Interest Rate Pass-Through and Monetary Policy Transmission in Thailand

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Dongyang Di

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Abstract

This dissertation examines the degree and speed of key retail interest rates in response to prime rate changes in Thailand. By using five deposit rates and three lending rates from 46 domestic and foreign banks between January 1996 and July 2013 at a monthly basis, I am able to investigate the impacts of the oligopolistic structure in the banking sector and the changing financial environment in Thailand on the interest rate pass-through. The results show that the long-run pass-through is higher than the short-run, but neither is complete. All retails interest rates are more rigid when they are below their equilibrium level than they are above. In addition, the oligopolistic structure has a positive impact on the degree of pass-through, but has no impact on the adjustment speed of the pass-through. Finally, changes in the financial environment could affect interest pass-through as introducing inflation targeting policy has increased the pass-through but financial crises have significantly reduced the pass-through. The findings imply monetary policy transmission via interest rate pass-through is less effective but improving overtime in Thailand.

Chapter 1: Introduction

Monetary policy plays an essential role in macroeconomic management across countries. One common approach to implementing monetary policy by a central bank is to use a short-term interest rate, known as the prime rate.[1] This prime rate can be changed by the central bank in accordance with its monetary policy. For instance, a tightened monetary policy requires the central bank to decrease the prime rate; in contrast, the central bank will increase the prime rate with a loosened monetary policy. Doing so, the monetary authority expects to influence the costs of funding on commercial banks, and therefore affect the short-term and long-term retail interest rates available to customers. Consequently, changes in retail interest rates are expected to have significant and direct impacts on consumers' consumption and investment in the economy, and therefore affect the desired macroeconomic goals such as price stabilisation and maintenance of target inflation. The adjustment of the prime rate in response to monetary policy changes is commonly assumed to be immediate and complete.[2] Therefore, the effectiveness of monetary policy largely depends on how commercial banks react in response to prime rate changes, a process that is known as interest rate pass-through.

Interest rate pass-through is defined as the degree and speed of adjustment of retail interest rates in response to prime rate changes (Ozdemir, 2009). The interest rate pass-through is complete when there is a one-on-one relation between the retail interest rates in response to the prime changes, and the coefficient of pass-through rate is equal to one. It implies an effective monetary policy and the changes in the prime rate are fully passed-through retail interest rates, with the magnitude of changes being large enough to influence the investment and consumptions activities in an economy (Aziakpono & Wilson, 2010). However, it is not always the case that commercial banks to adjust their retail interest rates immediately in response to prime rate changes. In this case, the interest rate pass-through would be incomplete and sluggish, and the

[1] Prime rate is defined as the base lending rate that can affect funding costs for commercial banks and other financial institutions.
[2] Sander and Kleimeier (2004) find that under the assumption of stable yield curve, any changes in monetary policy will result in an immediate change in the prime rate.

coefficient of pass-through rate would be less than 1.[3] An incomplete interest rate pass-through reduces the effectiveness of monetary policy and a consequence failure to stabilise unexpected shocks or achieve the desired macroeconomic goals. The interest rate pass-through can be either used to describe a long-run relation when retail rates adjust to their equilibrium level, or it can be used to capture an immediate impact on the retail rates in accordance with prime rate changes. The former usually has a higher pass-through than the latter (Cottarelli & Kourelis, 1994).

Interest rate pass-through has been widely studied in developed countries owing to its importance in banking theory and in the effectiveness of monetary policy (Boivin, Kiley & Mishkin, 2010). Early studies usually assume an immediate and complete adjustment on retail interest rates in response to prime rate changes (Bernanke & Gertler, 1995; Kashyap & Stein, 2000). However, other studies show the existence of incomplete pass-through in various countries (Hannan & Berger, 1991; Neumark & Sharpe, 1992; Moazzami, 1999) and across regions (Cottarelli & Kourelis, 1994; Borio & Fritz, 1995; Donnay & Degryse, 2001; De Bondt, 2002; De Bondt, Mojon & Valla, 2005). The empirical results show that the transmission of monetary policy shocks to the economy is not smooth due to the sluggishness with which retail interest rates respond to prime rate changes. Further, recent studies find that the adjustment speed differences can be also determined by whether the retail interest rates are above or below their long-run equilibrium. (Chong, Liu & Shrestha, 2006; Liu, Margaritis & Tourani-Rad, 2006).

Recent studies propose some determinants that may influence the degree and speed of retail interest rates in response to prime rate changes, and therefore cause the incomplete and asymmetric interest rate pass-through. For instance, Dutta, Bergen, Levy & Venable (1999) find that the existence of fixed menu costs makes commercial banks reluctant to adjust their deposit and lending rates with respect to prime rate changes, unless the change is significant and permanent. In addition to Dutta et al.'s (1999) finding, researchers find that factors such as high switching costs (Heffernan, 1997); imperfect competition (Neumark & Sharp, 1992) and asymmetric information (Stiglitz & Weiss, 1981) may not only cause the sluggishness of commercial banks

[3] De Bondt. (2005) explains that interest rate pass-through can exceed 1 when banks charge a high risk premium changed as compensation for the additional risks caused by adverse selection and/or moral hazard problem.

when adjusting their retail interest rates in response to prime rate changes, but also contribute to the asymmetric adjustment in the interest rate pass-through.

Apart from developed markets, researchers have also shifted their interests toward emerging economies, because the study of interest rate pass-through provides significant implications not only for monetary policy, but also for financial reforms and liberalisation (Scholnick, 1996). Thus, a comprehensive understanding of interest rate pass-through makes a significant contribution to the soundness of the financial system (Hofmann, 2006; Aydin, 2007). However, the empirical evidence on interest rate pass-through is more inconclusive in these countries. One plausible reason is because the rapid changes on their financial systems causes additional difficulties in assessing the monetary policy transmission process.

For instance, a majority of developing countries have experienced massive financial liberalisation and deregulation (Mohanty and Turner, 2008) and reformed their financial systems (Wang, 2010) in order to prevent financial market deterioration in early 2000s. On one hand, Cattarelli and Kourelis (1994) suggest increasing the competition and reducing the concentration within banking system by allowing the foreign ownership in national banking industry, and consequently the effectiveness of monetary policy transmission and completeness of interest rate pass-through can be improved. Besides, there is an expectation that rate liberalization, such as shifting the monetary policy from pegged exchange rate to inflation targeting in developing countries could also enhance the interest rate pass-through. On the other hand, Mohanty and Turner (2008), Aziakpono and Wilson(2010) and Wang (2010) argue that the rapid change in financial systems meanwhile could also lead to financial turmoil and interbank collusive owning to weak regulatory environment imposed by developing countries, for which banking competitiveness and the efficiency of interest rate pass-through can be reduced. Thus, empirical results on interest rate pass-through remain unclear in developing countries. Based on these forgoing discussions, Thailand has become one of the emerging countries that draw special interest, as it has seen rapidly fundamental changes in both monetary policy regimes and other characteristics that could potentially influence the interest rate pass-through in a very short time period. However, it appears that the existing literature on the effectiveness of the monetary policy transmission mechanism and interest rate pass-through

allowing for changing financial structure and reforms in Thailand is still under-explored.

The aim of this research is to investigate the dynamic linkage between prime and retail interest rates in Thailand. Specifically, it will consider major deposit and lending rates under the context of different banking structures and financial market conditions. In doing so, this research examines both long- and short-run interest rate pass-through. The latter includes symmetric and asymmetric relationships associated with following three aspects: (1) retail interest rates with different maturities; (2) the variation of changes in prime rate transmission to retail interest rates in terms of industry average and the two bank types: commercial banks and foreign bank branches; (3) the trend of pass-through over sub-periods, which reflect major changes taking place in Thailand.

This research focuses on Thailand for two reasons. First, there are major changes in the financial environment since the Asian financial crisis in 1997, which may affect the degree of interest rate pass-through. For instance, early studies document that changes in monetary policy regimes have a significant impact on the interest rate pass-through (Gidlow, 1998; Egert, Crespo-Cuaresma & Reininger, 2007; Aziakpono & Wilson, 2010). On the one hand, the monetary policy framework in Thailand changed rapidly from the pegged exchange rate to an aggregated monetary target by monitoring daily liquidity in 1997, and then to the inflation-targeting framework in May 2000. The 14-day Repo rate was initially used as the prime rate up until 16 January 2007, after which it was switched to the 1-day (bilateral) Repo rate (Charoenseang & Manakit, 2007). On the other hand, although it has been more than 10 years since the implementation of the new monetary policy, the existing literature on analysing the effectiveness of the monetary policy transmission mechanism via interest rate pass-through in Thailand is very limited. In addition, the effectiveness of inflation targeting policy during the global financial crisis in 2008 also remains unclear.

Second, there is a strong debate about whether high concentration in the banking sector could reduce the degree of competition among commercial banks and have negative impacts on the interest rate pass-through. Subsequently, lower interest rate pass-through could further reduce the effectiveness of monetary policy (Cottarelli &

Kourelis, 1994; Borio & Fritz, 1995; Weth, 2002). In line with early literature, the banking sector in Thailand has been highly concentrated during the last two decades,[4] and it is therefore expected that interest rate pass-through will be sluggish and asymmetric. However, the studies in Thailand are based on the oligopolistic structure and the analysis fails to examine whether the interest rate pass-through differs between high concentration banks and the ones with low concentration.[5] There is a knowledge gap on the impacts of the oligopolistic structure in the banking sector on interest rate pass-through in Thailand.

The main contribution of this dissertation is to fill the gap on the transmission behaviour of monetary policy via the interest rate channel in Thailand. To examine the dynamics of interest rate pass-through, this study follows an error-correction methodology as per Heffernan (1997) and Scholnick (1996) for analysing the level and speed of interest rate pass-through. Using a sample of five major deposit rates and three major lending rates from 46 banks in Thailand over the period January 1996 to July 2013, the results of this research can be summarised as follows.

First, I find that there is co-movement between the prime rate and retail interest rates in the long-run. Second, I can confirm that transmission between the prime rate and retail interest rates is not complete for both domestic banks and foreign bank branches in the long-run. More specifically, the degree of sluggishness is confirmed to be generally higher in lending rates than in deposits,[6] which provides strong evidence for the switching cost hypothesis. However, I find that the concentration/oligopolistic structure has a positive impact on the interest rate pass-through process, as the long-run rate of pass-through in high concentration banks (domestic ones) is greater than in low concentration banks (foreign ones), and this can be explained by better competitiveness caused by either new entry threats or Thailand's financial reforms.

In the case of short-run dynamics, I find incomplete and very low interest rate pass-through among all retail interest rates. This suggests the existence of menu costs, switching costs, imperfect competition and asymmetric information may explain the

[4] The five largest banks in Thailand account for 60.9% of the total national banking assets as of 1994 (Kamin, Turner & Van'Dack., 1998). The six largest banks account for around 55% of total loans as at 2003 (Menkhoff & Suwanaporn, 2007).
[5] Domestic banks are defined as high concentration banks and foreign banks are defined as low concentration banks, further discussion is developed in Chapter 2 and Chapter 5.
[6] The finding is in line with, for example, Rehman (2004) and Pih, Siok, and Wai (2012).

interest rate pass-through (Chong et al., 2006). In addition, the oligopolistic structure only has an impact on the level of interest rate pass-through but the effect is not the same for lending and deposit rates. Furthermore, all retail interest rates tend to converge to their long-run equilibrium, and the mean-reverting process provides evidence of price rigidity and asymmetric pass-through. The asymmetric adjustment appears to be faster when retail interest rates above than below equilibrium in relation to the prime rate.

Finally, I find evidence that the changing financial environment affects the interest rate pass-through process. The results suggest that interest rate pass-through increases after the adoption of more transparent monetary policy, but decreases during financial turbulences such as the financial crises

The implications of this dissertation are as follows. First, the effectiveness of monetary policy is compromised by the low speed with which retail rates adjust to prime rate changes. This may in turn lead to the failure of monetary policy to stabilise unexpected shocks or to achieve the desired economic goals. Moreover, financial reforms in the banking sector would enhance the industry competiveness and contribute to the soundness of the financial system. Finally, changes in the financial environment have significant impacts on the degree and speed of interest rate pass-through.

The structure of this dissertation is as follows. Chapter 2 provides an overview of the existing literature on interest rate pass-through with some empirical evidence that focuses on Thailand. Chapter 3 constructs key hypotheses to be tested in this research. Chapter 4 presents an empirical modelling framework. Chapter 5 provides discussion on the data obtained and its properties. Chapter 6 offers discussion on, and results of, the empirical model. Finally, Chapter 7 draws concluding remarks for the research.

Chapter 2: Literature Review

This section is divided into two parts. The first part introduces background of interest rate pass-through and its main determinants. The second part provides a review of the existing literature on both developed and developing countries with a special focus on Thailand.

2. 1 Background

Interest rate pass-through is one of the most direct links to the monetary policy transmission process (Manna, Pill & Quiros, 2001; De Bondt, 2002; Baugnet, Collin & Dhyne, 2007). It describes the reaction process of long- and short-run retail interest rates with respect to prime rate changes in terms of degree and speed base on the monetary policy approach [7] (Sander & Kleimeier, 2004). According to Ozdemir (2007), the interest rate is defined as the degree and speed of adjustment of retail interest rates in response to prime rate changes. The coefficient that measures the level of interest rate pass-through can vary in range from 0 to 1, where 0 indicates zero pass-through from prime rate to retail interest rates, while 1 indicates there is a one-to-one relation where retail interest rates adjust in response to prime rate changes and the pass-through is complete. As discussed previously, the effectiveness of monetary policy largely depends on the degree and speed of interest rate pass-through. Thus, a coefficient that is closer or equal to one implies the changes on prime rate pass to retail interest rate quickly and the magnitude of the prime rate changes is large enough to strengthen the monetary policy transmission. In contrast, a coefficient that is less than one represents a sluggish pass-through from prime rate to retail rates and the monetary policy transmission is less effective.

The interest rate pass-through is an important indicator of the level of competition in banking industry, and reflects on the soundness of the financial system in a country (Aydin, 2007). This aspect was first discussed by Hannan and Berger (1991), who observed asymmetric response between lending rates and deposit rates. They explain the nature of lending rates being rigid downwards whereas the deposit rates rigid

[7] Another approach is known as the cost of funds approach. The changes in prime rate is first reflected on the short- and long-term money market rate and is then passed to retail interest rates offered by commercial banks and other financial institutions. See De Bondt (2005) for detailed discussion.

upwards by the banks' concentration/ collusive pricing hypothesis. This is because if the banking sector is either less competitive or more concentrated, then banks are likely to use their market power for their own benefits, i.e. maximising their profits by squeezing customers.[8]

2.2 Determinants of interest rate pass-through

Because of the importance of the interest rate pass-through process to monetary policy, there is a growing awareness of the determinants on the degree and speed of interest rate pass-through. Specifically, there is an extensive literature focusing on the explanations regarding sluggishness and the disproportionate pass-through in the interest rate adjustment process.

Madsen and Yang (1998) notice the existence of menu costs such as changing and updating price lists, spending on adverts and brochures to notify customers about new products, which are time consuming and costly from banks and financial institutions' perspective. Consequently, they are reluctant to adjust against prime rate movements unless the changes are significant and permanent (Cottarelli & Kourelis, 1994; Dutta et al., 1999). Thus, interest rate pass-through may exhibit certain sluggishness at least in the short-run.

Switching costs faced by customers could also contribute to interest rate stickiness. On the one hand, customers face costs when searching favourable interest rates among banks, while the process is also time consuming and inconvenient. Thus, they may be less likely to switch from one bank to another. On the other hand, banks may pass additional fees to customers, which make it more difficult to switch to different products and/or banks. For instance, banks may obtain particular information on customers in order to deliver optimal products based on their characteristics. However, Lowe and Rohling[9] (1992) indicate that such research costs could be significant, which lead banks to further shift the expenses to customers in the form of a one-off payment. Therefore, customers are prohibited from switching either interest rate

[8] However, they also suggest a consumer behaviour or customer reaction hypothesis: if customers are sophisticated enough then banks have to work to attract customers and hence are unlikely to exercise their market power. Consequently, lending rates can be rigid upwards whereas the deposit rates rigid downwards.

[9] Indeed, Lowe and Rohling (1992) observe that consumer loans tend to be more rigid than business loans according to switching costs, in contrast with Aydin's (2007) finding in Turkey.

products or financial institutions according to additional sunk costs. Thus, Heffernan (1997) asserts that interest rates will be rigid if banks exploit customers' inertia.

Despite the price rigidity, several studies find that collusive pricing arrangements may lead to imperfect competition on interest rate products across banks, which result in asymmetric adjustment in interest rate pass-through. For example, in a highly concentrated financial system, Hannan and Berger (1991) suggest that deposit rates are more rigid upwards than downwards with respect to prime rate increases, as the deposit rate increase will result in additional payments to customers. In line with Hannan and Berger (1991), Neumark and Sharpe (1992) expand the investigation on lending rates in the US market and find the lending rates are more rigid downwards than upwards. By using an asymmetric error-correction model, Lim (2001) examines the deposit and lending rates on the Australian market. The results also confirm that deposit rates are rigid upwards, in contrast with lending rates that tend to be rigid downwards. For the asymmetric adjustment of retail rates, the role of customers should not be neglected, which leads to the so-called consumer behaviour hypothesis (Hannan & Berger, 1991). Under this hypothesis, depositors and borrowers are so sophisticated that banks are less likely to use their market power for their own benefit. Therefore, unlike the bank concentration hypothesis, the consumer behaviour hypothesis supports the asymmetric adjustment with lending rates being rigid upwards and deposit rates rigid downwards.

In addition, empirical studies also find evidence that information asymmetry may contribute to the asymmetric adjustment in the interest rate pass-through. Information asymmetry is a common phenomenon in financial markets when information is in disequilibrium between counterparties. For example, banks may lack information to distinguish between risky borrowers with bad credit histories and low-risk borrowers who may have good credit histories. However, this information asymmetry between banks and their borrowers may further result in adverse selection and moral hazard problems (Stiglitz & Weiss, 1981; Lowe & Rohling, 1992). On the one hand, Lowe and Rohling (1992) explain that risky borrowers may seek loans more actively and aggressively than those less-risky borrowers with good credit. However, because of the information asymmetry, banks are more likely to provide loans to risky borrowers resulting in adverse selection. On the other hand, high-risk borrowers are less

sensitive to interest rate changes. Thus, increasing lending rates raises the probability of defaulting on loans from the bank's perspective according to moral hazards, even though leaving lending rates unchanged may possibly increase their funding costs. Consequently, lending rates may be rigid upwards even though they are below equilibrium.

Motivated by the inconclusiveness of earlier literature, a growing number of studies further examined short-run dynamics of interest rate pass-through with more granular data. For example, Chong et al., (2006) apply an asymmetric error-correction model (ECM) to both deposit and lending rates for various maturities against prime rate in Singapore. Using a 20-year dataset, they find that the adjustment speed of retail rates in response to changes in the prime rate demonstrates strong asymmetry in terms of financial products, where adjustment speed on lending rates is significantly slower than the adjustment speed on deposit rates.[10] They also notice that the adjustment speed differs between commercial banks and other financial institutions, where deposit rates are more rigid in commercial banks than financial institutions but less rigid in lending rates for commercial banks. Thus, an important implication is that banks and financial institutions' characteristics[11] could have impacts on the speed and degree of the pass-through process. Similar conclusions are drawn by Liu et al. (2006) when modelling mortgage and SME lending rates in New Zealand. Their model is the same as Chong et al. (2006), but based on the cost of funds approach instead of the monetary policy one. They conclude the existence of a wide range of non-uniformity in administrated rates on smaller monetary policy systems.

2. 3 Interest rate pass-through in developed economies

There is a growing literature emphasising interest rate pass-through (Boivin, Kiley & Mishkin, 2010). Traditionally, researchers are interested in the magnitude and the speed of retail interest rates adjustment following the prime rate changes. Early studies usually assume an immediate and complete pass-through from prime rates to retail interest rates (Bernanke & Gertler, 1995; Kashyap & Stein, 2000). However,

[10] There are various studies documenting a conclusion consistent with Chong et al. (2006), such as Tieman (2004); De Bondt (2005); Kwapil and Scharler (2009) and Wang and Lee (2009).
[11] Cottarelli and Kourelis (1994) find that characteristics such as degree of bank concentration, ownership structure and profitability could contribute to the asymmetric adjustment of interest rate pass-through. See Cottarelli and Kourelis (1994) for a detailed discussion.

numerous recent studies argue that there is evidence of sluggishness in the adjustment speed and an interest rate pass-through that could be incomplete even in the long-run. For example, by investigating major lending rates from a cross-country perspective, Borio and Fritz (1995) find evidence of incomplete interest rate pass-through from prime rates to retail rates in Europe, where the coefficient shifts from 0.8 to 1.1 in the long-run. Similarly, Cottarelli and Kourelis (1994) study the behaviour of lending rates in response to prime rate changes by using data selected from 31 industrial and developing economies, and conclude that the range of long-run pass-through coefficient is between 0.75 and 1.25. In addition, changes in prime rate require a minimum of three-months and a maximum of two years in order to fully transmit to retail interest rates. Furthermore, Moazzami (1999) examines the lending rates in Canada and the US by using an error-correction approach and also finds that the long-run pass-through is significantly different from one. Besides these studies on lending rates, Hannan and Berger (1991) investigate the long-run pass-through behaviour from prime rate to deposit rates and confirm the significance of incomplete pass-through in the US market. By extending the sample into 255 banks in the US, Neumark and Sharpe (1992) reach a conclusion consistent with Hannan and Berger (1991). Indeed, by covering major deposit rates, lending rates and mortgage rates in the euro zone, Donnay and Degryse (2001), De Bondt (2002), De Bondt (2005), De Bondt et al. (2005) all document the existence of incomplete pass-through between prime rate and retail interest rates among countries whose economies are highly integrated.

Apart from the long-run study, the rigid and asymmetric characteristics of the relationship between prime rate and banks' retail interest rates are also not well understood in the short-run, as the empirical findings are inconclusive. For instance, Hannan and Berger (1991) examine deposit rates set by US commercial banks and find that small firms in a high concentration market and in a tightening monetary policy environment, exhibit price rigidity compared with large firms. In contrast, Heffernan (1997) examines lending and deposit rates of major banks in the UK and cannot find any asymmetric adjustments across both rate and institution types. More interestingly, Hofmann and Mizen (2004) further investigate various financial products in the UK and find complete pass-through for deposit rates but not for lending rates. Similarly, by using Auto-Regressive Distributed Lag (ARDL) (Hendry,

1995) and the Engle-Granger cointegration approach (Engle & Granger, 1987), Kwapil and Scharler (2010) find no evidence of asymmetric adjustments on deposit and lending rates in the US market, where the pass-through between 1995 and 2003 is nearly complete at 0.97.

In addition to single country cases, Borio and Fritz (1995) investigate the lending rates across 12 OECD countries and find interest rate pass-through differs across countries. Lending rates are sticky in some countries while in other countries exhibit high degrees of pass-through. One plausible explanation is due to the different lending rates used in these countries. In addition, they find asymmetric adjustments in lending rates. Mojon (2000) investigates the pass-through for a wide range of lending and deposit rates in Europe from 1979 to 1998. Consistent with previous studies, there is supporting evidence of a sluggish pass-through in Belgium, Germany, France, the Netherlands and Spain in the short-run. In addition, lending rates for corporate customers tend to have a higher pass-through than lending rates for households and the saving rates are sticky in response to prime rate changes in all countries. However, the determinants of such rigid and asymmetric adjustment remain less clear. Toolsema, Sturm & DE. (2002) try to explain the differences by comparing the regulatory framework among European Monetary Union (EMU) countries, which may lead to segmentation on financial markets. Besides, Sander and Kleimeier (2001) suggest that the information asymmetry and variation in banking structures are the major determinants with respect to asymmetric adjustment in pass-through on lending rates in the EMU countries.

2.4 Interest rate pass-through in developing economies

From the foregoing discussions on developed economies, a growing number of studies[12] have also been conducted on developing countries that follow the same trend of argument as for developed economies. However, the findings are also mixed and inconclusive. For example, Scholnick (1996) investigates the deposit rates in Singapore and Malaysia and finds a sluggish pass-through and the existence of asymmetric adjustment in both countries. Specifically, the deposit rates in Malaysia

[12]Scholnick, (1996); Iregui, Milas and Otero (2002); Espinosa-Vega and Rebucci, (2002); Berstein and Fuentes, (2003); Tomasz, (2003); Aydin, (2007); Aziakpono et al., (2007); Charoenseang and Manakit, (2007).

and Singapore are more rigid upwards than downwards. In line with Scholnick (1996), Ozdermir (2009) finds deposit and lending rates are more rigid downwards than upwards in Turkey. In contrast, Berstein and Fuentes (2003) examine the retail interest rates in Chile followed by Tomasz (2003) for Poland. They find evidence of sluggish pass-through in both countries but find no evidence of the asymmetric adjustment in deposit and lending rates. In addition, Tomasz (2003) finds that the profitability of banks can also be attributed to the sluggishness of the interest rate pass-through. Banks with high profits tend to adjust quickly in response to prime rate changes.

2.5 Interest rate pass-through in Thailand

While there is voluminous literature on interest rate pass-through for developed and developing economies, the studies from Thailand remain scarce. However, compared with other countries, there are two reasons to believe that an investigation on interest rate pass-through is essential and particularly important for Thailand, not only for the implications on conducting effective monetary policy, but also because interest rate pass-through is an important indicator of the level of competition in the banking industry, which further reflects the soundness of the financial system in an economy (Aydin, 2007).

First, the interest rate pass-through requires a close investigation after experiencing rapid shifts in the financial environment. An effective monetary policy and interest rate pass-through requires a stable relation between the prime rate and retail rates in order to establish a long-run equilibrium. However, there is a possibility that a derived steady relationship can be broken up when there are major changes in the financial environment and contribute to additional difficulties to monetary policy. For instance, the monetary policy regime in Thailand shifted from pegged exchange rate to inflation targeting in order to increase transparency in monetary policy post-crisis in 2000. Meanwhile, programmes of financial reforms and liberalisation took place right after the Asian financial crisis in order to increase the competition in the banking industry and therefore to rebuild a sound financial system. Mohanty and Turner (2008) suggest that such changes will increase the role of interest rates in an economy. It is important for monetary authorities to have a comprehensive understanding of the relations between the prime and retail rates via interest rate pass-through. Besides, one critical

goal for monetary authorities is to conduct effective monetary policy in order to stabilise unexpected shocks. Thus, the interest rate pass-through is one of the most important transmission mechanisms, and its effectiveness is particularly important for evaluating the monetary policy performance post-crisis. Although it has been observed that the global financial crisis and its consequent economic recession have made banks more risk-averse, resulting in tighter lending standards (Liu et al., 2011), the existing literature regarding Thailand remains scarce. Therefore, this research extends previous study by using the most up-to-date data in order to capture the effects of major changes in the financial environment on the interest rate pass-through.

Second, the significant oligopolistic structure in the banking sector also requires a prudent examination of the interest rate pass-through. The high oligopolistic banking structure in Thailand can be explained in two approaches. One approach is Kamin et al. (1998) reveal that the five banks in Thailand account for 60.9% of the total national banking assets as of 1994, followed by an additional increase at an accelerating rate after the financial crisis in 1997 and the Financial System Master Plan in 2000 (Kudo, 2006; Charoenseang & Manakit, 2007). Moreover, the Bank of Thailand together with the central government re-structured the banking system by recapitalising undercapitalised commercial banks after the Asian financial crisis in 1997 (Kawai & Takayasu, 2010). Such a re-structuring process usually involved mergers, acquisitions and privatisations of financial institutions, in particular finance companies that were badly hit during the crisis. For example, 7 out of 15 commercial banks were immediately taken into public ownership following the outbreak of the crisis in July 1997 (Hawkins & Mihaljek, 2004). The re-structuring process continued even post the crisis. The total number of financial institutions was reduced massively from 83 in 2003 to 38 in 2010. Thus, it is plausible to conclude that the reducing number of financial institutions and banks on the one hand reduced competition in the banking industry; whilst on the other hand, enhanced the domination of large banks in Thailand. Consequently, the oligopolistic structure in the banking sector has increased significantly as driven by the growing concentration in large banks as well as weak competition in the banking industry.

Understanding the impact of the oligopolistic structure then becomes critical to monetary authorities in Thailand. On the one hand, the purpose of financial reforms is

to increase competition in the banking industry and therefore increase the degree and speed of retail interest rates in response to prime rate changes. Consequently, high interest rate pass-through will strengthen monetary policy. On the other hand, Cottarelli and Kourelis (1994), Egert et al. [13] (2007) and Kuang (2008) suggest that the high oligopolistic structure in the banking sector could reduce competition among banks significantly, and therefore lead to lagged and imprecise interest rates movements. If this is the case, the efficiency of inflation targeting policy could be depressed and fail to stabilise unexpected shocks or achieve the desired macroeconomic goals. In line with their argument, Pih et al. (2012) investigate the effectiveness of interest rates pass-through in Thailand together with other countries. They find the pass-through rate is very minimal in both deposit and lending rates in the long- and short-run. In addition, the study suggests that adopting new monetary policy such as inflation targeting has made no contribution to increasing the pass-through and therefore to increasing the efficiency of monetary policy.

However, there is a strong argument that such a conclusion ignores the fact that the oligopolistic structure only represents a group of banks with high concentration, for example, domestic banks.[14] Analysis under such a framework at the industry level cannot disentangle the question as to whether the oligopolistic structure in the banking sector has the same impacts on low concentration banks, i.e. foreign bank branches,[15] which are deemed to not exhibit the oligopolistic structure. Therefore, research based on data of the high concentration banks inevitably leads to a reduction in the competitiveness and the efficiency of inflation targeting policy. Subsequently, failure to distinguish between high concentration and low concentration banks and their effects could impute the stickiness of interest rate pass-through as well as ineffective monetary policy to the financial reforms and oligopolistic structure and neglect other plausible determinants. To soften the problem, this research tries to control the

[13] Egert et al. (2007) explain this from a profit-maximisation perspective. They find that competition amongst banks subsequently results in profit-maximisation behaviour, which in turn forces the banks to adjust quickly in response to monetary policy changes. However, the high concentration in the banking sector usually leads to a lower level of competition, and therefore reduces the adjustment speed on retail interest rates regarding policy rate changes.

[14] Domestic banks are defined as share of foreign ownership is less than 50%. Chantapong (2006) further states that 9 domestic banks in Thailand weight 87.08% of total assets in Thailand while foreign banks only weight 6.26% of total assets. Another 6.66% account for joint venture banks that foreign ownership is between 50% and 100%.

[15] Foreign bank branches are defined as share of foreign ownership is 100% (Chantapong, 2006).

oligopolistic structure effect by splitting banks into two groups, i.e. high concentration banks (domestic banks) and low concentration banks (foreign bank branches).

To summarise the existing literature for Thailand, it appears that in order to get a full analysis of interest rate pass-through, a less aggregated dataset than the banking sector that can reflect the oligopolistic structure (concentration) should be used. In addition, due to the major changes in the banking industry that took place in Thailand the analysis should also take them into consideration.

Chapter 3: Hypotheses

This chapter introduces the hypotheses used in this dissertation. It discusses cointegration between prime and retail rates; the natural long-run behaviour of interest rate pass-through; the short-run dynamics of pass-through and the impact of major monetary changes on the interest rate pass-through.

3.1 Cointegration

Cointegration describes a long-run relationship, for which variables may deviate in the short-run but share a common trend in the long-run (Brooks, 2008). Prime and retail rates have been closely examined as a pair under this hypothesis, and empirical results confirmed the existence of cointegration between them over the last two decades (Cottarelli, Ferri & Generale, 1995; Scholnick, 1996; Tieman, 2004; De Bondt, 2005; Sander & Kleimeier, 2006). According to the nature of cointegration, it is possible to assume that such a long-run property remains during the sampling period of this research. Therefore I test the following hypothesis:

Hypothesis 1: there is cointegration between prime and retail rates.

3.2 Long-run pass-through

Given the fact that the effectiveness of monetary policy implementation is determined by the degree of interest rate pass-through, a quick and complete pass-through could strengthen the monetary policy transmission and therefore achieve the desired macroeconomic goals. Thus, the interest rate pass-through is expected to be complete in the long-run, when retail interest rates fully adjust to the response of prime rate changes. However, extensive literature[16] have observed disproportional pass-through from prime rate to retail interest rates across countries, and the level of pass-through is less than unity. Based on the inconclusive evidence of empirical studies, I therefore test the following hypothesis:

Hypothesis 2: there is one-on-one transmission between prime and retail interest rates.

[16] Cottarelli et al, 1995; Scholnick, 1996.

Researchers have also found that the long-run pass-through in individual banks is not different from the pass-through in industry, in order to avoid arbitrage activities (Szafrański, 2009). However, factors such as individual marketing policy, financial structure, customers' preferences and solvency ratio may lead the long-run pass-through in individual banks to not converge at the industry level (Szafrański, 2009). Therefore, it is plausible to assume heterogeneous behaviour on the pass-through in this study, and I test the following hypothesis:

Hypothesis 3: long-run interest rate pass-through in individual banks is not significantly different from the pass-through in the industry average.

3.3 Price rigidity of short-run pass-through

The existence of cointegration directly indicates an equivalent error-correction model, where the deviation (error) of a long-run relationship in the short-run will be corrected by a mean-reverting process. Therefore, in addition to the long-run retail interest rates pass-through, its short-run dynamics can be studied by an error-correction model. Researchers have found that the interest rate pass-through is rarely complete in the short-run, where the mean-reverting adjustment of retail interest rates to the changes in prime rates tends to be sluggish (Cottarelli & Kourelis, 1994). While existing literature proposes various explanations to the stickiness of pass-through, such as menu costs, high switching costs, imperfect competition and asymmetric information (Chong et al., 2006; Liu et al., 2006), banks and financial institutions are unable to eliminate such factors and their corresponding effects in the short-run. Therefore, it is plausible to assume that those factors have the same impact on pass-through in Thailand. Thus, I test the following hypothesis:

Hypothesis 4: interest rate pass-through is incomplete in the short-run and exhibits price rigidity for both deposit and lending rates.

Researchers have also found that the structure of the financial system relates to the concentration within the banking industry and can also attribute to the rigidity of interest rate pass-through (Cottarelli & Kourelis, 1994; Kuang, 2008). Given the fact that the banking sector in Thailand is highly concentrated, with specifically, domestic banks being more concentrated than foreign banks (Kudo, 2006; Menkhoff &

Suwanaporn, 2007); it is possible to assume that the adjustment speed is more rigid in domestic banks than in foreign banks. Thus, I test the following hypothesis:

Hypothesis 5: interest rate pass-through is more rigid in domestic than in foreign banks in Thailand, for both deposit and lending rates.

3.4 Asymmetry of short-run pass-through

Empirical evidence also suggests that the sluggishness and rigidity of the mean-reverting process for short-run dynamics of retail interest rates pass-through are conditional on the level and/or direction of the deviation from its long-run relation (Chong et al., 2006; Liu et al., 2006). In other words, the degree and speed of mean-reverting adjustments is asymmetric when retail interest rates are either above or below their long-run equilibrium.[17] In addition, Cottarelli and Kourelis (1994) have found that such asymmetric adjustment could be enhanced by banks' oligopolistic behaviour according to their high concentration within the industry. Therefore, it is plausible to assume the existence of asymmetry in short-run interest rate pass-through in Thailand according to its significant oligopolistic structure during the sample period; thus I test the following hypothesis:

Hypothesis 6: the adjustment speed of retail interest rates in response to changes in the prime rates is asymmetric.

3.5 Sub-sample analysis

The asymmetry and incompleteness of retail interest rates pass-through is even more pertinent in Thailand, due to unique factors that can play significant roles in interest rate transmission. On the one hand, researchers have found that the structure of monetary policy regimes is crucial for the level and speed of interest rate pass-through process. (Specifically, retail interest rates would adjust quickly under liberalised and deregulated economies, since monetary policies are more market orientated and interest rates are mainly determined by market forces; see Aziakpono & Wilson,

[17] Neumark and Sharp (1992) find that asymmetry adjustment for deposit rates can be explained by banks' concentration, for which the banks with high concentration may have the power to adjust upwards slowly but quickly when the adjustment is downward. Hofmann and Mizen (2004) explain that the asymmetry in loans is mainly attributable to the significant fixed costs, and the opportunity costs of unadjusted rates is also quadratic, thus, it is more costly for banks to adjust downwards than upwards. For a detailed discussion see Hofmann and Mizen (2004).

2010.) Besides, a transparent monetary policy such as inflation targeting would increase the adjustment speed. However, it appears that there is a gap in knowledge as to whether these factors impact on the interest rate pass-through process in Thailand since the introduction of inflation targeting monetary policy and FSMP in 2000. On the other hand, Sander and Kleimeier (2004) find that money market volatility might reduce the speed of interest rate pass-through, which also remains unclear after Thailand experienced the global financial crisis and consequent economic regression since 2008. Thus, I intend to investigate whether the structural breaks regarding major shifts in Thailand's banking system and financial turbulence have had an impact on the interest rate pass-through process, and therefore I test the following hypotheses:

Hypothesis 7: the speed of retail interest rates adjustment following the new monetary policy regime has increased in Thailand.

Hypothesis 8: the speed of retail interest rates adjustment following the financial crisis and economic downturn has decreased in Thailand.

Chapter 4: Methodology

This chapter addresses methodologies applied to test the hypotheses discussed in Chapter 3. It discusses Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) methods for unit root tests; the Engle-Granger two-step approach for testing cointegration; an augmented error-correction model (ECM), which is the main methodology to estimate both short-run dynamics of interest rate pass-through and the long-run equilibrium relationship between retail interest rates and prime rate. Finally, this chapter provides various approaches and tests for analysing the behaviour of interest rate pass-through in Thailand.

4.1 Cointegration

4.1.1 Stationarity, integration and unit root

Most time series analysis is based on the proposition of stationarity. A time series is defined as stationary when its mean and variance are both constant. In the case of non-stationarity, time series can be differenced once or more times to achieve stationary (Box, Jenkins & Reinsel, 1994). Thus, a differenced stationary series is said to be integrated of order $I(d)$, where *d* is the number of differencing orders. Processes with $d \geq 1$ are recognised as having a unit root.

Given most economic and financial time series analyses are potentially non-stationary,[18] direct regression analysis by using non-stationary data may produce spurious results (Engle & Granger, 1987).[19] Similarly, interest rates are time series data with potentially non-stationary features. Therefore, it is critical and natural to first investigate whether retail interest rates and the prime rate are unit root processes before cointegration tests.

The assumption of stationary time series can be tested using either the ADF test (Dickey & Fuller, 1979; Said & Dickey, 1984) or Dickey-Fuller (DF). This research is using the ADF method to investigate unit root processes. Assuming that a time series

[18] A typical application is to model them as a random walk, which is non-stationary.
[19] A spurious regression usually exhibits significantly high t-statistics for explanatory variables but their overall explanatory power, i.e. the goodness of fit, is poor.

of interest rates, x_t, is a $AR(p)$ process; an ADF-based unit root test following regression can be estimated by OLS:

$$\Delta x_t = \mu + \beta x_{t-1} - \sum_{i=1}^{p} \alpha_i \Delta x_{t-i} + \varepsilon_t \quad (1)$$

In the above equation for the ADF test, only a constant μ is included as the exogenous variable,[20] and the unit root test is equivalent to testing the significance of $\hat{\beta}$. For instance, if the test result for an interest rate series is greater than critical-value at the chosen level, it would be recognised as non-stationary, which confirms the existence of unit root processes. Similarly, the ADF test can be applied to differentiated data. In particular, a time series data which is non-stationary at its levels can be first differenced and then examined by ADF tests. The same process can be repeated by testing higher orders of differencing until the differenced time series is stationary.

4.1.2. Cointegration

A linear combination of non-stationary/integrated time series can be stationary if their trends co-move over time, and the process is defined as cointegrated (Brooks, 2008). The existence of cointegration implies that the non-stationary time series may share a common long-run trend. In the case of interest rate pass-through, retail interest rates and prime rate may be bounded by a long-run equilibrium relation, if they are cointegrated. Specifically, retail interest rates that deviate from prime rate are more likely to adjust back towards prime rate in the long-run.

There are several techniques that can be used to test for cointegration, namely the Engle-Granger two-step residual based approach (Engle & Granger, 1987); Johansen Maximum Likelihood approach (Johansen, 1988) and Cointegration Regression Durbin-Waston (CRDW) approach.[21] In this study, the Engle-Granger two-step approach is used for testing cointegration. The reason is that a maximum of n-1 cointegrating relations exists for n variables in practice, which implies one possible

[20] Other exogenous variables, such as a time trend, are deemed not necessary for the nature of historical interest rates.
[21] For a detailed discussion on cointegration tests see Brooks (2008).

cointegrating relation between retail and prime rate. Hence Johansen's cointegration method, which is mainly used for multiple cointegrating relations, appears to be excessive.

Since the cointegration test requires a time series to be non-stationary, this study first applies the unit root tests discussed in Eq. (1) to determine whether the series are of type $I(1)$. Depending on their unit root test results, if both interest rates and prime rate are proved to be $I(1)$s, e.g. they are not stationary at their levels; they will then be further examined by Engle-Granger's cointegration tests.

4.1.3 Engle-Granger's two-step cointegration approach

Let us assume a set of explanatory variables $x_{it}(i=1,...,n)$ and dependent variable y_t are all $I(1)$s. The first step in the Engle-Granger method estimates a standard linear regression of variables using Ordinary Lease Squares (OLS):

$$y_t = \beta_0 + \sum_{i=1}^{n} \beta_i x_{i,t} + \varepsilon_t \qquad (2)$$

which gives the residual term ε_t in equation that is estimated as:

$$\hat{\varepsilon}_t = y_t - \hat{y}_t$$
$$\hat{y} = \hat{\mu} + \hat{\alpha} x_t$$

Then the second step applies a unit root test on the stationarity of residuals under $H_0 : \hat{\varepsilon}_t \sim I(1)$ against $H_1 : \hat{\varepsilon}_t \sim I(0)$. If the null hypothesis of a unit root is not rejected and the residual term is non-stationary, then there is no cointegration among them even though they are proved to be $I(1)$s. In this case, a standard regression should be made on their first differences. Note that if the underlying economic theory related to these variables is correct, then the time series in the levels must be $I(1)$ and co-integrated such that there exists a linear combination of the $I(1)$ variables being $I(0)$.[22]

[22] See Hendry (1995) and Hendry and Krolzig (2005) for examples.

Based on the methodologies that have been discussed in Sections 4.1.1 to 4.1.3, I am able to investigate the cointegrating relations between the retail interest rates and the prime rate in hypothesis 1.

4.1.4 Engle-Granger's two-step error-correction model (ECM) approach

Eq. (2) can be further estimated when the non-stationary time series are cointegrated. Based on their two-step cointegration approach, Engle and Granger (1987) propose a two-step method for estimating an error-correction model (ECM). The first step of the ECM approach is consistent with the first procedure of Eq. (2). However, in the second step, the first difference of y_t is regressed on the lagged level of the estimated residuals $\hat{\varepsilon}_t$, together with lagged first differences of x_{it} using OLS, which can be expressed as :

$$\Delta y_t = \alpha_0 + \gamma \hat{\varepsilon}_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta x_{i,t-1} + \mu_t \qquad (3)$$

where Δ is the first order differencing operator.

Eq. (3) enables this study to capture both short-run dynamic and long-run equilibrium.

In the case of interest rate pass-though, retail interest rates and prime rate might be bounded by a long-run equilibrium relationship, if they are proved to be cointegrated by the Engle-Granger method. In addition, dynamics of interest rates series with a cointegration relationship can be further analysed by the Engle-Granger ECM approach. However, owing to the nature and complexity of interest rate pass-through in emerging markets, the Engle-Granger ECM method should be further augmented, which will be discussed in Sections 4.2 and 4.3.

4.2 Long-run equilibrium of interest rate pass-through

In this part, I first examine the long-run pass-through from prime rate to retail interest rates. The long-run relationship between retail interest rate and prime rate can be depicted as:

$$y_{i,t} = \alpha_{i,0} + \alpha_{i,1} x_t + \varepsilon_{i,t}; i = 1,...,n \quad (4)$$

where $y_{i,t}$ represents endogenously determined (lending or deposit) interest rates; x_t denotes monetary policy rate/prime rate, which is assumed to be exogenously determined by the central bank; $\varepsilon_{i,t}$ is the stochastic error term; while $\alpha_{i,0}$ and $\alpha_{i,1}$ are the constant long-run parameters. Specifically, $\alpha_{i,0}$ measures the mark-up for the retail product with a given maturity (for deposits) or with a given risk profile (for loans). The mark-up $\alpha_{i,0}$ accounts for idiosyncratic risk of the different retail products (Rousseas, 1985; De Bondt, 2002; Aziakpono & Wilson, 2010); $\alpha_{i,1}$ is the slope representing the long-run reaction of retail interest rates to money market changes.

Under the assumption of perfect competition across individual banks, $\alpha_{i,1}$ is expected not to be statistically different from one in earlier studies (Bernanke & Gertler, 1995; Kashyap & Stein, 2000; Altunbas & Molynuex, 2002). However, as discussed previously, such perfect competition in emerging markets may not be realistic in practice, and usually due to the oligopolistic structure of the banking sector, entry barriers, and product differentiation, banks can possess significant market power over their customers, and they may be unwilling to pass on any changes in interest rates administered by them, causing $\alpha_{i,1}$ to be less than one. Indeed, De Bondt (2005), Aziakpono and Wilson (2010) specify that $\alpha_{i,1}$ should range between zero and one for the cost of fund approach,[23] where $\alpha_{i,1}$ is close to zero when the degree of long-run interest rate pass-through is very slow, and $\alpha_{i,1}$ is close to one when long-run pass-through is complete.

With regard to the argument on long-run interest rate pass-through, I therefore conduct a Wald-test (F-test) to examine hypothesis 2, for which $H_0 : \alpha_{i,1} = 1$ against $H_1 : \alpha_{i,1} \neq 1$, as discussed in section 3.2, where a Wald-test can be defined as:

[23] However, it is possible that the average of long-run pass-through is higher than 1 for certain scenarios, for example, banks charge higher interest rates to compensate anticipated higher risks purely from asymmetric information rather than loans reduction (De Bondt, 2005).

$$F = \frac{(\hat{\alpha} - \alpha_0)^2}{[SE(\hat{\alpha})]^2} \sim F(1, n-k)$$

where n is the number of the observations and k is the number of independent variables.

The theory suggests that the long-run pass-through should be homogeneous among identical products across individual banks, where $\alpha_{i,1}$ should converge at the industry level α_1 to avoid any arbitrage activities. However, earlier studies indicate a significant heterogeneous behaviour on $\alpha_{i,1}$, especially when the analysis includes individual marketing policy, initial financing/portfolio structure, present and future customers' preferences, and solvency ratio (Szafrański, 2009). I therefore examine the dispersion of long-run interest rate pass-through across various retail products, defined as per Hypothesis 3 by conducting the following test: $H_0 : \alpha_{i,1} = \alpha_1$ against $H_1 : \alpha_{i,1} \neq \alpha_1$ with a Wald-test.

4.3 Dynamics of interest rate pass-through

In the presence of asymmetry, imperfectness and sluggishness of interest rate pass-through, the static framework of Eq. (4) is not appropriate for capturing these short-run behaviours, and the transmission mechanism of the monetary policy is usually analysed in a dynamic framework.

To estimate short-run dynamics of retail interest rates in response to prime rate changes, this study employs an error-correction methodology as per Heffernan (1997) and Scholnick (1996) for analysing the speed and level of interest rate pass-through in literature. Thus, an error-correction model can be expressed as:

$$\Delta y_{it} = \beta_0 \Delta x_{it} + \delta\left(y_{i,t-1} - \alpha_{i0} - \alpha_{i1} x_{i,t-1}\right) + \sum_{m=1}^{p} \Pi_i \Delta x_{i,t-m} + \sum_{m=1}^{q} \Gamma_i \Delta y_{i,t-m} + v_{it} \qquad (5)$$

Here, β_0 measures immediate pass-through rate at time t for each individual bank; $y_{i,t-1} - \alpha_{0i} - \alpha_{1,i} x_{i,t-1}$ represents the residual term of long-run relationship, which is

defined in Eq. (4). Hence, δ is the coefficient of Eq. (5), which captures adjustment speed when retail interest rates deviate away from the long-run equilibrium. In addition, δ is expected to be negative according to the mean-reverting feature of normal interest rates (Taylor, 1993); v_{it} is the stochastic error term; Π_i and Γ_i are dynamic adjustment coefficients to ensure that v_{it} is not serially correlated.[24]

The mean adjustment lag (MAL) method is then applied to decide the time required for retail interest rates to adjust towards long-run equilibrium. The calculation of MAL in this dissertation follows Doornik and Hendry's (1995) approach, which can be expressed as:

$$MAL = (\beta_0 - 1)/\delta \qquad (6)$$

Eq. (6) measures the time required for the retail interest rate to eliminate the deviation from the long-run, which measures the speed of retail interest rate adjustment to equilibrium in response to prime rate changes. It describes the degree of rigidity for Eq. (5).

With regard to the assumption that pass-through is incomplete in the short-run, I therefore conduct a Wald-test to examine hypothesis 4, for which β_0 in Eq. (5) is equal to one, against β_0 is not equal to one.

Concentration in the banking sector may have impacts on the adjustment speed, as discussed previously; therefore, I further examine hypothesis 5 by comparing δ and MAL in Eq. (5) and Eq. (6) respectively, according to the banks' concentration (domestic banks vs. foreign bank branches) based on a Wald-test.

Eq. (5) and (6) are commonly applied in the literature due to the assumption of symmetric adjustment speed, when retail interest rates are either below or above equilibrium (Scholnick, 1996; Aziakpono et al, 2007). However, there is the possibility that adjustment might be asymmetrical, when retail interest rates are either above or below equilibrium. Thus, Section 4.4 discusses a modified ECM framework with the presence of asymmetry.

[24] The number of lags, p and q is determined by AIC statistic.

4.4 Augmented error-correction model for asymmetric interest rate pass-through

In the presence of asymmetry, this research follows the traditional methodology that has been applied in the literature to analyse the speed and level of interest rate pass-through, namely the augmented error-correction model (ECM) or asymmetric ECM as per Chong et al. (2006) for Singapore and Liu et al. (2011) for New Zealand. Thus, Eq. (5) can be rewritten as:

$$\Delta y_{it} = \beta_0 \Delta x_{it} + \delta_{it}^{+} \lambda EC_{i,t-1} + \delta_{it}^{-} (1-\lambda) EC_{i,t-1} + \sum_{m=1}^{p} \Pi_i \Delta x_{i,t-m} + \sum_{m=1}^{q} \Gamma_i \Delta y_{i,t-m} + \nu_{it} \qquad (7)$$

$$EC_{it} = \mathrm{y}_{it} - \alpha_{0i} - \alpha_{1i} x_{it}$$

where δ_{it}^{+} captures the error-correction adjustment speed when the retail interest rates are above equilibrium and δ_{it}^{-} captures the error-correction adjustment speed when the rates are below equilibrium; λ is a dummy variable, which equals to one when $EC_{i,t} \geq \mu$, or zero otherwise, μ is the mean of EC_{it}.

Similarly, Eq. (7) can be further derived as the asymmetric mean adjustment lag either above or below their equilibrium means as shown in Eq. (8) and (9):

$$MAL^{+} = (\beta_0 - 1) / \delta^{+} \qquad (8)$$

$$MAL^{-} = (\beta_0 - 1) / \delta^{-} \qquad (9)$$

A standard Wald-test with $\chi^2(1)$ distribution on the restriction that $\delta_{it}^{+} = \delta_{it}^{-}$ applies to determine the existence of asymmetric adjustment. By testing $H_0 : \delta^{+} = \delta^{-}$ against $H_1 : \delta^{+} \neq \delta^{-}$, the Wald-test gives an important implication on the asymmetric reaction of retail interest rates in response to either expansionary or contractionary monetary policies in this study. In particular, asymmetric mean adjustment lag further indicates the degree and speed of price rigidity in interest rate pass-through analysis.

4.5 Sub-sample analysis

Finally, price rigidity of short-run pass-through can be tested in connection with major systematic breaks occurring during the sample period. Specifically, Hypotheses

7 and 8, which are proposed in Section 3.5 can be carried out in the same way as per Hypotheses 4, 5 and 6 but using relevant sub-sample periods.

Note that Hypothesis 7 uses the two sample periods prior to the global financial crisis: pre and post the inflation target monetary policy regime, and Hypothesis 8 applies the two sample periods: pre and post the global financial crisis in the era of the inflation target monetary policy regime in Thailand.

Chapter 5: Data

This chapter provides an overview on the data used in this study, including which data are obtained and pre-processed, the validation of data and a detailed description on data properties.

5.1 Data collection and pre-processing

5.1.1 Retail interest rates in Thailand

This study uses monthly series interest rate data of all registered commercial banks and foreign bank branches in Thailand, which have been obtained from the Bank of Thailand (BOT) website.[25] As discussed previously, available deposit and lending rates for individual banks and foreign bank branches are:

- deposit interest rates, including savings and fixed deposits, the latter of which consist of 3-month, 6-month, 12-month and 24-month rates
- loan interest rates, which comprise of Minimum Overdraft Rate (MOR), Minimum Loan Rate (MLR), Minimum Retail Rate (MRR). [26]

To increase the transparency of the banking system, the Bank of Thailand started to collect interest rate instruments in January 1996 and data are only available on a calendar month-end basis until 2000, from which date data are published on a daily basis. As the study requires pre-2000 data to fulfil its objectives, the monthly data frequency is chosen and the time points for all data are the last business day of the calendar month. The sample period is between January 1996 and July 2013.[27]

Note that published deposit rates of individual banks are in ranges with a maximum and a minimum rate for individual banks (if they are available) on a daily basis. In this study, the midpoint rate, which is calculated as the average of the maximum and the minimum rates, is used as a proxy of the deposit rates for analysis.

[25] http://www.bot.or.th/English/Statistics/FinancialMarkets/Interestrate/_layouts/application/interest_rate/IN_Rate.aspx.
[26]The MOR, MLR and MRR stand for overdraft facilities for corporate customers with good standing, term loans for corporate customers in good standing and retail customers in good standing, respectively.
[27] However, no data are available for 24-month deposits prior to 2000.

As far as individual commercial banks and foreign bank branches are concerned, there are in total 63 entities during the sample period.[28] However, during this period quite a few of them were either merged or acquired and names of consolidated entities are listed in Appendix B[29]. Such consolidations reflect the environment of the general economy and financial market, and potential structural changes. Finally, there are 46 banks/branches after the consolidation, which are the number of registered commercial banks and foreign bank branches that either are running or ran deposit/lending businesses in Thailand. Among these consolidated banking entities, there are 28 commercial (domestic) banks whereas 18 are registered as foreign bank branches.

It should be mentioned that one of the important reasons in motivating this research is the highly oligopolised banking sector in Thailand. As discussed previously, on the one hand, existing literature documents that the oligopolistic structure in the banking sector may have a significant impact on the interest rate pass-through process; on the other hand, as a matter of fact, the concentration in Thailand's banking system increases significantly over time (Kubo, 2006). However, recent studies on Thailand tend to focus on the oligopolistic structure in general. For instance, a majority of studies[30] investigate the impact of oligopolistic structure on the interest rate pass-through by obtaining a group of the largest public banks of domestic origin. However, it appears that there is a gap in knowledge as to whether the pass-through process differs between lager banks and the banks with low concentration. To investigate the impact of oligopolistic structure on retail interest rate pass-through, I further classify the 46 banks into three sub-groups based on their concentration, the industry average, the domestic banks and the foreign bank branches, for which the domestic banks represent the high concentration/oligopoly and foreign bank branches represent low concentration/competition. Next I compute monthly average rate on each interest rate series in the sub-groups respectively, for the entire sample period. Now I have three sub-datasets and each of them contains five deposit rates and three lending rates as introduced before, thus, I am able to assess and compare precisely the impact of the

[28] For the full list of entity names see Appendix A.
[29] This table was consolidated based on the unique identities of all 63 banks/branches published by BOT by searching historical data of any individual banks, and hence it is not guaranteed that these names are the active ones.
[30] Disyatat and Vongsinsirikul, 2003; Charoenseang and Manakit, 2007.

oligopolistic structure on interest rate pass-through and fill in the knowledge gap for Thailand.

5.1.2 Base rates in Thailand

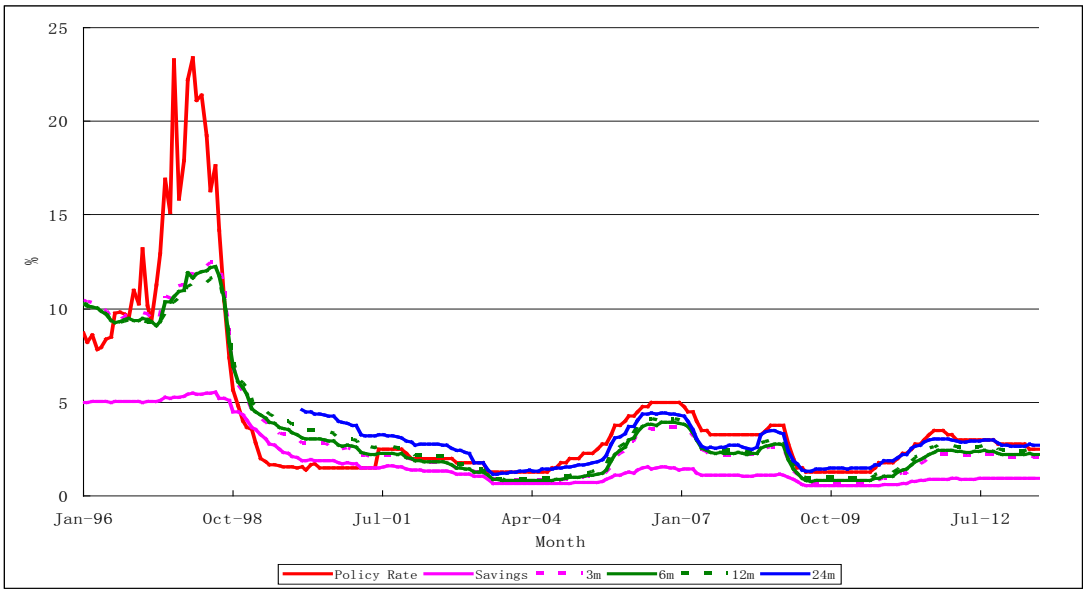
Note that the prime rate used in this study contains two forms. There is no market instrument for monetary policies in Thailand until 2000 when the Bank of Thailand established an official policy rate such as the base rate. Hence, a proxy of the base rate should be determined for data prior to 2000. Since the first policy interest rate set by BOT under its inflation-target framework was the 14-day Repo (RP) rate, it is natural to choose the 14-day RP rate as the prime rate for the pre-2000 period.

5.2 Data descriptive statistics

Figures 1-4 show plots of the historical average rates of deposits and loans, respectively, for commercial banks and foreign bank branches in Thailand, together with the prime rate. In general, the prime rate and interest rates are more volatile during the two financial crisis periods of 1997-2000 and 2000-2008, compared with the rest of the sample period. For instance, the prime rate shows significant movements with sharp increases and/or decreases during financial turbulence. Specifically, the volatilities are extremely high in 1997, when Thailand was central to the Asian financial crisis, and the Bank of Thailand was forced to modify its monetary policy frequently in order to stabilise the economy. Regarding the prime rate changes, Figures 1 and 2 show immediate and frequent adjustments on deposit rates to the response of unexpected shocks. The direction of changes on deposit rates for both domestic banks and foreign branches tend to be consistent with the direction of prime rate changes. In contrast with the deposit rates, Figures 3 and 4 show that lending rates exhibit a slightly lagged response to the prime rate changes when there is a shock to prime rate.

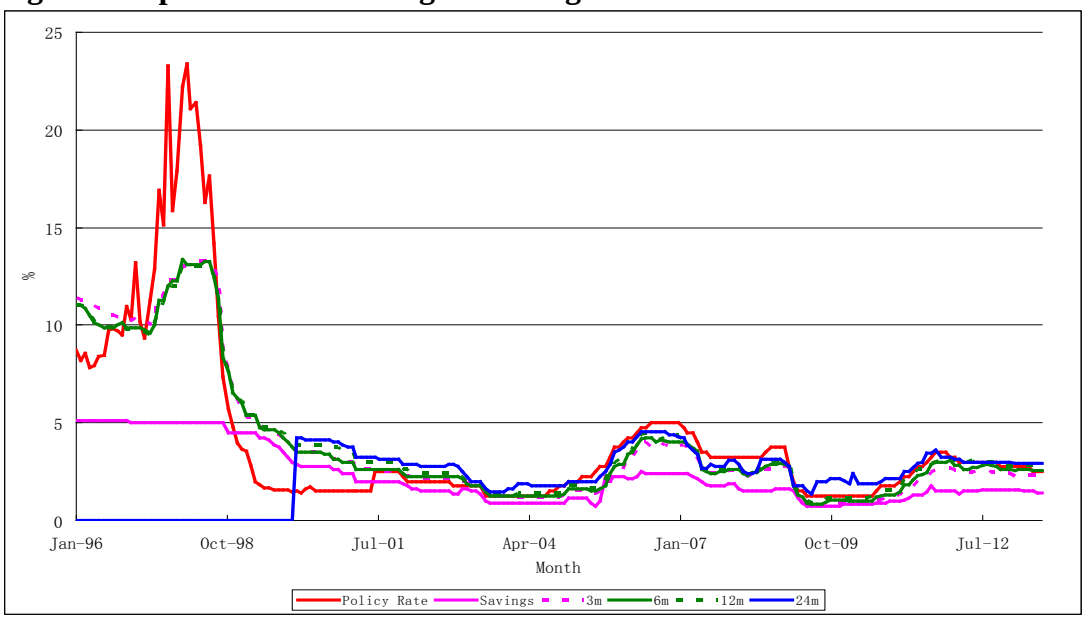
Figures 1-4 imply that the spread between the prime rate and deposit rates is narrower than the spread between prime rate and lending rates, for both domestic banks and foreign bank branches.

Figure 1 Deposit Rates - Average of Commercial Banks Registered in Thailand



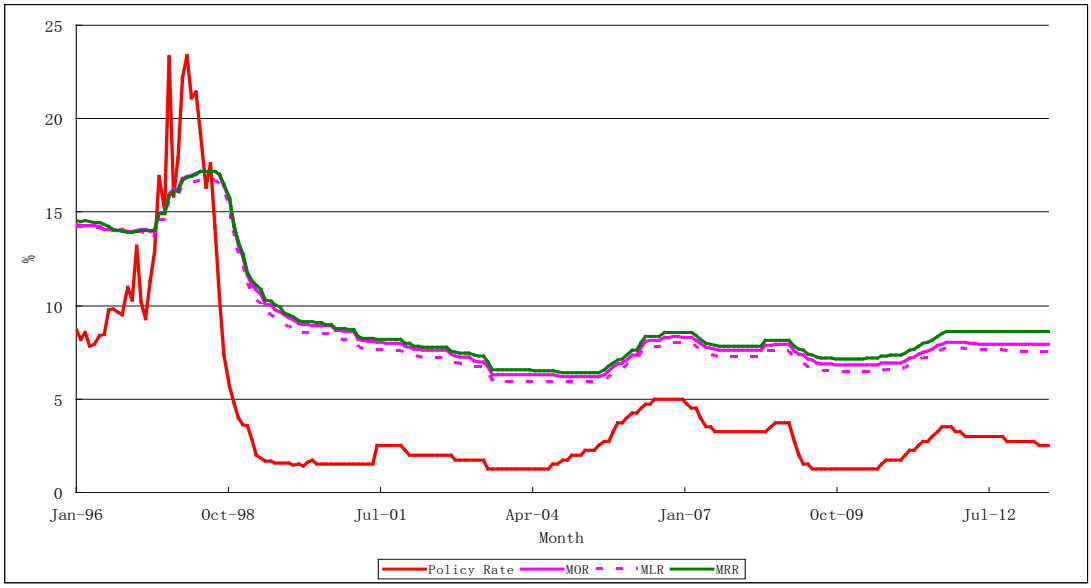
Note: The sample period is from January 1996 to July 2013. The figure plots monthly movements of prime rate and retail interest rates in Thailand. Policy rate = 14-day repurchase rate for commercial banks; Savings = saving rate for domestic banks; 3m = 3-month fixed deposit rate for domestic banks; 6m = 6-month fixed deposit rate for domestic banks; 12m = 12-month deposit rate for domestic banks; 24m = 24-month deposit rate for domestic banks.

Figure 2 Deposit Rates - Average of Foreign Bank Branches in Thailand



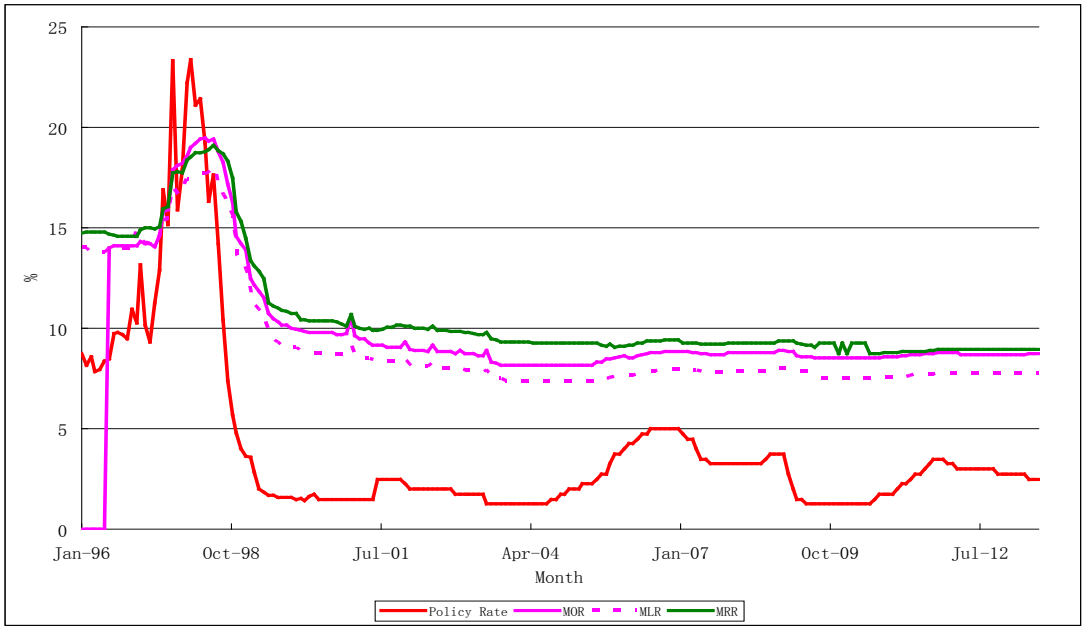
Note: The sample period is from January 1996 to July 2013. Policy rate = 14-day repurchase rate for commercial banks; Savings = saving rate for foreign bank branches; 3m = 3-month fixed deposit rate for foreign bank branches; 6m = 6-month fixed deposit rate for foreign bank branches; 12m = 12-month deposit rate for foreign bank branches; 24m = 24-month deposit rate for foreign bank branches.

Figure 3 Loan Rates - Average of Commercial Banks Registered in Thailand



Note: The sample period is from January 1996 to July 2013. Policy rate = 14-day repurchase rate for commercial banks; MOR = retail over drafts in domestic banks; MLR = minimum lending rate for major borrowers in domestic banks; MRR = minimum lending rate for retail borrowers in domestic banks.

Figure 4 Loan Rates – Average of Foreign Bank Branches in Thailand



Note: The sample period is from January 1996 to July 2013. Policy rate = 14-day repurchase rate for commercial banks; MOR = retail over drafts for foreign bank branches; MLR = minimum lending rate for major borrowers for foreign bank branches; MRR = minimum lending rate for retail borrowers for foreign bank branches.

For instance, Figures 1-2 show that despite the financial crisis in 1997, the spread between deposit and prime rates is moving within a 5% boundary for both domestic and foreign banks, for which the lower bound is within 1%[31] during 2000 to 2007. However, the spread between the lending and prime rates is wider during the same period, and the lower boundary of spread between prime rate and MOR, MLR, MRR, which are all close to 2% as shown in Figures 3-4.

Table 1 provides descriptive statistics for the sample. The descriptive statistics for industry average, domestic commercial banks and foreign bank branches are reported in Panel A, B and C, respectively. All panels show that the mean deposit rates for saving, 3-month, 6-month and 12-month deposit rates are positively related to maturity, which are indicated by upward sloping yield curves.[32]

As can be seen from Table 1, the average interest rates in Panel B are higher than those in Panel C, which implies significant differences between commercial banks and foreign bank branches in terms of their retail rates on markets. On the one hand, domestic banks pay their customers higher rates for their deposits than foreign bank branches for both savings and across all term products. For example, domestic banks pay an interest rate of 2.29% on average to customers' saving accounts whereas foreign bank branches only pay 2.15%; for term deposits, the interest rate margin between domestic and foreign rates can range from 0.66% for the 24-month term to 0.84% for 12-month deposits. On the other hand, domestic banks charge customers less for their loans than foreign ones. For instance, the three most important lending benchmark rates such as MOR, MLR and MRR are 8.96%, 8.60% and 9.21% for domestic banks, on average; however, their mean values are 9.99%, 9.24% and 10.70% for all foreign bank branches. Hence, by offering competitive products to customers compared to foreign bank branches, it is plausible to expect that domestic banks' oligopolistic structure has increased, as discussed before.

[31] The 1% is a general estimation from figures rather than a calculation base.
[32] The average mean for 24-month deposit products are 2.82% and 2.16% for domestic banks and foreign bank branches, respectively; however, those lower values are due to the fact that within the sample period, there are 49 missing values, which resulted in biased calculations and results.

Table 1
Descriptive Statistics of Prime and Retail Interest Rates: 1996-2013

Panel A. Descriptive Statistics of Historical Rates - Average of All Banks

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Mean	4.16	1.85	3.38	3.46	3.60	2.65	9.52	8.94	9.96
Median	2.75	1.13	2.19	2.30	2.58	2.71	8.32	7.66	8.73
Maximum	23.37	5.56	12.46	12.25	11.67	4.58	18.19	17.46	18.24
Minimum	1.25	0.53	0.70	0.80	0.86	1.18	7.20	6.75	7.70
Std. Dev.	4.51	1.59	3.27	3.16	3.03	0.96	2.93	2.97	2.85
Skewness	2.54	1.40	1.64	1.59	1.48	0.25	1.73	1.69	1.69
Kurtosis	6.31	0.38	1.31	1.20	0.93	-0.82	1.75	1.41	1.56

Panel B. Descriptive Statistics of Historical Rates - Average of Commercial Bank Branches

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Mean	4.16	2.29	3.84	3.9	4.03	2.82	8.96	8.6	9.21
Median	2.75	1.63	2.5	2.63	2.93	2.88	7.94	7.53	8.17
Maximum	23.37	5.13	13.25	13.38	13	4.53	17.17	16.72	17.17
Minimum	1.25	0.73	0.75	0.83	0.9	1.38	6.21	5.91	6.39
Std. Dev.	4.51	1.45	3.48	3.34	3.24	0.83	3.02	3.04	2.93
Skewness	2.54	0.99	1.62	1.62	1.57	0.31	1.54	1.55	1.51
Kurtosis	6.31	-0.46	1.27	1.39	1.29	-0.69	1.09	1.03	1.04

Panel C. Descriptive Statistics of Historical Rates - Average of Foreign Bank Branches

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Mean	4.16	2.15	3.04	3.11	3.19	2.16	9.99	9.24	10.7
Median	2.75	1.5	2	2.1	2.25	2.13	8.77	7.85	9.3
Maximum	23.37	8.75	10.75	10.88	10	4.56	19.46	18.04	19.08
Minimum	1.25	0.64	0.65	0.8	0.8	0.88	8.14	7.38	8.72
Std. Dev.	4.51	1.87	2.9	2.77	2.67	0.89	2.85	2.91	2.75
Skewness	2.54	1.89	1.59	1.53	1.45	0.5	2.15	1.78	1.81
Kurtosis	6.31	3.11	1.1	0.96	0.72	-0.57	3.52	1.76	2.03

Note: Table 1 reports the descriptive statistics of the prime rate and retail interest rates for the industry average, commercial banks and foreign bank branches, respectively. The sample period is from January 1996 to July 2013. No data are available for 24-month deposits prior to 2000.

Table 1 also indicates that the retail rates for both deposits and loans provided by commercial banks are relatively more volatile than comparable products offered by foreign banks. The standard deviation is 3.48% for domestic banks' 3-month deposits compared to 2.90% for foreign ones, and among the three lending rates, the maximum volatility for both inland and foreign banks is 3.04% and 2.91%, respectively.

Table 2
Correlation Coefficients of Interest Rates in Thailand: 1996-2013

Panel A. Correlation Coefficients - Average of All Banks Registered in Thailand

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Prime Rate	1								
Savings	0.9238	1							
3m	0.8944	0.9839	1						
6m	0.8786	0.9825	0.9935	1					
12m	0.8712	0.9841	0.9918	0.9841	1				
24m	0.6249	0.8497	0.9289	0.8497	0.9289	1			
MOR	0.8919	0.9565	0.9568	0.9565	0.9568	0.9565	1		
MLR	0.8868	0.9741	0.9662	0.9741	0.9662	0.9741	0.9662	1	
MRR	0.8587	0.9627	0.9410	0.9627	0.9410	0.9627	0.9410	0.9627	1

Panel B. Correlation Coefficients - Average of Commercial Banks Registered in Thailand

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Prime Rate	1								
Savings	0.7526	1							
3m	0.9032	0.9385	1						
6m	0.9136	0.9358	0.9986	1					
12m	0.9062	0.9408	0.9976	0.999	1				
24m	0.6432	0.9063	0.9467	0.9532	0.968	1			
MOR	0.8662	0.9411	0.9772	0.9775	0.9779	0.8438	1		
MLR	0.8677	0.9423	0.981	0.9807	0.9808	0.8579	0.9995	1	
MRR	0.8619	0.9358	0.9738	0.9749	0.9753	0.8009	0.9986	0.9982	1

Panel C. Correlation Coefficients - Average of Foreign Bank Branches in Thailand

	Prime Rate	Savings	3m	6m	12m	24m	MOR	MLR	MRR
Prime Rate	1								
Savings	0.9238	1							
3m	0.8944	0.9643	1						
6m	0.8786	0.9553	0.9968	1					
12m	0.8712	0.9527	0.9955	0.9983	1				
24m	0.6249	0.8722	0.9407	0.9149	0.9268	1			
MOR	0.8919	0.9601	0.9635	0.956	0.9494	0.6672	1		
MLR	0.8868	0.9612	0.975	0.9678	0.9624	0.6443	0.9945	1	
MRR	0.8587	0.95	0.9549	0.947	0.9409	0.3918	0.9912	0.9926	1

Note: Table 2 reports the correlation coefficients among the interest rates. The sample period is from January 1996 to July 2013. Correlation coefficients for 24-month deposits in Panel A, B and C are not comparable with the other saving products since 49 observations are missing during the sample period.

Table 2 reports pair-wise correlation coefficients among prime rate and retail interest rates of the industry average, domestic commercial banks and foreign bank branches, respectively reported by Panel A, B and C. Overall, correlation dispersions among the three panels are relatively small as the differences of calculated numbers are not

obvious. For deposits, the prime rate is highly and positively correlated with savings and other short-term deposit products, irrespective of bank types. Similarly, the correlation between prime rate and the three major lending rates MOR, MLR, and MRR are also highly correlated in all panels; however, on average, the deposit rates are slightly more highly correlated with prime rate than loan rates.

In terms of pair-wise correlations between interest rate variables, although all deposit rates and three benchmark lending rates are separately highly correlated, their cross-correlations are much bigger for domestic banks than foreign ones. For example, the minimum correlation between 24-month saving rate and MRR rate is 80% for domestic banks compared to that of 39% for foreign banks.

Chapter 6: Results

This chapter discusses the results of the empirical tests, including cointegration tests for the relation between prime rate and retail interest rates; the long-run pass-through; the short-run dynamics of interest rate pass-through; short-run asymmetric interest rate pass-through and structural breaks.

6.1 Stationarity and cointegration results

6.1.1 Results of stationarity tests

The results of the stationarity tests on the full data sample of prime rate and retail interest rate series are summarised in Table 3. The augmented Dickey-Fuller (ADF) test results confirm the non-stationarity based on the level of all interest rate series, for which the null hypothesis of a unit root cannot be rejected at 5% significance for the entire sample. However, the test results suggest that this hypothesis can be rejected at the 5% level of significance by taking first differences for all interest rates, and all interest rate series are stationary.

6.1.2 Results of Engle-Granger cointegration test

This section tests the hypothesis of the existence of cointegrated relations between the prime rate and retail interest rates in Section 3.1. I assess this hypothesis by using Engle-Granger's (EG) two-step cointegration approach and Table 4 displays the estimated results for Eq.(2). Most of the results in column 3 of Table 4 are significant at 10% significance level and I therefore accept that the null hypothesis of cointegrated relations exist between the prime rate and retail interest rates. In general, most of the deposit rates are cointegrated with the prime rate at 5% level of significance, irrespective of their bank types.

Table 3
Results of Augmented Dickey-Fuller Unit Root Tests

		Level	1st difference
Prima Market Rate		-2.049 (10)	-5.222*** (8)
Panel A. Industry Average			
	savings	-2.706 (4)	-3.181** (3)
	dpt3m	-1.990 (6)	-4.054*** (4)
	dpt6m	-2.020 (6)	-3.872*** (4)
	dpt12m	-1.957 (6)	-3.996*** (4)
	dpt24m	-2.610* (6)	-4.364*** (2)
	MOR	-1.823 (14)	-3.482*** (2)
	MLR	-1.925 (14)	-3.510*** (2)
	MRR	-1.926 (14)	-3.711*** (2)
Panel B. Commercial Banks			
	savings	-1.909 (1)	-3.763*** (7)
	dpt3m	-2.235 (2)	-4.476*** (4)
	dpt6m	-2.217 (9)	-4.502*** (4)
	dpt12m	-2.263 (2)	-4.430*** (4)
	dpt24m	-2.287 (1)	-5.308*** (2)
	MOR	-2.133 (4)	-3.584*** (2)
	MLR	-2.108 (4)	-3.808*** (2)
	MRR	-1.996 (14)	-3.590*** (2)
Panel C. Foreign Bank Branches			
	savings	-1.635 (13)	-3.524*** (8)
	dpt3m	-1.926 (2)	-4.081*** (4)
	dpt6m	-2.001 (2)	-6.076*** (8)
	dpt12m	-1.969 (2)	-4.693*** (3)
	dpt24m	-2.594 (1)	-4.199*** (5)
	MOR	-2.519 (4)	-3.497*** (3)
	MLR	-1.826 (14)	-3.432*** (3)
	MRR	-1.807 (14)	-3.245** (6)

Note: Table 3 reports ADF test results for the industry average, commercial banks and foreign bank branches in Panel A, B and C, respectively. The sample period is from January 1996 to July 2013. The ADF unit root test is based on a single exogenous variable as a constant, and the number of optimal lags is given in parenthesis, which is determined by the minimum of both SIC and/or AIC. ***, ** and * denote the significance level at 1%, 5% and 10%, respectively.

Table 4
Results of Engle-Granger Cointegration Tests

		E-G t-value
Panel A. Industry Average		
	savings	-3.018
	dpt3m	-4.401***
	dpt6m	-4.294***
	dpt12m	-4.009***
	dpt24m	-3.690**
	MOR	-3.232*
	MLR	-3.292*
	MRR	-3.027
Panel B. Commercial Banks		
	savings	-2.605
	dpt3m	-4.166***
	dpt6m	-4.360***
	dpt12m	-4.269***
	dpt24m	-3.126*
	MOR	-3.216*
	MLR	-3.315*
	MRR	-3.205*
Panel C. Foreign Bank Branches		
	savings	-4.281***
	dpt3m	-3.947**
	dpt6m	-3.849***
	dpt12m	-3.771***
	dpt24m	-4.564***
	MOR	-3.203*
	MLR	-3.254*
	MRR	-2.861

Note: The Table 4 reports the Engle-Granger Conintegration results for the industry average, the commercial banks and foreign bank branches in Panel A, B and C, respectively. The sample period is from January 1996 to July 2013. The Engle-Granger cointegration test is based on the DF test for non-stationarity of OLS regression residuals. ***, ** and * denote the significance level at 1%, 5% and 10%, respectively.

The only exception is the 24-month deposit rate from domestic banks, for which the t-value (-3.126) is significant at the 10% level. In contrast to deposit rates, cointegrated relations are weaker between lending rates and prime rate, as they are either significant at a lower level or are statistically insignificant. For instance, t-values of the MOR and the MLR are only significant at the 10% critical level irrespective of bank types. Indeed, the t-value reports in Table 4 show the MRR appears insignificant even at the 10% level for foreign banks.

It should be noted that the EG's cointegration test is based on the ADF test for unit roots in residuals, and as this type of unit root test is sensitive to initial conditions such as seasonality and significant structural breaks, the latter of which could be caused by the global financial crisis. Negligence of these characteristics tends to fail

to reject the unit root hypothesis, leading to more type II errors.[33] Besides, Lucey and Tully (2006) also argue that the strength of cointegration varies over time, specifically, they find cointegration becomes weaker during financial turbulence. In addition, t-value of the MRR for foreign banks and savings are not far greater than the critical value. Therefore, it is plausible to assume the existence of cointegrated relations between prime rate and lending rates in this research.

In short, both the unit root test and Engle-Granger cointegration tests confirm that all the prime rate series and major retail interest rate series are generally cointegrated for the entire sample period.

6.2 Long-run pass-through results

This section investigates the hypothesis that the interest rate pass-through is complete in the long-run, as addressed in Section 3.2. To examine whether there is a one-on-one transmission between the prime rate and retail interest rates, I estimate Eq. (4) and the results are reported in Table 5.

The third column of Table 5 represents the intercept of Eq. (4), which measures the mark-up proposed by individual banks. The mark-up for deposit products varies from 0.562 to 1.586 and the mark-up for loans are in a range of 6.170 to 8.519. It is not surprising that the mark-up for lending products is significantly higher than that for deposit rates, regardless of bank types. One plausible explanation is that loans are riskier than deposit products from the banks' perspective, thus, retail banks normally charge a premium on customers when they are lending. Besides, the higher mark-up for deposit products and lower mark-up for loans products in domestic banks indicate a possible funding advantage compared to foreign banks.

The fourth column of Table 5 reports the slope of Eq. (4), which measures the degree of pass-through. The slope is expected to be close/equal to one when the pass-through process is smooth and complete. However, all the slope coefficients reject the null hypothesis because they are statistically different from unity, even at 1% significance level. The results demonstrate that the transmission between the prime rate and retail interest rates is incomplete in the long-run.

[33] Perron (1989) argues that unit root is not a characteristic of most macroeconomic series and indeed, the non-stationarity detected by the ADF test is due to large shocks.

Table 5
Long-Run Interest Rate Pass-Through:

$y_{i,t} = \alpha_{i,0} + \alpha_{i,1} x_t + \varepsilon_{i,t}; i = 1,...,n$

	Model		Wald test (F-test)	
	Mark-up($\acute{a}_{i,0}$)	Slope($\acute{a}_{i,1}$)	$\acute{a}_{i,0}$	$\acute{a}_{i,1}$
Panel A: Industry Average				
savings	.631***	.293***		
	(.083)	(.014)		
dpt3m	.634***	.659***		
	(.127)	(.021)		
dpt6m	.810***	.636***		
	(.125)	(.020)		
dpt12m	1.115***	.598***		
	(.129)	(.021)		
dpt24m	1.287***	.554***		
	(.147)	(.055)		
MOR	7.140***	.573***		
	(.131)	(.021)		
MLR	6.525***	.580***		
	(.132)	(.022)		
MRR	7.696***	.545***		
	(.136)	(.022)		
Panel B: Commercial Banks				
savings	1.278***	.243***		
	(.090)	(.015)		
dpt3m	.943***	.697***		
	(.140)	(.023)		
dpt6m	1.084***	.676***		
	(.127)	(.021)		
dpt12m	1.322***	.650***		
	(.129)	(.021)		
dpt24m	1.586***	.499***		
	(.125)	(.047)		
MOR	6.549***	.580***		
	(.142)	(.023)		
MLR	6.170***	.584***		
	(.142)	(.023)		
MRR	6.885***	.559***		
	(.139)	(.023)		
Panel C: Foreign Bank Branches				
savings	.562***	.382***		65.46***
	(.067)	(.011)		
dpt3m	.650***	.574***		18.06***
	(.122)	(.020)		
dpt6m	.865***	.539***		23.52***
	(.124)	(.020)		
dpt12m	1.047***	.516***		16.81***
	(.123)	(.020)		
dpt24m	.878***	.521***		0.419
	(.137)	(.051)		
MOR	7.725***	.562***		0.303
	(.121)	(.020)		
MLR	6.860***	.573***		0.111
	(.126)	(.021)		
MRR	8.519***	.524***		0.911
	(.133)	(.022)		

Note: Table 5 reports the long-run interest rate pass-through results. The sample period is from January 1996 to July 2013. Standard errors are given in parenthesis. ***,** and * denote the significance level of coefficients being different from zero for $\alpha_{i,0}$ and unity for $\alpha_{i,1\ 0}$ (for testing completeness of long-run interest rate pass-through) at 1%, 5% and 10%, respectively based on the t-statistics.The Wald test (F-test) tests the hypothesis of the slope differences for commercial banks/foreign bank branches against the industry average (all banks). Markup is measured by the intercept, $\acute{a}_{i,0}$ and the degree of pass-through is measured by the slope, $\acute{a}_{i,1}$.

In column 4 of Panel A, the results show the level of pass-through is in a wide range of 29.3% to 65.9% for average deposit rates and in a range of 54.5% to 58% for average lending rates. The highest pass-through is the 3-month deposit for domestic banks in Panel B, around 69.7%, and savings has the lowest pass-through at 24.3% for the entire sample. In the case of deposit rates, savings have a minimal pass-through at 29.3%, 24.3% and 38.2% for industry average, domestic banks and foreign banks respectively. This finding is consistent with Rehman (2004) who concludes that savings are sticky in Thailand and they are less likely to adjust to changes in prime rate, even in the long-run.[34] Besides, the pass-through in deposit rates has a decreasing trend as the maturity increases in all three Panels, except in Panel C, the 24-month deposit for foreign banks. This finding is in line with Espinosa-Vega and Rebucci (2002), De Bondt (2005) and Egert et al. (2007) and can be explained by the expectation hypothesis of interest rate term structure.

It is worth noting that the degree of long-run pass-through for deposit rates is generally higher than that for lending rates. For example, in the fourth column of Panel A, the average pass-through for deposits ranges from 55.4% to 65.9% whereas the one for loans is between 54.5% and 58%. Similarly, column 4 of Panel B shows the long-run pass-through for deposit rates is mainly above 60% in contrast with the pass-through for loans, for which the rates are lower at 58%, 58.4% and 55.9% for MOR, MLR and MRR respectively for domestic banks. The finding of generally higher pass-through rates of deposits than lending rates is likely to be attributable to higher switching costs. As Chong et al. (2006) suggest, in the presence of different levels of switching costs, it is still easier for customers to switch banks for their deposit rates than their loan rates even when both deposits and loans have the same competitive degree.

Next, I investigate whether the long-run pass-through in domestic banks and foreign bank branches is different against the industry average as discussed in Section 3.2. I assess this hypothesis by conducting a Wald-test for testing the dispersion of long-run pass-through between the industry average, domestic banks and foreign bank branches, and the results are reported in the last column of Panel C. The results are uncertain regarding the hypothesis. Savings together with short-term deposits up to 12

[34] Chong et al. (2006) provide a plausible explanation on the sticky saving rates. They find savings are less sensitive to prime rate changes since they are more likely to be held for transaction purposes.

months confirm the long-run interest rate pass-through is significantly different across industry average and two bank types, as the corresponding Wald-statistics are statistically significant at the 5% level. In contrast, no strong difference can be found in all lending rates as well as 24-month deposits as their F-values ranging from 0.19 to 2.62 are insignificant at the 10% level.

Finally, it is worth mentioning that the results in column 4 of Table 5 indicate that the degree of pass-through is actually higher for domestic banks than foreign banks. This finding is inconsistent with prior expectation, where the high concentration in the banking sector actually increases the long-run rate of pass-through. In addition, the result is also inconsistent with Chong et al. (2006), who argue that in order to compete with domestic banks; foreign banks may adjust more frequently to the changes of prime rate in addition to offering higher rates. However, one plausible explanation regarding this inconclusive result is that banks with high concentration may also perform competitively as a highly concentrated environment is subject to the threat of new entry (Cottarelli & Kourelis, 1994).

As a summary of this section, I find that the long-run interest rate pass-through in Thailand exhibits strong sluggishness. Specifically, such incompleteness for lending rates is generally higher than that for deposit rates, and it is possibly due to higher switching costs. Besides, following the expectation hypothesis of interest rate's term structure, the level of interest rate pass-through has an inverse relation with the maturity of retail products. Finally, the long-run rate of pass-through is different across bank types, which may be attributable to concentration in the banking industry.

6.3 Symmetric short-run interest rate pass-through results

In this section, I examine the hypothesis that interest rate pass-through is incomplete in the short-run and exhibits price rigidity for both deposit and lending rates, as addressed in Section 3.3. Given the cointegrated relations between prime rate and retail interest rates that have been found, the short-run dynamics of interest rate pass-through is then analysed by an error-correction model in Eq. (5), and the results are reported in Table 6.

Table 6
Symmetric Price Rigidity of Short-Run Interest Rate Pass-Through:

$$\Delta y_{it} = \beta_0 \Delta x_{it} + \delta\left(y_{i,t-1} - \alpha_{i0} - \alpha_{i1} x_{i,t-1}\right) + \sum_{m=1}^{p} \Pi_i \Delta x_{i,t-m} + \sum_{m=1}^{q} \Gamma_i \Delta y_{i,t-m} + v_{it}$$

	Model (sample period: 1996:01-2013:07)					Wald test (F-test)	
Panel A: Industry Average							
	p	*q*	β_0	δ	*MAL*	β_0	δ
savings	12	1	.027*** (.004)	-.027*** (.008)	36.0		
dpt3m	12	10	.093*** (.011)	-.054*** (.014)	16.8		
dpt6m	12	9	.084*** (.011)	-.044*** (.013)	20.8		
dpt12m	12	1	.077*** (.010)	-.037*** (.012)	24.9		
dpt24m	12	1	.441*** (.058)	-.049*** (.014)	11.4		
MOR	11	7	.093*** (.011)	-.042*** (.012)	21.6		
MLR	12	10	.114*** (.010)	-.060*** (.012)	14.8		
MRR	10	8	.093*** (.010)	-.032*** (.011)	28.3		
Panel B: Domestic Commercial Banks							
	p	*q*	β_0	δ	*MAL*	β_0	δ
savings	12	12	.013*** (.010)	-.041*** (.015)	24.1		
dpt3m	12	9	.116*** (.014)	-.065*** (.016)	13.6		
dpt6m	12	9	.122*** (.014)	-.061*** (.017)	14.4		
dpt12m	12	12	.104*** (.015)	-.052*** (.017)	17.2		
dpt24m	12	12	.404*** (.082)	-.143*** (.035)	4.2		
MOR	10	8	.075*** (.010)	-.040*** (.010)	23.1		
MLR	10	8	.075*** (.011)	-.049*** (.011)	18.9		
MRR	7	8	.060*** (.009)	-.030*** (.010)	31.3		
Panel C: Foreign Bank Branches							
	p	*q*	β_0	δ	*MAL*	β_0	δ
savings	11	8	.161*** (.017)	-.051** (.025)	16.5	75.79***	0.16
dpt3m	6	6	.097*** (.014)	-.059*** (.015)	15.3	1.84	0.16
dpt6m	10	7	.072*** (.016)	-.064*** (.016)	14.5	9.77***	0.04
dpt12m	6	1	.067*** (.011)	-.046*** (.012)	20.3	11.31***	0.25
dpt24m	7	4	.452*** (.071)	-.097*** (.023)	5.6	0.46	4.00*
MOR	11	3	.112*** (.014)	-.021 (.015)	NA	6.98***	1.78
MLR	12	9	.134*** (.012)	-.053*** (.012)	16.3	24.17***	0.11
MRR	10	8	.106*** (.014)	-.022* (.013)	NA	10.80***	0.38

Note: Table 6 reports the short-run interest rate pass-through results. Standard errors are given in parenthesis. ***,** and * denote the significance level of coefficients being different from unity for β, and zero for γ at 1%, 5% and 10%, respectively based on the t-statistics. The Wald test (F-test) tests the hypothesis of the coefficient differences for the two bank types. The mean adjustment lag (*MAL*) = (β_0-1) / δ. *MAL* is not available if the corresponding δ is insignificant at the 5% level.

The fifth column of Table 6 reports the short-run pass-through. All estimated parameters are statistically significant. However, the β_0 estimated in column 5 rejects the null hypothesis that the rate of short-run pass-through is complete and equal to unity. The immediate pass-through rate is much lower than the pass-through rate in the long-run. In column 5, the majority short-run pass-through for average deposits is between 2.7% and 9.3%, except for 24-month deposits which has an impact pass-through of about 44.1%.[35] Similarly, the short-run pass-through is also incomplete for average lending rates, for which the range is between 9.3% and 11.4%. The result is not surprising according to the previous discussion in Sections 2.2 and 2.3, where the incomplete and sluggish short-run pass-through can be explained by factors such as menu costs, high switching costs, imperfect competition and asymmetric information (Chong et al., 2006; Liu et al., 2006).

In addition, by comparing the pass-through between domestic and foreign banks,[36] the results in column 5 however, do not appear to support that banks with high concentration have a negative impact on the degree of interest rate pass-through[37]. Finally, the β_0 in Table 6 also observes that the degree of short-run pass-through has an inverse relation with the maturities of retail interest rates, as found in the long-run.

Column 6 of Table 6 reports the error-correction adjustment speed in Eq. (5). As expected, most estimates of δ are found to be negative and statistically significant, expect δ for MLR in foreign banks, which is negative but insignificant. The negative sign of short-term interest rate pass-through in Table 6 confirms that retail rates are generally mean-reverting to their respective long-run trend during the sample period. In other words, retail interest rates adjust upwards when they are below their equilibrium and adjust downwards when they are above their long-run levels. Moreover, there is an expectation that high concentration in the banking sector will increase the price rigidity of short-run pass-through as discussed previously. However,

[35] This high pass-through rate in 24-month deposits is due to the fact that there are 49 observations missing during the sample period, for which the result may not be comparable to the other fixed deposits for the entire study.

[36] Column 8 of Table 6 shows the result of the Wald-test which rejects the hypothesis that the short-run pass-through is identical across domestic and foreign banks in most interest rates, except 3- and 24-month deposits.

[37] The finding is generally consistent with the finding in Section 6.2 for the long-run study, where the high concentration in the banking sector actually increases rather than reduces the pass-through. For plausible explanations see Cottarelli and Kourelis (1994).

by conducting the Wald-test as proposed in Section 4.3, the null hypothesis that there is no difference of δ between domestic banks and foreign bank branches cannot be rejected, which implies the speed of mean-reverting adjustments is quite similar regardless of banks' oligopolistic structure. In addition, the mean adjustment lags (MAL) results in column 7 provide a detailed description on the mean-reverting adjustment process. The results are consistent with the hypothesis addressed in Section 3.3, for which the short-run rate of pass-through exhibits price rigidity in both deposit and lending rates. In column 7 of Panel A-C, despite the 24-month deposit that has a minimum MAL of 11.4, 4.2 and 5.6 months for the industry average, domestic and foreign banks,[38] respectively, all mean adjustment process for savings and other fixed-term deposit rates are longer than one year. The mean adjustment lags is much longer for savings, on average, compared with the mean adjustment lags for other fixed-term deposit rates.

The result in column 7 of Panel A indicates that it takes up to 36 months for average savings to adjust towards long-run equilibrium, whereas it is about 16.8, 20.8 and 24.9 months for 3- to12-month deposit rates as shown in Panel B and C[39,40]. In the case of lending rates, the mean adjustment lags for MOR, MLR and MRR are 21.6, 14.8 and 28.3 months for industry average, and 23.1, 18.9 and 31.3 months for domestic banks. The only available MAL for foreign banks is 16.3 months for MLR.[41] The result implies the existence of price rigidity in lending rates, for which it takes more than one year to adjust toward the long-run equilibrium.

Finally, by comparing the available MAL for lending rates, the short-run adjustment speed is on average higher in deposit rates. A possible explanation for the high adjustment speed in deposit rates is the high switching cost, adverse selection and moral hazard problem for lending rates, as mentioned in the literature. Note that the calculated Mean Adjustment Lags (MAL) given by Table 6 can still be different across bank types, given the fact that MAL is not only determined by the speed of adjustment δ , but also determined by immediate pass-through β_0 as shown in Eq.(5).

[38] As discussed previously, the result for 24-month deposits is not comparable to the other deposit rates.
[39] Chong et al. (2006) explain that savings are less sensitive to prime rate changes since they are more likely to be held for transaction purposes compared with other fixed deposit rates, which are used as investment activities, thus, the MAL is higher for savings, regardless of bank type.
[40] The MAL results for deposit rates also confirm the inverse relation between the speed of pass-through and maturities of interest rates used, which is consistent with long-run pass-through.
[41] MAL is not available for MOR and MRR for foreign banks as δ is insignificant at the 5% level.

In summary, I find that the short-run interest rate pass-through in Thailand is incomplete and very low for all interest rate series. I also find the existence of price rigidity and significant sluggishness in all retail rates when they adjust towards their long-run equilibrium. In addition, the mean adjustment lag for these products varies from 6 months to three years. Finally, I find that concentration in the banking sector has a significant impact on the level of short-run pass-through, but no effect on the adjustment speed.

6.4 Asymmetric short-run pass-through

In this section, I investigate the hypothesis of asymmetric pass-through as addressed in Section 3.4. The ECM specification for examining symmetric short-run interest rate pass-through assumes that adjustments are symmetric when the retail rate is above or below their equilibrium level. However, existing literature is in favour of asymmetric short-run adjustments of retail rates in response to prime rate changes (Scholnick, 1999) owing to the hypotheses of banks' concentration (Hannan & Berger, 1991). To examine the assumption of asymmetric adjustments, I estimated Eq. (7) and the results are reported in Table 7.

Columns 6 and 8 of Table 7 report the adjustment speeds when retail interest rates adjust towards their long-run equilibrium. It can be seen from column 8 that the asymmetry is quite obvious over the entire sample as only 6 out of 24 retail interest rates demonstrate statistically significant estimated δ^- are; indeed, estimates of δ^+ are more apparent and dominate the short-term pass-through adjustments.

Comparing δ^+ and δ^- , the number of significant upward mean-reversion estimates are more than those of the downward ones, indicating that the adjustment speed for both deposit and lending rates upwards is faster than rates downwards. In addition, either upward or downward mean-reversion speed for retail interest rates is significant, and once a downward adjustment is significant it also has less degree of price rigidity as it has a much smaller downward mean adjustment lag (MAL).

Table 7
Asymmetric Price Rigidity of Short-Run Interest Rate Pass-Through

$$\Delta y_{it} = \beta_0 \Delta x_{it} + \delta_{it}^{+} \lambda EC_{i,t-1} + \delta_{it}^{-} (1-\lambda) EC_{i,t-1} + \sum_{m=1}^{p} \Pi_i \Delta x_{i,t-m} + \sum_{m=1}^{q} \Gamma_i \Delta y_{i,t-m} + v_{it}$$

	Model (sample period: 1996:01-2013:07)						
	p	*q*	β_0	δ^+	MAL^+	δ^-	MAL^-
Panel A: Industry Average							
savings	12	1	.026*** (.004)	-.038*** (.011)	25.6	-.007 (.016)	NA
dpt3m	12	10	.092*** (.011)	-.062*** (.014)	14.6	-.044* (.024)	NA
dpt6m	12	9	.083*** (.012)	-.050** (.020)	18.3	-.037 (.023)	NA
dpt12m	12	1	.078*** (.011)	-.036** (.018)	25.6	-.039* (.020)	NA
dpt24m	12	1	.424*** (.059)	-.023 (.021)	NA	-.114*** (.041)	5.1
MOR	3	3	.084*** (.010)	-.055*** (.013)	16.7	.006 (.021)	NA
MLR	12	10	.108*** (.010)	-.078*** (.014)	11.4	-.018 (.020)	NA
MRR	10	8	.088*** (.011)	-.046*** (.014)	19.8	-.003 (.021)	NA
Panel B: Domestic Banks							
	p	*q*	β_0	δ	*MAL*	β_0	δ
savings	12	12	.017* (.010)	-.002 (.023)	NA	-.099*** (.030)	9.9
dpt3m	12	9	.108*** (.015)	-.093*** (.024)	9.6	-.026 (.029)	NA
dpt6m	12	9	.119*** (.015)	-.070*** (.025)	12.6	-.048 (.031)	NA
dpt12m	12	12	.103*** (.016)	-.056** (.026)	16.0	-.047 (.031)	NA
dpt24m	12	12	.406*** (.085)	-.151* (.079)	NA	-.138** (.067)	4.3
MOR	7	4	.060* (.009)	-.051*** (.012)	18.4	.002 (.018)	NA
MLR	10	6	.074 (.011)	-.067*** (.013)	13.8	-.018 (.019)	NA
MRR	3	3	.061 (.009)	-.053*** (.011)	17.7	.005 (.017)	NA
Panel C: Foreign Bank Branches							
	p	*q*	β_0	δ	*MAL*	β_0	δ
savings	11	8	.163*** (.017)	-.017 (.046)	NA	-.110 (.072)	NA
dpt3m	6	6	.089*** (.015)	-.090*** (.023)	10.1	-.004 (.033)	NA
dpt6m	10	7	.066*** (.016)	-.086*** (.025)	10.9	-.033 (.031)	NA
dpt12m	6	1	.064*** (.011)	-.060*** (.018)	15.6	-.024 (.025)	NA
dpt24m	9	3	.427*** (.071)	-.044 (.035)	NA	-.189** (.075)	3.0
MOR	11	3	.106*** (.014)	-.046** (.019)	19.4	.020 (.026)	NA
MLR	12	9	.123*** (.012)	-.100*** (.016)	8.8	.008 (.018)	NA
MRR	10	8	.098*** (.014)	-.055** (.020)	16.4	.017 (.022)	NA

Note: Table 7 reports asymmetric interest rate pass-through results. Standard errors are given in parenthesis. ***, ** and * denote the significance level of coefficients being different from unity for $\beta_{,0}$ and zero for δ^+/δ^- at 1%, 5% and 10%, respectively based on the t-statistics. *MAL* is not available if the corresponding δ is insignificant at the 5% level. The Wald test (F-test) statistics are not reported as estimated coefficients to be tested are not always significant.

6.5 Sub-sample analysis

In this section, I examine the interest rate pass-through allowing for major changes occurring in Thailand during the sample period. It should be mentioned that this is also one of the important reasons in motivating this study. The hypothesis banks' concentration (Hannan & Berger, 1991) cannot be verified easily by the specification of an asymmetric ECM, and a possible explanation is that monetary policy mechanism and interest rate pass-through are affected by systematic changes, which is particularly the case for Thailand, as it experienced major shifts in its monetary policy regimes. Besides, there is a gap in knowledge on whether the global financial crisis has had any impact on interest rate pass-through in Thailand. To investigate the interest rate pass-through in connection with these factors, I first split the entire sample into three sub-samples, representing three different structures, e.g. pre the inflation targeting regime (1996-2000), post the inflation targeting regime but before the global financial crisis (2000-2008) and post the crisis (2008-2013). The next step is re-estimating the equations used in Sections 6.1 to 6.4 for each sub-sample, and the long- and short-run interest rate pass-through, both symmetrically and asymmetrically are then revisited.

6.5.1 Long-run pass-through

The long-run pass-through results for the three sub-periods are given in Table 8. In general, long-run pass-through for each of the three sub-periods appears to be consistent with what has been found for the entire sample data. For example, in terms of long-run pass-through completeness, all these coefficients are statistically different from unity except for 6-month and 12-month term deposits offered by commercial banks, suggesting the existence of sluggishness and rigidity of retail interest rates in response to prime rate changes. The estimated coefficients of the 6- and 12-month deposit rates are respectively 0.975 and 1.002, indicating the perfectness of long-run interest rate pass-through for domestic banks in Thailand after the global financial crisis.

Additionally, several long-run pass-through patterns can also be found over the three periods. First, the interest rate pass-through rigidity in general was reduced over time and the pattern is most obvious post the global financial crisis.

Table 8
Long-Run Interest Rate Pass-Through for Banks' Retail Products and Types

	Sub Period: 1996:01-2000:04		Sub Period: 2000:05-2008:08		Sub Period: 2008:09-2013:07	
	$\alpha_{i,0}$	$\alpha_{i,1}$	$\alpha_{i,0}$	$\alpha_{i,1}$	$\alpha_{i,0}$	$\alpha_{i,1}$
Panel A: Industry Average						
savings	2.940***	.151***	.969***	.082***	.288***	.208***
	(.176)	(.015)	(.082)	(.029)	(.029)	(.012)
dpt3m	3.933***	.450***	.523***	.569***	-.263***	.778***
	(.371)	(.033)	(.128)	(.045)	(.072)	(.021)
dpt6m	4.125***	.424***	.511***	.614***	-.224***	.830***
	(.344)	(.030)	(.138)	(.048)	(.068)	(.028)
dpt12m	4.586***	.374***	.733***	.605***	-.152**	.879***
	(.329)	(.029)	(.159)	(.056)	(.066)	(.027)
dpt24m	NA	NA	1.418***	.524***	.471***	.800***
			(.188)	(.066)	(.048)	(.020)
MOR	10.50***	.372***	7.778***	.125***	7.147***	.382***
	(.323)	(.028)	(.143)	(.050)	(.046)	(.019)
MLR	9.967***	.375***	7.269***	.098***	6.503***	.372***
	(.325)	(.028)	(.127)	(.045)	(.050)	(.021)
MRR	11.16***	.339***	8.693***	-.012***	7.342***	.429***
	(.338)	(.030)	(.124)	(.044)	(.076)	(.031)
Panel B: Domestic Commercial Banks						
savings	3.929***	.072***	1.066***	.245***	.322***	.395***
	(.133)	(.012)	(.118)	(.041)	(.050)	(.021)
dpt3m	4.711***	.460***	1.078***	.496***	.226***	.882***
	(.372)	(.033)	(.140)	(.049)	(.069)	(.028)
dpt6m	4.568***	.455***	1.039***	.549***	-.240***	.975
	(.320)	(.028)	(.138)	(.048)	(.070)	(.029)
dpt12m	4.783***	.431***	1.275***	.530***	-.134*	1.002
	(.310)	(.027)	(.166)	(.058)	(.077)	(.032)
dpt24m	NA	NA	1.644***	.486***	1.044***	.663***
			(.163)	(.057)	(.085)	(.035)
MOR	10.34***	.347***	6.758***	.264***	6.160***	.574***
	(.330)	(.029)	(.181)	(.063)	(.072)	(.030)
MLR	9.978***	.350***	6.371***	.274***	5.726***	.599***
	(.340)	(.030)	(.171)	(.060)	(.065)	(.023)
MRR	10.57***	.332***	6.946***	.274***	6.284***	.726***
	(.332)	(.029)	(.174)	(.061)	(.108)	(.044)
Panel C: Foreign Bank Branches						
savings	2.147***	.286***	.946***	.200***	.288***	.296***
	(.137)	(.012)	(.119)	(.042)	(.060)	(.025)
dpt3m	3.836***	.376***	.844***	.389***	-.010***	.553***
	(.332)	(.029)	(.128)	(.045)	(.061)	(.025)
dpt6m	4.095***	.334***	.834***	.447***	.100***	.551***
	(.344)	(.030)	(.138)	(.048)	(.054)	(.022)
dpt12m	4.301***	.309***	.882***	.481***	.201***	.558***
	(.327)	(.029)	(.147)	(.051)	(.037)	(.015)
dpt24m	NA	NA	.972***	.523***	.314***	.615***
			(.155)	(.054)	(.080)	(.033)
MOR	10.53***	.411***	8.772***	-.005***	8.375***	.120***
	(.368)	(.031)	(.113)	(.040)	(.020)	(.008)
MLR	9.957***	.394***	7.969***	-.030***	7.415***	.111***
	(.315)	(.028)	(.099)	(.035)***	(.046)	(.019)
MRR	11.57***	.350***	9.936***	-.149***	9.158***	-.074***
	(.352)	(.031)	(.083)	(.029)	(.077)	(.032)

Note: Table 8 reports long-run pass-through in subsamples. Standard errors are given in parenthesis. ***,** and * denote the significance level of coefficients being different from zero for $\alpha_{i,0}$ and unity for $\alpha_{i,1\ 0}$ at 1%, 5% and 10%, respectively based on the t-statistics.

An extreme example is that domestic banks could fully pass any changes from prime rate to the 12-month deposit rate in that period as its estimated pass-through is 1.002; in other words, there is no sluggishness in the prime rate transmission. Second, interest rate pass-through demonstrates significant sluggishness for lending rates during the transitory period between 2000 and 2008, and this is especially the case for foreign banks. It appears that no significant transmission can be observed for the average MLR and MOR. This is a plausible evidence that pass-through for domestic banks is improved due to the significant banking reform took place to enhance efficiency and competitiveness.

6.5.2 Symmetric short-run pass-through

Table 9 reports the symmetric price rigidity of short-run pass-through results for the three sub-samples. The β_0 displays an increasing trend on the completeness of short-run pass-through, when the monetary policy shifts to inflation targeting in 2000. For instance, the pass-through for average deposit rates is in the range of 15% to 38% after adopting the new monetary policy, compared with 2.4% to 7.3% for the period without the change. Similarly, all pass-through rates show a higher level of completeness on deposit rates irrespective of the bank type. The result is consistent with Aziakpono and Wilson's (2010) finding that transparent monetary policy increases the level of interest rate pass-through. In the case of lending rates, however, we can only observe improvements for domestic banks, for which the range of pass-through increases from 5.9%-6.4% to 17.6%-19.9% in the first two sub-sample periods. Besides, by comparing pass-through rates before and after the financial crisis, the results support that the smoothness of pass-through reduces during financial turbulence and increases thereafter, as the range of pass-through rates is generally higher in 2008-2013 than in 2000-2008, despite the lending rates for foreign banks, for which the result is inconclusive since all pass-through rates are statistically insignificant for the sub-sample period from 2008-2013. Finally, it is plausible to conclude that financial structural breaks have an impact on the level of pass-through in the short-run in general, where pass-through rate increases following the transparent monetary policy but decreases during the financial crisis. In the case of adjustment speed, however, among all three sub-periods it appears that only the sub-sample period in 2000-2008 demonstrates the existence of significant short-run pass-

through, whereas for the post financial crisis era, only foreign banks have significant mean-reverting speed. Furthermore, the calculated Mean Adjustment Lags (MAL) shows that the short-run adjustment speed differs across both retail products and sample periods. For example, foreign banks post the global financial crisis generally has the smallest MAL ranging from 1.1 months for the 24-month deposits to 7.5 months for savings rates, suggesting that short-run adjustment speed for these banks during the time period are faster than other bank types and sub-periods. On the other hand, the 2000-2008 period generally has the largest MAL, ranging from 5.1 to 30.5 compared to the ones (4.2-20.8) between 1996 and 2000. Despite the inconclusive result on price rigidity regarding structural breaks, it is still worth noting that adjustment speed actually increases for foreign banks after the financial crisis. This may, somehow, suggest that the financial crisis might have had a positive impact on the degree of smoothness for foreign bank branches as they may have to adjust their retail pricing more quickly to reflect rapid market changes.

6.5.3 Asymmetric short-run pass-through

Table 10 reports asymmetric price rigidity of short-run pass-through results for the three sub-periods. In general, the number of significant asymmetric short-run pass-through is very limited, in particular for downward mean reversions. Further, consistent with the previous findings of Sections 6.5.1 and 6.5.2, the asymmetric adjustment speed is broadly smallest in terms of δ^+/δ^- and MAL^+/MAL^- during the 2000-2008 sub-period whereas it demonstrate largest post the global financial crisis.

6.5.4 Summary of sub-sample analysis

As a summary of the sub-sample analysis, I find that the change in the financial system has effected the interest rate pass-through. For example, the adoption of inflation targeting policy improved the level of transparency of monetary policy, for which increased the degree and speed of interest rate pass-through. The financial crisis increased the market volatility and uncertainty of banks' funding conditions, which weakened the linkage between the prime rate and retail interest rates, and therefore reduce the efficiency of monetary policy transmission, as the degree and speed of interest rate pass-through are decreased.

Table 9 Symmetric Price Rigidity of Short-Run Pass-Through for Banks' Retail Products and Types

		Sub Period: 1996:01-2000:04					Sub Period: 2000:05-2008:08					Sub Period: 2008:09-2013:07				
		p	*q*	β_0	δ	*MAL*	*p*	*q*	β_0	δ	*MAL*	*p*	*q*	β_0	δ	*MAL*
All banks	savings	1	4	.024*** (.007)	-.047** (.021)	20.8	1	4	.150*** (.030)	-.031** (.014)	27.4	12	10	.098*** (.019)	-.204* (.106)	NA
	dpt3m	11	10	.073*** (.020)	-.069 (.044)	NA	1	4	.323*** (.051)	-.044*** (.015)	15.4	3	4	.547*** (.050)	-.053 (.065)	NA
	dpt6m	11	10	.059*** (.020)	-.074 (.049)	NA	1	4	.350*** (.055)	-.044*** (.015)	14.8	1	4	.601*** (.048)	-.013 (.058)	NA
	dpt12m	12	11	.044*** (.016)	-.111*** (.050)	8.6	1	4	.364*** (.062)	-.042*** (.015)	15.1	7	10	.553*** (.056)	-.040 (.069)	NA
	dpt24m	NA	NA	NA	NA	NA	1	4	.381*** (.086)	-.048*** (.017)	12.9	12	12	.440*** (.083)	.108 (.175)	NA
	MOR	2	3	.083*** (.018)	-.086** (.043)	10.7	1	4	.097*** (.061)	-.037** (.018)	24.4	7	1	.175*** (.018)	.001 (.045)	NA
	MLR	12	10	.150*** (.022)	-.204** (.084)	4.2	2	1	.085*** (.049)	-.030*** (.016)	30.5	6	1	.186*** (.017)	.017 (.053)	NA
	MRR	1	3	.073*** (.019)	-.106*** (.039)	8.7	2	1	.069*** (.048)	-.026 (.016)	NA	9	11	.130*** (.054)	-.030 (.067)	NA
Commercial banks	savings	1	3	.004*** (.007)	-.030 (.035)	NA	1	2	.141*** (.088)	-.076** (.030)	11.3	3	2	.111*** (.053)	-.226* (.114)	NA
	dpt3m	11	11	.090*** (.024)	-.124* (.061)	NA	4	1	.289*** (.075)	-.064*** (.022)	11.1	5	4	.309*** (.059)	-.100 (.116)	NA
	dpt6m	11	12	.095*** (.026)	-.093 (.093)	NA	4	1	.399*** (.078)	-.066*** (.023)	9.1	1	3	.399*** (.068)	-.164* (.086)	NA
	dpt12m	11	11	.086*** (.022)	-.168* (.085)	NA	4	1	.375*** (.084)	-.054*** (.020)	11.6	1	3	.392*** (.090)	-.184* (.102)	NA
	dpt24m	NA	NA	NA	NA	NA	4	1	.366*** (.089)	-.062*** (.022)	10.2	6	1	.595*** (.119)	-.404*** (.134)	1.0
	MOR	1	2	.064*** (.016)	-.073** (.031)	12.8	1	5	.194*** (.059)	-.026* (.013)	NA	3	3	.290*** (.029)	-.029 (.037)	NA
	MLR	1	2	.063*** (.017)	-.073** (.032)	12.8	1	5	.199*** (.058)	-.027** (.014)	29.7	6	1	.329*** (.033)	-.041 (.049)	NA
	MRR	1	3	.059*** (.016)	-.093*** (.032)	10.1	1	5	.176*** (.058)	-.027*** (.014)	30.5	3	3	.285*** (.034)	-.025 (.025)	NA
Foreign banks	savings	10	8	.141*** (.036)	-.730* (.421)	NA	1	5	.158*** (.098)	-.067* (.034)	NA	2	1	.073*** (.043)	-.124** (.059)	7.5
	dpt3m	3	1	.097*** (.025)	-.079* (.047)	NA	1	5	.268*** (.082)	-.055** (.026)	13.3	5	5	.323*** (.054)	-.252** (.102)	2.7
	dpt6m	12	12	.047*** (.037)	-.045 (.083)	NA	1	5	.197*** (.087)	-.067** (.026)	12.0	4	1	.374*** (.052)	-.232** (.105)	2.7
	dpt12m	2	3	.067*** (.018)	-.056* (.032)	NA	8	1	.176*** (.084)	-.055** (.023)	15.0	5	1	.378*** (.046)	-.395*** (.127)	1.6
	dpt24m	NA	NA	NA	NA	NA	9	3	.511*** (.093)	-.095*** (.025)	5.1	1	2	.296*** (.116)	-.642*** (.192)	1.1
	MOR	2	9	.125*** (.026)	-.176** (.073)	5.0	1	2	-.029*** (.083)	-.059* (.032)	NA	2	1	.015*** (.018)	-.267** (.125)	3.7
	MLR	12	12	.176*** (.031)	-.228 (.136)	NA	7	6	.119*** (.057)	-.027 (.022)	NA	8	7	.018*** (.020)	-.186** (.070)	5.3
	MRR	1	7	.099*** (.023)	-.154*** (.048)	5.9	3	2	-.037*** (.055)	-.027 (.027)	NA	1	4	-.144*** (.106)	-.328** (.162)	3.5

Note: Standard errors are given in parenthesis. ***,** and * denote the significance level of coefficients being different from unity for β_0 (for testing completeness of short-run interest rate pass-through) and zero for δ^+/δ^- at 1%, 5% and 10%, respectively based on the t-statistics. MAL^+/MAL^- is not available for δ insignificant at the 5% level.

Table 10 Asymmetric Price Rigidity of Short-Run Pass-Through for Banks' Retail Products and Types

		Sub Period: 1996:01-2000:04							Sub Period: 2000:05-2008:08							Sub Period: 2008:09-2013:07						
		p	q	β_0	δ^+	MAL^+	δ^-	MAL^-	p	q	β_0	δ^+	MAL^+	δ^-	MAL^-	p	q	β_0	δ^+	MAL^+	δ^-	MAL^-
All banks	savings	1	4	.024*** (.007)	-.043 (.053)	NA	-.050 (.041)	NA	3	4	.143*** (.032)	-.054** (.027)	15.9	-.000 (.035)	NA	12	10	.092*** (.021)	-.176 (.13)	NA	-.331 (.200)	NA
	dpt3m	11	10	.074*** (.023)	-.057 (.15)	NA	-.075 (.090)	NA	1	4	.323*** (.053)	-.044* (.024)	NA	-.044 (.037)	NA	3	4	.542*** (.051)	-.033 (.110)	NA	-.044* (.024)	NA
	dpt6m	11	10	.052*** (.022)	-.192 (.169)	NA	-.014 (.097)	NA	1	4	.345*** (.057)	-.038 (.029)	NA	-.057 (.038)	NA	1	4	.602*** (.048)	-.047 (.104)	NA	-.079 (.110)	NA
	dpt12m	11	10	.040*** (.017)	-.214 (.125)	NA	-.010 (.076)	NA	1	4	.354*** (.064)	-.030 (.024)	NA	-.064* (.038)	NA	7	10	.545*** (.058)	-.019 (.108)	NA	.127 (.140)	NA
	dpt24m	NA	NA	NA	NA	NA	NA	NA	1	4	.364*** (.088)	-.022 (.030)	NA	-.093** (.046)	6.8	12	12	.445*** (.085)	.162 (.232)	NA	.056 (.231)	NA
	MOR	2	3	.079*** (.019)	-.109* (.056)	NA	-.045 (.077)	NA	1	4	.108*** (.063)	-.058** (.029)	15.4	-.006 (.039)	NA	7	1	.176*** (.019)	.031 (.074)	NA	-.028 (.073)	NA
	MLR	12	10	.135*** (.023)	-.601** (.258)	1.4	-.045 (.122)	NA	3	1	.080*** (.051)	-.063** (.027)	14.6	.016 (.036)	NA	6	1	.185*** (.017)	.052 (.090)	NA	-.002 (.066)	NA
	MRR	1	3	.067*** (.020)	-.138** (.054)	6.8	-.049 (.076)	NA	2	1	.082*** (.049)	-.058* (.031)	NA	.019 (.040)	NA	9	11	.129*** (.055)	-.079 (.133)	NA	.025 (.144)	NA
Commercial banks	savings	1	3	.004*** (.007)	-.062 (.085)	NA	-.011 (.058)	NA	1	2	.111*** (.089)	-.022 (.048)	NA	-.168** (.071)	5.3	3	2	.069*** (.051)	-.636*** (.175)	1.5	.286 (.203)	NA
	dpt3m	11	11	.077*** (.025)	-.326* (.169)	NA	-.011 (.107)	NA	4	1	.291*** (.078)	-.093*** (.024)	7.6	-.026 (.029)	NA	5	4	.293*** (.061)	-.250 (.185)	NA	-.004 (.148)	NA
	dpt6m	11	12	.071*** (.027)	-.490* (.227)	NA	-.087 (.128)	NA	4	1	.397*** (.081)	-.062 (.038)	NA	-.072 (.062)	NA	1	3	.479*** (.075)	.144 (.161)	NA	-.457*** (.155)	1.1
	dpt12m	11	12	.061*** (.027)	-.531** (.211)	1.8	-.035 (.148)	NA	4	1	.356*** (.086)	-.029 (.032)	NA	-.104* (.055)	NA	1	3	.448*** (.091)	.131 (.176)	NA	-.414*** (.145)	1.3
	dpt24m	NA	NA	NA	NA	NA	NA	NA	4	1	.333*** (.089)	.001 (.037)	NA	-.173*** (.058)	3.9	6	1	.579*** (.125)	-.476** (.211)	0.9	-.335 (.209)	NA
	MOR	1	3	.049*** (.016)	-.189*** (.048)	5.0	.036 (.057)	NA	1	5	.202*** (.062)	-.035*** (.023)	22.8	-.014 (.027)	NA	3	3	.290*** (.030)	-.032 (.068)	NA	-.026 (.070)	NA
	MLR	1	3	.051*** (.017)	-.194*** (.054)	4.9	.034 (.060)	NA	1	5	.209*** (.060)	-.039 (.024)	NA	-.013 (.028)	NA	6	1	.324*** (.034)	-.085 (.091)	NA	-.003 (.082)	NA
	MRR	1	3	.045*** (.016)	-.184*** (.048)	5.2	.027 (.057)	NA	1	5	.186*** (.061)	-.038*** (.024)	21.4	-.014 (.028)	NA	3	3	.288*** (.040)	-.019 (.046)	NA	-.031 (.054)	NA
Foreign banks	savings	11	8	.157*** (.037)	-.332 (.501)	NA	-1.319* (.700)	NA	1	5	.142*** (.098)	.044 (.073)	NA	-.229** (.101)	NA	2	1	.073*** (.043)	-.093 (.123)	NA	-.146 (.097)	NA
	dpt3m	6	1	.069*** (.026)	-.321*** (.113)	2.9	.101 (.094)	NA	1	5	.271*** (.048)	-.060 (.047)	NA	-.047 (.066)	NA	5	5	.325*** (.056)	-.264** (.130)	2.6	-.234 (.155)	NA
	dpt6m	11	12	.029*** (.036)	-.437* (.232)	NA	.101 (.118)	NA	1	5	.196*** (.088)	-.065 (.049)	NA	-.071 (.070)	NA	4	1	.364*** (.052)	-.378** (.159)	1.7	-.117 (.141)	NA
	dpt12m	2	3	.062*** (.018)	-.169** (.067)	5.6	.061 (.069)	NA	8	1	.150*** (.085)	-.001 (.043)	NA	-.133** (.058)	NA	5	1	.364*** (.045)	-.851** (.236)	0.7	-.224 (.143)	NA
	dpt24m	NA	NA	NA	NA	NA	NA	NA	9	3	.503*** (.094)	-.069* (.039)	NA	-.154** (.073)	NA	1	2	.335*** (.113)	-.437** (.205)	1.5	-1.200*** (.306)	-0.55
	MOR	9	12	.110*** (.045)	-.517 (.514)	NA	-.625 (.414)	NA	1	2	-.015*** (.083)	-.113** (.048)	9.0	.023 (.064)	NA	2	1	.008*** (.018)	-.513*** (.187)	1.9	.067 (.227)	NA
	MLR	12	12	.172*** (.035)	-.303*** (.286)	2.7	-.186 (.199)	NA	7	6	-.108*** (.058)	-.074* (.040)	NA	.033 (.048)	NA	8	7	.019*** (.020)	-.190** (.071)	5.2	-.124 (.118)	NA
	MRR	1	7	.099*** (.025)	-.153* (.065)	NA	-.155 (.106)	NA	3	2	-.030*** (.056)	-.094* (.056)	NA	.059 (.068)	NA	1	4	-.161*** (.107)	-.440** (.197)	2.6	-.170 (.226)	NA

Note: Standard errors are given in parenthesis. ***,** and * denote the significance level of coefficients being different from unity for β_0 (for testing completeness of short-run interest rate pass-through) and zero for δ^+/δ^- at 1%, 5% and 10%, respectively based on the t-statistics. MAL^+/MAL^- are not available for δ insignificant at the 5% level.

Chapter 7：Conclusion

This research investigates the dynamics of retail interest rates in response to prime rate changes in Thailand. In particular, I examine the impacts of the oligopolistic structure in the banking sector and the changing financial environment in Thailand on the interest rate pass-through process. The analysis uses five deposit rates and three major lending rates from 46 banks between January 1996 and July 2013 at a monthly basis. The research follows Heffernan (1997) and Scholnick's (1996) error-correction approach for analysing the degree and speed of interest rate pass-through. The results of this research can be summarised as follows.

I find there is a long-run relation between the prime rate and retail interest rates. I also find that the transmission between the prime rate and retail interest rates is not complete in the long-run. More specifically, there is significant sluggishness in savings rates regardless of bank types, and lending rates have a lower level of pass-through than deposit rates in both domestic banks and foreign bank branches. In addition, I find that the oligopolistic structure has a positive impact on the interest rate pass-through, as the level of pass-through in high concentration banks (domestic banks) is greater than in low concentration banks (foreign banks).

In the case of short-run dynamics, the interest rate pass-through is rarely complete for all retail interest rates and the rate is much lower than in the long-run. Besides, evidence shows that the rate of pass-through varies according to interest rates' maturity. The pass-through is higher for shorter term deposit rates in both domestic banks and foreign bank branches. Moreover, the oligopolistic structure only has an impact on the degree of interest rate pass-through, for which the finding is consistent with the one in the long-run, but has no impact on the adjustment speed of the pass-through process. Furthermore, all retail interest rates tend to converge to their long-run equilibrium. However, the mean-reverting process provides evidence of price rigidity and asymmetric pass-through. Lending rates are more rigid than deposit rates, and all retail interest rates are more rigid upwards than downwards. An important implication is that the banks in Thailand are more likely to abuse their market power

by holding deposit rates whilst the prime rate is increasing. In other words, this finding confirms the existence of strong concentration in Thailand's banking sector.

Finally, I find a changing financial environment affects the interest rate pass-through process. The results provide evidence that financial reforms and a more transparent monetary policy has a positive impact on the interest rate pass-through, as the degree and speed of interest rate pass-through increases after the adoption of inflation targeting policy. Besides, the financial uncertainty such as a financial crisis has significant negative effect on the efficiency of the monetary policy transmission process, as the degree and speed of interest rate pass-through are reduced.

The findings in this research have several important implications for both academics and practitioners. First, the low speed of adjustment of retail interest rates to the prime rate changes decreases the effectiveness of monetary policy, for which may further lead monetary policy fail to stabilize unexpected shocks and fail to achieve desired macroeconomic goals. Besides, systematic reforms on the banking sector, particularly the domestic banking subsector should continue as improved industrial competiveness can help reducing price rigidity. Finally, the degree and speed of interest rate pass-through are not constant; rather, they are subject to major external changes, such as new monetary policy regimes and the global financial crisis.

Given that the present model is based on time series analysis, the interactions among financial products and across banks is ignored. Besides, all data used in this research are based on the monthly average of two dimensions, e.g. major financial products and two bank types. An extension by using higher frequency data such as weekly or bi-weekly data may produce more data observations and more granularities, which could capture a better insight as to the dynamics of the monetary policy transmission mechanism and its evolution over time. I therefore suggest further investigation on the subject with regards to robust estimation and extension of the method to panel data analysis. This will enable the capture additional explanatory factors regarding stickiness and price rigidity in the interest rate pass-through, and provides more precise measurement on the effect of oligopolistic structure.

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Appendix A: List of Individual Commercial Banks and Foreign Bank Branches in Thailand

ID	bank/Branch Name	Status	Samples	ID	bank/Branch Name	Status	Samples
1	ABN-AMRO N.V.	F	168	33	Oversea Chinese Banking Corporation	F	210
2	ACL Bank	C	55	34	RHB Bank Berhad	F	211
3	AIG Retail Bank	C	30	35	Societe Generale Bangkok Branch	F	44
4	Bangkok Bank	C	211	36	Standard Chartered Bank	F	117
5	Bangkok Metropolitan Bank	C	75	37	Standard Chartered Bank (Thai)	F	94
6	Bank of America, National Association	F	211	38	Standard Chartered Nakornthon Bank	F	117
7	Bank of Asia	C	118	39	Sumitomo Mitsui Banking Corporation	F	148
8	Bank of Ayudhya	C	211	40	Thai Farmers Bank	C	87
9	Bank Thai	C	152	41	Thanachart Bank	C	136
10	Bharat Overseas Bank	F	134	42	The Bangkok Bank of Commerce	C	34
11	BNP Paribas	F	172	43	The Bank of China	C	197
12	Calyon Corrorate and Investment Bank	F	66	44	The Bank of Novascotia	C	112
13	CIMB THAI Bank	C	59	45	The Bank of Tokyo-Mitsubishi	C	120
14	Citibank	F	211	46	The Bank of Tokyo-Mitsubishi UFJ	C	91
15	Credit Agricole Corporate and Investment Bank	F	39	47	The Chase Manhattan Bank	C	70
16	Credit Agricole Indosuez	F	103	48	The Dai-Ichi Kangyo Bank	C	58
17	DBS Thai Danu Bank	C	104	49	The Industrial Bank of Japan	C	55
18	Deutsche Bank AG.	F	211	50	The International Commercial Bank of China	C	127
19	Dresdner Bank AG.	F	49	51	The Royal Bank of Scotland N.V.	C	42
20	First Bangkok City Bank	C	34	52	The Sakura Bank	C	63
21	GE Money Retail Bank	F	12	53	The Siam City Bank	C	189
22	HSBC	F	211	54	The Siam Commercial Bank	C	211
23	Indian Overseas Bank	F	77	55	The Sumitomo Bank	C	49
24	Industrial and Commercial Bank of China (Thai)	C	37	56	The Thai Credit Retail Bank	C	79
25	JP Morgan Chase Bank	F	141	57	The Thai Military Bank	C	135
26	Kasikornbank	C	124	58	TISCO Bank	C	97
27	Kiatnakin Bank	C	94	59	TMB Bank	C	76
28	Krung Thai Bank	C	211	60	UFJ Bank	F	5
29	Land and Houses Bank	C	20	61	United Overseas Bank (Thai)	C	6
30	Land and Houses Retail Bank	C	72	62	United Overseas Bank (Thai) Company Ltd.	C	87
31	Mega International Commercial Bank	C	84	63	UOB Radanasin Bank	C	118
32	Mizuho Corporate Bank, Ltd.	F	136				

Appendix B: List of Consolidated Individual Commercial Banks and Foreign Bank Branches in Thailand.

Unique ID	Name 1	Name 2	Name 3
1	Bangkok Bank		
2	The Bangkok Bank of Commerce		
3	Kasikornbank	Thai Farmers Bank	
4	The Royal Bank of Scotland N.V.	ABN-AMRO N.V.	
5	Krung Thai Bank		
6	Standard Chartered Bank		
7	JP Morgan Chase Bank	The Chase Manhattan Bank	
8	Oversea Chinese Banking Corporation		
9	The Bank of Tokyo-Mitsubishi	The Bank of Tokyo-Mitsubishi UFJ	
10	TMB Bank	The Thai Military Bank	
11	DBS Thai Danu Bank		
12	First Bangkok City Bank		
13	The Siam Commercial Bank		
14	The Siam City Bank		
15	Citibank		
16	Sumitomo Mitsui Banking Corporation	The Sakura Bank	
17	UOB Radanasin Bank		
18	Standard Chartered Bank (Thai)	Standard Chartered Nakornthon Bank	
19	Bangkok Metropolitan Bank		
20	Calyon Corrorate and Investment Bank	CIMB THAI Bank	
21	RHB Bank Berhad		
22	Bank of Asia	United Overseas Bank (Thai)	United Overseas Bank (Thai) Company Ltd.
23	Bank of Ayudhya		
24	Mega International Commercial Bank	The International Commercial Bank of China	
25	Bank of America, National Association		
26	BNP Paribas	Credit Agricole Corporate and Investment Bank	Credit Agricole Indosuez
27	Bank Thai	Indian Overseas Bank	
28	HSBC		
29	Deutsche Bank AG.		
30	Mizuho Corporate Bank, Ltd.	The Dai-Ichi Kangyo Bank	
31	Dresdner Bank AG.		
32	Societe Generale Bangkok Branch		
33	Bharat Overseas Bank		
34	The Sumitomo Bank		
35	The Industrial Bank of Japan		
36	UFJ Bank		
37	The Bank of China		
38	The Bank of Novascotia		
39	Thanachart Bank		
40	TISCO Bank		
41	AIG Retail Bank		
42	Kiatnakin Bank		
43	Industrial and Commercial Bank of China (Thai)	ACL Bank	
44	The Thai Credit Retail Bank		
45	GE Money Retail Bank		
46	Land and Houses Bank	Land and Houses Retail Bank	