial intermediary is the deposit insurance program, which provides some degree of protection for depositors who would otherwise suffer losses from inappropriately managed financial systems in some economies. However, as it protects only depositors in traditional savings and current accounts, this system is constrained to traditional banking. Keeley (1990) presents a common view that the use of deposit insurance requires regulation because it promotes moral hazard, in which the financial intermediary may act more recklessly due to the perception that they will not be held accountable for the failure of their investment projects. He illustrates this point by studying the increase in competition in the 1980s in the US banking system, which he argues led to an increase in risk assumption through increasingly riskier asset assumptions as well as reduction in reserve capital (Keeley, 1990). He uses this point to demonstrate a common framework of assumptions regarding the role of deposit insurance in the banking system. However, a competing view holds that the use of depository insurance is required to protect depositors from exploitation by the financial institution and its controllers (Gorton & Pennacchi, 1990). This is particularly important because it calls into question the role of regulation and the need to protect depositors, who do not have any direct control over the use of their funds. Thus, the economic
efficiency of the bank must be balanced against the interests of others involved in the banking system. The case of depository insurance clearly shows that sheer efficiency of the banking system is not sufficient for setting regulations.

Empirical evidence on this point is mixed in its support for theory. A recent analysis of the use of deposit insurance demonstrates that it is rarely, if ever, drawn upon, although if it is drawn upon it can have disastrous consequences (Allen, Carletti & Leonello, 2011). This suggests that the role of depository insurance may not be as important as previously expected, given that it does not actually appear to promote default in any significant fashion. However, these findings are not consistent. For example, a study of a recently implemented Russian depository insurance program showed that banks entering the program did increase their operating risk and financial risk (Chernykh & Cole, 2011). However, the banks that entered the program also increased their assets and reserves, thus decreasing the overall financial risk. The question of how (if at all) deposit insurance increases financial risk is somewhat in question in the literature and it may vary depending on the regulatory context.

2.1.2.2 Non-Traditional Functions

2.1.2.2.1 Transaction-Based Functions

Although traditional banking is commonly used, it is not the only source of revenue in the business model of most banks. Non-traditional activities have been explored in recent years, at least in the US and UK, as a means of recouping revenues lost due to a reduction in traditional activities such as those discussed above. Allen and Santomero (2001) observe that saving and investing activities in the US and UK shifted between the 1980s and the early 2000s toward mutual funds and other direct investments and away from traditional savings accounts, leaving banks with less revenue from traditional activities. This shift away from risk-based activities on the part of the banks has two implications. First, individual households hold more risk-based assets directly than in countries such as Japan, where this change has not taken place. Second, US and UK banks cannot rely on intertemporal smoothing, but must instead use financial innovations, like derivatives, to smooth out their risk profiles. This has led to significant changes in the way that banks do business in these areas. However, these activities are
not nearly as common in environments where there is less emphasis on direct investment in risk-based assets (Allen & Santomero, 2001).

The movement toward non-traditional banking began in the 1980s, when banks began to offer interest-based services including lending for corporate buyouts and increased subprime lending in the US (Edwards & Mishkin, 1995). Banks also began to rely on non-interest, off-balance sheet (OBS) activities including derivatives and other financial instruments, asset management, brokerage, loan origination, and other services. By the mid-1990s, these activities were already associated with an increased level of risk involvement from the bank, and had played a role in the failure of several banks worldwide (Edwards & Mishkin, 1995). This trend accelerated during the 1990s and 2000s, with the majority of the expansion in this area focusing on fee-based services (Carbó & Rodriguez, 2007). Some types of fee-based services offered by banks include commissions on transactions, derivatives sales, and other fee-based services such as fee payment and money transfer. Most banks, however, do not offer only non-traditional services. Instead, they mix traditional and transaction-based services for customers. This has the result of improving net margins on lending (Carbó & Rodriguez, 2007). It is estimated that by 2001, 43% of net operating revenues of banks in the United States came from non-interest sources of income (Stiroh, 2004). However, statistics are rarely available for non-interest income in other areas, and it is not suggested that all banking systems were as reliant on non-interest income as in the US.

Transaction-based services do play an important role in the modern bank. One view suggests that fee-based or transaction-based services are a route to diversification of risk in banking services (Brunnermeier & Pedersen, 2009; Stiroh, 2004). Non-interest income, as it is tendered based on services provided, is believed to be less risky than interest-based income (which is at default risk, and in the case of variable interest rates may be variable based on market conditions). Thus, its inclusion in the banking portfolio has the result of lowering income volatility by ensuring that some portion of the bank’s income is from not-at risk sources. However, while this relationship between non-interest income and risk is reliable in theory, in practice it has been shown to not be as secure. In particular, Stiroh’s (2004) study of banks from 1979 to 2000 finds that as more banks used a higher percentage of non-interest income, the risk reduction benefits of non-interest income began to be reduced. This analysis shows that non-interest
income actually increased the risk-return ratio of average banks when volatility increased, despite the theoretical reduction in the risk-return ratio from non-interest income.

The degree of impact on the bank’s performance from non-traditional sources of income is inconsistent in the research. An analysis of 752 publicly listed banks from 87 countries around the world finds that inclusion of non-interest sources of income does increase profitability positively and significantly (Lozano-Vivas & Pasiouras, 2008). However, OBS activities, like loan origination and derivatives, do not have a statistically significant impact on profitability or direction of profits within the bank. A second study finds that fee-based (or transaction-based) services increase net margins on sales (Carbó & Rodríguez, 2007). A third study also finds that European banks that are heavily engaged in fee-based banking services tend to reduce the interest rates on loans, using them as “loss leaders (Lepetit, Nys, Rous & Tarazi, 2008, p. 2325)” by establishing relationships with bank customers through low-priced loans and then using these existing relationships to sell higher-margin fee-based services. Thus, the reliance on fee-based or transaction-based services has a number of effects, including increasing risk (especially in non-diversified situations), increasing net margins on lending, and reducing interest rates charged, particularly to new customers. However, despite the theoretical reduction in risk associated with income diversification, in fact the potential for risk reduction has fallen as firms have become more reliant on non-interest income. Thus, early observations about the role of non-interest income in balancing risk may be increasingly inaccurate over time.

2.1.2.2 Internationalisation
One increasingly important role for banks is facilitating the internationalisation of capital (Berger, Dai, Ongena & Smith, 2003). According to Berger et al. (2003), capital allocation and liquidity is increasingly managed on an international economic scale, rather than a national scale. Factors in this change include liberalisation of international banking markets as well as establishment of super national economic cooperation areas, such as the European Union and ASEAN. However, international lending for cross-border activities is still relatively rare. Berger et al.’s (2003) study of European firms and their choice of banking operations find that international firms routinely use host
country banking operations for their capital allocation and liquidity needs within that
country. Thus, it is more common for firms to move than banks, which could create
asymmetries in capital allocation between countries. Regardless, banks and other
financial institutions play a significant role in the development of international capital
flows. The internationalisation of capital flows creates a specific selection problem for
banks dealing with international firms. As Berger et al. (2008)’s study of India shows,
there are a number of criteria that host country banks use when dealing with foreign
firms. Use of host country banks is associated with a high level of financial
transparency, diversification across multiple types of bank (including state-owned and
domestic and foreign privately owned banks), and engagement with multiple banks. In
contrast, firms that engage specifically with state-owned banks tend to be less
diversified. These findings suggest that while internationalisation of capital is a key
element in some forms of banking, there are some banks that do not (whether through
their own choice or the choice of their customers) engage in it. Thus, the degree to
which banks and other financial intermediaries provide assistance for
internationalisation is mixed.

A case study of internationalisation of banks is the market penetration of South
American countries by Spanish banks including Banco Santander Central Hispano
(BSCH) and Banco Bilbao Vizcaya Argentaria (BBVA) (Guillén & Tschoegl, 2000).
These two banks entered South American markets in 1995, seeking new markets and
operating in an oligopolistic fashion. They used an intensive acquisitions strategy to
gain market share, with over 50 acquisitions of smaller domestic banks as well as
commercial loan companies, credit card companies, and other financial services firms.
This represented an increasing rate of consolidation within the South American banking
market as well as a centralization of the banking sector. The main market entry for both
banks was into the commercial and retail banking market (offering primarily traditional
short-term deposit and lending services). This can have a negative effect on the earnings
of domestic banks, as fee and interest income is reduced. The introduction of
international banks also disrupted social subsidy programs in place with domestic
banks. Thus, the entry of international banks and substantial consolidation of the
banking industry into these countries had a disruptive effect on the domestic banking
market, as well as negative social effects. There is also no evidence that positive effects
(such as reduction in transaction costs or improved interest rates) accrued that would
improve the market performance as a whole (Guillén & Tschoegl, 2000). This type of internationalisation, which includes consolidation and conglomerate as a means of gaining market share, raises some significant issues of financial risk (De Nicoló, Bartholemew, Zaman & Zephirin, 2004). De Nicoló et al.’s (2004) research finds that trends of increasing internationalisation and consolidation between 1995 and 2000 resulted in an increase in the risk-taking levels of large financial firms above that of smaller firms. They also find that banks in less consolidated systems had lower levels of risk than those in more consolidated systems. These findings strongly suggest that ongoing efforts to internationalise, consolidate, and conglomerate do not result in less risk-taking, but actually increase the level of risk-taking by banks overall. This also suggests that the market entry of international firms actually results in an increase in risk-taking by domestic firms as well, due to the need to compete with new market entrants. As such, the changing market conditions associated with internationalisation and industry consolidation do not spread risk, but instead serve to concentrate it.

A second concern in addition to excessive financial risk is financial contagion. Financial contagion involves the transfer of financial risk between national banking systems. Financial contagion arises when there are interdependencies between economic systems such that volatility and risk is transmissible between them (Karolyi, 2003). A common example of financial contagion is the general collapse of Asian economies following the Thai currency crisis of 1997-1998. Financial contagion is believed to be particularly associated with the transmission of money and market instruments from economies with more volatile growth patterns to those with less volatile growth patterns. This increases exposure of the lower-volatility economies to risk. One of the transmission routes of financial contagion is through international banking systems (including Interbank and others), which enable direct transfer of funds between economies. As Karolyi (2003) points out, the empirical evidence for financial contagion is mixed, with some general recessions and economic shocks showing the influence of financial contagion and some not. Regardless, this is one of the significant potential systemic risks that internationalisation implies.

The internationalisation of banks can affect banks in multiple ways. As the case of Spanish banks in South America shows, it affects the domestic banking market by reducing earnings for domestic banks, as well as potentially disrupting existing social
policy programs. Internationalisation of banking can also lead to financial contagion, although this is a matter of some debate. Finally, the internationalisation of banks can lead to an increase in the level of financial risk associated with operations, particularly when considered in light of other trends such as consolidation and conglomeration. These factors mean that bank internationalisation is important to consider in this research.

2.1.3 Bank Business Models
This section discusses the various business models that may be used by banks. This includes information about information flow, structure, and risk control procedures. The core functions of any bank include ensuring liquidity, transformation of assets, and establishing long-term relationships based on lending information (Trumpel-Gugerell, 2009). However, the extent to which the bank performs these tasks varies depending on the business model in use.

Defining a generic set of bank business models is highly complex given that the regulations and structures of the bank vary widely depending on the country of regulation (Koch & MacDonald, 2009). A general classification of banking structures internationally suggests that the three main business models include central banks (which manage government banking regulation and industries), deposit money banks, and bank-like institutions (those which do not rely on deposit money as a means of generating funds) (Beck, Demirguc-Kunt & Levine, 2000). These classifications are based on ownership and funding structures, but do not directly reflect any information about what the actual tasks of the banks are (Beck et al, 2000). Two generic business models that can be identified include investment banks and commercial banks. Legally, these entities were separated in the US by the Glass-Steagall Act, which required separation of banks and investment firms (Singh, 2007). Following the partial repeal of the Glass-Steagall Act by the Gramm-Leach-Bliley Act in 1999, the commercial and investment banking industries began to merge. Although the Glass-Steagall Act did not apply in Great Britain, there was similar deregulation of the UK financial markets in the 1980s, including the so-called Big Bang, which made changes in the stock market operation allowing for integration of investment firms and banks as well as other changes to the UK financial banking and services environment (Singh, 2007). Many
banks continue to operate either as separate investment and commercial entities or with a Chinese wall separating the operations of these two entities (Koch & MacDonald, 2009). However, there are also banks that have undertaken diversification into other markets or used securitization as a means of increasing their revenues (Trumpel-Gugerell, 2009). Of these business model classifications, the dichotomous commercial/investment framework presented by Singh (2007) as well as the hybridization practices discussed by Trumpel-Gugerell (2009) are most useful for understanding how commercial banks structure their business practices. As such, this discussion first examines the structure, information flow, and risk control of commercial and investment banks separately, and then considers specific issues, like originate-to-distribute models, the effects of bank size and ownership, and whether there is a best business model for the bank.

2.1.3.1 Commercial Banks and Relationship Banking

The first business model for discussion is the commercial bank, which is probably the most common bank structure. Beck et al. (2000) classify commercial banks as deposit money institutions, or those whose business is based on lending money and taking deposits. The commercial bank acts as a financial intermediary and provides liquidity between borrowers and lenders (Beck et al, 2000). The commercial bank (which may also be referred to as a retail bank) is the main service provider of financial services for individuals and businesses (Koch & MacDonald, 2009). The lending model used by commercial banks has traditionally been relationship banking (Berger, Hasan & Zhou, 2009).

An important role of the commercial bank is providing lending facilities and capital for small firms in the marketplace (Berger & Udell, 1995a). This is one area where it is possible to see the importance of relationship banking. Relationship banking acts as a means of providing information about the borrowers and creating a system of credit. Small firms can also suffer from external shocks, including economic shocks and changes in regulation, which affect the ways in which the borrower can access financial markets. The use of relationship banking also increases information reusability, offering long-term balance for lenders in terms of their ability to lend with full information (Boot, 2000). In relationship banking, the long-term relationship between borrower and
lender serves to rectify an asymmetric information situation about small borrowers, due to lack of publicly released information about firm finances (Berger & Udell, 1995a). This results in lower rates for small investment borrowing, allowing for improved risk management. Thus, although the commercial bank plays an important role in liquidity, it can also limit liquidity in this way. However, a distinction should be drawn between the business structure of the commercial bank and the business practice of relationship banking. Although all relationship banking is performed by commercial banks, not all commercial banks use relationship banking. Some commercial banks choose a lending approach that relies on quantifiable measures such as credit scores rather than information collected from established relationships. As such, relationship banking is important to the commercial bank. However, it is not required that it should be included in the business model, as commercial banks have other possible approaches to lending.

There are a number of issues with relationship banking that have reduced its popularity as a business model, particularly issues with information flow and risk controls. The use of relationship banking creates an agency problem, since the lending agent for the firm is the primary repository of information about the borrower. This leaves the firm dependent on the banking officer for information about the borrower (Berger & Udell, 2002). Furthermore, evidence suggests that borrowers and lenders do not benefit from competition between banks for their business, due to the importance of relationship banking for those with constrained access to the financial market. In particular, banks in unregulated competition tend to seek out the most valuable clients, while not providing traditional services for smaller, less well-known clients. There have been changes both in interbank competition and capital market competition (involving lenders other than banks) that reduce utility for many borrowers. Capital market competition increases added value of relationship banking while reducing access, while interbank competition increases access but reduces added value. Both situations lead to some loss for borrowers. Relationship lenders are not unaware of these problems, particularly problems of agency and information asymmetry, and do use contractual arrangements to control the potentially negative outcomes of relationship banking (Boot & Thakor, 2000). An evaluation of relationship banking compared to other business models does not necessarily indicate that the problems with commercial banking are any more problematic than other models (particularly models such as originate-to-distribute), which suggests that the relationship banking model is not necessarily deprecated from
an analytical comparison point of view, even though it is not currently dominant in the market.

2.1.3.2 Investment Banking

The second common business model is that of investment banking. Investment banking was until recently a legally separate practice from commercial banking in the United States and United Kingdom, although this is not the case in all other countries (Singh, 2007). Investment banks offer non-depository bank-like services, according to Beck et al.’s (2000) classification of services. The investment bank does not directly engage in borrowing and lending. Instead, it is a fee-based banking structure, in which the firm may offer securities for sale or facilitate the sale of securities in other ways. Investment banks also offer such services as valuing public offerings, underwriting public offerings and buyouts, and providing analysis to investors regarding specific securities.

Information flow is important in the investment bank to an extent that it may not be in commercial banking, because of the potential for regulatory fouling due to failure to keep separate information about buying and selling activities. Because of this, the investment bank commonly operates using a Chinese wall structure. Rather than encouraging information sharing, as is common in commercial banking (especially relationship banking), the transfer of information between the two functions of the investment bank is prevented. This is also the case in the investment arms of banks that have diversified commercial and investment operations. Since the investment bank’s income is fee-based rather than interest-based, it does not face a risk of interest loss, but there are still certain risks involved in investment banking. These include failure of returns, the potential for losses, and regulatory risks from inadvertent information sharing. Because of these factors, risk control is a systematic factor in the structure of investment banks (Rosenbaum & Pearl, 2009).

2.1.3.3 Originate-to-distribute and Other Non-traditional Models

There are a number of diversified models of banking that are used outside the classical dichotomy of investment and commercial banks. As the use of the traditional commercial bank business model has declined and deregulation has lowered barriers to their use, there has been an increase in the use of non-traditional banking models by banks (Allen & Santomero, 2001). These models commonly involve fee-based practices.
that reduce the importance of information about the borrower to the bank. They include services such as sales of stocks, derivatives, and other instruments; repackaging of financial instruments; commercial transaction-based services like money transfer; and even in some cases insurance and other non-banking financial services. Fee-based services can be sold either to the existing customer or to external parties that do not have a specific relationship with the bank; in many cases, these transactions are levied based on value-added or other services offered to borrowers or lenders, augmenting their traditional lending services with transaction-based services (Allen & Santomero, 2001).

One example of this type of diversification is the originate-to-distribute business model, in which banks originate loans, and then sell them on to others to service (Berndt & Gupta, 2008). This business model is known to have a number of problems related to risk controls and information flows. In particular, evidence suggests that secondary loans underperform between 8% and 14% compared to primary loans. This indicates that either there is moral hazard inherent in the lack of relationship between bank and borrower, allowing borrowers to make poorer investment decisions and have worse returns, or that the banks making the loans are relying on private information that is not passed on to the secondary servicer of the loan. In either case, this is a gap in the performance of the originate-to-distribute model that does not support its validity in terms of information flow or risk controls. Evidence shows that this model of transaction-based banking is significantly underperforming other models (Berndt & Gupta, 2008).

One study sheds light on the problem of relative risk between deposit and non-deposit income by studying different kinds of non-deposit income at banks (Demirgüç-Kunt & Huizinga, 2010). This study finds that non-deposit wholesale funding used at low levels does reduce risk (though it also reduces return on assets). However, this is not the non-deposit strategy used by most banks, which instead use an excessive proportion of short-term non-deposit funding (Demirgüç-Kunt & Huizinga, 2010). This result in increased risk exposure and an attendant increase in bank instability and fragility. Thus, the use of non-deposit income is not in and of itself a problem, when used as a minority risk diversification strategy, but it can actually increase risk if used excessively.
2.1.3.4 Bank size and Ownership Effects

There are differences in effectiveness of bank business models based on different characteristics of banks, such as size and ownership of banks as well as effectiveness for specific customers (Berger, Miller, Petersen, Rajan & Stein, 2005). Berger et al. (2005) find that larger banks, even those that nominally maintained a traditional commercial banking structure, were less likely to establish personal relationships and in some cases eliminated relationship banking altogether. Larger banks also had shorter relationships with borrowers than smaller banks. The ultimate outcome of this was that the larger the bank, the less it was able to facilitate lending and act as an intermediary to reduce credit constraints for private firms that do not have access to the public bond market. However, there are no differences found between small banks and large banks overall in terms of competitiveness for lending to small businesses. The authors specifically state that this includes informationally opaque small business customers, indicating that there is no competitive advantage for large banks in this market. There is also no evidence that large banks have competitive advantages in terms of their use of lending technologies or access to information, or that these advantages increase monotonically as the firm grows larger. Thus, at least insofar as small firms are concerned, there is not actually a lending advantage associated with larger banks (Berger & Black, 2011). This also suggests that large banks may not be developing technologies dedicated to improving the efficiency of lending to smaller businesses, although the study does not directly determine whether larger banks are more deliberately strategically oriented to servicing larger businesses or not. This would be an interesting area for more qualitative study into bank strategic practices.

Ownership is also a factor in bank business model. One study finds that businesses in countries with state-owned banks may maintain multiple banking relationships with private banks, but not with public banks (Berger, Klapper, Peria & Zaidi, 2008). This suggests that borrowers may perceive different risks associated with different ownership models (Berger et al, 2008). A study of Chinese banks finds that state-owned domestic banks are significantly less able to allocate capital than international banks. This suggests that international diversification can lead to increased banking efficiency (although this probably depends on the specific market and existing banking efficiency) (Berger et al, 2009). However, these studies have not explored the specific reasons for the differences in efficiency between types of banks.
Ownership does affect bank performance. A time series study of efficiency in Southeast Asian banking (using a Tobit regression for the period 1998-2004 in Indonesia, Malaysia, Philippines, Thailand, and Vietnam) finds that, as expected, the 1997 currency crisis significantly impacted the performance of domestic banks, while it had less effect on performance of international banks (Gardener, Molyneux & Nguyen-Linh, 2011). Following this period, banks did recover somewhat. Private domestic banks continued to perform less effectively than international banks, but state banks increased their lending efficiency, out-performing their private-sector counterparts significantly. The main determinant of performance improvement, however, was development of the national banking system and increasing integration of banking systems (Gardener, Molyneux & Nguyen-Linh, 2011). Thus, banking in the region increased in efficiency through increasingly specific regulations (Gardener et al., 2011).

A rapid increase in bank size can also increase risk. One study of loan growth in 16 banks in OECD countries indicates that a rapid increase in the amount of loans is associated with gradual decline of bank performance (Foos, Norden & Weber, 2010). This study finds that during the first three years following an abnormally high increase in loans on the banks books, there is a corresponding increase in the amount of loan-loss provisions. In subsequent periods, banks that show this pattern of loan growth also have decreased capital ratios and relative and risk-adjusted interest incomes (Foos, et al., 2010). Thus, by taking on more loans, banks increase their risk levels in the near term, and in the long term they reduce their profitability.

A study of banking in Asian emerging markets from 1994-2009 identifies several factors associated with increased risk factors (Soedarmono, Machrouh & Tarazi, 2013). This study shows that commercial banks that had higher market penetration also had higher capital ratios, and income volatility. They also find that except in a few markets, the higher capital ratio associated with these banks was insufficient to avoid excessive risk associated with the larger banks. The superficial increased stability of larger banks was largely attributable to government subsidies assigned to larger banks in banking markets with high concentration – in other words, these banks were “too big to fail”.

Another study complicates the view of market power and its role in bank stability in its analysis of banks with high levels of market power (Ariss, 2010). This study finds that
banks with higher market power have lower cost efficiency, but also have higher levels of bank stability and profit efficiency. Ariss (2010) argues that this does support the idea that increased bank competition is associated with increased bank stability, and suggested that developing countries should encourage the development of banks with high levels of marketing power (Brunnermeier, 2009). However, the findings of Soedarmono et al. (2013) need to be taken into account here also, particularly that this stability may be subsidized by governments because of the market power concentration rather than occurring naturally.

2.1.3.5 Is There a Best Model?
This discussion does raise the point of whether there can be a best business model for banking. One author argues that it is not so much the business model in use that is important as having appropriate controls on the degree of leverage (using mandatory leverage ratios), bank capital requirements, and the use of non-deposit liabilities and OBS activities as an anchor for bank assets (Trumpel-Gugerell, 2009). This suggests that appropriate regulatory control is more important than the specific business model. However, other evidence indicates that business models do not emerge independently, but are instead based on the regulation that is in place. All of the regulatory issues mentioned by Trumpel-Gugerell (2009) will be directly influenced by the regulation, or lack of regulation, of the bank business model. Furthermore, the business models that relied so heavily on OBS activities and originate-to-distribute, among other detrimental practices, emerged following deregulation (Brunnermeier, 2009), and as such could potentially be reverted by re-regulation. As such, there does need to be consideration of which types of business models should be encouraged or discouraged based on the choice of regulatory regimes, as this is part and parcel of establishing an appropriate regulation approach. However, the evidence indicates that there are differences in efficiency based on size and ownership, and there are some models (such as originate-to-distribute) that are known to be less effective than other models, due to moral hazard and information asymmetries.

2.2 Financial Instability and Shocks and Financial Crisis
The precipitating factor of financial crisis (discussed in the following sections in detail) is commonly either general financial instability or a specific financial shock. This
section defines the idea of financial instability and shocks and explores the ways in
which these occur, and then discusses the idea of financial crisis. Following a general
overview of financial crisis, specific financial crises (including the 1997 Asian financial
crisis and the 2007-2009 subprime crisis and its aftermath) are discussed to provide
insight into the development of financial crisis and its effects. This discussion is
intended to demonstrate the conditions under which the financial system may
experience strain and how this strain may be resolved.

2.2.1 Overview of Financial Instability and Financial Shocks
Two key issues in this research include financial instability and financial shocks, both of
which are slightly different conditions that may lead to financial crisis. In this section, a
definition and overview of each of these concepts is provided. This basic definition and
discussion of how financial instability and financial shocks occur will then be used to
support the analysis of specific recent instances of financial instability that have arisen
over the past several years, including the 1997-1998 Asian currency crisis and the 2007-
2009 subprime mortgage crisis, as well as a general discussion of financial crisis.

2.2.1.1 Financial Instability
Minsky’s (1977) reinterpretation of Keynes’s ideas about financial stability offers a
theoretical basis for understanding financial instability. Minsky’s (1977) financial
instability hypothesis states that growth in capitalism is dependent on and driven by
financial instability (as evidenced by the business cycle). The fluctuation of prices and
wages within a given market produces this instability; in essence, increasing
productivity creates conditions of a growth of available goods for consumption, while
wages may not grow as rapidly (particularly in systems where manufacturers control
costs by refusing to increase wages). Ultimately, this results in a state of constant
disequilibrium, with either demand outstripping production (the rising portion of the
business cycle) or production higher than demand (the falling portion of the business
cycle). Under the financial instability hypothesis, these conditions are endemic to
capitalism and cannot be avoided, although they may be mitigated by regulatory
controls and practices. Financial instability occurs due to four potential conditions
where asymmetric information prevents efficient allocation of funds, including balance
sheet deterioration (in the finance sector), interest rate increases, uncertainty or risk
increases, and changes in asset prices resulting in non-finance firm balance sheet deterioration.

The financial instability hypothesis can be used to understand the growing swings in the international financial markets (Mishkin, 1999). Mishkin (1999) indicates that there was a growth in financial instability during the 1980s and 1990s, which were indicated by wide swings in GDP growth in both developing and developed economies. Financial instability is defined by Mishkin (1999, p. 6) as the event that “occurs when shocks to the financial system interfere with information flows so that the financial system can no longer do its job of channelling funds to productive investment opportunities”. This failure can occur for a number of reasons, including information asymmetries and moral hazard (both of which prevent efficient use of money for lending due to lack of full information and responsibility) and external shocks, including economic shocks. It is commonly presumed that financial instability is indicative of a market failure or conditions where the financial structure in place is insufficient to meet a specific demand (Allen & Gale, 2004). This includes financial intermediary (bank) systems, financial markets, and complex systems made up of both intermediaries and markets. Allen and Gale (2004) suggest that in a complex system, requiring liquidity provision is appropriate to avoid financial instability. This is consistent with the majority of modern developed economies. Modelling financial instability and its causes are inherently problematic in complex banking systems due to the number of different mechanisms involved in the instability. However, taking into account factors including specific national regulations, international regulation, and other factors does allow for modelling of financial instability (Tsomocos, 2003).

Avoidance of financial instability is dependent on a number of factors. First and most importantly, well-developed and well-regulated financial sectors are less vulnerable to financial instability than poorly developed and run financial sectors (Barth, Caprio & Levine, 2001). This is likely due to several reasons, including increased confidence in the banking system, decreased likelihood of unexpected shocks, regulatory barriers to entry preventing inappropriate market entry from inappropriate competitors, and mechanisms in place to deal with these shocks (Barth et al, 2001). Barth et al. (2001) suggest that the degree of regulation is immaterial to the performance of the banking sector, but given their findings as well as further experience with deregulation and its
effects, this conclusion must be called into question. There are a number of regulatory approaches to avoiding financial instability. Allen and Wood (2006) observe that a financially stable system does not need to avoid all shifts from equilibrium (which would be difficult in any case). Rather, it needs to be a system that is capable of withstanding instability and shocks. Regulatory approaches include information provision, market conventions, enforced, laws and regulations, and liquidity, solvency, and other supports (Allen & Wood, 2006).

### 2.2.1.2 Financial Shocks

The main issue with financial instability is that it causes the financial system to be vulnerable to various kinds of shocks (Mishkin, 1999). The definition of a financial shock follows the general definition of economic shock, which is that it is an unforeseen event that affects the economy (Zandi, 2009). These shocks may be either positive (such as a tax reduction that increases spending) or negative (such as a sudden drop in demand related to falling incomes). Such shocks may also be from the demand side (such as a sudden fall in demand for commercial loans due to perception of loss of consumer demand) or the supply side (such as bank unwillingness to lend, which was a factor in the liquidity freeze during the subprime mortgage crisis) (Zandi, 2009). Beyond this analogous definition, however, arrival at a more concrete definition as to what is and is not a financial shock is more difficult. One group of authors identifies a wide range of types of financial shocks, including those that are associated with material and non-material factors in performance (Fornari & Stracca, 2011). Financial shocks include liquidity constraints and lack of demand for lending and/or borrowing. Common types of financial shock may include liquidity shocks (in which there is a sudden demand for more liquid assets, or money, than either is available or that banks are willing to lend) and leverage shocks (in which the bank has a position that is too leveraged, leading to an inability to repay loans) (Adrian & Shin, 2010). As Adrian and Shin (2010) demonstrate, liquidity and leverage shocks are procyclical. That is, they tend to occur when the general business cycle is swinging up or down, creating conditions where it is likely that there will be an increased influence of these shocks on the real economy.

In addition to pure financial shocks, the financial system also plays a role in amplifying the effects of other types of economic shocks, including supply shocks and demand
shocks (Fornari & Stracca, 2011). Under this model, the financial intermediation system (including banks) acts as a quantitative accelerator, or a mechanism by which shocks are transmitted to the rest of the economy and amplified in their effects (Bernanke, Gertler & Gilchrist, 1999). Bernanke et al. (1999) demonstrated that conditions including credit and price stickiness resulted in transmission of amplified shocks through the financial sector. There is also a direct connection between market liquidity (which is how easily a given asset can be traded) and funding liquidity (how easily traders can receive funding) (Brunnermeier & Pedersen, 2007). Thus, there is the possibility that economic shocks (which affect market liquidity within the wider economy) and financial shocks (which affect funding liquidity within the financial sector) may mutually reinforce each other, exacerbating the effects of the shocks. Thus, financial shocks and economic shocks are not truly separate, but are instead intimately connected (Brunnermeier & Pedersen, 2007). This connection is particularly important for considering the most recent economic crisis, which has been marked by aggressive contamination of a financial shock across geographic markets and economic sectors.

While technically the financial shock occurs within the financial system, it has direct effects on the macroeconomic system (Jermann & Quadrini, 2009). A time series analysis of US financial flows (from 1990 to 2009) shows that financial shocks in the 1990-1991 and 2007-2009 downturns in the business cycle had a direct effect on the US GDP. This effect came from the reduction of funding liquidity and the resultant reduction of funds availability for firms. In effect, the financial shock in these cases resulted in a lessening of credit availability, particularly for small firms that are dependent on relationship banking for funding due to lack of access to other sources. This suggests that understanding financial shocks and their causes is one of the ways in which there can be a reduction in the financial strain seen by firms during downturns in the business cycle (Jermann & Quadrini, 2009).

2.2.2 Overview of Financial Crisis

The basic event that is considered in this research is a financial crisis, which is a particular kind of economic challenge marked by effects in both the real and the financial sector. In this section, financial crisis is defined and types of financial crisis are identified. Key sources of financial instability that lead to financial crisis are also
identified, following the definition of financial instability in the previous section.
Finally, impacts of financial crisis are identified.

2.2.2.1 Definition of Financial Crisis
There are a number of inconsistent definitions available for financial crisis within the
literature, and arriving at a single definition can be difficult given the multiplicity of
indicators used in the empirical research (Jickling, 2009). However, there have been a
number of definitions that have been discussed within the literature that could be used
for analysis. A simple definition of the financial crisis that it involves the constriction of
credit flows to businesses and households and a concomitant fall in demand for goods
and services. This constriction of credit flows is most commonly seen from liquidity or
production constraints (Jickling, 2009). A further definition of a global financial crisis is
also important given the international nature of the current banking system. A definition
of the global financial crisis is that it affects one or more significant global financial
sectors; it is a systemic financial shock (rather than a particular shock, such as a firm
scandal); it spans two or more regions and with three or more countries in each region
affected; and that the effect on global GDP is measurable (Reinhart & Rogoff, 2009).
(Although the authors use a measurement of a composite-weighted GDP index to
determine this, the specific measurement is not as important as being able to measure
the influence on GDP generally). Thus, a financial crisis should be defined not only
according to its type (discussed in more detail below), but also according to its global
span.

2.2.2.2 Types of Financial Crisis
There are a number of different types of financial crisis that can be identified in the
literature. The currency crisis results from significant, rapid shocks to the currency
system (such as rapid devaluation from a hard peg in a fixed currency) (Pericoli &
Sbracia, 2003). The stock market crisis, which is driven by rapid changes and increasing
volatility in the stock market, increases volatility in asset prices and results in financial
losses. Banking crises can result from a number of different occurrences, including a
sudden increase in the ratio of non-performing to performing assets, bank runs,
scandals, and liquidity and credit crunches. Another type of crisis is a liquidity crisis, in
which banks and other financial market actors either do not have sufficient funds to lend
(due to factors like excessive leverage) or have taken an excessively conservative stance on actually lending it (Radelet & Sachs, 2000). A more general classification of these three types of shocks identifies fiscal crisis (where a government has difficulty managing its loans or currency); currency crisis (or capital flight); and banking crisis (reserves failure or a run on the bank) (Sachs, 1998). Various financial events are typically classified as resulting from one or more of these types of shocks, which may result from different sources (such as fiscal, currency, or banking crises).

Various types of financial crisis can also be defined based on the precipitating factor that generated them, particularly in terms of behavioural aspects of the crisis. For example, a financial crisis may be characterized as the popping of a bubble, in which a given asset overheated due to speculative investment activity and then rapidly adjusted following correction of an information asymmetry (Radelet & Sachs, 2000). A financial crisis may also be the result of a panic, in which investors rapidly divested in a given asset based on a perception that it may not be as valuable as thought. This may be a correct or incorrect adjustment of an information asymmetry. However, as Radelet and Sachs (2000) point out, there are some problems with characterizations of financial crises in this fashion. First, there is the problem of causality. While these types of financial occurrences do happen, they do not always turn into a general financial crisis. Second, there is the problem of disentanglement. A number of these types of occurrences may be going on at the same time and may thus be obscured or difficult to determine cause and effect (Radelet & Sachs, 2000). This is also true for the above typology of crises. For example, a number of these individual crises are associated with the 2007-2009 crisis, which became a general financial crisis (Zandi, 2009). Thus, although it is important to understand the general causes of financial crisis, it should not be presumed that any given financial crisis could be classed under a single typology.

2.2.2.3 Key Sources of Financial Instability

There are a number of key sources of financial instability that can precipitate financial crisis. One study of the post-World War II banking system in the United States finds that some financial sector shocks that were involved in the generation of a financial crisis included total factor productivity shocks (which result in a loss of productive capacity or demand); monetary policy shocks (including inflationary or deflationary
shocks and interest rate shocks); and financial friction shocks (including liquidity and credit shocks) (Nolan & Thoenissen, 2009). Of these types of shocks, financial sector shocks have more lasting effects than other types of shocks, account for significant GDP variance, and continue in their contractionary effects on the economy even following the end of the recession (Nolan & Thoenissen, 2009). Another possible source of financial instability is banking consolidation, which results in fewer, larger banks operating in a financial market (Berger, Demsetz & Strahan, 1998). This results in increased systemic risk within the financial system, increasing the overall financial instability risk (Berger et al, 1998).

Capital availability and capital reserves can also generate financial instability, by creating conditions in which funding liquidity is constrained (Berger, Herring & Szegő, 1995b). The availability of capital (and in particular the bank’s leverage or the degree to which its loans outweigh its retained deposits) is one of the keys to reducing financial instability (Adrian & Shin, 2010). Additionally, funding liquidity is tied directly to market liquidity. This means that financial instability caused by funding liquidity constraints (lack of capital) has the potential to precipitate financial crisis (Brunnermeier & Pedersen, 2007). Another potential source of financial instability leading to financial crisis is the decline of balance sheet quantities in broker-dealers (Adrian & Shin, 2009). Broker-dealers (or securities firms) retain balance sheets consisting of marked-to-market short-term claims (Adrian & Shin, 2009). The balance sheets within these firms tend to be procyclical (or occurring in time with business cycles); thus, the reduction of balance sheets within these firms is a harbinger and precipitator of financial instability (Adrian & Shin, 2009).

2.2.2.4 Impacts of Financial Crisis

Generally, financial intermediation is thought to be growth promoting in the real economy, as it allows for the efficient transfer of funds between investors and borrowers, who put invested funds to productive use (Bencivenga & Smith, 1991). However, under conditions of financial crisis this relationship may break down and no longer be beneficial. In effect, the financial crisis may have negative effects across the economy. One important factor is that financial crisis does not generally stay confined to the economy in which it was precipitated. Instead, contagion, or transmission of
financial crisis through international financial connections, commonly occurs (Pericoli & Sbracia, 2003). Thus, one of the impacts of financial crisis is that it rapidly affects international economies as well as domestic economies (Pericoli & Sbracia, 2003).

Financial crisis has significant effects in the real economy. One of these real economy effects is on labour market performance, including wages and employment rates (Choudhry, Marelli & Signorelli, 2010). Choudhry et al.’s (2010) panel analysis of between 64 and 86 countries from 1980 to 2005 indicated that unemployment rates were worsened by varying amounts (but by a statistically significant amount) during this period, and that this varied depending on the degree of severity of the financial crisis. This analysis also showed that some segments of workers, especially female workers and younger workers had worse effects on employment from financial crisis (Choudhry et al, 2010).

This strongly indicates that there is a negative impact on employment from financial crises; this can be explained by the constraint of credit to firms and households and a resulting loss in demand, leading to job losses or failure to expand employment as expected (Choudhry et al, 2010). Financial crises precipitated by financial shocks are directly associated with increasing constraints on borrowing by consumers and firms, which result in reduction in demand and loss of productivity. This has the ability to negatively affect the economy further by precipitating total factor productivity (TFP) shocks, which further worsen the economic decline (Jermann & Quadrini, 2009). Thus, financial crisis has a strong impact on the real economy through the connection between lending and consumption and/or production.

2.2.3 1997-1998 Asian Currency Crisis
One of the two most visible recent examples of a financial crisis is the 1997-1998 Asian financial crisis. This section provides a brief background to the financial crisis, and then discusses its root causes and the impacts of the crisis. Finally, it discusses the reaction of the Asian banking sector and regulators to the financial crisis, to demonstrate how this influenced the Asian financial sector. This discussion serves to demonstrate how a financial crisis centred on Asian economies particularly played out.
2.2.3.1 History of the Crisis
The pre-crisis macroeconomic conditions of the Southeast and East Asia region were a major factor in the crisis. Prior to the 1997-1998 Asian currency crisis, a number of Asian countries, including Thailand and South Korea, operated using a fixed-rate currency exchange regime, with their exchange rates pegged to the US dollar (Tobin, 1998). The period before this crisis was characterized by an increase in high-rate short-term lending, which increased the value of national currencies. The region’s economic development was also marked by a dramatic rise in foreign investment inflows, combined with increasing financial integration (Alba, Bhattacharya, Claessens, Ghosh & Hernandez, 1999).

Macroeconomic conditions such as those above combined with private-sector decision-making (particularly in regard to short-term borrowing and cost of currency) that resulted in vulnerabilities to economic shocks. This vulnerability was exacerbated by weak banking regulation, which meant that lending conditions were not being supervised and bank balance sheets were also not being supervised (Alba et al, 1999). One group of writers termed this a “crisis of success (Radelet & Sachs, 2000, p. 106),” wherein the sudden cash flows created the conditions for collapse. However, the financial crisis still came as a surprise. According to Radelet and Sachs (2000), as late as the third quarter of 1997 there was no sign in the market of an economic collapse. Although markets were expecting a slowdown in Thailand, there was no indication that a financial crisis was going to occur (Radelet & Sachs, 2000).

2.2.3.2 Root Causes
The financial crisis was caused by a sudden devaluation of the Thai baht, which was undertaken in mid-1997 as a means of cooling down the overheated Thai investment sector (Radelet & Sachs, 2000). This resulted in a sharp contraction in the value of the exchange rate and resulted in significant capital flight. Because of the increasing integration of the banking sector in the region as well as increased ties between countries, the rapid interest rate and exchange rate changes in Thailand quickly spread to other Asian countries. Countries that were closely connected to the Thai economy and that had similar investment conditions (including Malaysia, Indonesia, the Philippines, and Korea) rapidly were overtaken by the same problems; this also
eventually affected more developed economies and those further away due to contractions in trade across the region (Radelet & Sachs, 2000).

Although the Thai baht devaluation played a significant role in the initial crisis, there were a number of factors that exacerbated the crisis, spread it, and kept it going on for some time. One of these factors was the International Monetary Fund (IMF) policy used to attempt to control the contagion or reduce its impact. According to Radelet and Sachs (2000, p. 116), “The IMF programs generally called for six key actions: immediate bank closures, quick restoration of minimum capital adequacy standards… tight domestic credit, high interest rates on central bank discount facilities, fiscal contraction, and nonfinancial sector structural changes.” These six programs, especially bank closures, tight credit, and capital adequacy, increased the on-going financial panics and frozen liquidity in Thailand, Korea, and Indonesia (Radelet & Sachs, 2000). This is a particularly important point, since it demonstrates that the classical economics used by the IMF in determining a course of action in the middle of a currency crisis served to exacerbate the problem, rather than correct it. However, Radelet and Sachs (2000) did not decompose the effects of these six IMF recommendations, making it difficult to determine which of these actions, if any in isolation, were responsible for the on-going economic crisis.

2.2.3.3 Impact of the Crisis

The financial impact of the currency crisis has been discussed in broad detail in other areas, and there is a wealth of information about it. As such, a brief summary of the overall impact is offered here, but this does not encompass all the potential impacts. There was an immediate impact on economic productivity in a number of Asian countries from the currency crisis, which was marked by severe contagion throughout the region. Countries that were immediately affected included Thailand (the epicentre of the crisis), Malaysia, Indonesia, South Korea, and the Philippines (Radelet & Sachs, 2000). An estimate that was taken slightly after the immediate failure indicated a loss of $105.1 billion in net private inflows (resulting from a total of $12.1 billion in outflows as well as withdrawal of previous inflows), as well as loss of 11% of GDP (totalling $935 billion). There were further impacts of $24 billion in portfolio equity and $5 billion in non-bank lending. Thus, the immediate financial loss of this crisis can be
estimated at around $1,069 billion. In terms of the banking system, there was a drop of 3.6% of GDP in interbank lending for these five countries. The financial system also suffered, with Indonesia, Korea, and Thailand (the worst-affected countries) having their credit downgraded below investment grade (constraining import and export as well as debt servicing). These countries had partial defaults on their public debt, especially external debt; much of this debt was not renegotiated effectively, although some of it was (particularly in Korea). There were a rash of bank runs and bank collapses across the region as well due to panic about the banking system and concerns about liquidity (Radelet & Sachs, 2000).

The macroeconomic shocks created by the currency crisis created a range of effects across the region, although not all countries saw the same effects. One of the initial effects was an exchange rate depreciation. This was exacerbated by the withdrawal of foreign capital (capital flight). Interest rates also expanded sharply as funding liquidity was cut (due to a lack of market liquidity caused by capital flight). Some banks were so undercapitalized, particularly in Thailand and Korea, the IMF threatened to close them (Radelet & Sachs, 2000). Ultimately, this resulted in a contractionary shock in the real economy across the region, with substantial on-going productivity falls due to lack of funding liquidity and the on-going effects.

2.2.3.4 Reaction of the Asian Banking Sector
The immediate reaction of much of the Asian banking sector was to cease lending, even to established relationship customers and in cases where financial statements were available (Jiangli, Unal & Yom, 2008). This had the effect of not just limiting further capital expenditure, but also constraining the availability of working capital (Jiangli et al, 2008). Following the crisis, Asian bank regulators generally tightened banking regulations and oversight, particularly bank governance requirements and capital adequacy requirements (Pathan, Skully & Wickramanayake, 2008). Specific changes that were made included improved protections for minority shareholders and improved internal governance measures (Pathan et al, 2008). These measures have been shown by Pathan et al. (2008) to have increased Granger causality of bank returns with the stock markets, indicating that this served to improve performance consistently with the stock market. However, these reforms did not address the vulnerability of the developing
countries involved in the crisis to financial shocks from their trade partners. In particular, Park and Wang (2001) argue, the reforms were oriented to domestic and internal changes and did not address the need for international banking sector reform. Thus, despite the international nature of the banking crisis, there was a primarily domestic regulatory response.

A study of Asian banks during and after the 1997 financial crisis (1998-2003) finds that firm-specific risk was more important than systemic risk in bank instability and total risk load (Agusman, Monroe, Gasborrow & Zumwalt, 2008). Specific bank measurements that were positively and significantly related to firm-specific risk included gross loans to total assets and loan-loss reserves to gross loans (Agusman, et al., 2008). This study is interesting because it suggests that, contrary to other theories, banks were not subject to excessive contagion, but were instead negatively influenced by their own activities (Agusman, et al., 2008).

2.2.4 2007-2009 Financial Crisis
A second significant example of a general financial crisis is the 2007-2009 global financial crisis, which had its origins in the US subprime housing market and associated derivatives market. This section provides a brief history of the crisis and then discusses its root causes and impacts. It also discusses the reaction of global and Asian banking sectors to the crisis. As this crisis is still continuing in many places, however, this must remain a partial discussion.

2.2.4.1 History of the Crisis
The 2007-2009 financial crisis is a multi-stranded and complex phenomenon, and as such its history is wide-ranging and difficult to fully encompass. However, there is general agreement that deregulation in the US financial markets, particularly the repeal of the Glass-Steagall Act by the Gramm-Leach-Bliley Act in 1999, led to conditions where integrated investment and commercial banking could occur, implicitly allowed banks to retain more financial risk than previously was allowable (Tatom, 2011). As Tatom (2011) points out, the Gramm-Leach-Bliley Act was instrumental in reducing some of the worst damage from the bank failures during the crisis. However, it still allowed for the excessive build-up of OBS assets and liabilities, which ultimately would
lead to financial crisis. During the period leading up to the financial crisis (2000 to 2007), banks in the United States and the United Kingdom began to take on increasing OBS assets and liabilities without fully understanding the extent of their risk exposure (Kolb, 2010).

In addition to this financial market build-up, there were also other factors involved in the housing bubble that would eventually pop. One factor was an unprecedented period of low interest rates, generated by Federal Reserve policies that held the interest rate low to encourage creation in addition to strong interest in US instruments from Asian investors. Brunnermeier (2009) points out that the 1997-1998 currency crisis was one of the reasons for this low interest rate. These conditions created a subprime housing boom, with banks lending freely to less qualified buyers due to perceived lowered risk, low cost of money, and saturation in the prime lending markets. Additionally, the practice of originate-and-distribute lending (which has already been discussed and shown to be more risky than traditional models (Berndt & Gupta, 2008)) began to become common (Brunnermeier, 2009). These practices are clearly implicated in the crisis, as they enabled banks to take on undisclosed amounts of risk (and in some cases unknown amounts of risk) while circumventing already-inadequate capital adequacy and risk management requirements. Using originate-and-distribute models meant that banks were not carrying loans on their balance sheets, but were instead repackaging loans as collateralized debt obligations (CDOs) and reselling them to other banks. In return, they would buy CDOs from other banks and hold them as OBS assets (Brunnermeier, 2009). Unfortunately, the risk profile of these CDOs was misunderstood and in many cases underestimated, leaving banks with excessive amounts of risk on their books (though not on their balance sheets). Furthermore, these CDOs were not even sold as complete instruments, but were divided into tranches. These tranches had highly complex structures and risk profiles, which were sometimes not even understood by the issuer. By the relatively mild 2006 economic slowdown, the subprime mortgage market (which was heavily invested in by foreign investors as well as domestic) was complex, tangled, and extremely vulnerable to the shock of unexpected default rates from customers in vulnerable positions (Kolb, 2010).
2.2.4.2 Root Causes

The first cause of the financial crisis was a sudden shock in the subprime mortgage market in the United States. This occurred as a mild downturn in the economy combined with a sudden increase in interest rates meant that many homeowners in the subprime market (who commonly held high-rate variable mortgages) began to default, changing the ratio of performing to non-performing loans on the balance sheets of many banks. These balance sheet losses were only the start of the problem. A large number of banks were also suffering from depreciation of the OBS assets (credit derivatives) based on loans that were suddenly non-performing at a higher rate than expected. This situation rapidly escalated through contagion mechanisms (particularly to financially close countries like the United Kingdom) and across general financial markets as banks suddenly had a currency crisis (especially a liquidity and credit crisis). The lack of credit and funding liquidity available to firms led to a rapid slowdown in productivity and generalized global financial turmoil (Brunnermeier, 2009).

Globally, there were more far-reaching causes (Obstfeld, Shambaugh & Taylor, 2009). Obstfeld et al. (2009) identified one mechanism for the causation of the 2008 panic associated with the financial crisis as being a combination of a bank run (reducing capital reserves) and capital flight (removal of foreign exchange from the economy), happening across multiple economies. One analysis showed that the major problem was the manufacturing of tail risk (or risks that had a low probability of occurrence, but were poorly capitalized and systemic) by large complex financial institutions (Acharya, 2009a; 2009b). Acharya et al. (2009b) attributed the 2007-2009 financial crisis not to a single precipitating event, but instead to the cumulative impact of decades of changes in regulation and oversight of the banking industry, which allowed for the assumption of excessive systemic risk by these large institutions. They also find that moral hazard involved in the originate-and-distribute business model and risk mispricing were associated as causal factors, although they did not attribute the main causality to them (Acharya et al., 2009b). This is consistent with conditions of risk shifting, where banks making coordinated movements to avoid risk end up increasing systemic risk (Acharya et al., 2009a).
2.2.4.3 Impact of the Crisis

The impact of the 2007-2009 crisis has been global and has been reflected strongly in the real economy, rather than being constrained to financial markets. The immediate impact of the subprime housing crisis involved the freezing of liquidity and failure to lend to businesses, which almost immediately created a liquidity crisis and total factor production crisis (Zandi, 2009). This liquidity freeze was due to an increase in interbank risk premiums from around 0% to 5% to 6% almost immediately following the failure of Lehman Brothers in 2008 (McKibbin & Stoeckel, 2010). This has led to a continuous personal finance crisis within affected countries, involving increased unemployment rates and falls in personal income (Choudhry et al, 2010). A notable characteristic of this impact on unemployment is that it has disproportionately affected young and female workers. In this case, the impact on the real sector was global, due to increasing globalization and integration of supply and demand (McKibbin & Stoeckel, 2010). This resulted in a situation where some economies were shielded for a short period of time. However, by 2009 almost every economy (including those that were commonly countercyclical to the centres of contagion) had experienced a downturn in production and consumption. World trade volumes shrank by approximately 13% in 2008-2009 (although due to primarily domestic production of non-durable goods in many economies, the GDP contraction was not as strong) (McKibbin & Stoeckel, 2010).

2.2.4.4 Reaction of Global and Asian Banking Industries

The global banking industry was strongly affected by this financial crisis. The most immediate response was a rash of banking failures or bailouts in the United States, England, Iceland, and a number of other highly involved countries. These failures were largely due to excessive leverage of OBS liabilities and failure to realize risk; however, after the first bank failures it became clear that governments would need to react to prevent systemic failure (Zandi, 2009). This was followed by a slowdown of interbank lending due to a risk premium increase from 0% to 5%, which led to a liquidity crisis. Following immediate response there was some degree of divestment from the OBS assets that caused the crisis (Kolb, 2010). However, whether there will be a long-term change in regulatory structures or risk management structures remains an open question (Amable, Boyer, Levy-Faur, Parker & Vogel, 2010). As Amable et al. (2010) observe, there are increasing calls for expanded regulation in the banking market, despite pre-
crisis orthodoxy that the market was excessively regulated. However, whether this has been realized is uncertain as yet.

While developing economies are commonly countercyclical (that is, not synchronized with business cycles in Western countries), in the most recent financial crisis this was not the case in India and China, particularly due to service and production-oriented economic activity, which was immediately affected by a demand shock (Fidmuc & Korhonen, 2010). These trade ties meant that Chinese and Indian economies as well as the Japanese economy, which is procyclical to Western economies (Fidmuc & Korhonen, 2010). However, unlike banks in many Western countries, many Asian banks did not react with tightening liquidity and credit, and policymakers in many Asian countries took an aggressive approach to regulation and reducing the impact on the financial markets (Bernanke, 2009). This lessened the impact, generally speaking. However, it is difficult to make a brief statement of generalities regarding Asian banking, given the extent of diversity of responses between countries.

2.3 Changes in the Financial Landscape after Crisis
The financial landscape includes not just banks, but also the institutions, regulations, networks, and flows between these banks and non-bank financial actors that are involved in the intermediated and direct flow of capital around the world (Nagurney, 2008). In addition to these factors, the financial landscape also includes instruments and approaches to generating value; this includes loans, fee-based products such as derivatives, and all other products and services that are offered in the banking sector. In a more broad-ranging definition of the financial sector, this includes non-bank institutions; however, given that the goal of this research is to primarily discuss banks in their role as financial intermediaries, this discussion focuses on the changes to bank products and services, regulation, and other factors only. This discussion is also focused on the 2007-2009 crisis and the changes that have taken place in response to that crisis, rather than any other crises (which have, as discussed above, had a variety of responses). Specific topics for discussion within this section include the changes in the banking landscape, the key reasons for making these changes, and the impact of these changes (insofar as can be determined currently, given the relative newness of these changes. Three key areas of change identified include changes in banks and bank
concentration, regulation changes, and changes in business models and geographic scope.

2.3.1 Changes in Banks and Bank Concentration

Banking structures and business models have undergone a substantial number of changes following the crisis. First, there was a wave of bank failures, bankruptcies and supervisory takeovers across multiple economies that occurred immediately during the financial crisis (Freixas, 2010). This resulted in the change in the banking landscape in terms of the number of banks and concentration of banks in various markets. A number of banks and other financial services companies, including several British banks and AIG as well as others, received state aid, which resulted in some cases in a partial transfer to state ownership (Freixas, 2010). Concentration of banks in the EU generally rose slightly, with the CR5% in 2009 being 44% in the EU-15 countries (compared to 43% in 2006) (Schoenmaker, 2011). The CR5% is a market concentration ratio indicating the market share of the top five competitors, so an increase in this ratio indicates a more concentrated market. This concentration increase is not large, but could affect the international market.

One of the approaches used in this restructuring by supervisory overseers (such as central banks) was a good bank/bad bank approach, in which the bad assets of a failing bank were separated from the remaining assets and sold off (Freixas, 2010). This approach has been met with mixed success where it has been used, with some banks recovering and other banks not doing so. There have been a number of suggestions made for improving the outcomes of bank failures, including expedited resolution by using reverse convertibles as well as other changes in the bankruptcy laws specifically for banks and banking institutions (Freixas, 2010). However, there have been few actual implementations of these bankruptcy changes to determine whether they would be successful or not.

The concentration and internationalisation of banking sectors has also shifted following the crisis. The exit of a number of European banks resulted in a change in the cross-border penetration of international banks. Schoenmaker (2011) observe that while international banking penetration in the Netherlands fell to 7%, it rose to 54% in
neighbouring Belgium. In the Asia Pacific region, a large number of banks fell back from international positions and began to focus on the domestic market. The total number of global banks also fell back from 2009-2010, indicating a sharp increase in this area. Following the 2007-2009 crisis, the largest 15 Asia Pacific banks fell from 13% international revenues to 8% (Schoenmaker, 2011). This suggests a contracting of the international banking arena, as well as a redistribution of international banking. The reasons for this contraction are unknown, but they could be related to a tightening credit market making participation in international markets less profitable or the need to focus more tightly on domestic markets. Understanding the causes of this contraction would provide valuable information about changing business market models. However, this research has not been performed to date.

2.3.2 Regulation Changes
Immediately prior to the crisis, it was believed that despite the origin of banking regulations in a series of financial crises, the increases in efficiency gains following deregulation and the real economy effects that resulted from this increased efficiency were sufficient to justify deregulation (Kroszner & Strahan, 2007). This position was rapidly reversed following the onset of the crisis, with a number of regulations being implemented (Kolb, 2010). The specific regulatory changes that were put into place varied depending on the region (or country) and the existing laws. However, international banking regulation has also been changed, with the updated Basel III capital requirements framework focusing on increased liquidity and capital adequacy standards and requirements for risk-based capital requirements, especially increased rigidity for capital/asset ratios (Cecchetti, Domanski & von Peter, 2011). Although Basel III rules are generally supported, there are some controversial proposals like the SIFI reforms. Other regulatory changes that have not yet been put into place include the Volcker Rule and Vickers proposal, both of which propose a re-separation of investment and commercial banking (Wehinger, 2011).

In the European Union, there were new common principles identified by the ECOFIN Council in 2007 (Pisani-Ferry & Sapir, 2010). These new common principles enforced rules regarding cooperation between member states as well as laid out specific guidelines for financial stability. The four new principles addressed objectives of crisis
management (directed toward financial stability rather than prevention of failure of specific banks), the definition of cross-border crisis management as a common interest; full participation from affected states being expected at an early stage in the operations; and reasserting that “Policy actions in the context of crisis management must comply with EU competition and state-aid rules” (Pisani-Ferry & Sapir, 2010, p. 352). These new EU-wide principles were intended for implementation by the end of 2009. However, there were a number of gaps in these new cooperation principles, including that the incentive to cooperate was not aligned (Pisani-Ferry & Sapir, 2010). No specific assessment of effectiveness of these EU-wide rules has been performed. However, some interpretations of these rules could have led to a failure to implement some actions, such as the Northern Rock bailouts, which are credited with lessening the immediate impact of the financial crisis (Zandi, 2009). Thus, whether this is a positive change or not is still in question. There have also been a number of other changes to the European banking system, including conditions on bailouts, recapitalization, and other national aid efforts; these are primarily targeted to reducing the impact of national aid on EU-wide competition (Pisani-Ferry & Sapir, 2010).

Another significant change is in bank governance regulation, particularly in bank compensation rules and dividend policies (Freixas, 2010). These changes, which included legislation to ban bonuses from any banks receiving aid from the French state and limitations on bonuses in the United States, were prompted by perceptions that bank compensation was overblown and provided perverse incentives for short-term profits, thus driving much of the conditions leading to banking failures. However, as with other changes, there is a lack of evidence regarding how effective these changes have been, and bonus and compensation regulations are still being implemented. Finally, there have been movements toward restoring capital adequacy requirements and prevention of excessive risk assumption by bank (Freixas, 2010).

2.3.3 New Business Models

One issue that became clear during the financial crisis is that there was a misalignment and mispricing of bank instruments and bank risk (Freixas, 2010). This, plus regulation involving increased capital solvency requirements and additional changes, has resulted in the emergence of new business models and changes in the business involvement of
the banks (Cecchetti, Domanski & von Peter, 2011). One of these changes is refocusing on relationship banking and moving away from transaction-based services, particularly from the derivative instruments that were implicated in the financial crisis (Boot & Marinc, 2008). It is likely that a complete movement away from the transaction-based industry would not necessarily be effective, because of the importance of these transactions to financial markets. This particularly applies to services such as underwriting and securitization, which are used by financial markets to manage internal transactions. However, there are likely to be changes in the balance of business between transaction-based and relationship banking, though the effects of these changes have not yet been studied (Boot & Marinc, 2008). This would provide a valuable piece of information about the changes in the business model landscape that banks have undertaken voluntarily, and also provide information about how banks view the risk associated with various business models. Thus, it is hoped that this information will be available soon.

Geographic scope changes in banking are already being seen. Changes to the Basel III requirements are likely to lead to increased local components for international firms, because of the requirements for liquidity (which require that funds be held locally in order to meet these requirements) (Cecchetti et al, 2011). It is expected that this will lead to increased centralization of international banks, particularly multinational banks (which retain strong connections to the home country). However, existing trends in the market show an already-increasing trend toward multinational rather than international banking, with many banks withdrawing from international markets and refocusing on home country markets (Cecchetti et al, 2011). As with most of the reforms, it is not possible to determine whether this reduction in scope of business models will be effective in increasing financial stability.

2.3.4 Summary of Response
Overall, the Asian regulatory response to the most current banking crisis has been relatively rapid compared to the Western response, with tightened regulations and other changes from Asian governments seeking to mitigate the effects of the crisis. There have also been a number of changes in the business practices of banks themselves, including a withdrawal from the international banking arena and potential changes in
the balance of transaction-based and relationship banking and a withdrawal from transaction-based services. However, how these changes will persist in the long term, and any other changes that may occur, remains to be seen. One of the difficulties of this research is that, in effect, the financial crisis is still continuing, and governments and banks are still reacting to the crisis. As such, this can only be a preliminary analysis of the overall response.
3.1 Strategies and Business Models for Financial Instability

The discussion above makes it clear that it is necessary for the bank’s business model to be designed to cope with financial instability, although the problem of financial instability and the business model is also affected by regulation. However, it also makes it clear that excessive reliance on certain business models, particularly originate-and-distribute and excessive reliance on fee-based business models are actually causes of financial instability or serve to exacerbate this instability. These business models emerged in a deregulated atmosphere where the institutional framework was minimised and financial stability was de-prioritised. This suggests that re-regulation, including the selection of business models that promote rather than detract from financial instability, requires information about these models. This raises the question of what business models and strategies banks can use effectively to cope with conditions of financial instability, and conversely what strategies they should not consider because of their negative or exacerbating effects on financial instability. This is the key research question for this research. This section provides an overview of the research in this area and discusses how banks can effectively implement these strategies.

3.1.1 General Bank Structures and Business Models

Bank business models can be analysed in several ways. However, the main areas for concern, particularly for bank supervisors and regulators, include products and services and customer base, customer approach, and sources of profitability (Cavelaars & Passenier, 2012). The importance of these three factors is that they describe where a bank will face risk as well as where it will receive profit, which allows for identification of where a bank’s business may fail and where it may be exposed to risk. All three of these areas provide the focus of discussions of bank business models within this body of literature, although most of the discussion focuses on the first point (customers and products), which is defined by the classic division between traditional and non-traditional bank business models.

A comprehensive study of bank business models before and after the 2007-2009 crisis finds that business models play a significant role in the ability of the bank to weather the
financial instability caused (Altunbas, Manganelli & Marques-Ibanez, 2011). Altunbas et al. (2011) examine the business models in use in European banks prior to the crisis to determine the characteristics of banks that were more or less protected during the crisis. The authors find that changes in the size and opacity of bank business models had increased in the European Union and the United States during the 1990s and 2000s following successive rounds of deregulation that allowed for this type of growth. Using a large sample of European and American banks, the researchers find that business models that involved excessive risk-taking, large size, weaker capitalization, less business from customer deposits and traditional interest-generating activities, and credit expansion increased a bank’s risk of exposure to financial instability. Furthermore, market capitalization (or bank value based on the stock price) was not a protection against these problems. The authors posit that this was because market capitalization of at least some banks in the sample (if not all) was driven up during the mid-2000s by hiding systemic risk and the effects of excessive risk-taking. Thus, strong stock market performance during a bull market could actually be an indicator that the bank is more exposed to systemic risk and more vulnerable to financial instability rather than less. This effect was seen to be nonlinear in the case of customer deposits and market financing. Market financing had a disproportionate increase in financial instability for more risky banks, while customer deposits had a disproportionate reduction in the same area (Altunbas et al, 2011). This indicates that there is a strong connection between the bank business model selected and the exposure to financial instability.

A direct comparison between different bank investment models in the EU banking system also offers some interesting information regarding the influence of the bank’s business model on financial exposures during the 2007-2009 financial crisis (Ayadi, Arbak & De Groen, 2011). Ayadi et al. (2011) use three categories of business model, including: retail banks (traditional banking); investment banks (which use a lot of transaction-based and derivatives activities); and wholesale banks (which mostly focus on interbank and wholesale business). They survey the largest 26 banks in Europe (totalling 55% of the market) from 2006 to 2009 to determine which of these business models were most effective, based on five different dimensions including “risk characteristics, systemic stability, bank performance, efficiency and corporate governance” (Ayadi et al, 2011, p. ii). The study finds that traditional retail banking fared much better than either investment banking or wholesale banking during the crisis,
both in terms of their performance and risk characteristics and exposure to systemic risk. Furthermore, these banks were able to make the most significant continuing contribution to economic performance, as they continued to offer loans to customers during the period. In contrast, investment banks and wholesale banks suffered high exposure to systemic risk and did not show strong corporate governance and efficiency. Many banks in this category had a high level of risk exposure as well. Overall, investment and wholesale banks were also significantly more likely to require government support than were retail banks, suggesting that the retail banking strategy is more robust in terms of its sustainability in the face of financial instability than either investment or wholesale banks. However, the study did not examine hybrid banks or integrated banks, and so there is no information available from this study on how well firms that offers both retail and investment or wholesale banks might have fared against the economic crisis. This is a significant matter of concern particularly in regions where the division between retail and investment banking is not as strong.

The specific reasons for an increase in risk exposure associated with non-traditional banking activities and business models is explained by an analysis of diversification versus specialization of financial services (De Jonghe, 2010). This study compares banks that used traditional and non-traditional revenue activities to determine the risk profiles of each of these activities. He finds that the use of non-traditional revenue activities was associated with an increased tail beta (indicating increased tail risk). Tail risk is a form of risk encountered in portfolio generation when an assumption of normality is made, but in fact the distribution of risk is not normal, resulting in an increased and undetected potential loss. The increase in tail risk being associated with non-traditional revenues suggests a spectrum of potential risk exposure to financial instability. Traditional retail banks, which use few non-traditional revenue generation approaches, have the lowest rate of risk exposure and investment. Wholesale banks, which focus on non-traditional approaches or even rely on them entirely, have the highest such exposure. This is consistent with previous findings regarding the traditional and non-traditional business models and their implications for exposure to financial instability, as discussed above. These findings also expand on the previous research by confirming that diversification does not offer additional protection against financial instability, despite the general assumptions regarding diversification of portfolios and reduction of exposure to risk (De Jonghe, 2010). This suggests that
diversification of the business model does increase risk, and it may not improve resistance to economic instability. However, findings in this area are inconsistent, suggesting further study is required.

3.1.2 Bank and Market Characteristics

In addition to the general bank structures and business models, and characteristics such as risk exposure, there are also some additional characteristics of banks that can be seen to provide protection against financial instability. This is also true of banking markets. A number of these are discussed in the section below.

One study examined a large sample of European listed banks to identify specific characteristics that affected the bank’s resilience to financial instability (Vallascas & Keasey, 2012). This study finds that three basic characteristics, including size, asset growth, and share of non-interest income in the bank’s revenue mix, were the most important factors in determining how much systemic risk the bank was exposed to. This is in addition to specific factors addressed by the Basel III accords, and discussed below. The strongest factor in this study is bank size. This offers a significant indication that controlling the size of banks – particularly those operating in smaller economies – is an important step in controlling the risk exposure of banks. However, the authors observe, there is no current proposal to limit the size of banks, despite clear evidence that bank size is implicated in bank failures over time. This is very important to consider when considering business models and strategies, since many banks do not see a reason not to simply grow as large as possible (Vallascas & Keasey, 2012). A second study also supports the finding that smaller banks, as well as better-capitalized banks, would have better resistance to financial crisis regardless of their specific business model (De Jonghe, 2010).

The corporate governance of the bank is also one of the important factors in determining the overall level of risk exposure. One example of this is managerial discretion, or decisions that can be made by the bank managers on any basis chosen by those managers (Baele, de Bruyckere, De Jonghe & Vander Vennet, 2010). Baele et al. (2010) study a sample of US bank holding companies from 1991 to 2008. They find that there is evidence that managerial discretion and opacity in decision-making had a strong influence on bank efficiency (as measured by distance from the best-performing
competitor, considered to be the efficient frontier for this market). This study demonstrates that opacity and management efficiency, both of which are relevant to corporate governance of the bank and both of which reflect negatively in this area. However, these results should be taken with a grain of salt, given the demonstrated degree of value of market pricing in determining the degree of resilience to financial instability within the bank (Altunbas et al, 2011). Given Altunbas et al.’s (2011) findings that banks with higher market capitalization actually proved to be more fragile, and the supposition that this fragility could come about due to excessive risk-taking driven by management to improve stock returns, this suggests that in fact market capitalization and market valuation is not generally founded on high-quality information. Regardless, the influence of corporate governance on the bank’s business strategy should be considered to be important.

Multinational banks may face different levels of risk from financial instability than banks that do not compete in international markets. One study examined the performance of EU banks in an integrated economic market (Navaretti, Calzolari, Pozzolo & Levi, 2010). Navaretti et al. (2010) find that multinational banks provided a stabilizing force in the European market during the worst of the 2007-2009 financial crisis by continuing to maintain trading liquidity (continuing to lend in consumer and small business markets, particularly). The authors suggested that this was possible because of the isolation of multinational banks from local conditions and smoothing of market conditions across the internal EU market. This had the result of lowering the exposure of any one subsidiary of the bank to local conditions and increasing bank stability (Navaretti et al, 2010). This can be compared to domestic-only banks, which had a higher rate of exposure to domestic financial conditions. However, these findings should be qualified with the notation that the financial markets and banking systems of EU states are strongly integrated, and operate on similar rules across the market. Thus, these results may not hold in regions such as Asia, where there is not such a strong integration of financial markets and banking regulations.

Bank strategies begin with identifying appropriate competitive markets. This is important not just in terms of product-market considerations, but also because the competitive conditions within the market influence the potential exposure to risk. There are two competing views regarding the role of competition in exposure of banks to risk.
One of these views holds that bank competition encourages risk-taking by reducing profit margins and market power, while the other holds that it increases interest rates, adverse selection and moral hazard (Berger, Klapper & Turk-Aris, 2009). Berger et al. (2009) study 8,235 banks across 23 different developed countries. They find that banks with higher market power (that is, larger banks within a given market) had less risk exposure generally, but a better portfolio mix. They observe that this actually represents an integration of these two theories. However, this study also demonstrates that competition within the national industry and the position of the bank within this industry will affect risk exposure. This finding is supported by another study, which examines 45 banking systems across different countries (Schaek, Cihak & Wolfe, 2009). Schaek et al. (2009) use the Panzar and Rosse H-statistic to determine the degree of competition within these industries. This statistic categorizes a market as competitive, monopolistically competitive (branded), and monopolistic based on factor input elasticity. The study finds that markets in competitive markets had less exposure to systemic risk than those in monopolistically competitive or monopolistic markets (Schaek et al, 2009). These studies suggest that bank strategies in market choice are highly relevant to the exposure of the bank to financial risk. Thus, one bank strategy that needs to be taken into account when determining exposure to financial instability is how it chooses international markets to enter.

One of the reasons that retail banking may vary between regions is differences in how much people use retail banking in a region, as well as the kind of services they demand (Baumann, Hamin & Tung, 2012). Baumann et al. (2012) compare the share of wallet (or amount of business that goes to the primary bank chosen by an individual) across Canada, Australia, and China, as well as comparing Caucasian and Chinese users of banks. They find that China had the lowest market share compared to other markets. This suggests that banks may have locked-in customers in some regions and not in others, which could change the risk profile associated with the customer base.

3.1.3 Changing Business Models

While there is substantial evidence regarding the importance of the business model in the ability of the bank to withstand financial instability, there are gaps in the redesign and reregulation of the banking industry in order to account for this need. This section discusses the identified changes that need to be made to develop a regulatory and
competitive environment in which banks can effectively change their business models to be more resistant to financial instability influences. Of particular concern in the reregulation of banking industry to reduce exposure to financial instability is direct action to reduce contagion risk and counterparty risk, which were serious issues in both 1997 and 2007 (Blundell-Wignall, Wehinger & Slovik, 2009). However, there has not yet been any significant regulatory movement toward resolving this problem, indicating that it is likely to continue to be a problem over time despite changes to bank governance, transparency, and other bank-specific factors (Bundell-Wignall et al, 2009).

The international banking industry’s response to the 1997-1998 financial crisis was fundamental in shaping the financial environment in which the 2007 crisis emerged (Best, 2010). The 1997-1998 financial crisis showed that lack of transparency and risk assessment dramatically increased the systemic risk involved in the banking system generally, and in the banking business models that Asian firms were using to manage their businesses. In response, the international banking community generally implemented new models for bank transparency and reporting and tightened rules for bank governance and risk analysis. However, these new regulations did not address the core problems that bank business models reflected in the Asian crisis; in particular, issues like overinvestment in the property segment, high rates of OBS assets that were not assessed for risk, and excessive exposure to highly leveraged assets were not addressed by improved regulation or other response. This means that, despite increased risk assessment and transparency requirements, there was no actual difference made in regulation of bank business models. Instead, the same business models were in place during the 2007 crisis that emerged as problematic in 1997 (Best, 2010). In a very real sense, this means that the lessons of 1997 were not in fact learned.

There are a number of regulations that have been posed for reintroduction. The Basel III accords propose regulations on liquidity ratios, capital quality, and capital coverage, among other areas of improvement in bank governance, oversight, and transparency (Lehman, Levi & Tabak, 2011). These changes in regulation are intended to improve financial supervision and regulation and to promote conditions of system-wide banking stability (Lehman et al, 2011). An analysis of these proposed regulations shows that capital quality and coverage provisions encapsulated in Basel III will not have a strong effect on existing bank business models around Europe, although liquidity ratios could
pose a challenge for banks that maintain a high reliance on wholesale lending markets. A second analysis of the proposed regulations of the Basel III accords (once again in Europe) finds that liquidity ratio improvements and limits on the bank’s leverage ratio will also reduce the exposure to financial instability risk of most banks, although this exposure will also be influenced by other factors (Vallascas & Keasey, 2012). These are clearly regulatory factors, but they must be taken into account when considering the effects of international banks (given that banks have different regulatory regimes depending on the domestic regulations). The factors also influencing exposure found in this study are discussed in more detail above.

Regulation on banks such as those suggested above will have an effect on bank earnings and efficiency. A comprehensive study of bank reregulation in developed economies around the world has some interesting findings in regard to the potential impact on financial risk exposure as well as other issues (Fuchita, 2011). This study finds that liquidity requirements and rules on equity capital ratios, as well as regulation of leverage ratios, are likely to have a downward pressure on bank earnings. Additionally, stricter regulations posed on structurally important financial institutions (SIFIs or institutions that are “too big to fail”) are likely to further constrain earnings within these banks. It is also likely that banks will lose revenues from restriction of earnings sources, particularly OTC derivatives (Fuchita, 2011). Fuchita (2011) suggests that more banks may fall back to a traditional business model, emphasizing deposits and relationship lending rather than transaction services as a primary revenue stream. Given the information discussed above regarding the resilience of various bank business models to financial instability. However, this is not likely to be considered a bad thing. Instead, this movement toward traditional services is likely to be an improvement in the ability of the banks to withstand earnings disruption. Thus, although Fuchita (2011) presents the effects of reregulation as negatives, there is no need to necessarily consider them such, given the strong evidence that bank earnings are actually negatively associated with ability to withstand financial instability.
3.2 Limitations of Current Southeast Asian Banking Business Models and Structures in Response to Financial Instability

There has been a great deal of research that focuses on Southeast Asian banking models and industry structures and their effectiveness under instability during the 2007-2009 financial crisis. Much of this research specifically discusses changes made to Asian banking business models following the 1997-1998 crisis and how well they held up under the financial instability caused by the 2007-2009 crisis. This section reviews the present limitations of the Southeast Asian banking system in response to financial instability based on this evidence. The goal of this section is to demonstrate how the literature has treated the problem of Asian bank responses to the current crisis in light of the previous crisis, and what changes were effective over time. There is also a brief discussion of some factors that were previously identified as weaknesses in the Asian banking model, but have instead proved to be strengths.

3.2.1 Factors that are not Weaknesses

One of the reasons that Asian banking models generally responded well to the recent financial instability is that their business models were not heavily weighted toward the use of securitized assets, especially the subprime mortgage-backed securities (MBSs) and collateralized debt obligations (CDOs) that proved to be dangerous for Anglo-American banks (Fujii, 2012). These particular securitized assets proved to be a dangerous inclusion for banking business models for two reasons. First, they were generally created using an originate-and-distribute model, which is known to create moral hazard problems as compared to originate-and-hold models. Simply, issuing agencies were not as careful with the quality or the risk assessment of these instruments, since they would not remain on the books of the agency. A related problem is lack of transparency in the structure of these instruments, which do not allow for determination of what was being purchased in many cases and did not allow for adequate risk analysis. It is not the case that these assets did not form any part of the assets of Asian banks, but the damage from them was limited. This was believed to be a weakness in the Asian banking structure previously, given that it was perceived that risk was actually being lessened by these instruments. However, the clear evidence after the crisis is that it improved conditions and reduced the degree of impact from the systemic shock associated with the collapse of the American and British banking systems. In particular, it significantly reduced the tail risk to which banks were exposed (Fujii, 2012).
A study of South Asian banks in developing countries (including Bangladesh, Pakistan, and Sri Lanka) identifies how banks become profitable in this operating environment (Sufian, 2012). This study included 77 banks, studied from 1997-2008. Unsurprisingly, Sufian (2012) determines that higher costs are associated with lower bank profitability. Factors that are associated with increased profitability include non-interest income, credit risk, capitalization, and liquidity. Private investment is one of the additional factors that may influence profitability, though it is not certain. Overall, these factors are not strongly different from the factors associated with profitability in developed countries (Sufian, 2012).

3.2.2 Factors that Limited Response

Although there were some factors that actually proved to be positive in the Asian banking system, there are also a number of factors that limited the effective response to the 2007-2009 financial instability, and which in some cases continue to affect the system. Several of the most recent findings in this area are discussed in this section. Some of these factors found in recent studies include failed restructuring and on-going concentration and lack of diversification in bank services and portfolios.

Although there was a strong regulatory and bank response to the 1997-1998 crisis, analysis of banks following the crisis (from 2001-2007) suggests that this may not have done as much good as could be hoped (Soedarmono, Machrouh & Tarazi, 2011). Seodarmono et al. (2011) studied Asian banks from 12 different countries during this period, measuring the relationship between bank capitalization and bank instability. They find that there was a direct relationship between bank capitalization and instability. The larger the bank was, the more likely it was to experience earnings instability. This means that there is a higher default risk seen for these banks, despite changes in bank regulation and bank business models undertaken during this period. This also strongly suggests that despite the warning of the 1997-1998 crisis, banks did not make significant enough changes to improve the response to crisis. In particular, bank concentration actually grew during this period, increasing the exposure of banks in many Asian countries to systemic risk. While increased risk taking and instability in bank business models was to some extent offset by higher rates of economic growth, this is not enough to conclude that increasing the size of banks and their exposure to risk
was wise. In fact, it demonstrates that bank size and structure is a direct limit on how well Asian banks can react to financial instability. This relationship was suggested by previous research (as discussed above), and the findings of Seodarmono et al. (2011) serve to confirm this conclusion.

A second study suggests a reason for the failure of banks to respond adequately to the 1997 crisis by restructuring appropriately (Thoraneenitiyan & Avkiran, 2009). This study used data development analysis and stochastic frontier analysis to determine the immediate response of Asian banks to the 1997 crisis, using data from 1997 to 2001. The study finds that ownership restructuring (a major factor in the increasing concentration of ownership as observed above) did not automatically result in increased efficiency in the banking system, though domestic mergers did result in some improvements of efficiency. However, this restructuring could not overcome the effects of the external environments of banking that result in inefficiencies in many Asian countries. Some of these inefficiencies include high interest rates (driven either by government involvement or other difficult market conditions) and highly concentrated banking markets (a situation which the increase in mergers actually exacerbated). These conditions suggest that in many Asian countries (though not all) there were external barriers to implementing an effective banking structure, so, despite restructuring occurring, this restructuring did not actually serve to increase financial stability or robustness of the banking system against financial crisis (Thoraneenitiyan & Avkiran, 2009). This is particularly important given the need for further restructuring, which should be oriented to improving financial stability. This also suggests that banking systems, rather than simply individual banks, need to be considered as sources of potential instability and limits to meeting the challenges of the financial crisis.

One study on South Asian banks in Bangladesh, Sri Lanka, India, and Pakistan from 1998 to 2008 finds that one area of concern for the ability to react to financial instability is lack of diversification (Nguyen, Skully & Perera, 2011). Nguyen et al. (2011) find that most banks in this sample focused on interest-generating (or traditional) banking models, with the majority of their income coming from these types of industries. Furthermore, the study finds that the banks with the largest market power in the region were particularly focused on interest-generating activities, primarily on traditional lending and deposit activities. In contrast, there was relatively little use of non-interest
dependent activities, such as loan origination or other transaction-based services, among these banks (Nguyen et al, 2011). This resulted in a condition where the more undiversified banks were vulnerable to financial instability, particularly financial instability that reduced the amount of borrowings that business or private borrowers demanded. In contrast, diversification across non-interest or transaction-based business models resulted in an increased level of stability in earnings, even during periods of financial instability generally. There are a number of key lessons for Asian banks in this regard. Avoidance of innovative banking products does reduce risk, but it also means that the benefits of diversification will not be realized by the bank. Thus, a bank that remains too traditional may be limited in its ability to recover from financial instability due to lack of alternative revenue sources. This is a potential significant limitation.

The competitive environment of Asian banking could also play a significant role in limiting the ability to respond to increased risk, although this can be difficult to make a general statement on regarding a wide range of competitive environments and their stability across Southeast Asia (Liu, Molyneux & Nguyen, 2012). For example, Liu et al. (2012) observe that while Hong Kong and Singapore are generally considered stable competitive environments, other countries like Indonesia undergo frequent changes. Theoretically, increased competition stabilizes a given banking system by increasing efficiency and reducing asymmetric information relationships, thus resulting in less risk in a given banking system. However, this theoretical position is not entirely clear. It is also the case that strong competition (especially in a saturated or constrained market) could increase risk-taking decisions by bankers who are trying to gain an advantage over competitors. Finally, regulation may be said to either increase risk-taking (to catch up to regulations) or reduce risk-taking (because of transparency requirements). Given this conflicting theoretical landscape, empirical analysis is the best approach to determining whether competition influences risk generally. An analysis of banks across the Philippines, Vietnam, Malaysia, and Indonesia shows that there was an inverse correlation between market concentration and risk taking. This suggests that less-concentrated markets are likely to result in higher rates of risk-taking among these four environments. However, the degree of competition did not appear to affect risk-taking in the four environments studied. The degree of risk-taking was also directly associated with the development of financial fragility, or degree of exposure to harm from experiencing systemic risk. This suggests that the consolidation of the competitive
environment could influence the degree of risk taking, although competitiveness would not necessarily be involved (Liu et al., 2012). Thus, at least some Asian banks are likely to have constraints placed on them by the external market, and these limits are likely to lead to financial fragility in the case of at least some banking environments, which increases vulnerability to financial instability.

Many of the structural characteristics of Asian bank business models, including lack of heterogeneous portfolios, could lead to limits to their ability to react to financial crisis. In effect, this represents a vulnerability to systemic risk (or risk that cannot be removed from the banking system). One group of researchers examine Australian and Asian banking portfolios and their response to the collapse of the Lehman Brothers (a US bank that collapsed at the beginning of the crisis) to determine the response of the banks to increased systemic risks (Huang, Zhou & Zhu, 2011). Huang et al. (2011) find that the banks in the region were affected by spillover effects from the crisis occurring in North America and Europe almost immediately, although these responses would not be reflected in large-scale bank instability for some time. They also observe that the distress premium associated with the banks by insurers was not driven by actual default risk perceptions until Q4 2008. Prior to that, the majority of the distress premium was based on perceptions of increased systemic risk on the part of the banks. That is, the majority of initial perception effects were due to the liquidity freeze that became global around this time. However, much of the losses associated with Asian banks during this period were actually associated with size and diversification of the banking portfolio (Huang et al., 2011). Simply, larger banks were more exposed to systemic risk, and banks with undiversified portfolios such as those heavily involved in interest-generating activities, as discussed above by Liu et al. (2012) were also more vulnerable to systemic risk. This suggests that the business model of large, concentrated, and undiversified banks in several (though not all) Asian countries could be a significant barrier to reacting effectively to financial instability.

3.3 Summary of Factors in Choice of Business Model

The evidence that has been examined in this research has identified a number of different areas that are likely to influence the choice of business model that is most effective for the bank. A summary of these issues includes discussion of institutional
and structural changes that are likely to make a difference in the choice of business model, the identification of bank business model characteristics that either promote or detract from financial stability and performance, and discussion of approaches that have been either successful or unsuccessful in meeting the challenges of financial crisis.

3.3.1 The Regulatory and Institutional Horizon
As observed above, the business models chosen by banks are highly dependent on regulatory and institutional frameworks that they operate under. There are a variety of factors that could be seen to influence this choice already in place, even disregarding any other changes to regulation. The most important change in regulation is likely to be driven by the upcoming Basel III requirements, which will change capital adequacy and leverage ratio requirements (Lehman et al, 2011). The effects of this change are uncertain, although initial analyses suggest that business models in Europe will not be changed significantly (except for heavy wholesale lenders) (Lehman et al, 2011). Further analysis suggests that both bank earnings and financial instability risk exposure will be reduced (Fuchita, 2011; Vallascas & Keasey, 2012). Changes in regulation may help reduce financial instability risk, but not completely eliminate it.

3.3.2 Bank Business Models
The second issue that emerged in this discussion is the individual characteristics of the bank business model that are known to affect financial stability, and how these characteristics can be identified. Some of the factors that are known to be risks for financial instability exposure include excessive risk assumption, large size, weak capitalization ratios, low use of traditional, interest-based business, and credit expansion (Altunbas et al, 2011). In Seodarmono et al.’s (2011) research the relationship between size and instability was shown to be persistent in Asian banks, with larger banks being significantly more unstable than smaller banks.

In addition to evidence for characteristics that increase risk there is also evidence for characteristics that decrease risk. The traditional retail banking model is known to be more effective in Europe than investment banks or wholesale banks, when considering performance through the last crisis (Ayadi et al, 2011). This evaluation included continuing to protect liquidity (which traditional banks were strong in) and exposure to systemic risk (Ayadi et al, 2011). A second study also showed that the use of non-
traditional activities increased tail risk and increased exposure to unidentified amounts of financial instability (De Jonghe, 2010). Smaller banks are also exposed to less financial instability risk, as are banks with better capitalization ratios (De Jonghe, 2010; Vallascas & Keasey, 2012). Multinational banks also appear to be less exposed to financial instability, at least within integrated markets such as the EU, due to the slight isolation of banks from local conditions (Navaretti et al., 2010). This is already supported by existing Asian banking models, which have not been excessively positioned in CDOs or OBS transactions (Fujii, 2012).

Some factors that would theoretically protect against financial instability do not in fact appear to do so. These include market size and portfolio and business model diversification (Altunbas et al., 2011; De Jonghe, 2010). A high market capitalization does not necessarily signify bank stability, given the market focus on short-term profits. Thus, this is not the informational source it might be thought under a theoretical position (Altunbas et al., 2011). There is conflicting information about some elements of bank business models as well. For example, some studies hold that increased managerial discretion (relationship banking) reduces risk exposure, while others view market information like credit reports to be a valuable aspect of controlling financial instability risk (Baele et al., 2010; Altunbas et al., 2011).

It is not necessarily true that Western banking models are superior to banking models used in developing countries, as demonstrated by the recent financial crisis (Demirgüç-Kunt & Servén, 2010). This crisis has demonstrated that the rejection of longer-term relationship banking and increasing reliance on non-deposit income has led Western banks into a position of untenable risk taking (Demirgüç-Kunt & Servén, 2010). While some banks in developing countries did follow these approaches as well, many did not and continued to retain strict traditional risk controls, avoiding the worst effects of the economic crisis (Demirgüç-Kunt & Servén, 2010). Thus, there is considerable evidence that retaining traditional banking models is more appropriate for Asian banks than adopting Western models.

The question of how Asian-style and Western-style bank governance structures influence banks is analysed by a pair of researchers, who perform a historical comparison of divergent banks in Hong Kong (Zheng & Ho, 2012). They particularly
focus on the separation of ownership and management, and find that HSBC (the Western, separated bank) lent money more freely, but BEA (the Asian, controlled bank) had a higher return on its lending. From an investor standpoint, HSBC had higher dividends, but ultimately BEA had higher shareholder returns. BEA had a higher continued involvement of its founding families, while HSBC evolved more toward a multiple-family, partial outsider model of management. Ultimately, however, both banks are financially successful, though they have somewhat different attitudes to risk (Zheng & Ho, 2012).

Overall, the business model that is supported the best within the literature is the traditional or interest-based business model, in which the majority of the bank’s business comes from deposit and lending activities. Furthermore, the research supports a strong capitalization ratio, relatively small size, and international operations as positive features of a bank business model oriented to surviving financial instability. Characteristics that are contraindicated include large size and market capitalization and avoidance of OBS and other risky activities such as rapid credit expansion. There is no evidence for the use or disuse of relationship banking, though a mixed approach could provide the best balance of information.

### 3.3.3 Barriers to Change

The final question is what barriers stand in the way of effective implementation of a business model that is resistant to financial instability. It is known that banks did not address major risk exposures following restructuring in 1997-2001, instead becoming even more concentrated and using riskier business practices (Thoraneenitiyan & Avkiran, 2009). Asian banks also show a lack of diversification that could increase financial risk exposure (Nguyen et al, 2011; Liu et al, 2012; Huang et al, 2011), although as discussed above portfolio diversification does not necessarily reduce financial instability risk. There are also some significant regulatory issues that could be addressed. For example, regulatory changes intended to reduce counterparty risk and contagion has not yet been implemented (Bundell-Wignall et al, 2009). Changes in regulation following 1997-1998 did not address issues that emerged in 2007-2009, such as use of OBS, excessive real estate investment, or excessive leverage (Best, 2010).
3.4 Research Hypotheses

The researcher proposes three hypotheses by basing on the literature that has been discussed. These three hypotheses address the conditions under which banks will experience increased or reduced stability. The three factors that have been identified include diversification of income, use of traditional relationship banking, and maintaining control of balance sheets.

The first hypothesis concerns the role of income stream diversification as a risk management strategy. Several authors have supported the use of diversified income streams (including interest and non-interest sources) as a means of risk management within the bank (Carbó & Rodriguez, 2007; Lepetit, et al, 2008; Lozano-Vivas & Pasiouras, 2008; Stiroh, 2004). However, this must be truly diversified. Excessive reliance on non-interest income, or on some forms of non-interest income like originate-to-distribute lending, can actually increase risk exposure (Bernt & Gupta, 2008; Demirgűç-Kunt & Huizinga, 2010). Thus, the first hypothesis can be stated as:

**H1:** Under current banking conditions in Southeast and East Asia, a risk diversification strategy that includes a majority proportion of interest sources of income and a minority of non-interest sources of income will be most effective.

The second hypothesis concerns the use of traditional relationship banking models compared to non-traditional models. In this case, investment banking is excluded because it is different in nature and revenue sources from commercial banking. Relationship banking is the traditional model used by banks to generate income from short-term deposits, personal and business loans, and other interest-related activities from a set of people it already has relationships with (borrowers) (Berger, et al., 2009). The relationship banking model increases available information about small borrowers, who may be initially opaque to firms because they are not required to release public financial information (Berger & Udell, 1995a). Relationship banking has been one of the major changes resulting from the financial crisis, as banks move away from riskier non-deposit or hybrid models of banking (Boots & Marinc, 2008). Relationship banking is known to be a factor in reducing banking risk, although some researchers do consider it to be best when supplemented with market-based information models (Baele et al., 2010; Altunbas et al, 2011). Thus, there is substantial evidence to suggest that:
**H2:** Under current banking conditions in Southeast and East Asia, banks that rely on interest-bearing income from relationship banking will be more stable than those that rely on non-interest income (including transaction-based income and any other mechanisms that are not related to relationship banking).

The final hypothesis is related to the strength of the balance sheet (including capital reserve ratios and other factors). The weak balance sheets associated with banks heavily involved in OTD were implicated as a major risk factor in previous analysis of the problem of bank stability (Brunnermeier, 2009). Furthermore, capital ratios are known to have a direct implication for bank stability (Foos, et al., 2010; Seodarmono, et al., 2013). In contrast, banks with stronger capitalization ratios are known to have lower levels of financial instability risk (De Jonghe, 2010; Vallasca & Keasey, 2012). Thus, Hypothesis 3 can be stated:

**H3:** Under current banking conditions in Southeast and East Asia, banks that maintain a strong balance sheet will be more stable than those with a weaker balance sheet.
Chapter 4: Research Methodology

This chapter includes a description of the research methodology used in the study. In order to determine what methodology would be appropriate, the researcher first considered the problem space and the ways that other researchers have studied the problems of bank stability and bank failure previously. This yielded a set of potentially appropriate methods and practices that could be integrated into studying the specific timeframe and region that are of interest in this research. The potential methods were then refined, with some being rejected because of impracticality or because of problems with previous use of the methods in question. This resulted in a research design that is focused on econometric analysis, using previously collected data from BankScope as the main source of data. This method is intended to provide a robust, repeatable method by which the research questions can be answered.

This chapter explains the methods used to test hypotheses. The hypothesis relationships that are tested include:

- Bank stability indicators and diversification (Hypothesis 1): This hypothesis indicates that banks pursuing risk diversification strategy by having a majority of interest income and minority of non-interest income will be most effective.
- Bank stability indicators and net interest income (Hypothesis 2): This hypothesis argues that net interest income will have a positive effect on bank stability.
- Bank stability indicators and balance sheet indicators (Hypothesis 3): This hypothesis states that balance sheet indicators will be related to bank stability indicators.

Table 1 illustrates the connection between variables (both dependent and independent variables) and hypotheses. In all cases, the dependent variables tested (separately) with all independent variables. Then, independent variables selected for the final model for each dependent variable construct (Bank stability, Returns and Riskiness of Share Prices) are presented. Table 1 also shows the relationship between hypotheses and independent variables. Hypothesis 1 focuses on Diversification (%). Hypothesis 2 focuses on Net interest income. Hypothesis 3 focuses on the balance sheet indicators which include Total assets, Performing to non-Performing loans ratio, Cost-to-income ratio, and Equity-to-asset ratio.
Table 1 Relationship between research variables and hypotheses

<table>
<thead>
<tr>
<th>Underlying construct</th>
<th>Independents variables selected for the final model</th>
<th>Variables related to hypotheses</th>
</tr>
</thead>
</table>
| 1. Bank Stability    | • Total assets (USD)  
                      • Performing loans to non-performing loans (%)  
                      • Profit before tax and abnormal items (USD)  
                      • Net interest income (USD)  
                      • Diversification (%)  
                      • Cost-to-income ratio (%) | • H1: Diversification  
                      • H2: Net interest income  
                      • H3: Balance sheet indicators (Total assets,  
                        Performing to non-performing loans ratio,  
                        Cost-to-income ratio, and  
                        Equity-to-asset ratio) |
| 2. Returns           | • Total assets (USD)  
                      • Profit before tax and abnormal items (USD)  
                      • Turnovers (USD)  
                      • Diversification (%)  
                      • Cost-to-income ratio (%) |                                |
| 3. Riskiness of Share Prices | • Total assets (USD)  
                          • Performing loans to non-performing loans (%)  
                          • Turnovers (USD)  
                          • Net interest income (USD)  
                          • Diversification (%)  
                          • Cost-to-income ratio (%)  
                          • Equity-to-asset ratio (%) |                                |

The first topic for discussion in this chapter is the data collection and preparation approach. Data collection was done using BankScope, which is a commonly used way to easily collect data for financial analyses in the banking industry. Following data refinement, this resulted in a sample of 676 institutions from 14 Southeast and East Asian countries from 2001-2012, for a data set containing 129,792 data points. This
chapter also discusses the methods of analysis. Three types of regression are used to provide a comprehensive analysis of the data. The third section is research variables. It discussed research variables in detail, including their sources and definitions. After examining variables that have been used in previous studies, sixteen variables across three performance constructs have been selected.

4.1 Data Collection Procedures
There are two main topics for discussion in regard to the data collection procedures. This includes the data sources and selection and the further data transformations (in addition to those discussed above, which were used to generate some of the variables).

4.1.1 Data Sources and Selection
Discussion on the data sources and selection includes discussion of the data source, geographies, types of banks, type of data, and years selected.

4.1.1.1 Data Source
For econometric studies, there can often be difficulties in collecting and sourcing data that is consistent with the parameters of the study (Verbeek, 2008). Because of this, econometric studies are often designed to take into account the broadest study that can be conducted using a single data source or database, of which there are many that include different types of data (Wooldridge, 2009). This research is no exception, and the choice has been made to work within the confines of a single data set that is readily available, rather than attempt to make consistent data from several different sources. The data selected for this research was selected from BankScope, an international database that contains financial and other data for over 11,000 banks worldwide for up to 16 years (Bureau van Dijk, 2013). BankScope has been used as a data source in many other research projects that are related to the topic of study in this research, which have been reviewed in this study (De Jonghe, 2010; Distinguin & Tarazi, 2010; Heider & Gropp, 2008; Jeon et al., 2011; Shehzad et al., 2010; Tabak et al., 2012; Uhde & Heimeshoff, 2009). It is actually designed for econometric and financial studies of the banking industry, and includes a vast array of other information that can be used for research. BankScope is also easy to use with STATA, which is the main program that was selected for this research (Thibaut & Mathias, 2012). Overall, this makes it a highly
reliable data source and one that is widely used in similar contexts and studies, and it is ideal for the current research. However, BankScope does have some limitations that needed to be taken into account when designing the data set and analysis methods. These include constraints on time, data availability, and the type of data and data codes that can be extracted from BankScope. The sections below identify these limitations in detail and describe how the research was managed to avoid them.

4.1.1.2 Geographies

The choice of geographies is based on World Bank classifications of geographic regions. The original intent of the research was to focus on Southeast Asia as the region of interest. However, this region is relatively small, including only eleven countries (Indonesia, Thailand, Malaysia, Singapore, Philippines, Vietnam, Burma, Brunei, Cambodia, Laos, Timor Leste), many of which are currently under economic stress or do not have functional banking systems (World Bank, 2013b). Additionally, many of the banks operating in this region according to the BankScope data were actually international subsidiary banks. This meant that there were too few banks to use for analysis that were headquartered within the region. In order to increase the number of banks included in the study, East Asia was also included as an area for analysis. These countries were primarily in the East Asia and Pacific region of the World Bank analysis, which includes 22 countries (including Cambodia, China, Fiji, Indonesia, Japan, Kiribati, Korea, Laos, Malaysia, Marshall Islands, Micronesia, Mongolia, Palau, Papua New Guinea, Philippines, Samoa, Solomon Islands, Thailand, Timor Leste, Tonga, Tuvalu, Vanuatu, and Vietnam) (World Bank, 2013c).

After countries with no significant domestic banking and those that are regulated by external authorities were excluded, there were 17 countries left for analysis from these two regions. These included: Brunei, Cambodia, China, Hong Kong, Indonesia, Japan, Korea, Macau, Malaysia, Myanmar (Burma), Philippines, Singapore, Taiwan, Timor-Leste, Thailand, and Vietnam. Brunei is included form the Central Asia region of the World Bank database because of conflicting information about its position as South or Central Asia. The remainder of countries was from the East Asia and Pacific region. Finally, three countries (Timor-Leste, Myanmar (Burma), and Cambodia) are not found in the BankScope database.
The final selection of countries and their BankScope ISO codes for access include: 1) Brunei (BRN); 2) Macau (MAC); 3) Indonesia (IDN); 4) Laos (LAO); 5) Malaysia (MYS); 6) Philippines (PHL); 7) Thailand (THA); 8) Vietnam (VNM); 9) China (CHN); 10) Hong Kong SAR (HKG); 11) Japan (JPN); 12) Korea (KOR); 13) Singapore (SGP); and 14) Taiwan (TWN). Each of these countries is represented by at least one bank in the BankScope database that was domestic and that had data available for the time period in question. According to the World Bank figures (World Bank, 2013b; World Bank, 2013c; World Bank, 2013d), these countries span the range from low-income developing countries to high-income developed OECD member countries, and are different sizes in terms of population and economy.

4.1.1.3 Types of Banks

BankScope lists all types of banks, including private banks, commercially owned banks and state-owned banks, as well as commercial (retail) banks and investment banks. This could potentially allow for inclusion of many different types of banks. However, there are reasons to exclude some banks from consideration because of their structure and ownership models. In particular, state-owned banks have been routinely shown to be less efficient than private banks, because they have different investment priorities and practices (Berger, et al., 2009; Bonin, Hasan & Wachtel, 2005; Zhao, Zhou & Jiang, 2001). For example, state-owned banks may focus on low-return investment projects intended for infrastructure development or lend to higher-risk poorer individuals, thus changing their risk profile. They also may have greater support from government services. This makes state-owned banks incommensurate in terms of their earnings structures and risk profiles with publicly held or private banks that are operated for profit. This could potentially introduce exogenous factors into the analysis that would skew the results, since these types of banks are not truly operating in the same category or using the same rules. Thus, state-owned or nationalized banks (those with greater than 49% state ownership) are excluded from this analysis. Also excluded are private banks that file minimal financial information, since there is not enough information to include them in the analysis. This means that the main types of banks included in this analysis include public commercial banks and investment banks. Commercial banks are those that can be defined as deposit money institutions, or those that focus on deposits and lending (interest income) as their main source of revenue. Investment banks are
non-interest based banks that use fee income (usually generated from investment management services) as their main flow of income (Beck, et al., 2000).

4.1.1.4 Consolidated Data
One of the main problems with BankScope’s data is that in cases where ownership is managed by a conglomerate (such as when a bank operates as a subsidiary) the only information available is consolidated financial statements of the conglomerate (Thibaut & Mathias, 2012). Consolidated financial statements are statements that present the full financial performance of the firm, but not subsidiaries. Although specific rules for reporting vary by country and legal structure, in many cases consolidated firms do not report financial data for individual subsidiaries (Hove, 2006). This is not just a BankScope problem, but also one with the financial reporting regime in general, and it is not one that can be worked around effectively using any publicly available data. However, international subsidiaries of firms do have a contribution to make for the performance of the firm, and they do contribute to the overall financial strategy of the organisation, as well as being subject to it (Inkpen & Ramaswamy, 2005). Thus, the consolidated financial statements are not wholly unreflective of the performance of the subsidiary, though it is difficult to know the extent of contribution. Given the number of banks that were in the position of being a subsidiary of an international firm, it would have been impractical to eliminate these banks based on their financial status. Thus, for reasons both practical (lack of any replacement information or way to calculate it) and philosophical (the shared alignment of corporate strategy and actions), banks that are subsidiaries of other firms are included, and the consolidated data of the parent company is used when required to provide insight into the financial position of the firm. This does mean that bank sizes may be skewed, which is one of the reasons for use of ratios in the financial performance analysis.

4.1.1.5 Years Selected
This study uses a time series approach to analysis, meaning that two or more periods of convenient length should be included. Since bank financial reporting typically occurs in its most complete form annually and BankScope includes annual reports (Bureau van Dijk, 2013; Hove, 2006), an annual period was chosen for analysis. The analysis was designed to study the period of the Asian financial crisis (1997-1998). However, this
was problematic because of the general breakdown of the financial systems in many
countries like Thailand during this period. This resulted in a large number of missing
banks and missing data from the period from 1997 to 2000, which did not allow for full
time series analysis of the period. Although a panel data approach could have been
selected in order to account for these gaps (Wooldridge, 2009), this would have
compromised the reliability of the study due to the relatively small number of
companies included in earlier years compared to later years (Verbeek, 2008). There
would also be the problem of survivorship bias if these years were included. Since time
series and panel data analysis both rely on data points that are consistent across periods,
when firms drop out of the market they may be eliminated from the analysis, providing
an excessively optimistic view of performance (Verbeek, 2008). This meant that using a
data set that was sparse at the beginning of the period would have led to a certain
amount of unreliability within the study. Because of this, the choice was made to study
the period 2001 to 2012. This was more consistent with the availability of the full data
set in BankScope data. However, it does only provide some basic insight into the
recovery period of the Asian financial crisis, which will be discussed further in the
findings.

4.1.1.6 Summary of Data Sources
The initial selection criteria yielded a potential 9,500 candidate banks for inclusion in
this study. The selection criteria explained above provided several filters for selection of
data within the data that was potentially available from BankScope. The first filter
applied was the type of bank, excluding nationalized or state-owned banks but including
commercial and investment banks. Second, a geographic filter was applied, leading to
the selection of banks from 14 countries within the contiguous geography of and
Southeast and East Asia. Third, data was selected from individual financial statements
where available, or from consolidated financial statements where necessary. Finally, a
time period was selected that provided the best coverage of the banks within the data set
without unnecessarily including survivorship bias from the 1997-1998 financial crisis.
This resulted in a 12-year time series length (2001 to 2012). The final sample size
included 2,292 banks across 14 different countries, for a total sample size of 224,317
potential data points included in the sample. This is a sufficient sample size for the
analysis to provide statistical reliability and strong results. It will also provide balance
between data set completeness and the time periods of interest.
4.1.2 Data Reduction and Organisation

Following the initial raw data download from BankScope, data was examined in STATA for completeness and reduced as necessary in order to ensure that there was the strongest possible data set. This section describes the data reduction process, which resulted in a substantial elimination of about 60% of the sample. It also examines some potential issues with the data reduction process.

4.1.2.1 Data Reduction

On analysis of the data included in the sample, it was found that most banks had some missing data. Missing data can reduce the reliability of regression results (although most time series regression models can deal with a small number of missing variables) (Madsen, 2008). In particular, it can negatively affect the R-squared value derived for linear regression (Madsen, 2008). This is problematic since this was the main method of analysis selected for this research. Because of this, a data reduction process was undertaken to make sure that the data set actually used for analysis was as complete as possible, in order to avoid compromising the statistical reliability of the results.

The first step in data reduction was to eliminate any banks that were consistently missing one or more of the 16 foundational variables that were included in the study. This was done in order to avoid problems of inconsistent representation between banks or inability to include some banks in a given calculation, as well as to increase the reliability of the sample.

The second step in data reduction was to calculate the number of potential data points for the duration of potential time series. There were 16 variables included in the study (9 independent variables and 7 dependent variables, excluding two dummy variables that are assigned based on exogenous context). Thus, for the full 12-year time series (2001 to 2012), there would be 192 points per member of the data set. All banks that had the full set of data (all 192 points) were included in the sample set.

At a minimum, the desired number of data points should be nine years, or 75% of the total. The precise number of data points required for a time series can be variable, but much lower than this does result in significant impacts on the statistical reliability of the
outcomes (Madsen, 2008). Thus, banks with fewer than nine years of data available (a total of 144 data points) were discarded. Banks with between nine and twelve years of available data were included in the sample set, while those with fewer than nine years of available data were discarded. While this does introduce some degree of survivorship bias by excluding new entrants to the market that fail rapidly, this is not considered to be a major problem since the intent of this study is to establish the stability of established banks rather than to investigate the conditions of bank establishment under adverse conditions.

The raw data set prior to reduction included 2,292 banks across all 14 countries. The final sample following the data reduction process resulted in 680 banks. Each of these banks had sufficient data (16 variables with at least 144 data points) to be included. This yields a potential data set size of 130,413 data points. This represents a reduction in the potential data set size of about 60%, with the final sample totalling about 40% of the initial sample. While considerably smaller, this still represents a sizable sample that will be able to achieve statistical reliability.

### 4.1.2.2 Outliers

Outliers are data points at the extreme edge of distribution (either positive or negative) for a given variable. They can result either from extreme performance or from errors within the data set. Determining whether or not to eliminate outliers is a difficult question. Outliers do skew the distribution of the data, and for some statistical analysis methods this can significantly affect the outcomes (Alcock, 2008). In particular, outliers can affect regression lines if they are at the extreme edges of the distribution, meaning that the regression outcomes will be affected (Hamilton, 2009). At the same time, however, elimination of too much data does lead to a reduction in the data set, which is undesirable in this case because we wanted to maintain as much data a possible from the banks. Of course, if there are “too many” outliers, this likely means that they are not outliers at all, but evidence of bimodal distribution of a given variable (Alcock, 2008). Because of this, the most conservative approach possible to elimination of data was chosen, but the choice was made to eliminate any outliers that did show clear evidence of being outliers.
Outliers were defined using a rule of thumb that any point more than six standard deviations from the mean in a given variable could be considered to be an outlier. In this case, the qplot tool was used to identify outliers for each variable. The qplot package produces quantile plots, which graph the actual distribution of the data against a linear plot, generated from its quantile points (or the points at which the distribution falls at 0%, 25%, 50%, 75%, and 100%) (Hamilton, 2009). The qplot tool can be used to detect outliers because it identifies where there are extremes of distribution and identify potential points for elimination. It can also be used to examine the distribution of the data and determine whether or not it fits a particular shape, such as normal distribution or stepwise distribution (Hamilton, 2009). This makes the quantile plot (or in some cases q-q or quantile-quantile plot) a highly flexible tool for analysing the shape and content of the data set and identifying potential problems within it.

In order to identify outliers, we ran qplot for all variables in this study, including independent and dependent variables. Points identified as potential outliers were tested to determine how far they were from the mean. If they were identified as outliers using the guidelines above, they were removed from the study, along with all other data pertaining to that bank.

This analysis approach had a minimal effect on the data. Four data points were removed from the data set (including bank IDs 1242, 1861, 1885, and 2057). These removals were the result of outliers in two different variables. Points 1242 and 1861 had outliers in the performing loan to non-performing loan variable. Points 1885 and 2057 were eliminated because of outliers in the Diversification (%) variable. These eliminations were justified because, as four banks (621 data points) of out approximately 680 banks for each of the variables, it is clear that they were not evidence of a bimodal distribution in any sense. Additionally, actual inspection of the variables suggested that they were actually typos or data errors within the data set, rather than being performance outliers within these variables. Thus, the removal of four points within the data set as outliers is justified given that it has a minimal effect on the data set, resulting in the removal of only four potential banks and not showing evidence of a bimodal distribution.
4.1.2.3 Final Sample

The sections above have described the initial identification and selection of data points from BankScope, including the choice of sampling frames to be applied and the final data reduction and organisation process. Data was first selected based on geography, time period, availability of financial statements, and bank type (excluding nationalized or state-owned banks). This yielded an initial sample of 2,292 banks in the 14 countries identified as being in Southeast and East Asia, having substantial and locally controlled banking regimes, and having data in the BankScope database. A data reduction process was then undertaken, because of substantial gaps and sparseness in some of the data set. First, banks with a significant portion of their data missing were excluded, and only banks with the requisite 16 variables were included. Second, data reduction eliminated banks with fewer than nine years on statistical and practical grounds, as well as removing outliers as described. The final sample includes 676 banks, with 16 variables each. Banks are included from all 14 target countries, and all have data from at least 2004 (with some dating to 2001). This is a smaller sample than the initial sample, but it is more consistent with survey goals and will be more robust.

4.2 Data Analysis Procedures

The data analysis for this research is conducted using STATA. STATA has a number of advantages over other statistical packages for this analysis. First, it is readily integrated with BankScope data, which is highly useful for this research. Second, it has a range of analytical techniques built in. Particularly important is its multiple methods for analysis of time series data, which other statistical packages like SPSS do not include. This makes it highly appropriate for this study. However, the package also includes other methods of analysis, such as descriptive analysis, graphing, and so on, which also provide advantages (STATA, 2012). STATA is also relatively easy to use and consistent in presentation and techniques for use compared to other statistical packages (Alcock, 2008). These factors make it ideal both in terms of the techniques it can be used for and the ease and completeness of its use. This section describes the data analysis procedures, beginning with data preparation and then discussing the main regression techniques used in the study. It concludes with discussion of other analysis techniques used for comparison. This information can be used to replicate the study or examine its reliability and foundations.
4.2.1 Data Preparation

The first stage of the data analysis process was preparation of some variables for data. The two main preparation elements were creating lags and logs of the data.

In econometrics, a lag refers to a gap between time periods that allows for regression of one variable from one period with variables from another period (Wooldridge, 2009). In mathematical terms, lag can be defined as $t+k$ ($k > 0$), with events occurring at $t$ lagging $k$ periods behind $t+k$ (Verbeek, 2008). Lags are used in time series to detect effects on present variables from previous occurrences (Wooldridge, 2009). For example, a common macroeconomic model may assume that GDP growth occurs in the period following private investment; thus, GDP growth at time $t+k$ would be partially attributable to investment at time $t$, with $k$ representing the lag between them (Arnold, 2010). Determining the appropriate lags for analysis can be a matter of trial and error, and it is not always obvious which should be used, making the identification of appropriate lags difficult (Madsen, 2008). In this analysis, based on the available evidence about the effects of banks, lags of one to three years are prepared.

The second preparatory analysis technique is preparation of logarithms (logs) for some of the data. Mathematical logs are used in econometric analysis for scale reduction, in order to make objects of different sizes commensurate and identify effects that might otherwise be minimal (Madsen, 2008; Verbeek, 2008; Wooldridge, 2009). The natural log function (ln) can be applied to dependent or independent variables (or other) (Barreto & Howland, 2006). It is the inverse function to the exponential function, expressed as the following:

$$e^{\ln(x)} = x$$, assuming $x > 0$ (Barreto & Howland, 2006). (In this case, $e$ is the irrational base $e \approx 2.7182$). Logs are used in econometrics analysis for several reasons. First, because of their size reduction properties, they reduce the scale of raw data, which will make it easier to compare small institutions to larger institutions. This is particularly important because the sizes of the banks vary widely; if you consider that some of the banks included are large-scale multinational institutions and others are domestic or regional banks in developing countries, the scale problem becomes clear. In effect, logs
perform the same function that the ratios calculated for some of the variables discussed above do, by making it possible to compare institutions of different sizes. Other cases for using logs are a strong positive skew to the residuals, extreme outliers that need to be reduced in terms of their effect on the data, or a nearly (but not entirely) exponential relationship between variables (Wooldridge, 2009). Dependent variables that have had logs prepared include: Writedowns, Stock returns, and Stock volatility. Independent variables with logs prepared include Total assets, Turnovers, Profit before tax and Abnormal items, and Net interest income.

4.2.2 Analysis Tools
Based on the research objectives and hypotheses, three key regression analysis techniques have been identified for the research. The techniques selected include pooled OLS regression, fixed effects regression, and random effects regression. All three are panel analysis techniques that provide slightly different views on time series effects (Madsen, 2008). This section discusses the three techniques used in general, including how they work and why they are included in this research discussion. Specific equations created for use with these techniques are included in the results discussion in the next chapters.

4.2.2.1 Pooled OLS Regression
Pooled OLS (ordinary least squares) regression is a panel regression method that estimates the equation: \[ Y_{it} = \beta_0 + \beta_1 X_{1it} + \ldots + \beta_k X_{kit} + \epsilon_{it}, \] where \( i = 1, ..., N, t = 1, ..., T \) (Wooldridge, 2002). This specification can include multiple X terms, though it is limited to a single Y term (as is common with regression methods). This has the effect of pooling all observations into a single panel, rather than separating individual observations. Pooling has a number of positive advantages, including that it creates a much larger sample and that it can lead to better estimation of effects on Y (the outcome or dependent variable) from variation in X (the predictor or independent variable). These are significant benefits that can dramatically increase the ability of the regression model to predict the relationships. It also reduces the bias compared to cross-sectional OLS models, making it a strong method to use during a first analysis (Wooldridge, 2002).
There are several assumptions that need to be met in order for pooled OLS regression to be effective, which are based on the ordinary assumptions of the OLS technique (Wooldridge, 2009). The shared assumptions of the OLS model family include that:

- The model is appropriately specified;
- That all X variables have linear independence;
- That the data shows homoscedasticity (similarity of error variance) and non-autocorrelation;
- That the data shows normal distribution of the errors;
- That regressors are predetermined;
- And that the data shows an ergodic stochastic process (Madsen, 2008; Verbeek, 2008; Wooldridge, 2002; Wooldridge, 2009).

In most cases, STATA can be used to test the assumptions for OLS regression prior to completion, and will identify any errors that may violate the assumptions above (Alcock, 2008). However, these do still need to be kept in mind, since the conditions of the data will make OLS regression methods such as pooled OLS regression more or less appropriate depending on the data characteristics.

Pooled OLS regression is useful for the reasons highlighted above, and it is used in this research as a first method in order to provide the initial estimation of relationships. However, it is not a perfect regression method, particularly under some data conditions. In particular, it ignores heterogeneity between individual data points, and instead assumes that all individuals \( i \) have the same effect on the dependent variable (Verbeek, 2008). This can lead to a situation where all individual effects are included in \( \varepsilon_i \) (the error term), creating correlation between the error term and the explanatory variables. In order for the estimators to be derived from the pooled OLS regression to be unbiased and consistent, there should be no correlation between the error term and the explanatory variables (Wooldridge, 2002). Thus, pooled OLS regression may be insufficient on its own to show unbiased effects, since it is not possible to eliminate this correlation. Because of this, additional regression models are included in order to account for situations where there are heterogeneous effects from individuals.
4.2.2.2 Fixed Effect Regression

The second regression method selected for this research is fixed effect regression. Fixed effect regression models are intended to capture the time-invariant individual effects on the outcome variable, which in the pooled OLS model are included in the error term $e_{it}$ (Wooldridge, 2002). Thus, it is already apparent why we would include both pooled OLS regression and fixed effect regression in this analysis, since it will enable us to reduce the potential that pooled OLS outcomes will be biased or inaccurate if these time-invariant individual effects are observed.

Fixed effect regression may be specified as: $Y_{it} = \alpha_i + \beta_1 X_{1it} + \ldots + \beta_k X_{kit} + \epsilon_{it} Y$ where $i = 1,\ldots, N, t = 1,\ldots, T$ (Wooldridge, 2002). The intercept term $\alpha_i$ is where the potential influence of individual time-invariant effects is taken into account. In addition to the general OLS assumptions above, fixed effects regression has an additional assumption, that the error term is exogenous (or that $E(\epsilon_{it} | X_{it}, \alpha_i) = 0$) (Verbeek, 2008). This assumption is similar to the assumption that may be violated in pooled OLS, since it refers to the autocorrelation of the error term and the individual term, as well as the intercept (Verbeek, 2008). The second assumption (referred to as the fixed effects assumption) is that individual effects are consistent over time. This assumption can be tested with the Durbin-Watson test, which determines whether the fixed effects model is more appropriate (if it does not succeed) or if the random effects model is more appropriate (if it does succeed) (Wooldridge, 2002). This is calculated automatically in STATA (Alcock, 2008).

This specification makes it clear that the purpose of including the fixed effect model in the current analysis. In the case of a biased or unreliable pooled OLS estimator that can be attributed to time-invariant individual effects on the Y variable, the fixed effect model overcomes this problem by including the intercept term in the specification, thus allowing for the involvement of individual effects. This removes the individual effects from the error term and eliminates the autocorrelation of the error term and the X terms (Verbeek, 2008). However, the fixed effect regression model also has a number of potential weaknesses, which mean that it may not be appropriate for all specifications.
One of the issues with fixed effect regression is that it assumes that all individual effects are time-invariant, as expressed in the intercept term (Wooldridge, 2002). This is a stronger analysis technique than pooled OLS in the presence of such individual effects, but it does not take into account the potential that there may be variance in these effects over time. Because of this, it is necessary to use an additional analysis technique that takes into account the potential for variance in the individual effects over time.

4.2.2.3 Random Effect Regression

Random effect regression builds once more on the weaknesses of the previous regression model. Specifically, it accounts for the potential that individual effects are not time-invariant (as suggested in the fixed-effects model), but instead that they vary over time (Verbeek, 2008). This is an important distinction because it serves to further reduce the potential for biased or unreliable estimators compared to the previous analyses. Thus, the random effect regression model builds on the previous three models, allowing for accurate analysis in conditions that neither pooled OLS nor fixed effect regression can handle properly.

Random effect regression models are based on the assumption that there is no autocorrelation between the unobserved variables (modelled in fixed effects models as the intercept term) and the observed variables, or in other words that they are independent (Allinson, 2009). It is also based on the assumption that there is heteroscedasticity within the variables (or unequal error variance). Random effect models are different from pooled OLS and fixed effects models because they use generalised least squares (GLS) specification rather than the OLS specification of the previous two discussions (Allinson, 2009). GLS models can be generally specified as $Y = X\beta + \varepsilon$ (Allinson, 2009). In some cases a weighted least squares (WLS) specification may be used, in particular when heteroscedasticity is observed by there is no variance correlation (Allinson, 2009).

The advantages of the random effect model are obvious when compared to the pooled OLS and fixed effect model. However, it should not be presumed that random effect models are always best. In particular, the requirements that data should demonstrate heteroscedasticity mean that it will not always be appropriate for the analysis of every
data set – some data sets demonstrate homoscedasticity, requiring different methods of analysis. It may also be inefficient when there is no observed independence, which can make the fixed effects model more appropriate. Thus, the fixed effects model does provide certain advantages, but it is not necessarily the best choice for all analyses. This is why the choice to use it in conjunction with pooled OLS and fixed effect models has been made.

4.2.2.4 Comparison and Summary of Regression Tools

The discussion above has shown that there are strengths and weaknesses for each of the three regression models considered, which offer reasons to use all three models to estimate each equation and select the most satisfactory one. The pooled OLS model is the simplest model and provides the largest set of variables, which can lead to improved detection of X effects on Y. However, it also may become biased and unreliable due to ignoring potential individual effects of the variables. This can lead to a situation where the error term is correlated with the predictor (X) terms, creating conditions of undesirable autocorrelation in the model. In order to fix this problem, both fixed effect and random effect models are proposed. Fixed effect models include a time-invariant intercept that takes into account the individual influences on the outcome variable, removing this influence from the error term and reducing the potential for autocorrelation between the error term and the variables. However, this model does not account for the potential that individual effects may be randomly varying. Thus, the specification of the random effects model allows for this random variation. These various gaps make it clear that there is a reason for using all three models – simply, it allows for the analysis to account for a wide range of variation in the characteristics of the underlying data and its influence on each other, rather than simply accepting a single set of conditions that may or may not be appropriate.

Identifying the most appropriate model for each individual equation is part of the tool set offered by STATA. The first comparison occurs between the pooled OLS model and the fixed effects model. The fixed effect regression function in STATA generates an F-statistic that can be used to compare the outcomes of the pooled OLS and fixed effect regression, allowing for a determination of which model will be more appropriate given the observed bias in both models (Alcock, 2008). This function will be used to determine which model is a more appropriate representation of the various equations
that are tested. In the second analysis stage, the Durbin-Watson test can be used to determine whether the fixed effect model or the random effect model is more appropriate. If the test fails, then the fixed effects model is most appropriate, while if it succeeds, the random effects model is most appropriate. The Hausman test can also be used to make this determination (Wooldridge, 2009). Thus, identifying the best model to use is a case of two functions conducted in STATA.

Another issue is whether or not to use the vce() option in STATA. The vce() function provides the variance-covariance estimation for the regression function (Hamilton, 2009). The vce(robust) function calculates either sandwich or Huber/White variance-covariance estimations, which are appropriate for most regression functions (Hamilton, 2009). However, this variance method is only appropriate for regression models that are effective in conditions of heteroscedasticity (Hoechle, 2007).

4.2.3 Additional Analysis Tools
The analysis also included some additional tools that serve to improve the outcomes of the analysis techniques. The first is the Hausman test, which is used to determine whether the data is better fitted to fixed effect or random effects data. The second is squared terms, which are used to model data in cases where there may be nonlinear relationships between data sources. The use of these tools and their purposes is discussed briefly in order to show the reasons they have been used and how the data is to be interpreted around them.

4.2.3.1 Hausman Test
One of the reasons this research uses multiple regression models is that the most appropriate model is not based on the specification (which can be known in advance), but rather on the characteristics of the data (which cannot be known in advance) (Wooldridge, 2002). This means that it is important to have ways of identifying which models have produced the better results in terms of increased efficiency, lack of bias, and consistency. There are at least two tests that can be used to determine whether fixed effect or random effect regression models are a better fit for the data set. These include the Durbin-Watson test and the Hausman test (Wooldridge, 2009). Both of these tests can be used in STATA as a means of identifying the appropriate model for analysis. In this analysis, the Hausman test has been selected because it is more specific to the
problem of selecting between fixed effect and random effect models, while the Durbin-Watson test is a more general model.

The Hausman test checks for correlation between the intercept (representing the individual effects in the fixed effect model) and the x terms, using the null hypothesis that there is no correlation between $\alpha_i$ and $X_{it}$ (Cameron & Trivedi, 2005). If the null hypothesis holds, then the appropriate choice of model is the random effect model (since this satisfies the condition that there should be no correlation between the two variables). In contrast, if the null hypothesis does not hold, then the appropriate choice of model is the fixed effect model (since there is no requirement that there is no correlation between these two terms in the fixed effect model) (Cameron & Trivedi, 2005). This offers a way to simply and directly compare the outcomes of fixed effect and random effect models and identify which one will be most appropriate for the analysis process at hand. The Durbin-Watson statistic is a generalised version of this test, which compares autocorrelation of two statistics (Hamilton, 2009). Thus, while either test can be used, the Hausman test is specifically designed to identify the appropriate test between the fixed-effect and random-effect model. This makes it more appropriate for the current research.

Acceptance of the Hausman test outcome is relatively simple, as it generates a statistic and significance as with other variables. This can be tested as significant. If it is shown to be significant, then the null hypothesis is rejected, while if it is not significant then the null hypothesis is accepted (Cameron & Trivedi, 2005). This approach is used in the current research to determine whether the fixed effect or random effect model is more appropriate to the analysis, and select the model outcomes as appropriate. This approach is used in the findings to determine whether fixed effect or random effect models are more appropriate for each model specification.

4.2.3.2 Squared Terms

The final tool that is used in this research is squared terms. Squared terms are simply mathematically squared variables ($X^2$) included in some models (Wooldridge, 2009). Squared terms are highly useful in some situations, particularly where there may be a nonlinear relationship with some variables (Verbeek, 2008). One common example is
age and earnings, which have a non-linear relationship (increasing to close to retirement age, but then peaking and falling off). This type of relationship may often be seen in econometric specifications that involve time series or panel data analysis, because of changes in the variables over time (Madsen, 2008). Thus, the use of squared terms is sometimes appropriate in the regression model in order to account for conditions where there is not a linear model, or in other words where a curvilinear model should be fit to the data rather than a linear model (Wooldridge, 2009). This approach increases the appropriateness of the fit of some data to the models provided, though it cannot be used in all situations.

Squared terms can easily be calculated in STATA, and both the non-squared and the squared terms should be used in different versions of the equation in order to determine which model obtains the best fit (Verbeek, 2008). Squared terms may also need the use of dummy variables, which can be used to decompose the variables into a series of binary terms for comparison (Verbeek, 2008). Both of these approaches are used in this research to account for differences in the variables and identify the best fit models. The specific use of squared terms and dummy variables is discussed in the following chapter under the model presentation, which describes how and why these variables were used for each model.

4.3 Variables
Variables were selected for this research based on a comprehensive review of the existing literature, which included tabulation of variables used and selection of the variables most frequently found to be significant. This is an effort to ensure that the construct reliability (or how well the variables chosen represent the underlying conditions in the real world (Jackson, 2008)) remains high. In this section, first the source and method of calculation for variables is discussed. The independent and dependent variables are then examined and the relationships between the variables and the constructs they are intended to represent are examined. This will allow the reader to first, understand the basis for calculation within the study and second, to replicate the study if desired.
4.3.1 Variable Selection and Calculation

All variables are based on data available from BankScope. BankScope is described as “a comprehensive global database of banks’ financial statements, ratings and intelligence”. It includes up to 16 years financial records for banks, as well as Fitch Bank Credit Model information for each bank. BankScope includes approximately 11,000 banks from around the world within its database. The data included in BankScope is extensive, and includes market information, regulatory filings, business structures, and other characteristics (Bureau van Dijk, 2013). In this research, however, the main focus is on financial information from consolidated financial statements maintained within the database. BankScope is a source that has been routinely used in other studies of bank stability and financial records of banks in recent years (De Jonghe, 2010; Distinguin & Tarazi, 2010; Heider & Gropp, 2008; Jeon et al., 2011; Shehzad et al., 2010; Tabak et al., 2012; Uhde & Heimeshoff, 2009). BankScope data can be complicated to work with due to its structure and coding, but it is well designed to work with STATA (the statistical package used in this research) and can be managed effectively (Thibaut & Mathias, 2012). Data was selected and prepared in accordance with the recommendations from Thibaut and Mathias (2012) on selection and management of BankScope data.

Variables were selected directly from BankScope, and where necessary were transformed to create ratio variables. Variables that were available directly from BankScope included the following:

- **Independent variables**: Total assets (USD), Turnovers (USD), Net interest Income (USD), Equity-to-asset ratio
- **Dependent variables**: Capital ratio, Writedowns (USD), Tier 1 capital, Profits-to-assets ratio, Profits-to-equity ratio, Degree of total leverage (DTL) ratio, Stock returns (USD), Stock volatility

Cases where the variables were not directly selectable from BankScope included the following:

- **Independent variables**: Non-interest income to interest income ratio, Performing loans to non-performing loans ratio, Profit before tax and abnormal items, Diversification, and Cost-to-income ratio
• Dependent variables: Z-score

These variables were selected based on a review of the literature, as summarized in Tables 2 and 4. For these variables, the constituent elements of the ratios or variables were selected from BankScope and the variables were then calculated in order to provide the final variable. For example, to calculate the Z-score, the Return on average assets (ROAA) was calculated based on asset and return data in BankScope, and the standard deviation of ROAA was then calculated. Equity capital and assets were then selected to calculate $k$ (equity capital as a percentage of total assets). These intermediate calculations were then combined to create the z-score. Most of the calculations were simpler than the z-score, since they did not involve any intermediate calculations. However, all such variables were calculated using data that was available from BankScope. This approach was intended to improve the reliability of the study by using a single source of data, which could then be accessed by later researchers if necessary, and which would have consistent data representations.

Finally, though Tables 2 and 4 show 18 different variables, these variables have not all been used in the analysis. Following completion of a pilot analysis, it was determined that the adjusted R-squared contribution of the z-score and DTL variables (both dependent variables) were too low to consider them to be important variables. In general, an R-squared outcome of under $R^2 = 0.200$ indicates that the regression relationship between dependent and independent variables does not signify an important real-world connection, even though it may be statistically significant (Alcock, 2008). That is, the relationships may be statistically significant, but they are not important in terms of considering the real value of the research. For example, the z-score represents the risk of bank default (Uhde & Heimeshoff, 2009). However, in the current regulatory environment most banks are not defaulting, but instead are being bailed out by governments protecting economic interests, making it irrelevant. Thus, although these are included for completeness of methodological discussion, they were not actually used in the analysis, and only seven dependent variables were tested for bank stability.

4.3.2 Dependent Variables

The dependent variables used are shown in Table 2. Of these, the z-score (Uhde & Heimeshoff, 2009) and DTL ratio (DeYoung & Roland, 2001) proved not to be
statistically explanatory for the dependent variable in the pilot test as discussed above, and are eliminated from consideration. However, each of the three constructs – bank stability, returns, and risk – are still represented by at least two variables. As with the independent variables discussed above, there were no single variables that could be identified that captured all dimensions of the constructs. This is why several variables are used to test most constructs.

Bank stability is represented by the Capital ratio and the more specific Tier 1 capital ratio (which only includes capital that satisfies the Basel agreements) (BIS, 1989; Furlong, 2011; Schaeck & Cihák, 2010). Writedowns represent an instability factor within the bank (Acharya, et al., 2009a). This is required to make sure that there is a complete representation of bank stability constructs. Writedowns are expected to have a negative relationship in terms of bank stability, while the general and Tier 1 capital ratios have a positive relationship.

The second main construct is returns, which include ROA and ROE (Athanasoglou, et al., 2008; Albertazzi & Gambacorta, 2009). These representations for returns are chosen because it helps to stabilise differences between banks of different sizes. In other words, these variables calculate not absolute returns, but instead returns based on the assets and equity available to the bank. This also serves to show how efficient the bank is compared to the resources it has on hand, which is a better measure of returns than simple profits. Simply, a bank that is larger can be much more inefficient and still generate large profits, while a small but very efficient bank will generate much smaller returns. Both assets and equity are calculated because of variations in bank holdings, which could influence the outcomes (Gibson, 2010). Both of these variables are expected to have a positive relationship to bank returns.

The third factor is the riskiness of share prices. This represents the market’s view of the extent of risk being taken by the bank. Following Kirkwood and Nahm (2006), the first representation of share price riskiness that is used is the share price itself, but this is not a straightforward representation of risk. In particular, stocks that are more risky, but are seeing higher returns, may command a higher share price during some periods (Gibson, 2010). Because of this, the standard deviation of the share price is also included, since this represents the rate of volatility of share prices over a period of time (Fuertes, et al.,
Taken together, these two variables show a strong representation of the perceived riskiness of the bank’s stock as suggested by the market.

Table 2 Dependent variables

<table>
<thead>
<tr>
<th>Underlying construct</th>
<th>Variable</th>
<th>Brief description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bank Stability</td>
<td>1. z-score</td>
<td>Calculated from financial results as $z = \frac{\mu - k}{\sigma}$, where $\mu =$ return on average assets (ROAA), $k =$ equity capital as a % of the total assets, and $\sigma =$ standard deviation of $\mu$ over time (representing volatility)</td>
<td>(Uhde &amp; Heimeshoff, 2009)</td>
</tr>
<tr>
<td></td>
<td>2. Capital ratio</td>
<td>The capital ratio is defined as the bank’s holding of capital compared to existing loans. Capital (equity capital) is a liability for the bank, while existing loans are the bank’s assets. This definition includes Tier 1 capital (defined below) as well as lower-quality capital holdings. The general capital ratio was selected because it reflects a holistic view of the entire bank’s investment strategies, including its Tier 1 and Tier 2 capital requirements.</td>
<td>(Schaeck &amp; Cihák, 2010)</td>
</tr>
<tr>
<td></td>
<td>3. Writedowns</td>
<td>Total writedowns associated with assumption of systemic risk</td>
<td>(Acharya, Cooley, Richardson &amp; Walter, 2009a)</td>
</tr>
<tr>
<td>Underlying construct</td>
<td>Variable</td>
<td>Brief description</td>
<td>Source</td>
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<tr>
<td>4. Tier 1 capital ratio</td>
<td>Ratio of core capital (including common stock, retained earnings, and reserves) to total ownership equity. A minimum of 4% Tier 1 capital is required by the Basel II accords, but higher levels are usually held. The actual level of Tier 1 holdings is reported in financial reports. Tier 1 capital is a major component in banking stress tests. Tier 1 capital varies in definition between countries, but in all cases it reflects what is considered to be the strongest forms of capital (those appropriate for supporting reserves). Thus, this represents the instruments the bank has selected as potential reserves.</td>
<td>(BIS, 1989) (Furlong, 2011)</td>
<td></td>
</tr>
</tbody>
</table>

2. Returns

| 6. Profits-to- equity ratio | Calculated as ROE | (Athanasoglou, Brissimis & Delis, 2008) |
| 7. Degree of total leverage (DTL) | DTL | (DeYoung & Roland, 2001) |
### Underlying Construct

<table>
<thead>
<tr>
<th>Variable</th>
<th>Brief description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Stock returns</td>
<td>Return of publicly traded stock over time (retrieved from appropriate stock market reporting)</td>
<td>(Kirkwood &amp; Nahm, 2006)</td>
</tr>
<tr>
<td>9. Stock volatility</td>
<td>Standard deviation of stock returns calculated on an inter-day basis over time</td>
<td>(Fuertes, Izzeldin &amp; Kalatychou, 2009)</td>
</tr>
</tbody>
</table>

#### 4.3.3 Independent Variables

There are two categories of independent variables, including dummy variables and variables that show specific information about the bank. Each of these is discussed below.

##### 4.3.3.1 Dummy Variables

A dummy variable, or binary variable, is a variable that is set to 0 or 1 depending on whether the data point meets a certain characteristic (Wooldridge, 2009). Typically, dummy variables used in time series analysis group variables based on external context, such as time period in relation to a specific event or geographic region.

A common dummy variable that is used is the division between developing and developed economies (Wooldridge, 2009). This distinction is useful because developing economies have different macroeconomic characteristics than developed economies, including faster and more volatile growth rates, typically less rigid regulation regimes, and different industry structures than developed economies (Nafziger, 2006). Thus, developing countries (0) and developed countries (1) is the first dummy variable used in this research. Countries were classified as shown below (Table 3). These classifications were based on World Bank lending categories (World Bank, 2013b).
Table 3 Developing and developed countries

<table>
<thead>
<tr>
<th>Developing countries</th>
<th>Developed countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Brunei</td>
<td>1. Hong Kong</td>
</tr>
<tr>
<td>2. Indonesia</td>
<td>2. Japan</td>
</tr>
<tr>
<td>3. Laos</td>
<td>3. Korea</td>
</tr>
<tr>
<td>4. Malaysia</td>
<td>4. Singapore</td>
</tr>
<tr>
<td>5. Philippines</td>
<td>5. Taiwan</td>
</tr>
<tr>
<td>6. Thailand</td>
<td>6. Macau</td>
</tr>
<tr>
<td>7. Vietnam</td>
<td></td>
</tr>
<tr>
<td>8. China</td>
<td></td>
</tr>
</tbody>
</table>

The second dummy variable used is a time variable focused on a specific event, which is also common in time series analysis (Wooldridge, 2009). In this analysis, the breakpoint was the financial crisis, with data points being ranked as pre-crisis (1) from 2001 to 2007, and post-crisis (0) from 2008 to 2012. This is in order to account for the effects of contagion, market instability, liquidity crises, and changes in regulatory regimes (all discussed in detail in the literature review).

4.3.3.2 Independent Variables

Table 4 shows the independent variables that are used in the analysis, along with their definitions and the researchers that have previously used the variables. There are two key constructs that are defined through the use of these variables, including business model and financial performance. These constructs use multiple variables because there are no single variables that can be identified that fully reflect the construct conditions.

The bank business model is the first construct. This refers to the sources of income and ways in which this income is acquired. According to Beck, et al. (2000), the three main models of banking include central banks, deposit money banks, and bank-like institutions. Banks may also be classified by size. Some general types of bank business models can include commercial banks and investment banks (Singh, 2007). Bank business models can also be classified based on source of income, including interest income and non-interest income (Ferreira, et al., 2012). The three variables associated
with the business model are intended to represent three perspectives on the business model, including source of income, size, and portfolio riskiness.

The second group of variables that is included is financial performance. Financial performance variables reflect how profitable and consistent the bank is compared to its financial holdings. The variables in this group are focused first on profit, which is the basis for financial performance. However, profit itself is not enough because it does not address the potential for instability within the banking model. Another important factor is how well the bank is diversified and the total net interest income (which represents how much of the bank’s business comes from traditional models) (Albertazzi & Gambacorta, 2010). These variables show how well the bank is controlling risk from sources of income. A further aspect of financial performance is cost controls, which are reflected in the Cost-to-income ratio and the Equity-to-asset ratio (Pasiouras & Kosmidou, 2007). These variables together provide insight into the profitability, risk management approach, and cost controls of the bank, all of which reflect on the underlying construct of financial performance.

There are cross-connections between the construct variables that can be identified. For example, the ratio of Non-interest income to interest income (Ferreira, et al., 2012) is related to Diversification (Albertazzi & Gambacorta, 2010), and Turnovers (Foos, et al., 2010) are related to profit (Kirkwood & Nahm, 2006). These cross-connections do not divert from the validity of the constructs. It is reasonable to presume that bank sources of income, size, and portfolio riskiness are directly related to profitability, risk management, and cost controls – one of the basic assumptions of this research is that the business model and financial performance of the bank are related. However, it should be considered that there are connections between these variables and may be some degree of cross-correlation between them, which is taken into account in the analysis.
Table 4 Independent variables

<table>
<thead>
<tr>
<th>Underlying construct</th>
<th>Variable</th>
<th>Brief Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Business Model</td>
<td>1. Total assets (USD)</td>
<td>Total assets is used to reflect bank size in a study of bank concentration and stability</td>
<td>(Berger, Klapper &amp; Turk-Ariss, 2009)</td>
</tr>
<tr>
<td></td>
<td>2. Performing loans to non-performing loans (%)</td>
<td>A ratio that represents the riskiness of the bank’s loan portfolio</td>
<td>(Berger, Klapper &amp; Turk-Ariss, 2009)</td>
</tr>
<tr>
<td></td>
<td>3. Ratio of non-interest income to interest income (%)</td>
<td>Ratio of income associated with non-interest transactions to interest income (from lending activities)</td>
<td>(Ferreira, Kershaw, Kirchmaier &amp; Schuster, 2012)</td>
</tr>
<tr>
<td></td>
<td>4. Turnovers (USD)</td>
<td>Indication of total bank size</td>
<td>(Foos, Norden &amp; Weber, 2010)</td>
</tr>
<tr>
<td></td>
<td>6. Net interest income (USD)</td>
<td>Interest income minus interest paid</td>
<td>(Albertazzi &amp; Gambacorta, 2009)</td>
</tr>
<tr>
<td></td>
<td>7. Diversification (%)</td>
<td>(Non-interest income)/(Net interest income + non-interest income)</td>
<td>(Albertazzi &amp; Gambacorta, 2010)</td>
</tr>
<tr>
<td>Underlying construct</td>
<td>Variable</td>
<td>Brief Description</td>
<td>Source</td>
</tr>
<tr>
<td>----------------------</td>
<td>----------</td>
<td>-------------------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>8. Cost-to-income ratio (%)</td>
<td>Total costs/Total income. A higher figure indicates inefficient management and poorer financial performance.</td>
<td>(Pasiouras &amp; Kosmidou, 2007)</td>
</tr>
<tr>
<td></td>
<td>9. Equity-to-asset ratio (%)</td>
<td>Total equity to total assets (Capital adequacy ratio)</td>
<td>(Pasiouras &amp; Kosmidou, 2007)</td>
</tr>
</tbody>
</table>

### 4.4 Summary

This chapter has provided a discussion of the methods used in this research. The choice of methods was selected after analysis of the existing research on this topic as shown in the literature review chapters (Chapters 2 and 3), as well as consultation with econometrics tests and discussions. The approach selected is intended to provide a comprehensive approach to testing the hypotheses that were selected for analysis, which are included in the literature review as well (Chapter 3, Section 3.4).

The research relies on secondary data selected from the BankScope database. This choice was made because the extent and depth of data required is difficult to source from original sources (if not impossible), and BankScope offers a comprehensive, reliable, and trusted source of financial information. The variables that are used in the research have been discussed in the previous section. Independent variables include business model variables (Non-interest income to interest income ratio, Total assets, Performing loans to non-performing loans, and Turnovers) and financial performance variables (Profit before tax, Net interest income, Diversification, Cost-to-income ratio, and Equity-to-asset ratio). Dependent variables are grouped as bank stability variables (Capital ratio, Writedowns, and Tier 1 capital), Returns (Profits-to-assets ratio and Profits-to-equity ratio), and riskiness of share prices (Stock returns and Stock volatility). Dummy variables include pre/post crisis and developed/developing economies.
Data was collected from 14 countries in Southeast and East Asia (excluding East Timor, Myanmar, and Cambodia which are not included in BankScope). The main banks that were excluded were nationalised banks, which have different risk and return profiles and efficiency rates than international or domestic non-nationalized banks. For all banks, consolidated financial data was selected, because of the position of some banks as subsidiaries of others (which precluded the use of non-consolidated data). The time period selected for analysis was 2001-2012. Data was then reduced in order to eliminate banks that had excessive amounts of missing data (which can affect the reliability of the result) as well as outliers. The final sample consisted of 676 banks.

Data analysis was conducted in STATA, which was preferred to other packages because of its ability to handle time series data. Data was prepared by preparing lags and logs as required. The data tools used included pooled OLS regression, fixed effects regression, and random effects regression. These tools were selected because they offer different perspectives and have different sensitivities to conditions within the data. Additional tests included the Hausman test (to ensure that data fits the assumed distribution) and squared term regression (to identify potentially non-linear relationships).

The description of the method within this chapter is intended to provide insight into how these results were conducted and how the method was selected. It also shows how the findings can be related to previous studies through variables and methodologies, and allows the reader to assess the reliability and validity of the study. The following chapters present the findings of the study and discuss these findings in regard to the existing literature and context of the econometric analysis.
Chapter 5: Data Findings

This chapter presents the findings of the primary research in regard to the influence of bank business models on bank stability in Asia. This chapter is arranged in five main sections. A brief introductory discussion of the hypotheses, descriptive statistics and correlations for the variables (Sections 5.1 and 5.2) and analysis of the model selection process (Section 5.3) is followed by a much longer discussion of the main findings, including findings regarding bank stability, returns, and riskiness of share prices (Section 5.4). Finally, the hypothesis outcomes are discussed (Section 5.5). A brief summary of findings is presented in Section 5.6.

5.1 Review of the Hypotheses

The hypotheses that are used for this basis of this analysis are described in detail in Chapter 1 (Section 1.2) and in Chapter 3 (Section 3.4). A brief review is provided here in order to provide structure for the research.

The first hypothesis is based on the previous research on the effects of diversification on the bank’s stability levels. (Bernt & Gupta, 2008; Carbó & Rodríguez, 2007; Demirgüç-Kunt & Huizinga, 2010; Lepetit, et al, 2008; Lozano-Vivas & Pasiouras, 2008; Stiroh, 2004). This research has generally found that increasing the level of diversification, or the number and type of revenue sources, increases stability. Thus, the first hypothesis is proposed:

**H1:** Under current banking conditions in Southeast and East Asia, a risk diversification strategy that includes a majority proportion of interest sources of income and a minority of non-interest sources of income will be most effective.

The second hypothesis is based on research from previous authors as well. This research has suggested that interest-bearing income derived from relationship banking and non-interest bearing income derived from transactional income sources has differential effects on bank risk, though it may not have an effect on bank income (Altunbas et al, 2011; Baele et al, 2010; Berger & Udell, 1995a; Berger, et al., 2009; Boots & Marin, 2008). Although this has not been tested in the Southeast and East Asia region during...
the current financial crisis, it is assumed that the same relationship will hold. Thus, the second hypothesis can be phrased:

**H2:** Under current banking conditions in Southeast and East Asia, banks that rely on interest-bearing income from relationship banking will be more stable than those that rely on non-interest income (including transaction-based income and any other mechanisms that are not related to relationship banking).

The third hypothesis is based on the observation that bank balance sheet indicators, which serve as a measure of the management quality of the bank, could potentially provide behavioural evidence of stability-generating management practices. This is based on previous research that has associated weak balance sheets with increased risk (Brunnermeier, 2009; De Jonghe, 2010; Foos, et al., 2010; Seodarmono, et al., 2013 Vallascas & Keasey, 2012). Based on this previous research, the final hypothesis is phrased:

**H3:** Under current banking conditions in Southeast and East Asia, banks that maintain a strong balance sheet will be more stable than those with a weaker balance sheet.

These hypotheses will be tested throughout the research and a final discussion of the findings will be provided to integrate the various tests used and provide general support or rejection of each of them as appropriate.

5.2 Descriptive Statistics and Correlations
The first area for discussion is the descriptive statistics and correlations identified for each variable. Table 5 summarizes the descriptive statistics for each variable, except for the two dummy variables. DTL and z-score are eliminated because they were found insignificant. The minimum number of observations is 931, and the maximum is 7,834, with an average of 5,865 observations indicating relatively complete coverage. This difference between the naïve Capital ratio and the Tier 1 capital ratio probably is related to the regulatory nature of Tier 1 capital and its relatively high cost compared to other capital holdings. While banks can have a widely varying set of policies on capital
holdings generally, their holdings of Tier 1 capital, regulated by international agreements like the Basel II Accords, are much more closely managed. The ratio of non-interest to interest income \((M = 4.65, SD = 232.149)\) shows the same sort of extreme variation within the variable, suggesting that there is a serious difference between the income generation strategies chosen by different banks. Similar performance gaps are shown in the ratio of Performing loans to non-performing loans, though this is potentially due to other factors like differences in economic conditions within a given country. Diversification, Cost-to-income ratio, and Equity-to-asset ratio all showed some wide spreads between participants as well. Total assets, Turnovers, profits, and Net interest income were expected to show these differences since these factors relate more to the size of the bank than to bank strategy per se. These variables showed not just a wide spread between variables, but also skewed distribution, due to the influence of a few very large banks compared to many smaller ones. Based on this skewed distribution, a log value is appropriate for use in order to redistribute the variable around an appropriate mean (Sheather, 2009).

Table 5 Descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital ratio</td>
<td>4411</td>
<td>27.046</td>
<td>70.994</td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>2446</td>
<td>20.659</td>
<td>1.484</td>
</tr>
<tr>
<td>Writedowns</td>
<td>1750</td>
<td>17.892</td>
<td>2.471</td>
</tr>
<tr>
<td>Profits to assets ratio (ROA)</td>
<td>7874</td>
<td>0.003</td>
<td>0.017</td>
</tr>
<tr>
<td>Profits to equity ratio (ROE)</td>
<td>7874</td>
<td>0.005</td>
<td>0.542</td>
</tr>
<tr>
<td>Stock returns</td>
<td>931</td>
<td>1.290</td>
<td>1.917</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>931</td>
<td>-0.463</td>
<td>1.796</td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-interest income to interest income ratio</td>
<td>7827</td>
<td>4.649</td>
<td>232.149</td>
</tr>
<tr>
<td>Total assets</td>
<td>7874</td>
<td>22.040</td>
<td>1.868</td>
</tr>
<tr>
<td>Performing loans to Non-performing loans ratio</td>
<td>7416</td>
<td>100.404</td>
<td>568.739</td>
</tr>
<tr>
<td>Turnovers</td>
<td>6608</td>
<td>16.207</td>
<td>2.165</td>
</tr>
<tr>
<td>Profit</td>
<td>6622</td>
<td>16.589</td>
<td>2.167</td>
</tr>
<tr>
<td>Net interest income</td>
<td>7759</td>
<td>17.917</td>
<td>1.849</td>
</tr>
<tr>
<td>Diversification</td>
<td>7840</td>
<td>0.327</td>
<td>9.419</td>
</tr>
<tr>
<td>Cost-to-income ratio</td>
<td>7809</td>
<td>69.920</td>
<td>28.574</td>
</tr>
<tr>
<td>Equity-to-asset ratio</td>
<td>7874</td>
<td>7.847</td>
<td>9.322</td>
</tr>
</tbody>
</table>
Table 6 shows the correlations between variables. Most are very weak or actually due to statistical error ($r = 0.2$ or below, according to Jackson (2011)). Table 7 summarizes the moderate and strong correlations found in this analysis ($r = +/- 0.3$).

**Table 6 Correlations (Full table)**

<table>
<thead>
<tr>
<th>Capital ratio</th>
<th>Tier 1 capital ratio</th>
<th>Writedowns</th>
<th>Profits to assets</th>
<th>Profits to equity</th>
<th>Stock returns</th>
<th>Stock volatility</th>
<th>Ratio of non-interest income to interest income</th>
<th>Total assets</th>
<th>Turnovers</th>
<th>Profit</th>
<th>Net interest income</th>
<th>Diversification</th>
<th>Cost to income ratio</th>
<th>Equity-to-asset ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>-0.1 263 **</td>
<td>0.1 015 **</td>
<td>0.1 138</td>
<td>0.0 136 **</td>
<td>0.2 138 **</td>
<td>0.2 191 **</td>
<td>0.2 182 **</td>
<td>-0.516 **</td>
<td>-0.1 795 **</td>
<td>0.1 795 **</td>
<td>0.0 094 **</td>
<td>0.0 094 **</td>
<td>0.0 094 **</td>
<td></td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
</tr>
<tr>
<td>Writedowns</td>
<td>0.5 644 **</td>
<td>0.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Profits to assets</td>
<td>-0.0 899 **</td>
<td>-0.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>1.0 066 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Profits to equity</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>0.0 159 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Stock returns</td>
<td>0.0 076 **</td>
<td>0.0 982 **</td>
<td>0.0 191 **</td>
<td>0.0 191 **</td>
<td>0.0 191 **</td>
<td>0.0 191 **</td>
<td>0.0 191 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>0.0 076 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Ratio of non-interest income to interest income</td>
<td>0.0 473 **</td>
<td>0.0 047 **</td>
<td>0.0 047 **</td>
<td>0.0 047 **</td>
<td>0.0 047 **</td>
<td>0.0 047 **</td>
<td>0.0 047 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Total assets</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>0.0 204 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
<tr>
<td>Performing loans</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>0.0 983 **</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
<td>-0.0 353</td>
</tr>
</tbody>
</table>
Table 7 Moderate and strong correlations (from Table 6)

<table>
<thead>
<tr>
<th></th>
<th>Capital ratio</th>
<th>Tier 1 capital ratio</th>
<th>Writedowns</th>
<th>Profits to assets</th>
<th>Profits to equity</th>
<th>Stock returns</th>
<th>Stock volatility</th>
<th>Ratio of non-interest income</th>
<th>Total assets</th>
<th>Non-performing loans to performing loans</th>
<th>Turnovers</th>
<th>Profit</th>
<th>Net-interest income</th>
<th>Diversification</th>
<th>Cost to income ratio</th>
<th>Equity-assed ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Turnovers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0.0 205</td>
<td>0.8</td>
<td>0.5</td>
<td>0.2</td>
<td>0.4</td>
<td>0.1</td>
<td>0.0</td>
<td>0.8</td>
<td></td>
<td>0.0</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.0 123</td>
<td>0.8</td>
<td>0.5</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.8</td>
<td></td>
<td>0.0</td>
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<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Net interest income</strong></td>
<td>0.0</td>
<td>0.8</td>
<td>0.2</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
<td>0.9</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diversification</strong></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost to income ratio</strong></td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.8</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equity to asset ratio</strong></td>
<td>0.6</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.8</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**

- **:** p < 0.10
- **:** p < 0.05
- **:** p < 0.01
- **:** p < 0.001

**Table 7 Moderate and strong correlations (from Table 6)**
The relationship between Stock volatility and Stock returns could be expected, given the expected equity risk premium associated with a higher volatility stock that would require higher returns (Pinto et al., 2010). Correlation and other variables are also expected, since these are linked through operational practices. Correlation does not provide true statistical support for hypothesis testing, but some of these correlations are suggestive of the relationships proposed in the hypotheses. The correlation between diversification and profit ($r = 0.3644$) suggests that there is a relationship between diversification and effective management of funds. This provides some suggestive support for hypothesis 1, though it does not prove it. The correlation between Tier 1 capital and net interest income ($r = 0.8314$) provides suggestive support for the relationship proposed in hypothesis 2, though it does not prove it. The correlation between Writedowns and net interest income ($r = 0.6933$) is also positive, suggesting that there could be some conflicting relationships between variables in testing this hypothesis, since Writedowns and Tier 1 capital are opposite forces in the bank stability picture. Correlations between Capital ratios and Equity-to-asset ratios; Tier 1 capital and Total assets, Turnover, Profit, and Equity-to-asset ratios; and Writedowns and Total assets, Turnover, profit, and Equity-to-asset ratios (negative) all provide support for the relationship between the bank’s balance sheet and stability (hypothesis 3). Based on these correlation outcomes, there is sufficient initial support for the hypotheses to move forward with the findings, though the support for hypothesis 2 is the weakest. Overall, there are no surprises in the data structure revealed by the correlation analysis.

### 5.3 Preliminary Testing

#### 5.3.1 Method Selection

Both pooled OLS and robust fixed effects model are used for analysis. The fixed effects (FE) model is used in order to handle endogeneity problems within the data (Sheather, 2009). The particular problem the use of FE handles is that it reduces bias when the source of endogeneity is a time-invariant individual effect that influences both
dependent and independent variables. An example of such a situation that might apply in this research is a long-standing management policy within a bank that influences its balance sheet management. If such a factor is not accounted for (as it is not in alternate models), this will introduce some bias. However, it is impossible to manually account for all such potential variables. In all discussions in the following sections, ‘robust FE’ refers to a FE model with VCE. Robust fixed effects regression is an approach that is used to handle outliers within the data set robustly, rather than requiring the researcher to trim or eliminate outliers inappropriately (Verardi & Wagner, 2010). Robust estimation reduces the effect of outliers on least squares by appropriately identifying and weighting outliers. As Verardi and Wagner (2010) show, this generates much better fit for fixed effects linear models than a standard approach. An additional model has been used for some tests. The time-fixed effects model is used to understand the effects of variables that change between members, but not over time (Brooks, 2008). The time-fixed effects model assumes that a given variable is the same across all sample members cross-sectionally (at a specific time). It is primarily used to capture the effects of the financial crisis on the banks’ performances.

A fourth approach is selected in order to make sure that the potentially nonlinear effect of Diversification is reflected. The optimal level of Diversification is identified by including Diversification as an additional squared term in each of the models above. A dummy variable is introduced to account for negative terms. Negative Diversification dummy is set to 0 if the bank had no years of negative Diversification and 1 if it had one or more years of negative Diversification. The third dummy variable did have an effect on the Y variable in all three segments of the model. Squared terms could only be used with the pooled OLS model, since there were not enough data points to accurately model the squared term using a FE or RE model. Because of this, all discussion below refers to the pooled OLS model. The outcomes of these models are presented below. In general, the finding suggests that there is as anticipated a nonlinear relationship between Diversification and bank performance, with Diversification improving performance to a point, but if too much Diversification is applied it negatively influences the performance of the firm.

Some tests did indicate significance of country group (developed or developing) for outcomes. To explore potential latent causes of this relationship, the country variable
was decomposed into six variables. This step is taken in order to provide more information on the characteristics of the economy and bank, rather than simply classifying countries based on GNI per capita, as World Bank specifications do (World Bank, 2013e). Table 27 (Appendix) summarizes the six variables that the country dummy has been decomposed into, as well as their sources in the literature and the data collection sources. More information can be found in Chapter 4 on these variables and their literature foundations. In order to prepare for this analysis, Taiwanese banks were removed, because financial data for Taiwan of the type listed above is either very limited or unavailable. The World Bank (2013b) explains that in most cases Taiwan is not listed as a separate country, and data is only specifically available for a few indicators (none of which are related to this study). Although data is sometimes available for Taiwan, it is commonly integrated into world or high-income country indexes, or is only available from Chinese government statistics. Because of this, the choice is made to exclude Taiwan from the analysis because of uncertainty in measurement.

All five models are presented for all tests, along with goodness of fit ($r^2$), significance ($p$), and other determinant variables. However, these models should not be taken as equivalent. In most cases, the model outcomes did not differ by very much, suggesting that there is no need to select a best representation model. Differences in the models are also discussed. The first three factors demonstrate the quality of the model and how well it reflects the underlying data (Baltagi, 2008). The ultimate choice of regression method is dependent on the characteristics of the data as well as how well it reflects underlying reality (Wilcox, 2010). This is an informal approach to discrimination rather than a formal approach, though it relies on statistical measures (Sawa, 1978). In this case, it is appropriate because of the differences in what the models represent, as well as a desire to demonstrate both views of the data.

5.3.2 Hausman Tests
One question about the models presented is whether the random effects method or the fixed effects method is most appropriate for modelling the outcomes. The decision to use random effects or fixed effects models can most effectively be made using the Hausman test, though this is not fully sufficient to determine which model is most appropriate. According to Clark and Linzer (2012), the random model assumes that unit
effects and explanatory variables are uncorrelated (independent). If this assumption is correct, then fixed effects and random effects models will provide similar estimates, while if not, the estimates will vary. The Hausman checks the distance between these estimates ($\beta$) between the fixed effects and random effects model. If the difference is insignificant, then the random effects model is more appropriate because it will be less biased. However, if this difference is significant, then this means that the assumptions of the random effects model have been violated and the fixed effects output should be used instead (Clark & Linzer, 2012). Table 8 shows the Hausman test outcomes for all groups of indicators for the initial models, as well as the Hausman test outcomes for the decomposed country group variable testing discussed in Section 5.5.2. As this table shows, in all cases the FE model is appropriate because the difference in coefficients is not systematic (i.e. the assumptions of the RE method were violated).

### Table 8 Hausman test outcomes

Null hypothesis: difference in coefficients not systematic

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Prob&gt;chi2</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Models</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital ratio</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Tier 1 capital</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Writedowns</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Profits to assets (ROA)</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Profits to equity (ROE)</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Stock returns</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>0.0001</td>
<td>Fixed effect</td>
</tr>
<tr>
<td><strong>Decomposed country variable models</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital ratio</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Tier 1 capital</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Writedowns</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Profits to assets (ROA)</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Profits to equity (ROE)</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Stock returns</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>0.0000</td>
<td>Fixed effect</td>
</tr>
</tbody>
</table>
### 5.3.3 FE Approach Selection

There are two approaches that could be used for FE modelling of the equations below. The time fixed effect model demonstrates the effect of time-invariant, rather than entity-invariant, effects on the model (Brooks, 2008; Lee & Yu, 2010; Kézdi, 2004; Plümper & Troeger, 2007). In order to determine if this would be an effective approach, the time fixed effect check is run. If \( \text{prob} > F \leq 0.05 \), then time fixed effects should be used. This indicates that the time series is less significant. Table 9 shows that all \( Y \) equations discussed above in Section 5.3, except for the Capital ratio equation, support the use of the time fixed effect model. The outcomes of six tests (Tier 1 capital ratio, Writedowns, ROA, ROE, Stock returns, and Stock volatility) are presented below.

#### Table 9 Fixed effects model selection

<table>
<thead>
<tr>
<th>Model</th>
<th>Prob &gt; F</th>
<th>Time fixed effects?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>0.2134</td>
<td>No</td>
</tr>
<tr>
<td>Tier 1 capital (In)</td>
<td>0.0000</td>
<td>Yes</td>
</tr>
<tr>
<td>Writedowns (In)</td>
<td>0.0002</td>
<td>Yes</td>
</tr>
<tr>
<td>ROA</td>
<td>0.0004</td>
<td>Yes</td>
</tr>
<tr>
<td>ROE</td>
<td>0.0000</td>
<td>Yes</td>
</tr>
<tr>
<td>Stock returns (In)</td>
<td>0.0007</td>
<td>Yes</td>
</tr>
<tr>
<td>Stock volatility (In)</td>
<td>0.0006</td>
<td>Yes</td>
</tr>
</tbody>
</table>

There are some general remarks about the models that should be discussed. First, the time FE model required elimination of the Diversification dummy, 2001 year dummy, and 2012 year dummy in all variables, because of collinearity issues. The pre-post crisis period dummy and the year dummies are both included. This is a question because of the potential for non-independence. However, this is not actually the case. The pre-post dummy captures the effect of an aggregate period, while the year dummy captures the effect of a time series in a yearly sequence. Thus, both of these variables could be included.

### 5.4 Main Findings

Having shown with descriptive statistics that the data is shaped largely as expected, and determined which models should be used using Hausman testing and testing for time fixed effects. We can now move on to presentation of the main findings of the study.
There are three key questions that are discussed in this section, including bank stability, returns, and riskiness of share prices. These three analysis groups each include at least two dependent variables tested against a suite of independent variables, as described in Chapter 4. These main findings offer the most important set of insights that are found in the study, although there are also some additional findings that offer some interesting information presented in the next section.

5.4.1 Bank Stability
The first set of analyses focuses on bank stability. The bank stability analysis uses three main dependent variables, including 1) Capital ratio, 2) Tier 1 capital ratio, and 3) Writedowns, as indicators of stability. Although related, these three variables offer a different viewpoint on stability. While the Capital ratios are a potential indicator of bank stability, Writedowns are a measure of bank instability; they represent the total assumption of systemic risk within the bank (Acharya, et al., 2009a). These three perspectives do not individually show the extent of stability or instability within the bank, but instead offer distinct perspectives that could be used to understand the development of stability within the bank. In this discussion, an initial and final model for each of these dependent variables is presented that shows which of the independent variables were associated with them.

5.4.1.1 Capital Ratio and Tier 1 Capital Ratio
The first two models to be calculated for bank stability are the Capital ratio and Tier 1 capital ratio models. Capital ratio and Tier 1 capital ratio are closely related variables. The Capital ratio describes the ratio of capital holdings to existing loans (Schaeck & Cihák, 2010). The Tier 1 capital ratio is similar, but it only includes capital that meets the stricter definition required under the Basel II Accords; in other words, it can only include common stock, retained earnings, and reserves (BIS, 1989; Furlong, 2011). While Basel II requirements demand 4% Tier 1 capital holdings, many banks hold more than this as a strategic measure. Thus, while the denominator of both variables is the same (total existing loans), the numerator is different, with the Tier 1 numerator being in most cases more restrictive; this would lead to most banks having a lower Tier 1 capital ratio than total Capital ratio. There are also differences in the denominator of the two variables, with the Tier 1 capital ratio being risk-adjusted while the Capital ratio is naïve (Furlong, 2011; Schaeck & Cihák, 2010). This adjustment typically means that
the difference is not as great as it otherwise may be. Inspection of the descriptive statistics in Table 5 shows that Capital ratios are typically higher than Tier 1 capital ratios, with a mean difference of 6.397. Tier 1 capital showed a stronger relationship with predictive factors, as well as showing a weak relationship with Performing loans to non-performing loans (which the Capital ratio did not). Each of these models used one-year lags for all independent variables. Lags are used for some independent variables because the dependent variables are balance sheet variables, meaning that they are not calculated instantaneously, but instead are prepared only once a year. This means that the performance of the variable is dependent on past performance, rather than simultaneous performance. The final model is presented for each of these ratios. The impact of each of these variables on the hypothesis outcomes is also discussed, since these are the three key variables (stability indicators) for each of the outcomes. Table 10 shows the outcomes for pooled OLS, robust FE, time-FE, and Diversification squared term (pooled OLS) for Capital ratio, while Table 11 shows the outcomes for Tier 1 capital ratio.

5.4.1.1.1 Capital Ratio
Three models are tested for Capital ratio, including pooled OLS, robust FE, and squared term pooled OLS (to check for nonlinearity in the Diversification term). Time FE is not run for this model (see Section 5.3.3).

The pooled OLS model for Capital ratio finds that profit, Net interest income, Diversification, Cost-to-income ratio, Time period, and Country are significant (with time period and net interest income having a negative relationship). The final model (adjusted $r^2 = 0.183$) shows moderate effects within the data set.

The robust FE model, which represents time-invariant effects and shows unit variation, shows that Total assets (negative relationship) is the only significant variable in this group. The final model (adjusted $r^2 = 0.007$) is very weak, suggesting a poor model fit. These results are very different from the pooled OLS model. One reason for this very weak result could be the relative shallowness of the time series, with some banks having only nine years of data available. However, this difference could also be related to the effect of the 2007-2009 financial crisis period on banks, which could have dramatically
influenced their Capital ratios through devaluation of assets, writing off or reducing rates on net interest-based income, and so on. Another potential factor is that Capital ratios are determined by within-year factors, rather than lagged factors, at the bank level, which could have made the lagged approach less suitable. However, this is not the case when lags were tested, so it is discounted as a possible reason.

In both models, there is a significant negative effect from being a developed economy. This is consistent with the current economic crisis beginning in developed economies in the West, and the position of developed economies generally being pro-cyclical, while developing economies are to a greater or lesser extent anti-cyclical (Kaiser, 2001). Neither outcome indicates that there is a strong goodness-of-fit to the variables included in the model, with effects being characterized as weak (Jackson, 2011). There is the possibility that the pooled OLS outcome may be biased because of increased time-invariant endogeneity within the model that is not accounted for, which could give the illusion that there is an increased goodness-of-fit within the model. This should be accounted for when considering the findings, in this and all other pooled OLS models.

The addition of the decomposed economic variables is mostly insignificant for both pooled OLS and robust FE models. However, Liquid liabilities are significant, and resulted in an improved fitted value for this model. (Pooled OLS adjusted $r^2 = 0.203$, robust FE adjusted $r^2 = 0.023$). Interestingly, the relationship of this variable is reversed, with it having a negative effect on pooled OLS and a positive effect on robust FE. This suggests different effects within the pooled data set as compared to time-invariant unit effects. This may be because banks in a larger financial system can diversify risks, but the risk is still systemic to the banking system. This is related to previous findings, which suggested that banks can individually choose risk levels to influence performance, but that the banking system as a whole could not do that.

The Diversification (squared term) model shows that Profit and Diversification are significant positive factors, while Net interest income and Diversification (squared term) are significant negative factors. Total assets, Performing loans to non-performing loans, and Cost-to-income were not significant variables. None of the dummy variables were significant in this model. The r-squared of this model (adjusted $r^2 = 0.191$)
indicates it is a relatively weak model in terms of fit, and does not reach a level of goodness-of-fit required to make it a strong model (Jackson, 2011).

Based on this analysis, there is evidence that testing stability as indicated by the Capital ratio provides support for all three hypotheses. H1 queries the effects of Diversification. This can be seen in the significant relationship between Diversification and the Capital ratio. While Diversification is positive up to a point, the squared term analysis indicates that it does have a nonlinear effect, suggesting excessive Diversification has a negative impact on bank stability. H2 focuses on the impact of interest income on stability. The relationship in this model is also reflected in the significance of net interest income. Finally, H3 focuses on the impact of balance sheet indicators on stability. Relationships between total assets, profit, and cost-to-income ratios provide support for this hypothesis.

General outcomes for the Capital ratio tests indicate that there are significant positive relationships with Profit, Diversification, Cost-to-income ratio, and Time period. There are significant negative relationships with Total assets, Net interest income, Diversification (squared term), and Country Group.

**Table 10 Summary tables of outcomes for Capital ratio**

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>-5.344</td>
<td>-6.705*</td>
<td>-1.706</td>
<td>-2.566**</td>
<td>-7.918***</td>
</tr>
<tr>
<td></td>
<td>[-0.851]</td>
<td>[-1.802]</td>
<td>[-0.380]</td>
<td>[-0.513]</td>
<td>[-3.147]</td>
</tr>
<tr>
<td>Performing loans to nonperforming loans</td>
<td>0.010</td>
<td>0.010</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit</td>
<td>17.356***</td>
<td>0.569</td>
<td>11.435***</td>
<td>13.133***</td>
<td>1.129</td>
</tr>
<tr>
<td></td>
<td>[4.313]</td>
<td>[0.708]</td>
<td>[3.303]</td>
<td>[3.382]</td>
<td>[1.643]</td>
</tr>
<tr>
<td></td>
<td>[-2.948]</td>
<td>[-0.553]</td>
<td>[-2.417]</td>
<td>[-2.382]</td>
<td>[-0.694]</td>
</tr>
<tr>
<td>Diversification</td>
<td>33.420**</td>
<td>0.672</td>
<td>65.116***</td>
<td>70.468***</td>
<td>-1.088</td>
</tr>
</tbody>
</table>
### 5.4.1.1.2 Tier 1 Capital Ratio

Four models, including pooled OLS, robust FE, pooled OLS with squared term, and time FE, are run for Tier 1 capital ratio.

The pooled OLS model (adjusted $r^2 = 0.913$) showed significant variables including Total assets, Profit, net interest income, Diversification, cost-to-income ratio, Country group (negative relationship to developed country), and Time period (pre- and post-crisis). The strongest effects include Total assets and Diversification, while Cost-to-income ratio had the smallest effect.

The robust FE model (adjusted $r^2 = 0.599$) showed the same significant variables as the pooled OLS model, but the individual effects were weaker. The strongest effect is once again Total Assets, while the weakest is Diversification (though it is slightly positive rather than slightly negative).
Overall, the model fits for pooled OLS and robust FE using Tier 1 capital ratio as the outcome variable were consistent with the previous tests for Capital ratio. However, that here were more significant factors for this robust FE model compared to the Capital ratio could be because the Tier 1 capital ratio is far more carefully controlled than the general Capital ratio. The much stronger result is consistent with an increasingly rigorous approach to management of Tier 1 capital as compared to the general capital pool. Given that a minimum level of Tier 1 capital is required by the Basel II Accords and is enforced by banking supervisors (BIS, 1989), it is to be expected that it would be more strongly linked to balance sheet indicators. However, on average Tier 1 capital holdings were higher than required by Basel II, as indicated in the descriptive statistics. The Tier 1 capital ratio of 20.64% is significantly higher than the required 4%. This suggests that banks may also prioritize holdings of Tier 1 capital, which makes sense given that Tier 1 capital includes higher-quality capital that is directly related to bank operations. This probably explains the increased significance of balance sheet factors for Tier 1 capital as compared to general capital.

The squared term test shows the outcomes of testing for nonlinearity in the Diversification variable. This shows that Total assets, Profit, and Diversification have positive significant relationships with Tier 1 capital, while Diversification squared term, Time period, and negative Diversification variables have significant negative relationships. Performing loans to non-performing loans, Net interest income, Cost-to-income ratio, and the Country group dummy variable did not have a significant relationship with Tier 1 capital. The adjusted r-squared of this model (adjusted $r^2 = 0.920$) indicate that it is a relatively strong model.

Testing the six decomposed variables shows that Liquid liabilities and Deposit bank money assets to GDP are significant in both the pooled OLS and robust FE regressions, and other variables were not significant. This suggests that larger financial intermediaries have increased Tier 1 capital ratios. The same relationship for Liquid liabilities is also seen as above, with the pooled OLS showing a negative relationship and the robust FE showing a positive relationship. As above, it is suggested that a larger banking system may allow individual banks to diversify risks, but systemic risk within the system remains consistent and cannot be removed. However, it could also be because of latent variables causing endogeneity bias in the pooled OLS.
The time fixed effects model has some insights for the time period. The fixed effect regression results show that operating during the pre-crisis period reduced Tier 1 capital ratio significantly compared to the post-crisis findings. The time FE regression shows that Tier 1 capital significantly increases over time, both during the pre- and post-period model. This is consistent with Tier 1 capital reserves growing generally as the financial system grows. Additional effects are similar to the initial test under FE.

All three hypotheses also had support when using Tier 1 capital ratio as the dependent variable indicating stability, and relationships were stronger compared to the Capital ratio. H1 (Diversification and stability) is supported by the relationship between Diversification and Tier 1 capital ratio, which is one of the strongest effects found. H2 (interest income and stability) is also supported by these findings, which included net interest income as a significant variable. Finally, the balance sheet strength (H3) is reflected in the relationship between Tier 1 capital and total assets, profit, and cost-to-income ratios.

Table 11 Summary table of outcomes for Tier 1 capital ratio

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>0.633***</td>
<td>0.550***</td>
<td>0.621***</td>
<td>0.631***</td>
<td>0.437***</td>
<td>0.382***</td>
</tr>
<tr>
<td></td>
<td>[14.773]</td>
<td>[13.968]</td>
<td>[11.945]</td>
<td>[10.867]</td>
<td>[9.297]</td>
<td>[8.134]</td>
</tr>
<tr>
<td>Performing loans to nonperforming loans</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000**</td>
<td>-0.000**</td>
<td>-0.000**</td>
<td>-0.000**</td>
</tr>
<tr>
<td>Profit</td>
<td>0.227***</td>
<td>0.037*</td>
<td>0.193***</td>
<td>0.186***</td>
<td>0.035</td>
<td>0.036</td>
</tr>
<tr>
<td></td>
<td>[7.817]</td>
<td>[1.783]</td>
<td>[7.797]</td>
<td>[7.502]</td>
<td>[1.635]</td>
<td>[1.496]</td>
</tr>
<tr>
<td>Net interest income</td>
<td>-0.030</td>
<td>0.125***</td>
<td>0.033</td>
<td>0.022</td>
<td>0.154***</td>
<td>0.174***</td>
</tr>
<tr>
<td></td>
<td>[-0.653]</td>
<td>[3.838]</td>
<td>[0.579]</td>
<td>[0.354]</td>
<td>[3.562]</td>
<td>[4.049]</td>
</tr>
<tr>
<td>Diversification</td>
<td>0.416***</td>
<td>0.074</td>
<td>0.703***</td>
<td>0.686***</td>
<td>0.312***</td>
<td>0.275***</td>
</tr>
<tr>
<td></td>
<td>[3.064]</td>
<td>[1.580]</td>
<td>[4.564]</td>
<td>[4.069]</td>
<td>[2.950]</td>
<td>[2.579]</td>
</tr>
</tbody>
</table>
## 5.4.1.1.3 Comparison of Capital Ratio and Tier 1 Capital Ratio

The two models above showed some different results for the outcomes of tests for Capital ratio and Tier 1 capital ratio. In terms of variables, the final models integrated the same predictor variables (Total assets, Profit, Interest income, Diversification, and Cost-to-income ratio, as well as dummy variables including country group and time period). Both of these models are considered to support all three hypotheses. Comparison of the outcomes showed that these variables did have a significant difference in effectiveness of the model, with the adjusted r-squared values being higher for the Tier 1 capital ratio than for the Capital ratio generally, suggesting the model has

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient 1</th>
<th>Coefficient 2</th>
<th>Coefficient 3</th>
<th>Coefficient 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diversification (sq)</td>
<td>-0.120***</td>
<td>-0.129***</td>
<td>-0.060***</td>
<td>-0.052**</td>
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<td>Cost-to-income</td>
<td>-0.004***</td>
<td>0.001*</td>
<td>-0.003</td>
<td>-0.004*</td>
</tr>
<tr>
<td></td>
<td>[-2.660]</td>
<td>[1.833]</td>
<td>[-1.569]</td>
<td>[-1.699]</td>
</tr>
<tr>
<td>Liquid liabilities</td>
<td>-0.027*</td>
<td>0.298***</td>
<td>0.121**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-1.753]</td>
<td>[6.868]</td>
<td>[2.187]</td>
<td></td>
</tr>
<tr>
<td>Deposit money</td>
<td>0.001**</td>
<td>0.003**</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.154]</td>
<td>[2.195]</td>
<td>[0.957]</td>
<td></td>
</tr>
<tr>
<td>Country dummy Yes/No</td>
<td>Yes/No</td>
<td>Yes/No</td>
<td>Yes/No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Negative Diversification dummy Yes/No</td>
<td>No/No</td>
<td>Yes**/Yes**</td>
<td>No/No</td>
<td></td>
</tr>
<tr>
<td>Time period dummy Yes/No</td>
<td>Yes***/Yes***</td>
<td>Yes***/Yes***</td>
<td>Yes***/Yes***</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2003 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
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<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2005 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2006 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2007 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2009 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes</td>
</tr>
<tr>
<td>2010 dummy</td>
<td>No/No</td>
<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>2011 dummy</td>
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<td>No/No</td>
<td>No/No</td>
<td>Yes***/Yes***</td>
</tr>
<tr>
<td>No. of Observations</td>
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<td>1,932</td>
<td>1,822</td>
<td>1,627</td>
</tr>
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<td>F-statistic</td>
<td>618.6</td>
<td>223.4</td>
<td>889.7</td>
<td>791.8</td>
</tr>
<tr>
<td>R-Squared adjust</td>
<td>0.913</td>
<td>0.599</td>
<td>0.920</td>
<td>0.916</td>
</tr>
<tr>
<td>RMSE</td>
<td>0.433</td>
<td>0.229</td>
<td>0.416</td>
<td>0.427</td>
</tr>
</tbody>
</table>

Note: ***, **, * Indicate significant at 1%, 5% and 10% levels, respectively.
a better fit for the Tier 1 capital ratio than for the Capital ratio. However, there are some general observations that can be identified for each of these variables.

First, both models showed that the country group dummy is a significant negative predictor, indicating that being in a developed economy has a negative effect on bank stability. Developing economies have different characteristics to developed economies, which include faster growth rates and less regulation, making them a commonplace inclusion in econometric models (Nafziger, 2006; Wooldrige, 2009). For example, developed countries may embrace riskier financial products, which was a point developed in Chapters 2 and 3. These characteristics also make developing economies anti-cyclical compared to developed economies, meaning that their business cycles tend to increase when those of developed countries slide (Kaiser, 2001). In this case, there is a relatively simple explanation for this relationship, which is that the most recent long-lasting and severe economic downturn started in a developed economy and remained there for some time (Adrian & Shin, 2010). Thus, at least over the past decade, being in a developed economy has been a negative influence on the stability of banks as measured by these characteristics.

The results for the time period dummy are not as clear, which is one of the reasons the time FE model used. In the final Capital ratio equation, the time period is shown to be significant and negative, while in the initial model and for Tier 1 capital this is not found to be significant. This inconsistent finding may be due to the rapid increase in loans across developed economies during this period (Foo’s, et al., 2010). Foos et al. (2010) found that the pattern of increased lending first increased loan-loss ratios (suggesting increased risk), and then reduced Capital ratios and incomes over a period of three years. Using a time lag of only one year (as is thought to be appropriate in this case) does run the risk that the partial cycle will be captured, where risk is increased but income and Capital ratios have not yet been disturbed.

There are some differences in the Capital ratio and Tier 1 capital ratio models that should be considered. First of all, the large negative relationship between total assets and bank stability found in the Capital ratio model is not shown in the Tier 1 capital ratio model (where it is a positive relationship). This is likely related to the method of
calculation of Capital ratio compared to Tier 1 capital ratio. Simply, the coefficient of total assets in the Capital ratio is much higher than in the Tier 1 capital ratio (which includes only specific categories of assets). A similar relationship is shown for net interest income, with a higher net interest income being associated with lower bank stability in the Capital ratio model but not in the Tier 1 capital ratio model. This is probably due once again to the more restrictive definition of Tier 1 capital, especially the risk-adjusted denominator.

Another important issue is the issue of diversification. The pooled OLS model shows that diversification had a large effect on stability, but this effect is an order of magnitude higher for the Capital ratio than it is for the Tier 1 capital ratio. In part, this could be due to the Basel II requirements, which demand that banks have a certain floor of Tier 1 capital holdings (and which may be higher based on the national implementation of the Basel rules) (Kolb, 2010). The FE model shows a reduced effect of diversification. However, it could also be due to interaction effects within the data, such as with net interest income or other factors, which were not examined within this model.

Regardless, the findings suggest that the large effects shown in the pooled OLS outcomes for the Capital ratio are likely to be exaggerated, compared to other models and the Tier 1 capital data. This is consistent with the possibility of endogeneity-related bias within the pooled OLS model, which is a known risk of this model (Baltagi, 2008). In other words, the pooled OLS model could simply be due to statistical error. The same relationship is seen for Writedowns.

5.4.1.2 Writedowns

While the Capital ratio and Tier 1 capital ratio can be considered as measures of bank stability, Writedowns offer a different perspective, since they are a measure of bank instability. The predictor variables in the Writedowns model were also implemented using a one-period lag. There are no significant changes made between the initial and final model for Writedowns. The only variable that did not affect the initial equation significantly is the Equity-to-asset ratio; however, it also did not reduce the accuracy of the model, and so it is left in.
For the pooled OLS model (adjusted $r^2 = 0.596$), significant variables include Profit (negative), Net Interest Income, diversification, and time period. The strongest variable is Net Interest Income, while the weakest is Profit.

For the robust FE model (adjusted $r^2 = 0.081$), the significant variables include Performing loans to non-performing loans, Profit (negative), Net interest income, Diversification, Cost-to-income ratio, and time period. The strongest is Net interest Income, while the weakest is Performing loans to non-performing loans. Performing loans to non-performing loans barely achieved significance (with an effect size of $<0.000$), an effect that disappeared in the pooled OLS model.

The decomposed economic variable test shows that Deposit money bank assets to GDP (negative) is significant in the pooled OLS model. This suggests that on the scale of the entire banking system, higher levels of assets reduce Writedowns. The robust FE model did not show this relationship, but it did show a strong negative effect from liquid liabilities, suggesting that higher liquid liabilities at the bank level were associated with lower levels of Writedowns.

Since the pooled OLS model assumes that there are no significant differences between banks, this model could be missing significant variance in Writedowns and Profits caused by latent effects such as differences in management skill, choice of risk level, or lending costs. In other words, it could be ignoring endogenous effects that influence the outcomes of the test. This is supported by the significance of Performing loans to non-performing loans in this category, as well as the relative weakness of the relationship. However, on the level of the banking system it is not possible to choose a risk level to operate at in this way. The banking system cannot simply increase risk in order to increase profits; instead, it must encompass the risk involved in the entire banking system. The time period dummy’s significance in both models suggests that Writedowns are higher in the post-crisis period than in the pre-crisis period, which is precisely as expected if banks were suddenly overtaken by excessive risk associated with their lending practices both individually and across the board. This is not a testable assertion, and the possibility for biased estimators within the pooled OLS model needs to be considered. However, it is worth considering and could be tested in future research.
The models both have a positive relationship between Writedowns and net interest income. While this may be at first counterintuitive, it does actually make sense from a systemic and individual time period. In particular, interest income is subject to Writedowns (since there is a chance loans may not be repaid), while non-interest income is subject to Writedowns at a much lower rate (since fee-for-transaction services are likely to be paid immediately). Thus, it is simply that interest income is riskier than non-interest income (Stiroh, 2004). Thus, an increase in Writedowns is expected given an increase in net interest income. Additionally, Writedowns are a one-off expense, while profit is a continuing flow, meaning that there would be a negative relationship regardless given the lag structure.

Another seemingly counterintuitive finding is the positive relationship between diversification and Writedowns in all cases. In part, this is due to the higher Writedowns risk associated with interest income (as discussed above). However, excessive diversification is known to be associated with increased risk and reduction of the benefits of diversified income streams (Stiroh, 2004). At the same time, however, under-diversification is associated with reduced flexibility and increased systemic risk exposure (Stiroh, 2004). This does raise the question within this research of what the optimal level of diversification is. This issue is discussed in the further findings (Section 5.3). In general, this model indicates that profit has a negative relationship to Writedowns, while Net interest income, Diversification, Cost-to-income ratio, Equity-to-asset ratio, and country group are related positively to Writedowns.

As with other models, potential nonlinearity in diversification is tested using a squared term. Positive significant relationships were found with Net interest income, Diversification, and Time period. Negative significant relationships were found with Profit, Diversification (squared term), and Country group. No significant relationship is found with Non-performing loans, Cost-to-income ratio, or Equity-to-asset ratio. The adjusted r-squared of this model (adjusted $r^2 = 0.611$) suggests this is a moderately effective model.

The final test is for time FE. Writedowns showed a higher level during the pre-crisis period than during the post-crisis period in the initial test. The findings of this test show
that once more, there are similar indicators. However, this result also shows a slowing pattern of Writedowns, with Writedowns getting lower approaching the crisis year (2008) and afterwards. This slowdown is likely associated with two factors. One could be survivorship, with the Writedowns of failed banks being eliminated from the data set. However, a more important factor in this data set (compared to European and North American banks which suffered a lot of early attrition during this period) is likely that there was increased lending caution on the part of banks that led to a reduction in Writedowns.

Comparison of all three of these models offers some interesting insights into the relationship between the diversification squared term and the stability indicators. First, all three of the variables showed a significant positive relationship with the diversification first-order term. However, the relationship of the Capital ratios and Writedowns is inverse, which means that there are mixed messages from the data. It suggests that increasing Diversification increases Capital ratio and Tier 1 capital ratio (increasing stability), but also increases Writedowns (perversely, decreasing stability). The squared term of diversification offers some insight into why there is such a relationship. All three stability indicators showed a negative significant relationship with the diversification squared term. However, only the models for Tier 1 capital and Writedowns reached a level of practical interest, as capital on its own is too weak to indicate an interesting outcome.

The hypothesis implications for Writedowns are somewhat different from those of Capital ratio and Tier 1 capital ratio, since it could be expected to move in the opposite direction. However, the findings do not fully support this. H1 (diversification and stability) should show a negative relationship between Diversification and Writedowns. However, this relationship is positive. This discrepancy could be because banks that increase their Net interest income also increase risk of non-repayment (thus triggering increased Writedowns), while those that maintain a transaction-based strategy avoid Writedowns. However, it does weaken the position of H1. The same relationship is found for H2 (interest income and stability), similarly weakening this hypothesis but also pointing to the effect of interest income. There is also the possibility that diversification has a nonlinear relationship to stability indicators, a possibility explored in Sections 5.4.1.1.1 and 5.4.1.1.2. H3 (balance sheet indicators and stability) did have
some support with the negative relationship between profit and Writedowns. However, this is also relatively weak. When viewed from the perspective of Writedowns as a stability indicator, H3 does not gain more than weak support generally.

Table 12 Summary table of outcomes for Writedowns

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing loans to non-performing loans</td>
<td>0.000</td>
<td>0.000***</td>
<td>0.000</td>
<td>0.000*</td>
<td>0.000***</td>
<td>0.000***</td>
</tr>
<tr>
<td>Profit</td>
<td>-0.427***</td>
<td>-0.203***</td>
<td>-0.418***</td>
<td>-0.414***</td>
<td>-0.125**</td>
<td>-0.120*</td>
</tr>
<tr>
<td>Net interest income</td>
<td>1.560***</td>
<td>0.766***</td>
<td>1.545***</td>
<td>1.549***</td>
<td>0.832***</td>
<td>1.002***</td>
</tr>
<tr>
<td>Diversification</td>
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<td>0.490**</td>
<td>2.602***</td>
<td>2.470***</td>
<td>0.543</td>
<td>0.677</td>
</tr>
<tr>
<td>Diversification (sq)</td>
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<td>-0.464***</td>
<td>-0.047</td>
<td>-0.096</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost-to-income</td>
<td>0.008</td>
<td>-0.009*</td>
<td>0.005</td>
<td>0.011*</td>
<td>-0.001</td>
<td>0.002</td>
</tr>
<tr>
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<td>-0.003</td>
<td>-0.016</td>
<td>-0.019</td>
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<td>Liquid liabilities</td>
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</tr>
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<td>-0.003</td>
<td>0.008</td>
<td></td>
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<td>No</td>
<td>No</td>
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</tr>
<tr>
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<td>No</td>
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<td>Yes***</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Time period dummy</td>
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<td>Yes***</td>
<td>Yes***</td>
<td>Yes***</td>
<td>Yes**</td>
<td>Yes</td>
</tr>
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<td>2002 dummy</td>
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<td>No</td>
<td>No</td>
<td>No</td>
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</tr>
<tr>
<td>2004 dummy</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
</tr>
<tr>
<td>2005 dummy</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2007 dummy</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
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</tr>
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<td>1,230</td>
</tr>
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<td>89.70</td>
<td>85.42</td>
<td>20.75</td>
<td>220</td>
</tr>
<tr>
<td>F-statistic</td>
<td>1.536</td>
<td>1.071</td>
<td>1.507</td>
<td>1.435</td>
<td>0.995</td>
<td>0.0933</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.596</td>
<td>0.0808</td>
<td>0.611</td>
<td>0.638</td>
<td>0.0574</td>
<td>1169</td>
</tr>
<tr>
<td>adjust</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Note: ***, **, * Indicate significant at 1%, 5% and 10% levels, respectively.

5.4.1.3 Effects of Diversification

Taken together, the findings strongly indicate that there is a nonlinear relationship with Diversification, as indicated in the discussion above, though the three models do not identify a specific point of Diversification that is appropriate. Pragmatically, what these findings suggest is that Diversification of the business model initially supports business stability as measured by the Tier 1 capital ratio and the Capital ratio. The positive influence on Writedowns could result from an increased reliance interest income, which brings with it an increase in Writedown risk (Simply, transaction-based services are paid immediately, while interest may be defaulted on). This is related more to the volume of interest-based income, rather than an increase in the interest rate itself. An increase in the interest rate without an attendant increase in interest-based income volume would, as is generally accepted, reduce default risk and Writedowns. The strongest positive effect is seen in the Tier 1 capital ratio. However, the squared term shows that after a certain point of Diversification, this direction changes, with negative effects on bank stability indicators shown. The strongest effect is also shown in Capital ratios. These models support the idea that Diversification has a non-linear effect on bank stability. This means that up to a point, Diversification will assist in achieving bank stability. However, after that point it will be counterproductive, with increased Diversification leading to decreased bank stability.

5.4.2 Returns

Variables used to model bank returns include Profits-to-assets ratio (ROA), and Profits-to-equity ratio (ROE). These variables have been selected because raw returns (profits) are inappropriate for modelling between organisations of widely varying sizes (Athanasoglou, et al., 2008; Albertazzi & Gambacorta, 2009). Variations in bank
holdings and profits mean that a ratio of these holdings to profit more consistently
models across a given set of banks, allowing for comparison. ROA is the ratio of Profits
to total assets held, while ROE is the ratio of profits to total shareholder equity
(Athanasoglou, et al., 2008; Albertazzi & Gambacorta, 2009). As Table 5 shows, the
central tendencies of these variables are actually very similar, but ROA (M = 0.003, SD = 0.017) has a much smaller level of variation than ROE (M = 0.005, SD = 0.542).

Two models are constructed for stability, with ROA and ROE acting as the dependent
variables. ROA and ROE mainly have implications for H2 (the relationship between use
of interest income and bank success). When using ROA as a measure of bank success,
there is some evidence for the impact of interest income indirectly, through the
relationship with Diversification. (Since Diversification reflects the relative sources of
income, this provides some relationship, though not as strong as a direct measurement
for net interest income.) ROE showed the same relationship, with the same implications.
H3 (balance sheet strength) cannot be tested directly in this case since ROA and ROE
are essentially balance sheet ratios.

5.4.2.1 ROA
Five tests are used for ROA, including the pooled OLS and robust FE, squared term,
and time FE (OLS and robust FE). Table 13 shows the outcomes of each of these tests.

The pooled OLS outcomes for ROA (adjusted $r^2 = 0.598$) show significant relationships
for variables including Total assets (negative), Turnovers, Cost-to-income ratio
(negative), Country group, and Time period. However, most of these effects sizes are
relatively small.

The robust FE model (adjusted $r^2 = 0.310$) shows significant variables including Total
assets (negative), Turnovers, Diversification (negative), and Time period. These
variables are significant on the bank level over the time series. Again, none of these
effects are very large. The reason for total assets is inherent in the ROA model, since
ROA is determined by net income divided by assets. Thus, holding income steady but
decreasing assets generates a negative relationship between ROA and assets. The
negative relationship with Diversification in this case is the most interesting difference
from the pooled OLS models.
There are some similarities between the two models. The amount of total assets does have a significant negative effect, but this is a very small effect for both models. This is probably due to the lack of direct relationship between assets and firm performance, and is small enough that it might be considered to be significant but not necessarily important. The Ratio of performing to non-performing loans is not significant in either of the models. Turnovers has a small positive significant influence (though this is once again very small and may not be of practical significance). Diversification and Cost-to-income ratios do have a significant effect, but it is very small (less than 0.0005), suggesting that these factors may not be a good source of performance improvement in this area.

In terms of the reduction in ROA from the pre-crisis period, this could be related to excessive reliance on derivatives and other transaction-based banking services, which would increase revenues without increasing the assets held on the balance sheet. This could also be the reason for the impact on ROA from developed country status, since banks in these countries were much more likely to take on heavy transaction-based loads compared to others (Carbó & Rodriguez, 2007; Stiroh, 2004). The withdrawal from high-risk (and high-return) projects would cause a reduction in the return on assets, though it would also cause a reduction in the amount of risk involved in the bank’s balance sheets. The impact of the financial crisis on risk aversion could have diverted some banks back toward interest-bearing assets as well as causing them to abandon OBS investments (Lozano-Vivas & Pasiouras, 2008). Thus, it is consistent that ROA would be both impacted by both developed economy status and pre-crisis time period due to over-involvement in transaction-based services due to involvement in fee-based services that did not impact the balance sheet during this period and in these economies.

The outcomes of the squared term test for Diversification effects show that there were positive significant relationships with Turnovers and Diversification. Significant negative relationships include Total assets, Diversification (squared term), Cost-to-income ratio, Country group and Time period. However, the majority of these variables have very small effects, with several of them being 0.0005 or under (too small to be reported). Insignificant variables in this model include Performing loans to non-
performing loans and the negative Diversification dummy. The goodness-of-fit of this model (adjusted $r^2 = 0.606$) is moderate.

In the decomposed economic variable test, the main significant variables for the pooled OLS are deposit money to GDP and GDP growth, but these are not significant for robust FE. Goodness-of-fit of both models is improved (pooled OLS: adjusted $r^2 = 0.611$, compared to previous adjusted $r^2 = 0.606$). This suggests that a larger size of financial system results in improved ROA in general. This could potentially be because a larger financial system offers more potential assets, but may also include more competitors, reducing the effect on the individual bank while continuing to impact the system as a whole. The other variables that were tested were not significant. Thus, the main effect that could be seen on ROA from this analysis is an increase from the size of the financial system. There were no specific effects seen from the additional variables at the bank level. However, since this is not tested previously it is difficult to say whether it represents a change.

The results for the time FE are similar to the findings above. The bank’s ROA was lower in the time before the crisis, and increased after the crisis. This is probably due to post-crisis lending constraints, increased interest rates, and tighter controls on lending. However, the time FE model shows that ROA was increasing up to 2008 (the crisis year). However, after 2008 the results drop substantially. This could be due to withdrawal of riskier (and thus higher return) projects, but it could also reflect the sudden drop in prime interest rates, which would reduce returns by percentage on new projects. The implication is that as the crisis hit, banks refocused back to asset-based products and increased risk aversion, thus increasing assets and decreasing returns. This results in a reduced overall ROA. Thus, the crisis does show an effect, with a change in the relationship between ROA and its predictor variables following the crisis.
Table 13 Summary table of outcomes for Profits to assets ratio (ROA)

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>-0.006***</td>
<td>-0.005***</td>
<td>-0.006***</td>
<td>-0.006***</td>
<td>-0.006***</td>
<td></td>
</tr>
<tr>
<td>Performing loans to non-performing loans</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000**</td>
<td>-0.000*</td>
</tr>
<tr>
<td></td>
<td>[0.347]</td>
<td>[-1.518]</td>
<td>[-0.144]</td>
<td>[-0.059]</td>
<td>[-1.973]</td>
<td>[-1.948]</td>
</tr>
<tr>
<td>Turnovers</td>
<td>0.005***</td>
<td>0.003**</td>
<td>0.005***</td>
<td>0.005***</td>
<td>0.004***</td>
<td>0.004***</td>
</tr>
<tr>
<td></td>
<td>[14.744]</td>
<td>[14.102]</td>
<td>[15.229]</td>
<td>[14.967]</td>
<td>[11.999]</td>
<td>[11.935]</td>
</tr>
<tr>
<td>Diversification</td>
<td>0.000</td>
<td>-0.000***</td>
<td>0.002***</td>
<td>0.004***</td>
<td>0.001**</td>
<td>0.001*</td>
</tr>
<tr>
<td></td>
<td>[1.099]</td>
<td>[ -17.157]</td>
<td>[2.888]</td>
<td>[4.175]</td>
<td>[2.038]</td>
<td>[1.892]</td>
</tr>
<tr>
<td>Diversification (sq)</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000*</td>
<td>-0.000*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost-to-income</td>
<td>-0.000**</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.000***</td>
</tr>
<tr>
<td>GDP</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>[ 0.018]</td>
<td>[ 0.878]</td>
<td>[-0.385]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deposit money</td>
<td>-0.000**</td>
<td>-0.000</td>
<td>0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-2.309]</td>
<td>[-0.438]</td>
<td>[ 0.444]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country dummy</td>
<td>Yes***</td>
<td>No</td>
<td>Yes***</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Negative Diversification dummy</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Time period dummy</td>
<td>Yes**</td>
<td>Yes***</td>
<td>Yes**</td>
<td>Yes*</td>
<td>Yes**</td>
<td>Yes**</td>
</tr>
<tr>
<td>2002 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
</tr>
<tr>
<td>2003 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes***</td>
</tr>
<tr>
<td>2004 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
</tr>
<tr>
<td>2005 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
</tr>
<tr>
<td>2006 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
</tr>
<tr>
<td>2007 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes*</td>
</tr>
<tr>
<td>2008 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2010 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2011 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>No. of Observations</td>
<td>6,189</td>
<td>6,189</td>
<td>6,189</td>
<td>4,577</td>
<td>4,577</td>
<td>4,577</td>
</tr>
<tr>
<td>F-statistic</td>
<td>105.5</td>
<td>761.8</td>
<td>.</td>
<td>54.30</td>
<td>21.24</td>
<td>623</td>
</tr>
<tr>
<td>R-Squared adj</td>
<td>0.598</td>
<td>0.310</td>
<td>0.606</td>
<td>0.611</td>
<td>0.310</td>
<td>0.0515</td>
</tr>
<tr>
<td>RMSE</td>
<td>0.00485</td>
<td>0.00320</td>
<td>0.00480</td>
<td>0.00510</td>
<td>0.00337</td>
<td>0.317</td>
</tr>
</tbody>
</table>

Note: ***, **, * Indicate significant at 1%, 5% and 10% levels, respectively.

5.4.2.2 ROE

Tests used included pooled OLS and robust FE, squared term, pooled OLS and robust FE with additional economic variables and time FE, as with other models. Table 14 shows the outcomes of each of these tests.

The pooled OLS model (adjusted $r^2 = 0.431$) shows significant relationships with variables including Total Assets (negative), Turnovers, Performing loans to non-performing loans, and Diversification (negative). Cost-to-income ratio, Country group, and Time period are not significant. Most of these effects were small, and Total Assets and Diversification were very small. The robust FE model (adjusted $r^2 = 0.275$) shows that the significant relationships include Total assets (negative), Turnovers, Diversification, and Cost-to-income (negative). Country group is not significant. Although cost-to-income ratio is significant in this model (as it is not in the pooled OLS model), the effect is very small. These results are quite similar to ROA, and the same observations apply to the impact of these effects as above.

The addition of economic variables shows that deposit money bank assets as a percent of GDP does have a significant negative effect on ROE in the pooled OLS model, but this effect is extremely slight (<-0.0005). It does not have this effect on the robust FE model. This suggests that in theory, there could be a very slight negative effect of increased deposit money bank assets on ROE at the financial system level. However, at the time-invariant unit level, there is no effect. In terms of significance, it is not certain that there is any particular difference for this area between the banking system and the bank. The pooled OLS goodness-of-fit (adjusted $r^2 = 0.414$) is slightly lower than the previous test in Section 5.4.2 (adjusted $r^2 = 0.432$).
In the time FE test, ROE is not significantly affected by the pre- or post-crisis period. This could be due to market evaluation differences, which affects equity. Banks may have been viewed as an investment stock prior to the crisis, while following the crisis they could have been viewed as riskier stocks, thus reducing shareholder equity. It could also have been due to reduction in retained earnings following the crisis as the bank relied on its retained earnings in order to meet operational or investment needs. The results of the time fixed effect regression show that ROE significantly decreases in the run-up to the crisis year (2008). It then continues to decrease following the crisis year. This probably reflects a combination of effects, of the stock market gradually withdrawing and reducing its valuation of banks, banks withdrawing riskier investments and focusing on lower-risk, lower-return investments, and drawing down of retained capital in order to fund operations. Thus, the contribution to ROE is falling during the post-crisis period because of increased cautiousness on the part of both banks and investors.

H1 did receive some support from this test, with ROE showing a slight positive effect from Diversification. Net interest income is not tested, meaning that H2 does not have any reflection in this test. Balance sheet variables were not tested, meaning that there is no significant change in the outcomes of H3.

Table 14 Summary table of outcomes for Profits to equity ratio (ROE)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Fixed Effects</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>-0.032***</td>
<td>-0.030***</td>
<td>-0.032***</td>
<td>-0.034***</td>
<td>-0.027***</td>
<td>-0.027***</td>
<td>-0.023***</td>
</tr>
<tr>
<td>Performing loans to non-performing loans</td>
<td>0.000***</td>
<td>-0.000</td>
<td>0.000***</td>
<td>0.000***</td>
<td>-0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[2.864]</td>
<td>[-0.502]</td>
<td>[3.022]</td>
<td>[3.554]</td>
<td>[-0.002]</td>
<td>[0.092]</td>
<td></td>
</tr>
<tr>
<td>Turnovers</td>
<td>0.036***</td>
<td>0.038***</td>
<td>0.036***</td>
<td>0.038***</td>
<td>0.041***</td>
<td>0.042***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[20.543]</td>
<td>[20.662]</td>
<td>[20.685]</td>
<td>[18.543]</td>
<td>[16.782]</td>
<td>[15.309]</td>
<td></td>
</tr>
<tr>
<td>Diversification</td>
<td>-0.000***</td>
<td>0.000***</td>
<td>-0.002</td>
<td>-0.009**</td>
<td>-0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[-4.991]</td>
<td>[10.069]</td>
<td>[-1.012]</td>
<td>[-1.972]</td>
<td>[-0.091]</td>
<td>[0.031]</td>
<td></td>
</tr>
<tr>
<td>Diversification</td>
<td>0.000</td>
<td>0.001*</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.000</td>
<td></td>
</tr>
</tbody>
</table>
5.4.2.3 Effects of Diversification

The findings in this case are not as clear as they were for the bank stability indicators. The main effects of the analysis without the squared term shows that there is a significant positive effect of Diversification on ROA and ROE, but this effect is very small (< 0.0005). It is suggested in this section that while Diversification does have a minor statistical effect on ROA and ROE performance, it is unlikely that modifying Diversification at this level will actually improve this performance. The findings in this section support this assumption. When the Diversification squared term is added to the equations for ROA there are only very small effects (once again under 0.0005). For ROE, the effect of Diversification and the Diversification squared term is insignificant. These findings, plus the main findings discussed above, suggest that there is little, if
any, practical impact of Diversification (or the Diversification squared term) on ROA or ROE. Considering the basis for ROA and ROE shows why Diversification may not have a significant influence one way or another. In particular, Diversification of the bank business model should be performed in such a way as to minimize income volatility (Stiroh, 2004). However, it does not impact either equity or asset holdings directly. Thus, there may be complex interaction effects, or there may simply not be a relationship between these variables at all. It should be recalled that this is the unit-invariant effect for the entire data set, not for individual time series; thus, there may be different effects found in individual time series data.

5.4.3 Stock Market Riskiness
The third indicator of bank stability that is considered is riskiness of Stock returns. In this case, two dependent variables are included, including Share price and Share price volatility. These dependent variables are analysed separately because they represent fundamentally different aspects of risk perception. The Share price itself is a forward-looking risk expectation, incorporating expected future value as well as a risk premium (Kirkwood & Nahm, 2006; Gibson, 2010). In contrast, Share price volatility (operationalized as the standard deviation of share price change) represents the immediate perception of risk inherent in the stock (Fuertes, et al., 2009). Thus, while both variables represent riskiness of the stock as assessed by the market, the time period for risk assessment is different.

Lags for these models were complex. In this case, lags are required because both Stock returns and Stock volatility are assessed based on previous performance and investor expectations about future performance. However, the lags required varied with the model. The option 1 models were performed with 1 lag period, which gave the best results for pooled OLS. The final models (with two lags) had the best results for the robust FE models.

As previously discussed, both pooled OLS and robust FE models are used, in order to represent both types of time series. This has the effect of showing both the effects of variables over time within the data set and the effects of time-invariant effects on a single bank (Bell & Jones, 2012; Mundlak, 1978).
5.4.3.1 Stock Returns

The outcomes of the pooled OLS model for Stock returns (adjusted $r^2 = 0.277$) show significant variables including Total assets, Turnovers (negative), Country group, and Time period. Cost-to-income ratio, Diversification, and Equity-to-asset ratio were not significant. The country group indicates negative outcomes for developed country members, while time period indicates that pre-crisis had a stronger effect.

The outcome of the robust FE test (adjusted $r^2 = 0.116$) finds significant variables including Performing to non-performing loans (negative), Diversification, Cost-to-income ratio (negative), and Time period.

The difference in prediction between pooled OLS and FE models was entirely consistent with expectations, since on the industry level it can be assumed that Stock returns will even out. However, Stock returns are likely to be different between banks given that there are a number of factors that can influence Stock returns other than the balance sheet factors used here. For example, earnings announcements and variance from analyst estimates, changes in leadership, or other news items could influence Stock returns for some time without being related to the balance sheet. However, neither of these models had what might be termed a strong effect since neither went above adjusted $r^2 = 0.3$ (Jackson, 2011). Thus, this relationship can be viewed as weakly predictive at best. Differences between the tests can probably be explained through generalized effects on the industry compared to specific effects on individual banks. While individual banks will have differences in management practices and market perceptions, the industry-level analysis will reflect systemic risk, which cannot be managed away by individual banks. Thus, these two tests are actually measuring slightly different phenomena. However, the difference between the tests is not enough to be considered materially important.

Model fit when adding the Diversification squared term is somewhat improved. The pooled OLS estimation shows that a positive significant relationship is found between Stock returns and Total assets, Diversification squared term, time period, and negative Diversification. Negative significant relationships are found between Stock returns and Turnovers, Net interest income, Diversification, and country group (with developed countries showing lower Stock returns). No significant relationship is found with
Performing loans to non-performing loans, Cost-to-income ratio, or Equity-to-asset ratio. It is noticeable that the effect of Diversification is far stronger in this model than in the original estimation. The adjusted r-squared (adjusted $r^2 = 0.322$) is also stronger than the original specification.

The significant variables in the pooled OLS model for Stock returns include Total assets, Net Interest Income, Diversification, Diversification (squared), time period, and country group. During the post-crisis period there were lower Stock returns. The country dummy indicates that countries include in the developed economies group have lower Stock returns. The fixed effects model shows significant variables including Turnovers, Diversification, Diversification (squared), Cost-to-income ratio, Equity-to-asset ratio, inflation, Bank credit, and time period (increased returns post-crisis). Overall, the goodness of fit of both these models is only moderate.

There are several interesting aspects to these findings. First, inflation and bank credit to bank deposits were significant in the FE model but not the pooled OLS model. This could be due to the level of development of the banking sector, with increased banking sector development being associated with increased use of riskier innovative and advanced banking products. This is supported by some evidence that suggests a relationship between inflation, returns, risk, and banking sector development (Kane, 1981; Simpson, 2002). However, it is not directly tested in this research. The same type of relationship can be seen between bank credit to bank deposits ratio and Stock returns. In theory, the higher the bank credit to bank deposits ratio gets, the higher the Stock returns would get. The credit-to-deposit ratio represents the bank’s use of funds, with a high ratio demonstrating that the bank has a high reliance on its deposits to fund lending activities (Beck, et al., 2009; Cihak, et al., 2012). If this is higher, it suggests stronger intermediation efficiency in the banking system on the whole. This suggests that banks operating in economies with higher intermediation efficiency will have increased Stock returns.

The high collinearity rate in the time FE test left relatively little for analysis, though the findings were still interesting. Under the fixed effect regression, it is shown that banks operating during the pre-crisis period generated higher returns than the post-crisis period. This probably reflects the information asymmetry associated with investors (and
banks) not understanding the risks involved in pre-crisis investment activities. However, the post-crisis returns for this analysis show that information may have increased. In particular, the 2010 year dummy shows that Stock returns are significantly increased. This could indicate that investors perceive that if banks can survive for two years during the crisis they are stable and can get through the crisis. It also suggests that it took two years for the market to begin supporting increased share prices for banks. This has an implication for H3, which is that the impact of balance sheet variables may be dependent on the amount of information that is available to the market and how it is perceived.

Table 15 Summary table of outcomes for Stock returns

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>1.144***</td>
<td>-0.158</td>
<td>1.268***</td>
<td>1.097***</td>
<td>0.163</td>
<td>0.455**</td>
</tr>
<tr>
<td></td>
<td>[4.140]</td>
<td>[-1.182]</td>
<td>[4.390]</td>
<td>[3.564]</td>
<td>[0.787]</td>
<td>[2.062]</td>
</tr>
<tr>
<td>Performing loans to non-performing loans</td>
<td>0.000</td>
<td>0.000*</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>[1.495]</td>
<td>[1.951]</td>
<td>[0.603]</td>
<td>[0.445]</td>
<td>[0.771]</td>
<td>[-0.209]</td>
</tr>
<tr>
<td>Turnovers</td>
<td>-0.363**</td>
<td>0.084</td>
<td>-0.317**</td>
<td>-0.153</td>
<td>0.145**</td>
<td>0.159**</td>
</tr>
<tr>
<td></td>
<td>[-2.397]</td>
<td>[1.627]</td>
<td>[-2.142]</td>
<td>[-0.934]</td>
<td>[2.067]</td>
<td>[2.308]</td>
</tr>
<tr>
<td>Net interest income</td>
<td>-0.339</td>
<td>0.035</td>
<td>-0.529**</td>
<td>-0.464*</td>
<td>-0.009</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>[-1.564]</td>
<td>[0.489]</td>
<td>[-2.128]</td>
<td>[-1.937]</td>
<td>[-0.098]</td>
<td>[0.374]</td>
</tr>
<tr>
<td>Diversification</td>
<td>0.000</td>
<td>0.001***</td>
<td>-0.635**</td>
<td>-0.796**</td>
<td>0.142**</td>
<td>0.164**</td>
</tr>
<tr>
<td></td>
<td>[0.736]</td>
<td>[4.264]</td>
<td>[-2.210]</td>
<td>[-2.113]</td>
<td>[1.986]</td>
<td>[2.194]</td>
</tr>
<tr>
<td>Diversification (sq)</td>
<td>0.001**</td>
<td>0.001**</td>
<td>-0.000**</td>
<td>-0.000**</td>
<td>-0.000**</td>
<td>-0.000**</td>
</tr>
<tr>
<td></td>
<td>[2.208]</td>
<td>[2.110]</td>
<td>[-1.978]</td>
<td>[-2.190]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost-to-income</td>
<td>-0.010</td>
<td>-0.012***</td>
<td>-0.013</td>
<td>-0.001</td>
<td>-0.013**</td>
<td>-0.011**</td>
</tr>
<tr>
<td></td>
<td>[-0.906]</td>
<td>[-3.031]</td>
<td>[-1.279]</td>
<td>[-0.084]</td>
<td>[-2.405]</td>
<td>[-2.298]</td>
</tr>
<tr>
<td>Equity to asset</td>
<td>0.009</td>
<td>0.019</td>
<td>0.003</td>
<td>0.003</td>
<td>0.037**</td>
<td>0.034**</td>
</tr>
<tr>
<td></td>
<td>[0.573]</td>
<td>[1.568]</td>
<td>[0.214]</td>
<td>[0.156]</td>
<td>[3.404]</td>
<td>[3.294]</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.098</td>
<td>0.066*</td>
<td>0.006</td>
<td>[0.987]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank credit</td>
<td>0.001</td>
<td>0.002**</td>
<td>0.002*</td>
<td>[0.531]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country dummy</td>
<td>Yes*</td>
<td>No</td>
<td>Yes**</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Negative Diversification</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
<td>Yes***</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>
### Stock Volatility

The second variable for Stock return is Share price volatility. This model is more satisfactory than the previous model, which used raw share price as the dependent variable, but only slightly. Significant variables in pooled OLS include Total assets (once again the main effect) and Diversification (negative). The outcome (adjusted $r^2 = 0.184$) suggests a slightly reduced goodness-of-fit for this model, though it could also be due to reduction in bias. Overall, this model is not significant strong unit-invariant panel effect for Stock return volatility, and it is slightly weaker than the outcomes for the same model for stock price (adjusted $r^2 = 0.277$).

The robust FE model (adjusted $r^2 = 0.075$) is essentially similar. Significant variables include Total assets, Performing loans to non-performing loans, Turnovers, Diversification (negative), and Equity-to-asset ratio. This suggests that Stock return volatility is higher for pre-crisis firms. Insignificant variables include Net interest Income and time period. As above, this could be related to news items or other individual bank factors that were not accounted for in this study. This demonstrates that there is surprisingly little relationship between the bank’s business model or its balance sheet indicators and the performance of the bank on the stock market. There are similar gaps in the adjusted r-squared values for this model, as discussed above. On the whole, even in its refined form this does not seem to be a significant model for understanding variation in share price, whether one is considering the systemic market effects over time or the time-invariant unit effects.
There is some impact from the additional economic variables, though this is limited. Inflation and bank credit to bank deposits have an effect on the models in the same direction, but only inflation is significant in the FE model. This suggests that increased inflation is associated with increased Stock volatility. Previous studies have found that Stock volatility does have a relationship with Inflation (Corradi et al., 2013; Schwart, 1989). The same reasons discussed above, including the increased assumption of risk in a well-developed banking sector due to the adoption of innovative and advanced banking products, also apply here. The effect of bank credit to bank deposits is very small, but it does suggest that banks operating in countries with higher intermediation efficiency may have higher Stock volatility. This could be due to the effect of sophisticated financial products, but it could also be due to the increased transmission of news about these products and financial outcomes.

Even though these models were on the whole inconclusive, they do point to some interesting relationships that can be found within the data. First of all, both the pooled OLS and FE models suggest that increase in Total assets is associated with increase in Stock volatility – in other words, bigger banks are more volatile in terms of their market performance. On the other hand, Turnovers, Net interest income, and Diversification are shown in some models to have the opposite effect (though this effect is very slight). Developed economies in some models do have lower Stock returns and Stock volatility. This is not surprising given the differential growth rates of developed and developing economies, since developing economies are known to grow faster and in a more volatile fashion (Naflziger, 2006). A difference in the directional relationships for Diversification and equity-to-asset ratio is also interesting. These variables have a negative relationship with Stock volatility and a positive relationship with Stock returns. This is probably due to the increased positive perceptions of the stock on the part of investors with increased Diversification and equity-to-asset ratios, which would increase the value of the stock (Stock returns) and reduce its volatility.

There are also some significant differences to be found within the pooled OLS and robust FE model, some of which have caused inconsistencies that cannot be rectified based on this analysis. For example, Turnovers have a negative effect in pooled OLS and positive effect in robust FE model. A similar reversal is found in the Time period, with pre-crisis effects on Stock volatility being reversed in pooled OLS compared to FE.
The position of this effect could be explained because of a pre-crisis information asymmetry (which would be why when information is released there is a market crash). However, there is no apparent reason for the directional reversal in this model. It could be due to endogeneity bias in the pooled OLS test, which is not present in the robust FE test.

Model fit when adding the Diversification squared term is somewhat improved. The pooled OLS estimation shows that a positive significant relationship is found between Stock returns and Total assets, Diversification squared term, Time period, and negative Diversification. Negative significant relationships are found between Stock returns and Turnovers, Net interest income, Diversification, and Country group (with developed countries showing lower Stock returns).

No significant relationship is found with Performing loans to non-performing loans, Cost-to-income ratio, or Equity-to-asset ratio. It is noticeable that the effect of Diversification is far stronger in this model than in the original estimation. The adjusted r-squared (adjusted $r^2 = 0.322$) is also stronger than the original specification.

The results of the time FE test suggest that volatility is highest during the crisis year. This is a result that is expected given the general amount of stock market volatility, as well as the strong impact of the crisis on banks. However, the findings also suggest that two years following, volatility had decreased. This suggests a two-year recovery period for Stock return volatility. This is consistent with previous findings, which have generally suggested a two-year period within the industry for recovery.

### Table 16 Summary table of outcomes for Stock volatility

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Pooled OLS</th>
<th>Fixed Effects</th>
<th>Pooled OLS with Squared Term (Diversification)</th>
<th>Pooled OLS with Additional Economic Variables</th>
<th>Fixed Effects with Additional Economic Variables</th>
<th>Time Fixed Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total assets</td>
<td>0.849***</td>
<td>1.021***</td>
<td>0.912***</td>
<td>0.608**</td>
<td>-1.214***</td>
<td>-0.304</td>
</tr>
<tr>
<td></td>
<td>[3.229]</td>
<td>[4.414]</td>
<td>[3.211]</td>
<td>[2.220]</td>
<td>[-4.550]</td>
<td>[-0.894]</td>
</tr>
<tr>
<td>Performing loans to non-performing</td>
<td>0.000</td>
<td>-0.000 ***</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000***</td>
<td>0.000**</td>
</tr>
<tr>
<td>Variable</td>
<td>Coefficient 1</td>
<td>Coefficient 2</td>
<td>Coefficient 3</td>
<td>Coefficient 4</td>
<td>Coefficient 5</td>
<td>Coefficient 6</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>loans</td>
<td>[1.110]</td>
<td>[-4.915]</td>
<td>[1.192]</td>
<td>[1.249]</td>
<td>[6.572]</td>
<td>[2.224]</td>
</tr>
<tr>
<td>Turnovers</td>
<td>-0.173</td>
<td>0.137**</td>
<td>-0.104</td>
<td>0.034</td>
<td>0.145</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>[-1.199]</td>
<td>[2.076]</td>
<td>[-0.719]</td>
<td>[0.217]</td>
<td>[1.524]</td>
<td>[0.961]</td>
</tr>
<tr>
<td>Net interest income</td>
<td>-0.344</td>
<td>-0.087</td>
<td>-0.491**</td>
<td>-0.350</td>
<td>0.196</td>
<td>0.216</td>
</tr>
<tr>
<td></td>
<td>[-1.604]</td>
<td>[-0.903]</td>
<td>[-2.026]</td>
<td>[-1.597]</td>
<td>[1.004]</td>
<td>[1.203]</td>
</tr>
<tr>
<td>Diversification</td>
<td>-0.001***</td>
<td>-0.001***</td>
<td>-0.391*</td>
<td>-0.509</td>
<td>0.184**</td>
<td>0.169**</td>
</tr>
<tr>
<td>Diversification (sq)</td>
<td>0.000**</td>
<td>0.001</td>
<td>-0.002***</td>
<td>-0.021***</td>
<td>-0.017***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.661]</td>
<td>[1.557]</td>
<td>[-2.279]</td>
<td>[-2.053]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost-to-income</td>
<td>-0.007</td>
<td>-0.007</td>
<td>-0.010</td>
<td>-0.005</td>
<td>-0.021***</td>
<td>-0.017***</td>
</tr>
<tr>
<td></td>
<td>[-0.657]</td>
<td>[-1.586]</td>
<td>[-0.995]</td>
<td>[-0.551]</td>
<td>[-3.014]</td>
<td>[-2.897]</td>
</tr>
<tr>
<td>Equity to asset</td>
<td>-0.001</td>
<td>0.029***</td>
<td>-0.010</td>
<td>-0.011</td>
<td>0.001</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>[-0.086]</td>
<td>[2.911]</td>
<td>[-0.637]</td>
<td>[-0.631]</td>
<td>[0.060]</td>
<td>[0.505]</td>
</tr>
<tr>
<td>Inflation</td>
<td>0.044</td>
<td>0.097**</td>
<td>0.027</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.444]</td>
<td>[2.348]</td>
<td>[0.491]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank credit</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.431]</td>
<td>[0.314]</td>
<td>[0.573]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country dummy</td>
<td>Yes</td>
<td>No</td>
<td>Yes*</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Negative Diversification dummy</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
<td>Yes**</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Time period dummy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes**</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2008 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2010 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2011 dummy</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes**</td>
<td></td>
</tr>
<tr>
<td>No. of Observations</td>
<td>795</td>
<td>795</td>
<td>793</td>
<td>524</td>
<td>524</td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>47.59</td>
<td>317.0</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>154</td>
</tr>
<tr>
<td>R-Squared Adjust</td>
<td>0.184</td>
<td>0.0752</td>
<td>0.223</td>
<td>0.142</td>
<td>0.129</td>
<td>198.8</td>
</tr>
<tr>
<td>RMSE</td>
<td>1.636</td>
<td>0.790</td>
<td>1.592</td>
<td>1.599</td>
<td>0.639</td>
<td>0.188</td>
</tr>
</tbody>
</table>

Note: ***, **, * Indicate significant at 1%, 5% and 10% levels, respectively.

### 5.4.3.3 Overall Outcomes

Share price variables could be regarded as an indicator of stability, making them potential determinants of any of the hypotheses. For Stock returns in the initial test H1 (Diversification) is not upheld. H2 (Net interest income) also is not upheld. H3 (balance sheet indicators) is somewhat upheld, with Total assets and Turnovers being predictors for Stock returns. Share price riskiness has a negative relationship with Diversification, offering support for H1 (since increased Diversification lowered share price riskiness,
thus suggesting higher stability). Similarly, Total assets (H3) do have a relationship. However, Net interest income has no relationship (H2). Thus, there is mixed support from these tests for the hypotheses. In terms of H1 outcomes, Diversification is positive both for Stock returns and Stock volatility, indicating mixed effects; it is not possible to determine from this test which is stronger.

5.5 Hypothesis Results

The final area of discussion in this research is the hypothesis results. Three hypotheses were proposed for this research. These hypotheses were not tested directly within the research, but were instead examined throughout the analysis in Sections 5.2 and 5.3. In this section, the hypothesis results are discussed using the statistical tests that are presented in the previous sections.

5.5.1 Hypothesis 1

The first hypothesis read:

**H1:** Under current banking conditions in Southeast and East Asia, a risk diversification strategy that includes a majority proportion of interest sources of income and a minority of non-interest sources of income will be most effective.

The main predictor variable that can be identified in Hypothesis 1 is Diversification. Thus, understanding the relationships between the bank’s diversification ratio and its performance is critical. Positive significant relationships were found in the pooled OLS model between Diversification and all three financial stability models (Capital ratio, Tier 1 capital ratio, and Writedowns). No significant effect was seen between Diversification and ROA, and only a very small significant effect was seen between Diversification and ROE. Diversification had a very small negative significant relationship with the two stock indicators, including Stock returns and Stock return volatility. Diversification clearly helps in terms of bank stability, but appears to have little effect on stock performance indicators. Results were not as strong in the robust FE model, with such weak adjusted $r^2$ outcomes that it is difficult to state that there were practically important relationships at all.
These mixed results do not lead to a direct conclusion about whether Diversification is associated with improved performance. Because of this, further analysis was conducted using Diversification and a squared term of Diversification, in order to determine whether this was a non-linear relationship. This was conducted using a pooled OLS model. These findings indicated that Diversification is useful to a point, but after this point it leads to reduced stability and performance because of increasing risk associated with increased interest income (which carries with it the risk of default and attendant Writedowns). Once again, this refers to interest income volume, rather than interest rate charged. Higher interest rates are generally accepted as a means of controlling lending risk. Charging a higher interest rate will not reduce the risk of Writedowns associated with increased lending volume, although it will protect the bank’s income stream through the risk premium. The squared term models (Section 5.3) do show some evidence for this. Once again, results do not show a strong impact from Diversification (even with the squared term), but inclusion of the squared term does improve the impact of Diversification on stock returns. The opposing findings regarding significance of diversification and the Diversification squared term in the stability indicators, however, strongly suggest that there is a non-linear relationship between stability and Diversification. The effects of economic variables on Diversification were not tested when a decomposed country group dummy was used, but the overall model indicates that these economic variables did not increase the significance of Diversification on either banks or the banking system on the whole. While directly testing the effects of economic variables on Diversification could yield some interesting information, it would still be inconsistent in terms of its impact on bank stability.

In the time FE models, Diversification had a positive effect on Tier 1 capital, while the squared term had a very slight negative effect. The same pattern was seen for Writedowns, although these were not significant effects. ROA and ROE showed the same patterns, with a slight significant effect for ROA and insignificant results for ROE. Stock Returns and Stock volatility were similar, with both effects being positive. This suggests that Diversification affects firm performance at all three levels of analysis, although these effects are nonlinear (as indicated by the slight negative effects of the squared terms). In general, it appears that Diversification improves performance to a point, but it is possible to over-diversify and suffer negative effects.
These findings, taken together, indicate that Hypothesis 1 is partially proved. *Up to a point*, and assuming unit invariance rather than time invariance, Diversification improves the performance of the bank in terms of the stability indicators, without negatively affecting the bank’s returns or stock price volatility. However, after that point, excessive Diversification results in a loss of stability, with only a very mild impact on stock price volatility and no increase in returns. In other words, an appropriate level of Diversification is a good risk mitigation strategy, but excessive Diversification actually leads to a loss of stability and increase in risk with no apparent increase in returns. This research was not designed to capture the precise optimal point of Diversification (which would likely vary by market anyway), but knowing that this point does exist allows for identification of appropriate models that can identify it.

5.5.2 Hypothesis 2

The second hypothesis read:

**H2:** Under current banking conditions in Southeast and East Asia, banks that rely on interest-bearing income from relationship banking will be more stable than those that rely on non-interest income (including transaction-based income and any other mechanisms that are not related to relationship banking).

This hypothesis essentially addresses the relationship between net interest income and other variables. The suggestion of the hypothesis is that net interest income should have a significant, positive relationship with stability indicators. In other words, the higher the net interest income, the more stable the firm should be.

However, evidence does not fully support this assumption, either in the pooled OLS or robust FE models. Net interest income was shown to be a negative significant factor in the pooled OLS estimations for Capital ratio, though it is a mild positive significant factor in the robust FE estimation for Tier 1 capital ratio. (It is not significant in the pooled OLS estimation for this model.) This could be due to the difference in the definition of the Capital ratio and Tier 1 capital ratio. As previously noted, Tier 1 capital is more tightly defined, including only reserves, common stock, and retained earnings, while its denominator (existing loans) is risk-adjusted.
The third stability indicator also indicated that net interest income is associated with a significant, positive relatively large effect. Overall, this does not actually suggest that there is a positive relationship between bank stability indicators and net interest income, but rather that it may be mixed or actually negative (that is, excessive interest-based income may negatively influence stability). Net interest income was not tested in regard to the return variables (ROA and ROE), but it did show a small significant negative relationship to Stock returns in the pooled OLS model. Thus, its influence outside the stability indicators could be said to be limited.

Although the country group indicator did offer one way to identify potential external effects on bank stability, in fact this had limited effects. The six decomposed country group variables (economic indicators) had a limited effect on the stability indicators, with the most significant effect coming from liquid liabilities and a secondary effect coming from deposit bank money assets to GDP. These variables do not offer any particular insights, only suggesting that an increase in the size of the banking system could lead to increased stability overall, but not offering much insight into the individual bank’s situation. Thus, this information was of limited use.

The time fixed effects models showed a positive effect of net interest income on both Tier 1 capital and Writedowns. This does not provide information about whether it is likely to increase or decrease stability. Net interest income was not included in the model for ROA and ROE. Stock returns and Stock volatility both showed positive effects from Net interest income, though neither effect was significant. The interpretation of H3 was not significantly improved by the use of the time fixed effects model.

Ultimately, these findings do not support Hypothesis 2. There is no evidence that a high use of interest-bearing income increases stability as compared to non-interest income in either the pooled OLS or FE models. This could be because of a potentially higher risk of default with interest-bearing income, since it is generally considered to be riskier than transaction-based income. This was not tested in the current analysis, but given that Net interest income is a secondary measure of Diversification this could be a factor. This is an opportunity for further study.
5.5.3 Hypothesis 3

The third hypothesis read:

H3: Under current banking conditions in Southeast and East Asia, banks that maintain a strong balance sheet will be more stable than those with a weaker balance sheet.

This ratio can be considered based on variables including Total assets, Performing to non-performing loans ratio, Cost-to-income ratio, and Equity-to-asset ratio, which are all indicators of the strength of the balance sheet.

These models had very mixed results. None of the stability variables showed a significant relationship with the Equity-to-asset ratio (either negative or positive), either in the pooled OLS or FE models. This suggests that they are not significant either individually or systemically. The Capital ratio test had a negative significant relationship with Total assets in the FE estimations, a positive significant relationship with Cost-to-income ratio in the pooled OLS estimation, and no relationship with Performing to non-performing loans. There was little information that could be gained from the economic variables that were tested either, limiting the amount of information that could be collected in this area.

This suggests that there are different influences on the individual banks and the overall data set. The negative relationship with Total assets could be related to the negative relationship between size and stability in individual banks indicated in the literature (Berger, et al., 2005; Foos, et al., 2010). The Tier 1 capital ratio had a positive relationship between Total assets and Tier 1 capital as expected, as well as a variable (and very small) relationship with the Cost-to-income ratio. Writedowns had a very small bank-level positive relationship with the Performing to non-performing loan ratio in the Robust FE estimation, along with a small negative relationship with Cost-to-income ratio. These relationships, though small, actually support the idea of increased stability associated with the balance sheet, due to the directions of the relationship. These findings generally support that bank stability indicators are influenced by balance sheet strength, as was expected from the literature review. Although there are some
variable relationships (especially the variable relationship of the Cost-to-income ratio), most of the factors associated with a high level of balance sheet strength are also appropriately related to stability indicators.

Under the time fixed effects model, effects of balance sheet variables are substantially similar for stability indicators (Tier 1 capital ratio and Writedowns) as they were in the FE model. They were also similar for profit indicators (ROA and ROE), as well as the stock return indicators (Stock returns and Stock volatility). In general, the time fixed effects model did not add much to interpretation of H3.

Although this was not a comprehensive examination of this hypothesis since it did not include an exhaustive list of balance sheet strength indicators, to the extent possible in this research Hypothesis 3 is proved.

5.6 Summary of Findings

This chapter has discussed the empirical findings from an econometric analysis of 676 financial institutions (including private and publicly-owned banks) in 14 Southeast and East Asian countries from 2001 to 2012. This data was collected initially from BankScope, and then variables were transformed as necessary to create the appropriate ratios for analysis. The descriptive statistics and correlation outcomes (presented in Section 5.1) were primarily as expected, although there were some wide distributions of some of the variables. However, there was no indication that the variables were malformed or otherwise required adjustment.

The main portion of the analysis used time series cross-sectional estimation techniques, including pooled OLS regression with VCE and fixed effects regression with VCE (robust FE), to test the relationships between business model indicators and stability, returns, and stock volatility. According to the Hausman tests, in only one case (the initial specification for the stock return model) was a random effects model preferable to a fixed effects model. The Capital ratio and Tier 1 capital ratio outcomes showed generally that the country group (developing and developed) had an effect on Capital ratios, although some of the other variables were contradictory. Writedowns also showed relationships mostly as expected. ROA and ROE were relatively resistant to
bank business models, but there were a few variables that were found to be consistent. The models for Stock returns and Stock volatility were highly inconsistent and had low goodness of fit, suggesting that these were not necessarily strong factors. In general, the findings in this section provided support for Hypothesis 1 and Hypothesis 3, but did not support Hypothesis 2.

An important finding in this section was that Diversification had a somewhat contradictory relationship in many of the models, often showing as a negative relationship where it might be expected to be positive and vice versa. This was explored further in Section 5.4, which tested squared terms for Diversification against all final models in Section 5.3. These tests showed that the relationship between Diversification and stability was nonlinear; that is, to a point, Diversification aided stability, but after that it impeded it. No significant effects were found for Diversification effects on returns, and only a small and inconsistent effect was seen on Stock returns and Stock volatility. Given this, it seems that Diversification’s nonlinearity is primarily a factor in bank stability. Decomposition of the Country group dummy variable into six variables and retesting of the squared term models using this decomposed variable found that Liquid liabilities and to an extent, Deposit money assets affected bank stability indicators. Deposit money assets affected returns in the pooled OLS test, but not the FE test. There were no effects found from these decomposed indicators on Stock returns and volatility. This section also included time fixed effects models, which decomposed the Time period dummy into individual years. There were some effects shown in this case, which provided more detailed information about how the models worked.

The final stage of the discussion was hypothesis testing. Hypothesis 1 addressed the influence of Diversification on stability. As previously noted, this is somewhat upheld, but it is actually a nonlinear relationship that becomes negative at high Diversification rates. Time fixed effects testing showed that there is a positive relationship between Diversification and the individual variables throughout the period. Thus, H1 was partially proved. Hypothesis 2 referred to net interest income, which was found to have a limited or even negative impact on retained earnings. Time fixed effects tests did not improve this outcome. Thus, this was not upheld. Hypothesis 3 addressed the strength of balance sheets in stability, which was generally supported (though not fully) by both the main effects and time fixed effects models.
The results of this empirical analysis show that the relationship between elements of the bank business model and indicators of bank stability, returns, and Stock volatility are complicated. The most satisfactory evidence was found for bank stability, including strong evidence of business model indicators as expected, a nonlinear relationship between Diversification and stability, and so on. Evidence for a relationship between returns and business model indicators was also relatively good, with relationships being seen approximately as expected. However, evidence for a relationship between the business model indicators and stock market returns was weak and contradictory, and the researcher had difficulty finding an appropriate model for this relationship. This suggests that, while stock market returns and volatility do have some form of relationship, it may not be as tested in this research. In the next chapter, the findings of the empirical research are more thoroughly discussed.
Chapter 6: Discussion

The previous chapter has presented the empirical findings of research into bank business models in Southeast and East Asia and factors in achieving stability. These findings were generated using a set of time series regression tests (including pooled OLS and robust FE). The tests focused on several different aspects of the bank business model as dependent variables, including bank stability indicators (Capital ratio, Tier 1 capital ratio, and Writedowns), indicators of bank returns (return on assets and return on profitability), and bank market value indicators (including stock price and volatility of stock price). Two additional issues were also explored, based on observations within the key findings. One of these issues was whether Diversification had a nonlinear relationship with the key indicators. This was examined using a squared term for Diversification, inserted into each of the final equations that had been used previously. There were moderate findings to support nonlinearity of Diversification on stability and return indicators, although the evidence for influence on market value was much weaker. The second additional issue explored was that being in a developed economy routinely (though not always) negatively affected business model indicators. To examine this issue, the country group indicator was decomposed into six additional indicators, which were indicative for bank stability and returns (though not for market returns).

In this chapter, these findings are discussed based on the research that was discussed previously in Chapter 2 (Literature Review) and Chapter 3 (Business Models and Strategies for Financial Instability). The goal of this discussion is first to summarize the outcomes of the study, and second to contextualize the outcomes based on existing knowledge about bank stability and how it can be managed. The main findings are discussed first, and then additional findings regarding the impact of Diversification and country indicators are examined.

6.1 Bank Stability

Bank stability was examined using three indicators, including Capital Ratio, Tier 1 capital ratio, and Writedowns, which were determined to be the three best choices for outcome variables based on the previous literature. There were slightly different
significant predictor variables found for each of these variables out of those tested. Table 17 summarizes significant variables for the pooled OLS and robust FE models.

Table 17 Summary of significant variables for indicators for bank stability

<table>
<thead>
<tr>
<th>Indicators for bank stability</th>
<th>Pooled OLS</th>
<th>Robust FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>Profit</td>
<td>Total assets</td>
</tr>
<tr>
<td></td>
<td>Net interest income (negative)</td>
<td>(r² = 0.007)</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost-to-income ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time period (Pre- or post-crisis)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Country group (developed or advanced)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(r² = 0.183)</td>
<td></td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>Total assets</td>
<td>Total assets</td>
</tr>
<tr>
<td></td>
<td>Profit</td>
<td>Profit</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td>Net interest income</td>
</tr>
<tr>
<td></td>
<td>Cost-to-income (negative)</td>
<td>Cost-to-income ratio</td>
</tr>
<tr>
<td></td>
<td>Country group (negative)</td>
<td>Country group (negative)</td>
</tr>
<tr>
<td></td>
<td>(r² = 0.913)</td>
<td>(r² = 0.599)</td>
</tr>
<tr>
<td>Writedowns</td>
<td>Profit (negative)</td>
<td>Performing loans to non-performing loans</td>
</tr>
<tr>
<td></td>
<td>Net interest income</td>
<td>Profit (negative)</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td>Net interest income</td>
</tr>
<tr>
<td></td>
<td>Country group</td>
<td>Cost-to-income ratio (negative)</td>
</tr>
<tr>
<td></td>
<td>(r² = 0.596)</td>
<td>Country group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(r² = 0.081)</td>
</tr>
</tbody>
</table>

These indicators are primarily aspects of the bank’s business models that reflect on bank stability. Previous studies have found extensive connections between bank business models and total performance, including how the individual banks fared during periods of financial crisis (Altunbas, et al., 2011; Ayadi, et al, 2011; Baele, et al., 2010; Baumann, et al., 2012; Berger, et al., 2009; De Jonghe, 2010; Navaretti, et al., 2010; Schaek , et al, 2009; Vallascas & Keasey, 2012). These studies found that both bank and market characteristics were associated with the stability and performance of banks, especially during periods of market crisis. However, very few of these studies took into account Southeast and East Asian data, since most were conducted in Europe and the United States. This means that whether or not the data from this study agreed with the
previous studies offers some information about similarities and differences across regional banking systems. Thus, it is worth considering how well this study has supported what is known about the factors tested, and what changes were seen.

6.1.1 Capital and Tier 1 Capital Ratios

Capital ratio and Tier 1 capital ratio were selected because they represent a holistic and focused view of the bank’s investment respectively. The Capital ratio reflects the entirety of the bank’s capital investment strategy, including all tiers of capital it invests in. Tier 1 Capital, on the other hand, includes only capital that is potentially held as reserves. While Tier 2 capital could have been used in opposition to Tier 1 capital, this would not represent the full picture of the bank’s investment strategy. The Capital ratio in its entirety reflects the bank’s entire risk strategy, while its Tier 1 capital ratio reflects its core capital. The Tier 2 capital ratio, on the other hand, only reflects non-core capital, which is meaningless without comparison to Tier 1. Thus, using Capital ratio and Tier 1 capital ratio was the best approach to understanding the bank’s core capital and total capital position. The difference in findings, which are discussed below, justifies this division, since it shows that there are different effects (particularly effects sizes) between Tier 1 capital ratio and full Capital ratio.

Overall, the findings were consistent with the expected relationship between capital and Tier 1 capital and the dependent variables that were tested. Relationship directionality was expected for capital and Tier 1 capital based on the existing literature (Albertazzi & Gambacorta, 2009; Albertazzi & Gambacorta, 2010; Berger, et al., 2009; Foos, et al., 2010; Pasiouras & Kosmidou, 2007). Thus, there are at least some similarities between the data tested in Southeast and East Asia and previous studies in Europe and North America. However, there were some interesting differences. In this study, the predictor variables showed a stronger relationship with Tier 1 capital ratio than with the full Capital ratio in both the pooled OLS and FE tests. This could be because Tier 1 capital is considered to be higher quality capital, and it is required to be held at a certain level based on the Basel II accords (Lehman et al, 2011). In contrast, the general Capital ratio reflects the value of all assets held by the bank compared to outstanding loans (Schaeck & Cihák, 2010). However, since the Capital ratio includes the assets that are also included in the Tier 1 capital ratio, it would be expected that there would be a somewhat stronger relationship. Both the Capital ratio and the Tier 1 capital ratio reflect the
stability of the bank, since an increased level of capital reserves indicates more resources the bank can draw on (BIS, 1989; Furlong, 2011; Schaeck & Cihák, 2010). However, Tier 1 capital is specifically held to meet Basel II requirements, while the overall capital stocks of a bank can include assets that are much less liquid as well as the Basel II-qualified Tier 1 assets (Lehman, et al., 2011). Thus, the Tier 1 capital ratio is likely to be a stronger indicator of the bank’s stability than the plain Capital ratio, since it reflects the bank’s strongest capital position. However, this could also be indicative of a regional difference in banking models. For example, since Asian banks may be more conservative and less likely to offer novel banking products like derivatives or use off-balance sheet assets, especially following the 1997-1998 currency crisis (Vichitsarawong, et al., 2010), it is possible that Tier 1 capital is more representative of the bank’s total capital position than is the case in Western banks. Finally, the time FE showed that Tier 1 Capital was significant throughout the period, suggesting it is a fundamental aspect of bank stability rather than being crisis-dependent.

6.1.2 Writedowns
Writedowns are an indicator of bank instability; the relationship should be negative, with more stable banks having lower levels of Writedowns and vice versa (Acharya, et al., 2009b). In both pooled OLS and FE tests, profits were negatively related to Writedowns, which makes sense given the negative effect of Writedowns on profit (Acharya, et al., 2009b). Similarly, Performing loans to non-performing loans in the FE test, which is sensible given that these will eventually contribute to Writedowns. The time FE showed that Writedowns were actually affected by years starting from 2004, earlier than expected given the timing of the crisis.

That there was a positive relationship with Diversification and Net interest income is more complex. However, this also makes sense when considering the nature of interest versus non-interest income. Interest income, the traditional source of income for banks, is risky in that it may not be realised (Beck, et al., 2000). In contrast, fee-based income or transactional income, the other source of income for most banks, is different in that it is realized at the time the service is provided (Beck, et al., 2000). Thus, banks that are more heavily involved in interest-bearing activities are more likely to be exposed to Non-performing loans and Writedowns, simply because they accept a higher level of at-
risk income than banks that rely on transactional income. This is one of the key reasons for including transactional income streams in the bank business model (Stiroh, 2004). Stiroh (2004) found that increased volatility conditions reduced the effectiveness of inclusion of transactional income in the income stream, which was not directly tested in this analysis. Although increased failure was indicative of the post-crisis period, it is not certain that increased volatility was actually a characteristic. Additionally, larger banks with higher market penetration have higher income volatility than smaller banks (Soedarmono, et al. 2013). Since bank market penetration and the number of markets served by a particular bank were not directly tested in this study, it is not possible to determine whether this would have affected the outcome for Writedowns, though bank size was tested using independent variables such as Profits and Total assets. It is easy to see that this could be a potential factor, particularly over a period of bank failure, consolidation, and international spread or withdrawal. The result for Writedowns suggested that Total assets was insignificant, which could contradict the outcomes of Soedarmono et al.’s (2013) study. Thus, for Writedowns at least this model may be more reflective of systemic risks than individual bank risks. However, it could also be due to early interruption of the bank’s business model in the time series, since the 2007-2009 crisis began to affect some banks as early as 2006. This could generate inconsistent effects related to Writedowns and reduce the overall effects, although this might be timed differently for Asian banks, which were typically affected later, than for Western banks.

6.1.3 Hypothesis Outcomes

There were two hypotheses that related to the indicators of bank stability discussed in this section. (Hypothesis 1 is discussed below in Section 6.4, as it is more directly related to the issue of Diversification.) These hypotheses included the following:

**H2:** Under current banking conditions in Southeast and East Asia, banks that rely on interest-bearing income from relationship banking will be more stable than those that rely on non-interest income (including transaction-based income and any other mechanisms that are not related to relationship banking).
**H3:** Under current banking conditions in Southeast and East Asia, banks that maintain a strong balance sheet will be more stable than those with a weaker balance sheet.

The outcomes of these hypotheses are discussed in Section 5.5. Briefly, however, findings did not support Hypothesis 2, but did support Hypothesis 3. The literature shows similar disconnections, with general support being shown for Hypothesis 3 but a more mixed picture being presented for Hypothesis 2.

### 6.1.3.1 Hypothesis 2

Relationship banking is important to consider because it forms an important source of capital for small businesses, many of which may have trouble accessing capital from other sources (particularly during times of financial crisis) (Jermann & Quadrini, 2009). However, the literature does suggest that this might fail during crisis periods. For example, many banks shut down relationship lending during the 1997-1998 crisis (Jiangli et al, 2008). In the recent crisis, many banks have moved away from transactional banking models (especially derivatives-based models) in an attempt to regain banking stability (Boot & Marinc, 2008). As Boot and Marinc (2008) specified, the effect of this movement toward relationship banking had not been previously studied. Previous studies have shown that an increase in non-interest income (particularly that derived from derivatives or originate-to-distribute) as well as an increase in the size of the bank was associated with an increased exposure to systemic risk (Bernt & Gupta, 2008; Demirgüç-Kunt & Huizinga, 2010; Vallascas & Keasey, 2012). At the same time, non-interest income is also associated with increased profitability (Sufian, 2012). Thus, the evidence for the impact of interest income derived from relationship banking on bank stability was actually mixed. At the level of the banking system, net interest income was negatively associated with Capital ratio (though not with Tier 1 capital ratio), and positively with Writedowns. It was also positively associated with Tier 1 capital ratio and Writedowns at the bank level. This may be due to the impact of bank information availability and the use of advanced information models, which could vary widely between banks (Berger & Udell, 1995a; Berger, et al., 2009; Baele et al, 2010; Altunbas et al, 2011). Thus, there are reasons for this mixed result, but ultimately it cannot be said according either to the literature or the
results of this study that increasing net interest income contributes to the stability of the bank or the banking system.

6.1.3.2 Hypothesis 3
In contrast to Hypothesis 2, Hypothesis 3 was generally accepted based on the findings in this report. There were indications that increased stability was associated with a stronger balance sheet. In the FE test Total assets, profit, and net interest income are balance sheet specifics that were positively associated with Capital and Tier 1 capital (stability indicators), while Performing loans to non-performing loans, profit (negative relationship), and net interest income are associated with Writedowns (the instability indicator). The seeming conflict regarding the dual role of interest income is discussed above. However, the findings for this case were entirely consistent with the expected literature (Brunnermeier, 2009; De Jonghe, 2010; Foos, et al., 2010; Seodarmono, et al., 2013; Vallasca & Keasey, 2012). These findings were less consistent with the expected literature at the banking system level, though some of the same indicators were still found. This could be because while individual banks can use their balance sheet to mitigate some of the risks involved in their business activities, at the systemic level this risk remains, particularly in Writedowns (Acharya, et al., 2009b).

6.2 Bank Profitability
Two factors were examined as signals of bank profitability and returns. Raw returns were not used because of difference in bank sizes. Instead, return on assets (ROA) and return on equity (ROE) were used to signal returns outcomes for the banks. Table 18 summarizes the significant variables that were found for each of these indicators. It should be noted that most of the effects for ROA were very small (<+/- 0.05).
Table 18 Summary of significant variables for indicators for returns

<table>
<thead>
<tr>
<th>Indicators for returns</th>
<th>Pooled OLS</th>
<th>Robust FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on assets (ROA)</td>
<td>Total assets (negative)</td>
<td>Total assets (negative)</td>
</tr>
<tr>
<td></td>
<td>Turnovers</td>
<td>Turnovers</td>
</tr>
<tr>
<td></td>
<td>Cost-to-income ratio</td>
<td>Diversification (negative)</td>
</tr>
<tr>
<td></td>
<td>(negative)</td>
<td>Cost-to-income ratio</td>
</tr>
<tr>
<td></td>
<td>Time period</td>
<td>Country group</td>
</tr>
<tr>
<td></td>
<td>Country group</td>
<td>(r² = 0.310)</td>
</tr>
<tr>
<td></td>
<td>(r² = 0.598)</td>
<td></td>
</tr>
<tr>
<td>Return on equity (ROE)</td>
<td>Total assets (negative)</td>
<td>Total assets (negative)</td>
</tr>
<tr>
<td></td>
<td>Performing loans to non-performing loans</td>
<td>Turnovers</td>
</tr>
<tr>
<td></td>
<td>Turnovers</td>
<td>Diversification</td>
</tr>
<tr>
<td></td>
<td>Diversification (negative)</td>
<td>Cost-to-income ratio</td>
</tr>
<tr>
<td></td>
<td>(negative)</td>
<td>(negative)</td>
</tr>
<tr>
<td></td>
<td>(r² = 0.431)</td>
<td>(r² = 0.275)</td>
</tr>
</tbody>
</table>

The attainment of a certain level of operational profitability is one of the main reasons that banks select a business model (Cavelaars & Passenier, 2012). This is because the bank structure and sources of income directly affect the bank’s profitability and ability to perform flexibility in the market (Cavelaars & Passenier, 2012). There are a variety of factors associated with increased profitability in the literature, including non-interest income (to a point), credit risk, capitalization, liquidity, and private investment (perhaps) (Sufian, 2012). These factors, according to Sufian (2012), are mostly consistent across developed and developing economies. However, profitability can be affected by a number of different factors, including not just gross income flows but also cost controls (Pasiouras & Kosmidou, 2007). The relative advantage of both ROA and ROE is that they reflect the impact of cost controls and cost savings on the bank’s profitability, rather than simply reflecting raw flows of income. This makes them ideal for the purposes of understanding profitability in this research. The fact that Cost-to-income ratio was significant in these indicators (when it did not figure in most others) provides evidence that these models are reflecting cost considerations as well as income.

The negative relationship of Total assets is expected, given that ROA and ROE are ratio variable with a denominator of assets, and higher levels of assets are associated with lower levels of ROA and ROE (Berger, et al., 2009). However, it is possible that there may be stronger effects of indicators ROA and ROE within banks than between banks.
over time, simply because the effect of factors like Total assets does not persist over
time, but is instead a snapshot indicator of a bank’s financial statement in one year
(Athanasoglou, et al, 2008; Albertazzi & Gambacorta, 2009). This is suggested in the
time FE, where time period was significant for ROA up to 2007, and not thereafter,
while from ROE they were significant from 2004. This means that there would be
stronger effects seen in a pooled test, where all the variables are treated as one time
period. Thus, the relatively weak between-banks outcomes represents a methodological
quirk, rather than a true statement that the variables tested are not associated with ROA
and ROE (at least in the short term, rather than the time series analysis used here).

6.3 Riskiness of Share Prices
The final set of indicators related to the bank’s outcomes was the riskiness suggested by
the bank’s share prices. This was indicated by Stock returns and Stock volatility. Both
of these indicators reflect investor expectations about the bank’s future performance,
and so were considered to be appropriate for assessment. These factors were associated
with previous research, which suggested that perceived riskiness of shares functioned as
a market-based view of the institution’s stability (Fuertes, et al., 2006; Kirkwood &
Nahm, 2006). Table 19 summarizes the effects found for these variables in the final
model tested under the initial premises. It is worth noting that although the country
group was significant for Stock returns, when this dummy variable was decomposed
into six economic variables, there were no significant relationships found between these
variables and either Stock returns or Stock volatility (initially reported in Section
5.3.2.3). Although it is likely that there are some economic effects on share prices, this
could also have to do with market structure or regulation, which could be very different
in Southeast and East Asia where this study took place than in the environments studied
by previous authors. Thus, this is an opportunity for further study, and also
demonstrates the value of studying this issue within the developing and developed
countries of Southeast and East Asia.
Table 19 Summary of significant variables for indicators for riskiness of share prices

<table>
<thead>
<tr>
<th>Indicators for riskiness of share prices</th>
<th>Pooled OLS</th>
<th>Robust FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock returns</td>
<td>Total assets Turnovers (negative) Time period (negative) Country group ($r^2 = 0.277$)</td>
<td>Performing loans to non-performing loans Diversification Cost-to-income ratio (negative) Country group ($r^2 = 0.116$)</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>Total assets Diversification (negative) ($r^2 = 0.184$)</td>
<td>Total assets Performing loans to non-performing loans (negative) Turnovers Diversification (negative) Equity-to-asset ratio ($r^2 = 0.075$)</td>
</tr>
</tbody>
</table>

As Table 19 shows, the models’ goodness-of-fit values are relatively poor, with the strongest model (the pooled OLS model for Stock returns) only reaching $r^2 = 0.277$. This suggests that the independent variables targeted for analysis do not truly represent bank performance as reflected in Stock returns and Stock volatility. This is interesting because the majority of the variables that were included in the test for Stock returns and Stock volatility were associated with the bank’s financial performance and business model (Albertazzi & Gambacorta, 2009; Albertazzi & Gambacorta, 2010; Berger, et al., 2009; Ferreira, et al., 2012; Foos, et al., 2010; Kirkwood & Nahm, 2006; Pasiouras & Kosmidou, 2007). This strongly suggests that, based on this study at least, stock prices and the riskiness of stock prices (as reflected in their volatility, which was calculated as the standard deviation of the variation of stock prices) is not significantly related to fundamental aspects of the bank’s performance. It may be more significantly related to other fundamentals, which is an issue that could be studied in additional research. The time FE test showed limited significance of years, though they were after the financial crisis. Overall, this study cannot shed any substantial light on the seeming disconnection between business model indicators and perceived riskiness of the bank as reflected in the stock market.
6.4 The value of Diversification

Diversification was the subject of Hypothesis 1, which read:

H1: Under current banking conditions in Southeast and East Asia, a risk diversification strategy that includes a majority proportion of interest sources of income and a minority of non-interest sources of income will be most effective.

The between-subjects effects reflected in the pooled OLS did show a positive relationship between Diversification and all three bank stability indicators (Capital, Tier 1 Capital, and Writedowns). However, it was only significant for within-subjects effects for Writedowns. It showed exceptionally small (<0.0005) effects for ROA (between) and ROE (both within and between), but these results are so small that it is difficult to assign them any practical significance. The same situation is found in the between (robust FE) tests for Stock returns and Stock volatility. Overall, the main effect of Diversification is seen in bank stability.

It was also considered that the effect of Diversification might be nonlinear; that is, Diversification might be beneficial to a point, and then negatively impact the bank’s performance (or vice versa). This was explored using a Diversification squared term inserted into each of the previous tests using a pooled OLS model (reflecting the entire banking system). The squared term of Diversification showed a negative significant relationship for each of the three stability indicators while the first-order term showed a positive relationship, demonstrating a nonlinear relationship between stability and Diversification. The same was true for ROA (but not ROE), though effects were much smaller and approached lack of practical significance. A significant but very small effect was also seen for Stock Returns and Stock volatility. Thus, it can be said that Diversification has a nonlinear relationship with the bank’s financial indicators.

The effect of Diversification is one of the main debates in the literature, and as such it was one of the key areas of interest in this study. Diversification of income streams through interest bearing and non-interest bearing income streams is one of the ways in which banks can diversify their risk exposure in the market (Stiroh, 2004). However, this relationship is not linear or straightforward. Stiroh (2004) found that there was a point where increased inclusion of non-interest sources of income actually increased,
rather than reduced, income volatility, indicating an increased level of risk assumption. Other studies have found that different types of non-interest income have different effects on the bank’s income. In particular, while fee-based non-interest income was generally considered beneficial, increasing net margins, off-balance sheet income reduced the stability of income (Carbó & Rodriguez, 2007; Lozano-Vivas & Pasiouras, 2008). Furthermore, many banks, particularly in Europe, may use fee-based services as “loss leaders” in order to attract interest-based income or reduce churn, which deliberately reduced the income received from them (Lepetit, et al., 2008). Thus, the impact of fee-based income diversification on the bank’s stability and income stream is more complex than it may seem at first glance, as banks use different qualities of non-interest income and use a different approach to targeting these incomes.

Another factor is that the increased use of non-interest income streams has reduced the risk reduction capability of these streams over time, since there has been reduced quality and increased systemic risk associated with them (Lepetit, et al., 2008). This could explain why the relationship was much stronger for between-subjects effects shown in the pooled OLS than in the within-subjects effects from the robust FE model. This could be because of shifting value of non-interest income streams for individual banks, which would work against the assumption of unit invariance in the robust FE model. This is important to consider because it might indicate that the impact of Diversification changes as more banks undertake it.

Finally, diversification can also imply not just diversification of income streams, but also diversification of business models and markets, which could have different effects. For example, banks have traditionally been structured either as commercial or as investment banks, or if banks did undertake both types of investments a Chinese wall had to separate operations and information flows (Koch & McDonald, 2009). However, this has recently broken down, with commercial banks becoming more involved in securitization as a revenue stream (rather than as a risk reducer), as well as implementing hybrid commercial/investment bank business models without the traditional divisions between them (Singh, 2007; Trumper-Gugerell, 2009). There is no indication in this data as to whether banks have undertaken this type of reorganisation of the business model. However, if this were the case then it would provide some level of explanation for the seemingly mixed effects of Diversification in the data, and in
particular the nonlinear relationship of Diversification and stability. For example, if banks can diversify with relatively safe non-interest income streams up to a point and improve stability, but beyond that point they have to rely on riskier non-interest income streams like securitization, OBS transactions, and so on, then this would explain why Diversification has a nonlinear relationship with the bank stability indicators. This should be considered an area for further research, since this study has made it clear that Diversification is not all equal, but has not explicitly identified differences.

A final topic for discussion about the Diversification outcomes is why there was little impact (if any) of Diversification on riskiness of stock prices. One factor could be information asymmetries between investors and banks. For example, originate-to-distribute (OTD) business models and other forms of riskier non-deposit income are not always clearly disclosed on bank balance sheets (Berndt & Gupta, 2008; Demirgüç-Kunt & Huizinga, 2010). Some banks do use these diversification tactics as income streams, rather than as hedging practices or other risk reduction practices (Demirgüç-Kunt & Huizinga, 2010). This means that some forms of diversification could actually appear positive to investors, since the source may not be clearly disclosed and it may appear to have a positive effect on the bank’s business outcomes in terms of profitability. Of course, this is not a good long-term business strategy, since OTD and OBS transactions and assets are known to be riskier than most other forms of business, particularly because of lack of information, along with other factors (Berndt & Gupta, 2008; Brunnermeier, 2009; Trumpel-Gugerell, 2009). Thus, this could provide an incorrect or inconsistent picture of the total riskiness of the bank’s diversification strategy to investors, muddying the waters and making it uncertain how diversification has affected the bank’s riskiness because of lack of information about diversification sources.

6.5 Developing versus Developed Economies
One of the most interesting findings was the prevalence of a negative relationship between one of the dummy variables used and almost all the indicators. This is particularly interesting given the differences found in the study between the countries of Southeast and East Asia, where this study was fixed, and Europe and North America, where most previous research took place. The country group dummy had mixed results,
with Tier 1 capital ratio and ROA being negatively associated with developing countries and Capital ratio, Writedowns, and Stock returns being positively associated with them. These findings suggest that while developed countries have advantages as far as stock market performance, overall their banking sector performance is poor. In order to identify possible causes for this poor performance, the country group dummy variable was decomposed into six economic development indicators, including growth of GDP per capita, inflation, private credit by deposit money banks and other financial institutions as a percent of GDP, the ratio of bank credit to bank deposits, liquid liabilities, and deposit money bank assets as a percent of GDP. Liquid liabilities and deposit money ratio were significant for stability indicators. Deposit money ratio and GDP growth were significant for return indicators. No significant variables were found for market performance indicators.

Some characteristics of developing and developed economies are shared. For example, there was increasing instability in GDP growth in both types of economies in the 1980s and 1990s (Mishkin, 1999). However, other characteristics are different; for example, the greater complexity of economic systems in developed economies means that liquidity provision is more determinant of outcomes (Allen & Gale, 2004). This was in fact found to be the case, with liquid liabilities being factors in financial stability indicators. Another factor is that developing economies are typically countercyclical (Fidmuc & Korhonen, 2010). This could account for the lack of impact of some of the identified variables, as well as the lack of impact of developing economies versus developed economies on stock riskiness. It could also account for the increased negative impact of being in a developed economy. This is likely to be the main factor, since these developed economies (starting in the US) were the main sources of economic crisis in the most recent market crisis beginning in 2006 (Acharya, 2009a; Acharya, 2009b; Brunnermeier, 2009; Kolb, 2010; Obstfeld, et al., 2009). It is particularly notable that the origins of the 2008 crisis were in banking practices including subprime lending, off-balance sheet assets, and originate to distribute lending, all of which have been identified as increasingly risky diversification approaches that are more oriented to improving income streams than reducing risk (Berndt & Gupta, 2008; Demirgüç-Kunt & Huizinga, 2010; Kolb, 2010). Given that these practices originated in developed countries, it is not surprising that these countries showed increased signs of stress. Thus,
this is clearly an important result, even though the decomposed country dummy did not identify its exact causes.

6.6 Summary
This chapter has focused on two key issues. The first issue was summarizing the main findings from the study and encapsulating these findings, as well as discussing the outcomes of the hypotheses that were tested. This summary focused on bank stability, bank profitability, and market value of the bank. In addition to summarization, the results were deconstructed and contextualized using the previous literature reviews (Chapters 2 and 3). It showed that while there were relatively strong relationships between bank business models and stability and profitability, the strength of this relationship did not carry over into the area of market value. Various reasons for this potential lack of connection were discussed, although there is no clear evidence for issues such as market knowledge or sophistication that could explain the outcome. This remains an issue for further study. Overall, however, these findings were consistent with the literature review. The second area for discussion in this chapter was the additional findings, which focused on the issue of diversification and status as either a developing or developed country. This discussion highlighted some of the reasons the results that were found may have been seen, as well as discussing how the findings could be refined in future. Diversification, as the subject of Hypothesis 1, was of particular interest. The impact of Diversification has not been satisfactorily resolved either in the literature or in this research, and understanding its role in bank stability is still problematic. The issue of economic development is also a complex and interesting area of discussion, which involves more attention than can be offered here. In the next chapter, the discussion concludes with summary and examination of the implications of the research findings for financial service providers and bank governors and regulators.
Chapter 7: Conclusion and Recommendations

The goal of this chapter is to tie together the ends of the research project and offer a conclusion to the research questions. The conclusion of the research is presented in Section 7.1. In Section 7.2, research implications are discussed. The main focus of this section is on recommendations for banks and financial service providers, though recommendations for policymakers and regulators are also discussed. In Section 7.3, the design and outcomes of the study are assessed and limitations are discussed. Finally, Section 7.4 focuses on opportunities for future research that arose during this project, including topics and suggested methods to explore them.

7.1 Conclusion

The main aim of this research was to understand the implications of bank business models and to identify effective business banking models in the post-banking crisis landscape in Southeast and East Asia. The research was based on a single research question, which was “What are effective banking business models for Southeast and East Asian banks to cope with possible financial instability?”

7.1.1 Methods Review

A description of the methods used in this research is available in Chapter 4, and Chapter 5 provides the regression equations used to derive results. However, a brief review of the methods used is helpful in understanding the outcomes. The research method chosen to examine this question was time series and panel analysis of BankScope data from banks in 14 Southeast and East Asian countries for the period between 2001 and 2012. This time period offers a crisis period (2008) as well as years before and after. The time period that could be selected was limited by the BankScope database, which holds a maximum of 16 years data for any bank. State-owned banks were excluded because they often have different income goals and strategic preferences from for-profit banks. After cleaning and elimination of outliers as appropriate the final data set included 676 banks across all 14 target countries, with all banks having data from at least 2004. A search of the literature identified 16 variables, including eight independent and eight dependent variables, which could be used to describe the bank business model and bank stability, respectively. These variables were either retrieved directly from BankScope or
calculated from consolidated accounting information available in BankScope as required. Analysis was then performed using pooled ordinary least squares (OLS) regression and robust fixed effects (FE) (with VCE). These regressions were performed using a model that was based on existing literature on bank stability. Time fixed effects were also used to determine the effects of time-invariant effects (rather than invariant unit effects) on the outcomes.

7.1.2 Operationalizing Variables

This research took a broad approach to the operationalization of dependent and independent variables, in order to capture the strongest effects and identify the widest range of potential impacts. Sections 4.2.2 and 4.2.3 describe the variables used and their origins in detail.

One key independent variable construct was Bank business model, which was operationalized using seven different variables based on previous literature practices. These variables included Total assets; ratio of Performing loans to non-performing loans; Non-interest income to interest income ratio; and Turnovers. The second independent variable was Financial performance, which was operationalized using: Profit before tax and abnormal items; Net interest income; Diversification; Cost-to-income ratio; and Equity-to-asset ratio. Additionally, two dummy variables were used. Dummy variables represented the Time period (2001-2007 or 2008-2012, representing pre-crisis and post-crisis periods) and the Country group (developed or developing economy).

There were three key dependent variable constructs, each of which was operationalized using two or more variables. Bank stability was operationalized using Capital ratio; Tier 1 capital ratio; and Writedowns. Returns were operationalized using Profits-to-assets ratio (ROA) and Profits-to-equity ratio (ROE). Finally, Riskiness of share prices was operationalized using Stock returns and Stock volatility. Two dependent variables were found to be insignificant in the analysis, though they were prepared for the data set based on the literature. These included Altman’s z-score and degree of total leverage (DTL).
7.1.3 Models and Results
The main analysis used pooled OLS regression and fixed FE regression, as above, to understand the between-effects and within-effects of each independent variable on the dependent variables. Presented below in summary form are the outcomes of these models. A Hausman test was also used to determine whether the fixed-effects or random-effects model was appropriate. In all cases, the fixed-effects model was appropriate because there was a significant probability that the assumptions of the random-effects model were violated. Thus, only FE outcomes are presented.

7.1.3.1 Bank Stability Indicators
The first set of indicators was bank stability indicators, including Capital ratio, Tier 1 capital ratio, and Writedowns. Table 20 summarizes the significant independent variables for each of these dependent variables in the pooled OLS and robust FE models, in order of strength, as well as the adjusted $r^2$ achieved by each model.

To some extent, this is probably due to the relatively shallow time series, which included as few as nine years for some banks. Based on this information, the strongest indicator of bank stability that can be predicted based on the selected independent variables was the Tier 1 capital ratio. This is interesting because Tier 1 capital is to some extent regulated by the Basel II Accords, meaning that each bank must retain a base level of Tier 1 capital in order to satisfy Basel funding requirements (BIS, 1989; Furlong, 2011). Similar findings were supported by the tiem fixed effects series. Overall, bank stability indicators provided support for H1 and H3, but not strong support for H2.

Table 20 Summary of significant variables for indicators for bank stability

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Pooled OLS model</th>
<th>Fixed effects model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>Diversification</td>
<td>Total assets (negative)</td>
</tr>
<tr>
<td></td>
<td>Net Interest Income</td>
<td>Adjusted $R^2 = 0.007$</td>
</tr>
<tr>
<td></td>
<td>(negative)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Profit (log)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cost-to-income ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time period (negative)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Country group</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjusted $R^2 = 0.183$</td>
<td></td>
</tr>
</tbody>
</table>
### 7.1.3.2 Returns Indicators

The second question was the effect of the independent variables representing the bank business model with returns indicators, including ROA and ROE. Table 21 summarizes the outcomes of this test in the same manner as above (Section 7.1.3.1). It should be noted that the effects sizes of all independent variables for ROA were very small (<0.10). However, significant variables were substantially similar, which suggests that banks do not diversify away much of the risk to returns as indicated by ROA compared to the banking system. ROE showed that equity was more robust than assets in terms of time period and country group, and did not show significant results for either dummy variable. These results provide a satisfactory model for factors that affect bank returns. Time fixed effects models showed that ROA and ROE dropped following the crisis. This test only showed support for H3 (balance sheet indicators). However, given that ROA and ROE are derived from the balance sheet itself, it is uncertain how much of this is cross-correlation.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Pooled OLS model</th>
<th>Fixed effects model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1 capital ratio</td>
<td>Total assets</td>
<td>Total assets</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td>Net interest income</td>
</tr>
<tr>
<td></td>
<td>Profit (log)</td>
<td>Profit</td>
</tr>
<tr>
<td></td>
<td>Country group (negative)</td>
<td>Cost-to-income ratio</td>
</tr>
<tr>
<td></td>
<td>Cost-to-income ratio (negative)</td>
<td>Country group (negative)</td>
</tr>
<tr>
<td></td>
<td>Adjusted $R^2 = 0.913$</td>
<td>Adjusted $R^2 = 0.599$</td>
</tr>
<tr>
<td>Writedowns</td>
<td>Net interest income</td>
<td>Net interest income</td>
</tr>
<tr>
<td></td>
<td>Diversification</td>
<td>Country group</td>
</tr>
<tr>
<td></td>
<td>Country group</td>
<td>Diversification</td>
</tr>
<tr>
<td></td>
<td>Profit (negative)</td>
<td>Profit (negative)</td>
</tr>
<tr>
<td></td>
<td>Adjusted $R^2 = 0.596$</td>
<td>Performing loans to non-performing loans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cost-to-income ratio (negative)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjusted $R^2 = 0.081$</td>
</tr>
</tbody>
</table>
Table 21 Summary of significant variables for indicators for returns

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Pooled OLS model</th>
<th>Fixed effects model</th>
</tr>
</thead>
</table>
| ROA                  | Total assets (negative)  
|                      | Turnovers  
|                      | Time period (negative)  
|                      | Country group (negative)  
|                      | Cost-to-income ratio (negative)  
|                      | Adjusted $R^2 = 0.598$  
|                      | Total assets (negative)  
|                      | Turnovers  
|                      | Country group (negative)  
|                      | Cost-to-income ratio (negative)  
|                      | Diversification (negative)  
|                      | Adjusted $R^2 = 0.310$  
| ROE                  | Turnovers  
|                      | Total assets (negative)  
|                      | Performing loans to non-performing loans  
|                      | Diversification (negative)  
|                      | Adjusted $R^2 = 0.431$  
|                      | Turnovers  
|                      | Total assets (negative)  
|                      | Diversification  
|                      | Cost-to-income ratio  
|                      | Adjusted $R^2 = 0.275$  

7.1.3.3 Riskiness of Stock Prices

The final area of business model analysis attempted to capture the market perception of bank stability by using Stock returns and share price volatility as indicators. These models were inconsistent, and the outcomes do not support a strong relationship between these variables. This is probably because stocks are traded against each other in a given market, maximizing the effects of systemic risk, but individual companies cannot diversify away what are essentially the effects of their balance sheet. As the outcome for the Stock returns model shows, there is a lack of consistency between these two levels of analysis as well. Overall, there is little illumination to be had from these results, as they do not offer much insight. However, the time fixed effects model did provide some information. This suggested that a lack of information in the run-up to the crisis may have led to exaggerated growth in stock prices, while post-crisis stock volatility lasted about two years. Much of this information was omitted based on collinearity, which reduced the impact, but it is suggestive of the conditions of the market at the time. Overall, the stock price variables do not provide strong support for any of the hypotheses.
Table 22 Summary of significant variables for indicators for riskiness of share prices

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Pooled OLS model</th>
<th>Fixed effects model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock returns</td>
<td>Total assets</td>
<td>Country group</td>
</tr>
<tr>
<td></td>
<td>Turnovers (negative)</td>
<td>Cost-to-income ratio</td>
</tr>
<tr>
<td></td>
<td>Time period</td>
<td>(negative)</td>
</tr>
<tr>
<td></td>
<td>Country group</td>
<td>Diversification</td>
</tr>
<tr>
<td></td>
<td>Adjusted R² = 0.277</td>
<td>Performing loans to non-performing loans</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjusted R² = 0.277</td>
</tr>
<tr>
<td>Share volatility</td>
<td>Total assets</td>
<td>Total assets</td>
</tr>
<tr>
<td></td>
<td>Diversification (negative)</td>
<td>Turnovers</td>
</tr>
<tr>
<td></td>
<td>Adjusted R² = 0.184</td>
<td>Equity-to-asset ratio</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diversification (Negative)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performing loans to non-performing loans (negative)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjusted R² = 0.0752</td>
</tr>
</tbody>
</table>

7.1.3.4 Other Analysis

There were four additional analysis approaches taken, in order to clarify various questions that arose. The first question was whether Diversification could have a nonlinear relationship with the stability, returns, and riskiness of share price indicators. That is, does Diversification benefit a firm up to a point, but then have a negative impact on these factors? This was tested by including Diversification as a squared term alongside the original models, tested as described above in Sections 7.1.3.1 to 7.1.3.3. The Diversification squared term was found to have a significant negative relationship with all three stability indicators (Capital ratio, Tier 1 capital ratio, and Writedowns). This indicates that in fact there is such a nonlinear relationship, though this analysis did not identify the equation for it. ROA did show a very small significant effect (<-0.000), but ROE did not, suggesting that Diversification does not necessarily affect revenues in a nonlinear way. The Diversification squared term had a very small positive (0.001 or below) effect on share price and share price riskiness. Thus, the outcomes of this test are mixed, suggesting that Diversification may have different effects on the bank’s financial performance. However, there is clear evidence of a nonlinear relationship with bank stability.

The second additional analysis stemmed from the observation that country group was frequently a significant factor in the tests. Specifically, these tests often (though not
always) showed a negative affect stemming from developed country of origin. In order to try to determine why, the country dummy was decomposed into six variables, including GDP growth per capita, inflation, private credit by deposit money banks as a percent of GDP, bank credit to bank deposits, liquid liabilities, and deposit money bank assets to GDP. These were then tested against the bank stability and returns variables. Liquid liabilities were the most significant factor for stability, though it had a stronger systemic than individual impact. Tier 1 capital and deposit money bank assets to GDP affected Writedowns. This effect suggests that a larger banking system was likely to be more stable on the whole, which is consistent with expectations. Slight effects of deposit money bank assets were seen in the pooled OLS but not in the FE model. No significant factors were found for any of the riskiness of share price variables. This suggests that the variables identified are only moderately well fitted, and some other factors affect the relationship between developed and developing countries and bank stability.

The third additional analysis was based on the elimination of variables from the stock price riskiness model. The model was rerun in a maximum completeness approach, including decomposed country level variables. However, this did not result in significant new information, and still reflected a relatively low goodness-of-fit compared to other models. It is most likely that share prices and share price volatility indicators are more based on information efficiency or news than macroeconomic indicators, which could be why both share prices and share volatility are lower on average in developed countries. However, this was not tested by the research.

The final additional analysis was generation of time fixed effects models for six of the seven dependent variables (excluding the Capital ratio, which did not show any significant time fixed effects). This was done in order to isolate the effects of time-invariant, rather than unit-invariant, fixed effects within the model. The results of this analysis do point to a variety of interesting effects. The general indication of the stability and profitability indicators suggests that bank managers pulled back from risky investments during the years leading up to the crisis, resulting in a reduction of income and increase in stability. Stock returns showed an immediate impact from the crisis and took about two years to recover. These findings generally support H1 and H3, but do not support H2.
7.1.4 Hypothesis Outcomes

The results of the three hypotheses showed mixed success. Hypothesis 1 addressed the role of Diversification in banking stability. The literature suggested that Diversification would provide a stabilizing effect. Time fixed effects findings suggested a complicated relationship between Diversification and stability, showing positive effects on both Tier 1 capital and Writedowns for various years throughout the period. This suggests that these are fundamental aspects of bank stability, rather than being crisis dependent. The combined findings of the main models, time fixed effect, and models including squared terms for Diversification suggest that Diversification have a nonlinear effect. Up to a certain point, Diversification provides a stabilizing effect for banks. However, beyond this point, further Diversification no longer helps in stabilizing the bank, and may have a detrimental effect. Although this study did not identify a precise inflection point, it clearly suggests that too high Diversification can be a negative element of the bank business model.

The second hypothesis addressed the role of interest-bearing income and non-interest income. The findings did not fully support this hypothesis either, with little evidence showing that high interest-based income increased stability. This could be due to the relationship between Diversification and Interest income, which could prevent a general relationship from being recognized in a linear model, though it could also be due to fluctuations in the reliability of interest income (regardless of the information level of lending). It is reasonable to state that reliance on interest income does not necessarily increase bank stability. Time fixed effects had no impact on this hypothesis.

The third hypothesis addressed the relationship between stability and the bank balance sheet. This hypothesis did find some support, particularly Cost-to-income ratio and Total assets. This is sensible given the relationship between banking performance indicators and stability indicators. Overall, the hypothesis testing outcomes suggest that bank stability is positively influenced by Diversification (though in a nonlinear relationship) and by balance sheet factors like Cost-to-income ratio and Total assets. The result also indicates that the traditional relationship banking with strong balance sheet and effective risk management system is the most appropriate model in Southeast and East Asia, particularly in developed economies.


7.2 Research Implications

The findings presented in this research have some particular implications for the banking industry, as well as for regulators and policymakers tasked with banking industry stability. They are also suggestive of requirements for future research, which will be discussed in more detail below. These implications should be understood in the context of this particular study. This study is the only study that could be found that focused exclusively on Southeast and East Asia, which makes it unique in the literature. This could provide a unique view on bank operations and practices.

The first implication for bank managers is that diversification needs to be carefully evaluated as a strategy. Common wisdom in investment suggests that increasing the level of diversification in income or investment stream minimizes risk, thus strengthening the bank (Nguyen, et al., 2011; Stiroh, 2004). However, other studies in the literature have complicated the relationship between diversification and bank strength and stability (Carbó & Rodriguez, 2007; Lepetit, et al., 2008; Lozano-Vivas & Pasiouras, 2008). These studies suggest that it is not simply the fact of diversification that creates stability or returns, but the specific choice of instruments and revenue streams and how they are used. This is the first study to directly test the effects of diversification in the Southeast and East Asia region only, although other studies have tested it empirically in other areas, included Southeast and East Asia countries in global analysis or discussed effects theoretically. Thus, this study provides some interesting insights into the topic. The findings of the present study suggest that the relationship between diversification and risk (as expressed by bank stability and returns) is not so simple as suggested by authors like Stiroh (2004), and is instead more consistent with the complex picture presented by other authors. Diversification had a very small effect on returns, which probably speaks to effective targeting and management of assets and equity on the part of banks. It had a much stronger effect on bank stability. However, this effect was not straightforward. Instead, it appeared to be nonlinear in the initial findings, which was verified in additional analysis. This suggests that diversification, or mixing of interest and non-interest sources of income, is helpful to a point. If the bank is too diversified, it will have a negative effect on bank stability. This research did not assess sources of non-interest income, which could be relevant to individual outcomes.
Since banks use different business models for diversification, the source of income could be very important. It is possible that banks may be able to manipulate this effect somewhat by selectively targeting some forms of non-interest income that are less risky than others. For example, offering money transfer and payment services to existing customers is non-interest based, but is likely to be far less risky than engaging in OTD lending (either lending or buying secondary loans). A more wide-ranging possibility is that the choice of general business model and the relationships between the different business units could influence the outcomes of diversification more than the simple fact of diversification itself (Koch & McDonald, 2009; Singh, 2007; Trumpel-Gugerell, 2009). Ultimately, however, the mixture of interest income and non-interest income does need to be managed in order to increase bank stability, and this management needs to be strategically chosen for the desired effects. This could be particularly problematic for some banks, since increased risk from revenue streams is rewarded with increased returns. For example, higher-risk lending is typically associated with higher interest rates. Higher returns are typically associated with short-term increases in the bank’s share price, due to positive investor reaction, but this effect is not sustained. Thus, if the bank strategy developer prioritizes returns or share price over stability, then the degree of diversification selected may be beyond the point of optimal bank stability. This is another aspect that bank strategists need to take into account when considering the balance between profit, shareholder value, and stability. This could call for a substantial revision of the bank’s approach to diversification, although of course this would need to be decided on a case-by-case basis.

There is a second research implication that is more relevant to banking regulation than bank management. The systemic nature of bank stability suggests that banking regulators and policymakers also need to take into account the findings of this study. As the literature reviewed showed, banking policies have a substantial effect on the choice of business models and diversification approaches for banks; for example, bank size and capitalization ratios, known to reduce risk, are determined in part through regulation (De Jonghe, 2010; Vallascas & Keasey, 2012). There is also evidence that previous regulatory responses have been too weak to overcome problems; for example, the regulation following the Asian currency crisis was not sufficient to prevent further problems, though it did help (Seodarmono et al., 2011). It is clear that there were regulatory changes in response to the 1997-1998 currency crisis that did shield
Southeast and East Asian banks from the crisis, at least initially. Many regulatory changes, such as those that allowed OTD, have proven deleterious for bank stability in other regions (Bernt & Gupta, 2008; Demirgüç-Kunt & Huizinga, 2010). However, many of these regulatory changes were not put into place in Southeast and East Asian countries, which were still wary because of recent experience of financial crisis. This could have provided a protective effect, though it did not completely ensure bank stability or prevent exposure. This study provides more evidence that it is necessary to consider regulation when examining bank business models, since they are so intertwined. Many of the implications discussed above for individual banks, such as the balance between profit, shareholder value, and stability and the selection of non-interest income, are also of concern for banking regulators. For example, banking regulators should consider whether particular types of banking activity are too risky to allow, or whether they need to be more tightly controlled than others, in order to limit the amount of systemic risk associated with them. Banking regulators also need to consider approaches to encouraging the selection of bank stability, rather than short-term profitability or shareholder value, in the banking system. Clearly, some regulators will have an easier time managing this than others. In particular, highly regulated banking systems with existing rules about business models or investment strategies would be relatively easy to modify to allow for prioritization of bank stability. In general, this would include emerging economies, which are known for less rigid regulation than developed economies (Nafziger, 2006). However, highly deregulated banking systems, such as those based on the Anglo-American, deregulated, shareholder-based model, may be far harder to impose such regulations on. Ideally, the impact of loosening regulations on banks to allow for different business models and novel products should be considered before deregulation takes place, but it is difficult to enact this thoughtful deregulation process post hoc. Because of this, banking regulators need to impose a strong culture of stability on their banking systems, ensuring that banking regulations are fully scrutinized for their effect on stability, and not just on the potential profits of the bank. Without this scrutiny, it will be difficult for banking regulators to actually achieve systemic bank stability. The Basel III accords that are currently being developed could be one step toward improvement of these conditions, although these regulations remain controversial in some respects (Cecchetti, et al., 2011; Wehinger, 2011). However, they should be considered as a means of developing increased stability. Differences in regulatory regimes between different countries could also be
considered as protective or facilitating factors for financial crises, an area that has been under-examined in the literature. This point of discussion is examined in more detail below.

### 7.3 Research Limitations

There are some limitations that should be considered for this research. These can be divided into methodological limitations and limitations on application of the findings. Some of the limitations of the method included limits on time series and resulting survivorship bias as well as potential errors in BankScope data, and limitations on the scope of consideration. Limitations on application include time and geographic limitations, as well as limitations on inferences about impact of regulatory regimes.

The data available was relatively shallow for a time series analysis. With some banks having data available only from 2004, a time series would encompass only nine years. This could be strength in some ways, since this would allow for recovery from the 1997-1998 crisis in the figures as well as eliminating survivorship bias from this period. However, it is also a weakness since, as shown in most of the robust FE results; it allows limited room to build statistical strength. This is not just a methodological problem, but has some potential impacts on the application of this research. One of the implications of this limitation is that the direct impact of policy changes following the currency crisis could not be considered. For example, the effects policy changes that occurred in response to the currency crisis were not analyzed, and only the post-crisis regulatory regime was examined. This could have potentially serious implications, particularly given the lessened severity of the crisis and its impact in Asia, but the current research did not provide enough information to examine it in detail. This would be an interesting area for future research, a prospect that is developed below. It also introduces the potential for survivorship bias in banks that existed during the beginning of the analysis, but did not continue to exist at the end of the period. In other words, banks that actually failed during or after the 2008 crisis were eliminated from the analysis. This is problematic since it reduces some of the most obviously unstable banks. However, this problem was not easily resolvable. A third methodological limitation is that there was no easy way to identify errors or potential gaps in BankScope data. BankScope is generally reliable and is routinely used in similar banking analysis studies. However, as the data clean-up showed, there are some errors
or potential errors in the data. While the data clean-up and outlier removal process identified the most egregious errors, it is also possible that some errors could be reasonable in appearance, though wrong, and thus are included in the data used. This is obviously accounted for in the statistical error calculations and significance levels, but it is worth considering since the researcher did not collect the data.

There are also some limitations on how this research should be used and applied. The most obvious limitation is that it reflects conditions in a particular geographic and economic region and time period, during which occurred a particular series of economic events. This means that even though general findings may be repeatable (such as effects of general bank business model choices on stability indicators), the precise results cannot be applied to another region or time period. Differences such as regulatory regimes and previous experience in the market could influence the findings. For example, in the region under this study, a more recent financial crisis (the 1997 currency crisis) resulted in changes in regulations that could potentially prevent negative impacts, unlike Western countries that suffered the full brunt of the 2008 crisis. The regulatory regime that was investigated in this research was mostly put into place after the currency crisis, which means there is no comparative information available either to the pre-crisis period or to other regions that did not have this type of regime in place. It is possible that the regulatory regime implemented after the Asian crisis partially shielded the region and increased bank stability by limiting foreign-currency investments, which could have prevented currency mismatches and excessive contamination from the US mortgage market and the Euro crisis. However, this could not be proved in this study, since it focused only on Southeast and East Asia in the post-crisis period and did not incorporate policy factors. However, it could be relevant in another context, which means that applying these findings could be imprecise for some regions. A second limitation of its application is that this study does not take into account the regulatory environment of banks. There is some implicit recognition of general regulatory frameworks, such as with the Tier 1 capital ratio (which reflects Basel II requirements for capital holdings). However, explicit analysis of regulatory frameworks and their impact on the bank’s business model and stability was beyond the scope of this study. Thus, findings from this study cannot be used to support inferences about the regulatory system, though this is discussed as a potential area for further exploration.
7.4 Recommendations for Future Research

This research followed a somewhat exploratory path, but did retain a focus on central questions about bank business models and stability. Thus, some of the questions and issues that arose during the research were outside the scope of the project, and could not be explored within it. However, these questions do open up some opportunities for future research.

One question the research raises is why being headquartered in a developed country should have a negative effect on bank stability, returns and share price riskiness. This research made some preliminary inquiries into this question by decomposing the dummy variable into six country-level variables that have been used in similar research studies. However, this provided only a limited answer to the questions, with the strongest result being seen for bank stability. Thus, the first suggestion for future research is extensive comparison of developing and developed countries in order to determine what economic and financial factors influence bank outcomes. One way this could be done is by increasing the number of variables included at the economy level, in order to capture more macroeconomic activity on a national level. Another way it could be done is by extending the set of countries that are used for comparison. The current comparison only used 14 countries, because these countries had data available for one or more banks during the time period and these countries were located in Southeast and East Asia. By extending the set of countries to the global level, it would be possible to determine whether the negative impact of developed country status was global or whether it disappeared. It would also be possible to determine more firmly what macroeconomic factors impact bank stability and financial performance. This extension of the current research would provide valuable insights into the structural and macroeconomic differences between developing and developed economies and their impact on the financial sector’s stability.

The second recommendation for research is based on one of the limitations above. Specifically, this research could not take into account the regulatory differences between countries that could have influenced bank stability as well as choice of business models. Regulatory variables would clearly have an impact on the business models selected by banks. For example, the choice of whether to separate their investment and commercial operations would be constrained by the regulatory
environment. If, as was previously the case in the US and UK, these types of operations had to be separate business entities or operate with a Chinese wall (Koch & MacDonald, 2009), this would lead to different business model choices. The regulatory treatment of Tier 1 capital was already discussed briefly, but since many banks actually maintain more than the regulatory requirements for Tier 1 capital the findings in this study are not truly indicative of the impact of regulation in this area. Finally, the legality and availability of business model choices such as OTD lending, derivatives investments, off balance sheet investments, and other sources of income will vary depending on the regulatory environment. Thus, examining the effect of the regulatory environment on the bank business model, and through the business model to the bank’s stability, could offer valuable insights into how regulation affects bank stability. This is a different question than the question of country group, since banking industry regulations vary widely within developed and developing country groups. By beginning with one country and selecting all banks within that country, it would be possible to isolate potential regulatory impacts that could then be extrapolated into variables for testing in a larger data set selected from developed and developing countries. A related concern is global trade imbalances and savings surpluses, which could interact with bank stability. This issue is particularly relevant given the general relevance of surplus of savings in Asian economies, and the impact this has on bank holdings and assets. It should be examined in more detail, either in a cross-regional or global study.

A third area of interest for future research is the interaction between capital control policies that were placed as a result of the Asian currency crisis and the business models of banks. This was outside the scope of the present research, due to limitations on data availability. However, it would be interesting to examine how the capital control policies implemented in Southeast and East Asian economies influenced the stability of banks and the bank business models chosen in the region. It appears possible, from the findings of this research and the available literature, that these capital control policies may have had a shielding effect. The recent experience of currency contagion resulting from the currency crisis may have imposed stricter rules about asset holdings in foreign currencies, which could have limited the exposure of banks to the American mortgage lending bubble that provoked the global financial crisis. This would not provide full protection, particularly over time as global financial flows began to be affected. It would be interesting to explore this area of potential impact and determine what
protective effect the policies put into place had (and how they could have been improved). It could also shed light on the effect of currency mismatches and the potential impact of global trade and financial imbalances on future financial crises. In addition to a quantitative component, this research could benefit from a comprehensive policy analysis focusing on one or more countries.
References


Appendices

Appendix A Model Summaries
The tables below summarize the models used for testing each variable in the main findings, time fixed effects, and squared terms. Each of these is based on Equation (4), the fundamental model for this study.

Table 23 Model summaries (main findings)

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>( \text{capital ratio} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td></td>
<td>( \text{capital ratio} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>( \text{capital ratio} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Writedowns</td>
<td>( \text{writedowns} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Profits to assets (ROA)</td>
<td>( \text{profit to assets} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Profits to equity (ROE)</td>
<td>( \text{roa} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Stock returns</td>
<td>( \text{stock return} = \alpha + \text{total assets}<em>{t-1} + \text{non performing loans}</em>{t-1} + \text{intermediate loans}<em>{t-1} + \text{diversification}</em>{t-1} + \text{cost to income}<em>{t-1} + B</em>{1} + B_{2} )</td>
</tr>
<tr>
<td>Outcome variable</td>
<td>Model</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
</tr>
</tbody>
</table>
| Stock volatility | \[
\begin{align*}
\text{Stock volatility} &= \alpha + \text{Initial assets}_{t-2} + \text{non performing loans}_{t-2} + \text{interests}_{t-2} \\
&\quad + \text{net interest income}_{t-2} + \text{diversification}_{t-2} + \text{cost to income}_{t-2} \\
&\quad + \text{equity to assets}_{t-1} + D_1 + D_2 \\
\end{align*}
\] |

Table 24 Model summaries (Time FE)

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio (Not tested)</td>
<td></td>
</tr>
</tbody>
</table>
| Tier 1 capital ratio | \[
\begin{align*}
\ln(\text{Tier 1 capital}) &= \alpha + \ln(\text{total assets})_{t-1} + \ln(\text{non-performing loans})_{t-1} + \\
&\quad \ln(\text{profit})_{t-1} \\
&\quad + \ln(\text{net interest income})_{t-1} + \text{diversification}_{t-1} + \text{cost to income}_{t-1} \\
&\quad + \ln(\text{liquid liabilities}) + \text{deposits} + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 \\
\end{align*}
\] |
| Writedowns | \[
\begin{align*}
\ln(\text{writedowns}) &= \alpha + \ln(\text{net interest income})_{t-1} + \ln(\text{profit})_{t-1} \\
&\quad + \ln(\text{liquid liabilities}) + \text{deposits} + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 \\
\end{align*}
\] |
| Profits to assets (ROA) | \[
\begin{align*}
\text{ROA} &= \alpha + \ln(\text{total assets})_t + \ln(\text{net interest income})_t \text{ } + \text{diversification} + \text{cost to income} \\
&\quad + \ln(\text{liquidity}) + \text{deposits} + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 \\
&\quad + D_9 + D_{10} \\
\end{align*}
\] |
| Profits to equity (ROE) | \[
\begin{align*}
\text{ROE} &= \alpha + \ln(\text{total assets})_t + \ln(\text{net interest income})_t \text{ } + \text{diversification} + \text{cost to income} \\
&\quad + \ln(\text{liquidity}) + \text{deposits} + D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 + D_8 \\
&\quad + D_9 + D_{10} \\
\end{align*}
\] |
<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stock returns</td>
<td>$ln(\text{stock returns}) = a + \ln(\text{total assets})_t + \text{non-performing loans}_t + \text{in (turnover)}_t + \ln(\text{net interest income})_t + \text{diversification}_t + \text{inflation}_t + \text{cost} - \text{to} - \text{income} + \text{equity} - \text{to} - \text{asset} + \ln(\text{inflation})_t + \text{Bank Credit}_t + D_1 + D_2 + D_3 + D_4$</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>$ln(\text{stock volatility}) = a + \ln(\text{total assets})_t + \text{non-performing loans}_t + \text{in (turnover)}_t + \ln(\text{net interest income})_t + \text{diversification}_t + \text{inflation}_t + \text{cost} - \text{to} - \text{income} + \text{equity} - \text{to} - \text{asset} + \ln(\text{inflation})_t + \text{Bank Credit}_t + D_1 + D_2 + D_3 + D_4$</td>
</tr>
</tbody>
</table>

Table 25 Model summaries (Diversification squared term)

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital ratio</td>
<td>$\text{capitalratio} = a + \text{Intotalassets}<em>{t-1} + \text{nonperformingloans}</em>{t-1} + \text{inprofit}_{t-1}$</td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>$\text{in} \times 1 = a + \text{Intotalassets}<em>{t-1} + \text{nonperformingloans}</em>{t-1} + \text{inprofit}_{t-1}$</td>
</tr>
<tr>
<td>Writedowns</td>
<td>$\text{writedowns} = a + \text{nonperformingloans}<em>{t-1} + \text{inprofit}</em>{t-1} + \text{netinterestincome}_{t-1}$</td>
</tr>
<tr>
<td>Outcome variable</td>
<td>Model</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Profits to assets (ROA)</td>
<td>[ y_{it} = \alpha + \text{intotal assets}_t + \text{nonperforming loans}_t + \text{intnconv}_t + \text{banks}_t + \text{diverstfication}_t + \text{costs income}_t + \text{D}_1 + \text{D}<em>2 + D</em>{it} ]</td>
</tr>
<tr>
<td>Profits to equity (ROE)</td>
<td>[ y_{it} = \alpha + \text{intotal assets}_t + \text{nonperforming loans}_t + \text{intnconv}_t + \text{banks}_t + \text{diverstfication}_t + \text{costs income}_t + \text{D}_1 + \text{D}<em>2 + D</em>{it} ]</td>
</tr>
<tr>
<td>Stock returns</td>
<td>[ \text{stock return} = \alpha + \text{intotal assets}<em>{t-1} + \text{nonperforming loans}</em>{t-1} + \text{intnconv}<em>{t-1} + \text{banks}</em>{t-1} + \text{diverstfication}<em>{t-1} + \text{interest income}</em>{t-1} + \text{costs income}_{t-1} + \text{D}<em>1 + D</em>{it} ]</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>[ \text{stock volatility} = \alpha + \text{intotal assets}<em>{t-1} + \text{nonperforming loans}</em>{t-1} + \text{intnconv}<em>{t-1} + \text{banks}</em>{t-1} + \text{diverstfication}<em>{t-1} + \text{interest income}</em>{t-1} + \text{costs income}_{t-1} + \text{D}<em>1 + D</em>{it} ]</td>
</tr>
<tr>
<td>Variable</td>
<td>Model</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Capital ratio</td>
<td>$\text{capitalratio} = a + \text{totalassets}<em>{t-1} + \text{nonperformingloans}</em>{t-1} + \text{profits}<em>{t-1} + \text{interestincome}</em>{t-1} + \text{diversification}<em>{t-1} + \text{diversification}</em>{t-1} + \text{capitalratio}$</td>
</tr>
<tr>
<td>Tier 1 capital ratio</td>
<td>$\text{Tier 1} = a + \text{totalassets}<em>{t-1} + \text{nonperformingloans}</em>{t-1} + \text{profits}<em>{t-1} + \text{interestincome}</em>{t-1} + \text{diversification}<em>{t-1} + \text{diversification}</em>{t-1} + \text{capitalratio} + \text{liquidity}$</td>
</tr>
<tr>
<td>Writedowns</td>
<td>$\text{writedowns} = a + \text{nonperformingloans}<em>{t-1} + \text{profits}</em>{t-1} + \text{interestincome}<em>{t-1} + \text{diversification}</em>{t-1} + \text{diversification}<em>{t-1} + \text{equity}</em>{t-1} + \text{liquidity} + \text{deposits} + D_1 + D_2$</td>
</tr>
<tr>
<td>Profits to assets (ROA)</td>
<td>$\text{ROA} = a + \text{totalassets} + \text{nonperformingloans} + \text{turnover} + \text{diversification} + \text{equity} + \text{deposits} + D_1 + D_2$</td>
</tr>
<tr>
<td>Profits to equity (ROE)</td>
<td>$\text{ROE} = a + \text{totalassets} + \text{nonperformingloans} + \text{turnover} + \text{diversification} + \text{equity} + \text{deposits} + D_1 + D_2$</td>
</tr>
<tr>
<td>Variable</td>
<td>Model</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Stock returns</td>
<td>$\ln(\text{stock return}) = a + \ln(\text{asset}<em>{t-1}) + \ln(\text{non performing loan}</em>{t-1}) + \ln(\text{interest}<em>{t-1}) + \ln(\text{interest}</em>{t-2}) + \ln(\text{interest}<em>{t-3}) + \ln(\text{income}</em>{t-1}) + \ln(\text{income}<em>{t-2}) + \ln(\text{income}</em>{t-3}) + \ln(\text{equity}<em>{t-1}) + \ln(\text{asset}</em>{t-1}) + \ln(\text{asset}<em>{t-2}) + \ln(\text{asset}</em>{t-3}) + \ln(\text{inflation}_{t}) + \ln(\text{bankruptcy}) + D_1 + D_2$</td>
</tr>
<tr>
<td>Stock volatility</td>
<td>$\ln(\text{stock volatility}) = a + \ln(\text{asset}<em>{t-1}) + \ln(\text{non performing loan}</em>{t-1}) + \ln(\text{interest}<em>{t-1}) + \ln(\text{interest}</em>{t-2}) + \ln(\text{interest}<em>{t-3}) + \ln(\text{income}</em>{t-1}) + \ln(\text{income}<em>{t-2}) + \ln(\text{income}</em>{t-3}) + \ln(\text{equity}<em>{t-1}) + \ln(\text{asset}</em>{t-1}) + \ln(\text{asset}<em>{t-2}) + \ln(\text{asset}</em>{t-3}) + \ln(\text{inflation}_{t}) + \ln(\text{bankruptcy}) + D_1 + D_2$</td>
</tr>
</tbody>
</table>
### Appendix B Additional Economic Variables

#### Table 27 Description of additional economic variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Brief Description</th>
<th>Source</th>
<th>Data Collection Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Brief Description</td>
<td>Source</td>
<td>Data Collection Source</td>
</tr>
<tr>
<td>----------</td>
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</tbody>
</table>