THREE ESSAYS IN FINANCIAL GLOBALIZATION

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Financial globalization has many economic implications for countries. On one hand, it provides protection against national shocks and more efficient global allocation of resources. On the other hand, the financial interlinkage driven by globalization increases the exposure of countries to the financial and real shocks and to the risk of sudden capital reversals. This, in turn, has an impact on countries in various aspects. This dissertation explains the three different roles of financial globalization in individual countries and group of countries.

The first essay examines the degree of regional consumption risk sharing of countries in ASEAN+3 and investigates the extent to which financial integration determines the degree of regional consumption risk sharing. There are three main questions that this paper attempts to answer. First, the paper examines whether or not consumption risk sharing exists in ASEAN+3. Second, the paper explores to what directions should they contribute to the degree of regional consumption risk sharing. Finally, this paper examines to what extent ASEAN+3 shares the risk within the region *vis-à-vis* the rest of the world. According to the empirical analysis, there is a limited degree of regional and bilateral risk sharing among ASEAN+3 and the degree of such has not changed much during 2000–2007. However, despite the limited degree of regional risk sharing, countries that invest in ASEAN+3 in moderate proportion, that is, Singapore, Korea, and Thailand, tend to have a higher degree of regional consumption risk sharing than global risk sharing.

The second essay addresses the major issues of inflation targeting in Thailand. An empirical study shows there is no evidence that inflation targeting has contributed to economic improvement since Thailand does not perform any better, and even worse in terms of output stability, than non inflation targeting countries. Moreover, the results show that exchange rate channel under the transmission mechanism plays a major role which contradicts the traditional inflation targeting, and thus does not fit Thailand's economy. In addition, SVAR indicates that the disinflation is accompanied by declined and volatility in output, suggesting that the adoption of inflation is not free from expenses. Regarding oil price surge, results obtained from SVAR estimation suggest that any active interest policy is able to help relieve the oil price shock and leaving other variables unaffected while having an impact of shorter duration than does inflation targeting.

The third essay presents an analysis of the interrelation between financial institutions and the housing sector in the United States. The evidence presented in the first and the second section of the essay suggests that all economic sectors have increasingly participated in financial investment and have been exposed to a higher degree of volatility in financial investment, combining with changes of regulations, and new available instruments, creating the unsustainable boom in U.S. housing markets during the late 1990s to early 2000s, and later resulted in the subprime crisis. The third section sheds light on the dynamics of house price by the panel error correction formulation. The econometric estimation shows the slow adjustment of housing prices towards long-run equilibrium. The last section examines the spill over effects of housing markets to other economic sectors. The estimated results from VECM indicates the strong and statistically significant of all channels of *wealth effect*, *credit effect*, *and balance sheet effect*.

BIOGRAPHICAL SKETCH

Mingkwan Thongpruksa was born in January 1981 in Songkhla, Thailand. She attended the Economics Department at Thammasat University, Bangkok, after completing high school at Hatyai Wittayalai School, Songkhla, Thailand. After graduation with First-Honor from Thammasat University, she received the Anandamahidol Foundation Scholarship, which funded her graduate studies in the Ph.D. program in Regional Science at the Department of City and Regional Planning, Cornell University. Mingkwan completed her Ph.D. program in Regional Science at Cornell University in August 2009.

To my beloved family.

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CHAPTER 1

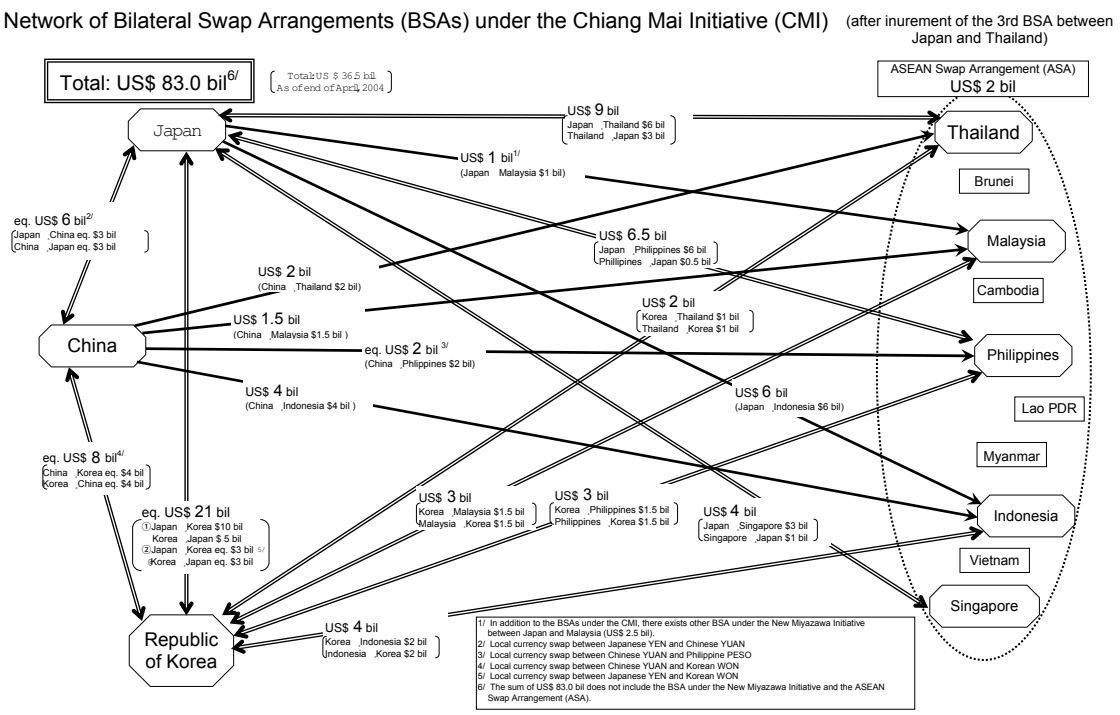
CONSUMPTION RISK SHARING AND REGIONAL FINANCIAL COOPERATION IN ASEAN+3

1.1 Introduction

The Asian financial crisis of 1997–1998 caused extensive damage to East Asia. This experience made the East Asian countries acutely aware of the need to promote regional financial cooperation to prevent resurgence of a crisis and to attain stable economic growth. Since then, ASEAN+3[1] have been vigorously promoting regional financial cooperation. With the rapid increase in economic interdependency in East Asia, regional financial cooperation is becoming all the more important.

The ASEAN+3 framework consists of five initiatives. First is the Chiang Mai Initiatives (CMI) which aims to create a network of bilateral swap arrangements (BSAs) among ASEAN+3 countries to address short-term liquidity difficulties in the region and to supplement the existing international financial arrangements. CMI comprises (i) bilateral swap arrangements among China, Japan, Korea, and between any of these plus-3 countries and a core ASEAN member and (ii) the ASEAN Swap Arrangement (ASA). The total bilateral swap size reached 83 billion USD and the total ASA was at 2 billion USD. Recently in February 2009, member countries agreed to create a multilateral currency swap, or the so called "crisis fund," worth 120 billion USD under CMI framework, to ease the economic difficulties resulting from economic situation in the USA.

[1] ASEAN+3 consists of 10 countries of the Association of Southeast Asian Nations which are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam,and plus three countries are China, Japan, and the Republic of Korea.



Source: Ministry of Finance, Japan

Figure 1.1: Network of Bilateral Swap Arrangement(as of July 2007)

Second is the Economic Review and Policy Dialogue (ERPD). ERPD contributes to the prevention of financial crises through the early detection of irregularities and the swift implementation of remedial policy actions. ERPD acts as a foundation in providing an emergent assistance, especially in the event of financial crisis.

Third is the Asian Bond Markets Initiative (ABMI). The objective of ABMI is to develop efficient and liquid bond markets in Asia, enabling better utilization of Asian savings for Asian investments. Bonds market development received much attention among ASEAN+3 as new channel of fund allocating and prevent currency and maturity mismatch which were the main causes of financial crisis in 1997. It is estimated that there is a potential need for infrastructure

investment of 300 to 400 billion USD per year in Asia over the next ten years.

Forth is "Research Group" whose main task is to explore ways to further strengthen financial cooperation by providing academic input from researchers and research institutes in ASEAN+3 countries. Last but not least, "Monitoring Short-Term Capital Flows." ASEAN+3 countries agreed to exchange the data on bilateral capital flows on a voluntary basis to assist the regional monitoring system.

Financial cooperation in this region is addressed in various frameworks. ASEAN countries have planned to move the relation forward. ASEAN finance ministers agreed to accelerate the process to establish an ASEAN Economic Community by 2015,[2] In this context, the finance ministers agreed in 2002 on the Roadmap for Financial and Monetary Integration of ASEAN by focusing on capital market development, capital account liberalization, financial services liberalization, and ASEAN currency cooperation.The Vientiane Action Program signed at the 2004 ASEAN Summit identified three financial cooperation initiatives: (i) strengthen surveillance mechanisms including the setting up of an early warning system, (ii) enhance domestic financial systems through capacity building, and (iii) develop and integrate financial markets.

Financial cooperation in the ASEAN+3 or within the ASEAN itself is not only initiated as a means of crisis prevention, it is also believed to enhance the higher degree of financial regionalization among country members. The opening of financial markets in Asia and ASEAN+3 countries have many implications on investments region-wide. One implication is the opportunities that countries in the region benefit from smooth consumption growth and diversify

[2]Parties to the agreement set the goal to be achieved 5 years earlier than the last decision made in the Declaration of ASEAN Concord II in Indonesia in 2003.

the country-specific income fluctuation. For the case of ASEAN+3, benefits from consumption smoothing could be reaped regionally and internationally.

The objective of this paper is to study the extent to which countries in ASEAN+3 share the risk regionally. The analysis is extended to study whether the more open of regional financial markets and net position of the current account balance would determine the degree of regional risk sharing. The paper is organized as follows. The next section presents the current situations of financial regional cooperation among ASEAN+3 countries. Section 3 reviews the existing literature with regards to relevant issues. Section 4 provides the data snapshot of the co-movement of ASEAN+3's consumption and regional and global aggregates. Section 5 investigates the degree of consumption risk sharing of ASEAN+3 countries. Section 6 studies the role of potential determinants and their contributions to regional risk sharing and bilateral risk sharing. Section 7 examines to what extent ASEAN+3 countries share the risk within their own region *vis-à-vis* the rest of the world, by allowing an individual country to pool their consumption stream either within a region, with the rest of the world, or with their national output. The final section explains policy implication and the conclusions.

1.2 Literature Review

Risk sharing analysis has been widely used to measure the degree of financial and economic integration: if the economy of a region is fully integrated, all countries in the region will equally share the risk, and consumers are able to take advantage of the wider range of investment opportunities, thereby smoothing

out their lifetime consumption patterns.

The studies on risk sharing are done theoretically and empirically. Considering the previous theoretical studies, many, such as Obstfeld (1994a), Crucini (1999), Athanasoulis & van Wincoop (2001), and Crucini & Hess (2000) focused on studies of the precise measurement of incomplete risk sharing, while some did not pay much attention to the degree of intertemporal consumption smoothing of the region. For instance Athanasoulis & van Wincoop (2001) assumed away intertemporal consumption smoothing while Crucini (1999) and Crucini & Hess (2000) assumed the extreme degree of intertemporal consumption smoothing by using the permanent income hypothesis. Obstfeld (1994a) did not take the intertemporal consumption into account.

On the empirical style, the studies touch upon measuring the contribution to risk sharing (Asdrubali *et al.* (1996); Sørensen & Yosha (1998); Mélitz & Zumer (1999); Asdrubali & Kim (2003)).These papers provided the distinction between risk sharing and intertemporal smoothing. By using the purely empirical technique on the studies, these papers provided no theoretical supports that would make them soundly reliable. Furthermore, there are some of studies that combined the two extreme approaches, which made the results more rigorous.Asdrubali & Kim (2003) and Kim *et al.* (2004) developed a method that jointly measured the degree of risk sharing and the degree of intertemporal consumption smoothing, which are derived from the theory of intertemporal consumption smoothing and risk sharing theory. Asdrubali & Kim (2003) obtained the approach mentioned above to test both of the intranational and international degree of risk sharing using the data from the United States, OECD, and EU countries to show how the degree of risk sharing and consumption smooth-

ing differ within countries and across the regions. The results showed that both of degree of consumption smoothing and the degree of risk sharing are higher within the countries than across the regions.

The degree of risk sharing and consumption smoothing across the regions, in addition, is used to measure the effectiveness of financial and economic integration. Kim *et al.* (2004) found that the degree of risk sharing in ten East Asian countries was quite low and did not increase over time. The result indicated the premature level of financial and economic integration in East Asia that corresponds to the results from Fujiki & Tareda-Hagiwara (2007) who suggested the high degree of integration between East Asia and the world financial markets. They also found welfare gain is archived if East Asia financially integrated with global markets.

There are also studies that test the channels through which risk sharing takes place. Sorensen *et al.* (2007) documented that the extent of risk sharing among industrial countries rose during the late 1990s while the home bias in debt and equity holding declined. Giannone & Reichlin (2005) found an increase in the extent of risk sharing among European countries during the early 1990s, when financial integration in Europe had started gaining momentum. Results correspond to a study from Fratzscher & Imbs (2007) who found that, by using sample countries from both matured and emerging countries, the international consumption risk sharing was significantly improved by capital flows, especially portfolio investment. They also found that the quality of financial institutions determine the degree of risk sharing. Kose *et al.* (2007) used various empirical

techniques and came up with the conclusion that there is at best a modest degree of international risk sharing which is far from what is predicted by theory. They argued that industrial countries have attained better risk sharing outcomes during the recent period of globalization, whereas developing countries have been shut out of this benefit.

Some studies focus on the regression framework used by Obstfeld (1994b) to evaluate changes over time in the extent of risk sharing. Bai & Zhang (2006) used a data set which comprises 21 industrial and 19 developing countries. They found that there are no significant changes in the regression coefficients from 1973–1985 to 1986–1998. Moser *et al.* (2004) ran the same regression for 15 EU countries and formally tested the stability of the regression coefficients over time. They did not find any break points in the regression coefficients over the period 1960–2002. They interpreted these results as indicating the absence of any improvement in the extent of risk sharing.

Another branch of literature analyzes how the international correlations of output and consumption have been affected by financial globalization. For instance, Kose *et al.* (2003) examined the factors that influence output and consumption correlations of individual country macroeconomic aggregate with the corresponding world aggregates. Their results indicated that actual gross capital flows have no significant impact on output correlations, and they found even weakerlink in case of consumption correlation. And so they concluded that there is little evidence that financial globalization has influenced consumption co-movement across countries.

There have been discussions about interactions between trade openness and financial integration. There are papers studied about the effect of trade integra-

tion and financial integration on economic growth, many of them support that these two parts of economic integration help promoting growth. Guerin (2006) found that regional trade agreement (RTAs) help to reduce transaction cost, and geographical patterns of trade and portfolio investment are similar to those of FDI. In addition, by using gravity model to find the relationship between trade and financial credits, Rose & Spiegel (2002) found that there is a positive effect of bilateral trade on bilateral lending patterns. And so the pattern of lending is determined by pattern of trade. Debtors tend to borrow more from creditors with whom they share more international trade ties. Regarding the study of trade relations and risk sharing, Kose *et al.* (2007) found the striking evidence of risk sharing improvement for 21 emerging economies when financial integration is accompanied with trade integration. That is, financial integration works in terms of delivering risk sharing benefits only when the economy is also open to trade flows.

1.3 Correlations of Consumption and Output

The preliminary study of risk sharing can be undertaken by looking at correlations of growth rate of output and consumption nationally and internationally. According to Kose *et al.* (2007), perfect risk sharing suggests (i) weakly correlations (or no correlations) between consumptions and national output, (ii) high cross-country correlations between consumption and output, (iii) cross-country correlations of consumption are much higher than those of output, and (iv) domestic consumption is more highly correlated with world consumption than with national output. All mentioned four theoretical predictions were used as guidelines to look at data with regard to consumption risk sharing among

ASEAN+3 countries. In this part, I examine the correlations of household consumption and output during the years 1991 to 2007 and divide the period of study into two sub periods which are 1991 to 1999 and 2000 to 2007, to see the pattern of changes in correlations overtime.[3] Correlations are computed in three sets (i) within a country (ii) between a country and world aggregates, and (iii) between a country and ASEAN+3 aggregates,[4] in order to compare the degree of regional and global risk sharing of countries in ASEAN+3.

The relationship between country's household consumption growth rate and GDP growth rate at the national level is positive (as illustrated in Figure 1.2) in every country except Brunei where the pattern of median spline is not quite clear. Pairwise correlations between country's consumption and country's output are calculated over the period 1991 to 2007 and then are split into two sub periods that is, 1991 to 1999 and 2001 to 2007, in order to see structural change of correlations before and after CMI had taken place. The bottom left panel in Figure 1.3 shows the correlations between country's consumption and country's output for the entire period. More than half of ASEAN+3 countries have high national correlations of consumption and are above 0.5 except for Brunei. According to Figure 1.2, Brunei's correlation was -0.1. Sub period correlations provide the useful information that ASEAN+3 have high correlations of domestic consumption and domestic output in the early period, and right after that correlations tend to scatter across countries. From the top right panel of Figure 1.3, Brunei, Indonesia, Japan, Philippines, Thailand, and Vietnam have correlations below 0.4, whereas the rest of the ASEAN+3 countries have correlations above 0.4. China's and Malaysia's consumption correlations with domestic output are

[3]The other two motivations are to see the development of correlations after financial crisis and the year 2000, when the Chiang Mai Intiatives (CMI) was officially announced.

[4]Myanmar and Laos PDR were excluded from the study dues to data unavailability.

almost one.

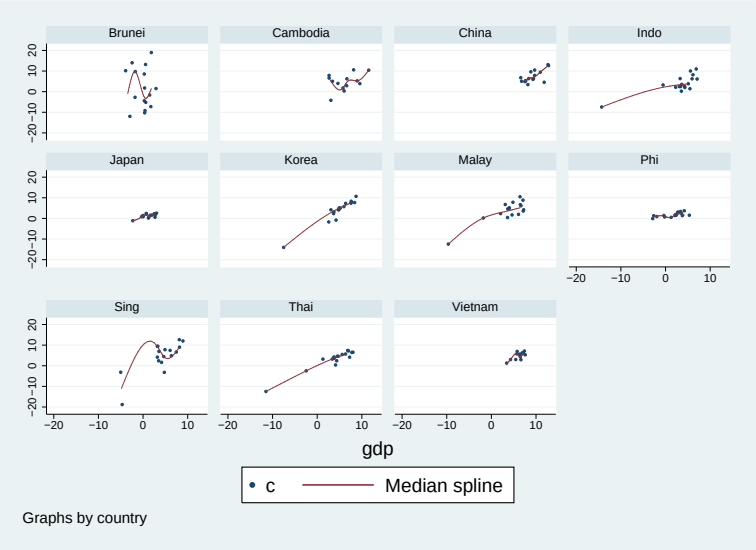


Figure 1.2: Country's Consumption and Country's Output (fitted line is median data with 5-year rolling window)

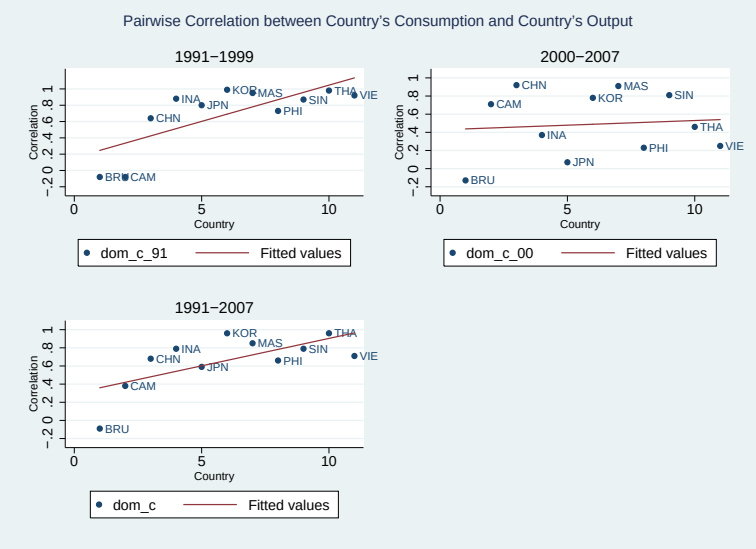


Figure 1.3: Pairwise Correlation of Country's Consumption and Country's Output

Regional consumption co-movement is measured by pairwise correlation between individual country and ASEAN+3 aggregates. The first graph is between country's consumption and ASEAN+3's output. The second is between

country's consumption and ASEAN+3's consumption. Correlations of consumption and ASEAN+3 output aggregates (see Figure 1.4) from 2000 to 2007 are scattered and relatively are within a relatively lower range than those for 1999–2007. Correlations range from -0.4 to 0.9. Brunei outperforms the entire group and shows improvement of consumption correlations over time. Cambodia, China, Philippines, Singapore,Thailand, and Vietnam saw decreasing correlations. A similar pattern of correlations is found in between individual country's consumption and ASEAN+3's consumption, except that correlations of individual country's consumption and ASEAN+3 are relatively higher and less scattered than correlations of consumption and regional output in 2000–2007. For the entire period (the bottom left panel of figures 1.4 and 1.5), correlations of consumption and regional output overall are higher than correlations of consumption and regional consumption in most of countries.

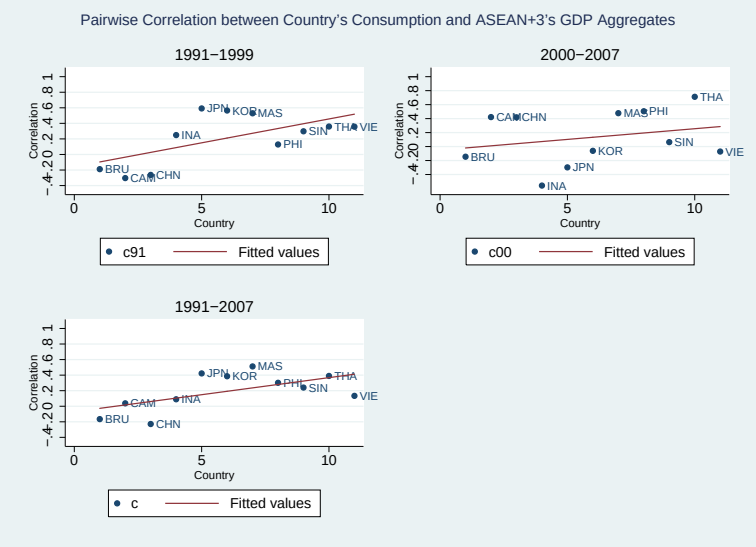


Figure 1.4: Pairwise Correlation of Country's Consumption and ASEAN+3's Output

On the global basis, countries in ASEAN+3 have slight correlations with world output. Correlations of most countries stay in a narrow range of 0–0.2.

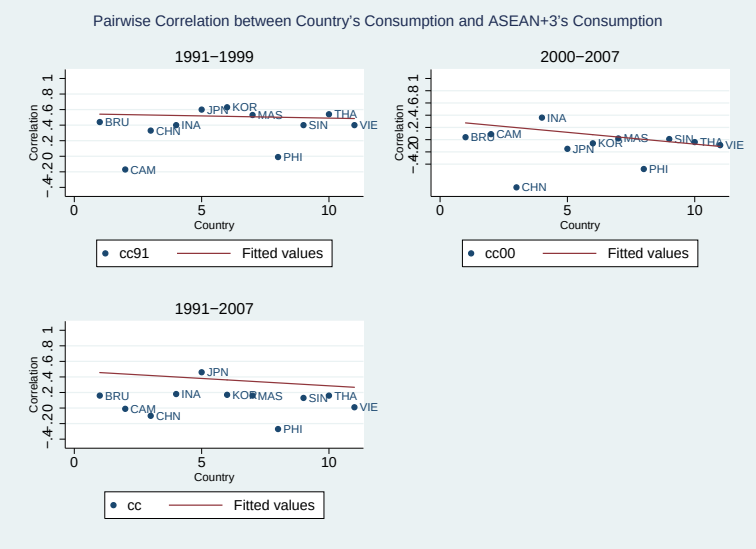


Figure 1.5: Pairwise Correlation of Country's Consumption and ASEAN+3's Consumption

Sub period figures (left and right top panel of Figure 1.6) suggests that the correlations are scattered over time. Some countries have higher correlations in the latter sub period whereas others have lower ones. For instance, Cambodia's correlation is -0.7 during 1991–1999 and jumps to 0.6 during 2001 to 2007. China's correlation also improved while the rest of ASEAN+3's correlations either stayed at the same level or declined overtime.According to Figure 1.7, correlations of individual country's and world's consumption are mostly at -0.4 in all countries during 1991–1999. The pattern of correlations is more disperse from 2000 to 2007 and rises to between 0.2 and 0.4. However, overall, correlations between country's and world's consumption are negative between 1991 and 2007.

Contrary to the first suggestion from risk sharing theory, the consumptions in ASEAN+3 are highly correlated with national output aggregates despite the significant increase in financial openness since the 1990s. Correlations of consumption with regional and world consumption is less than unity, which con-

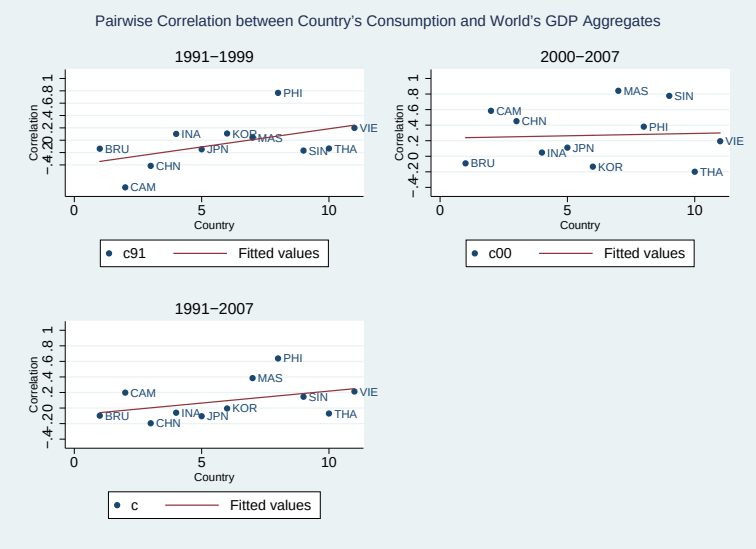


Figure 1.6: Pairwise Correlation of Country's Consumption and World's Output

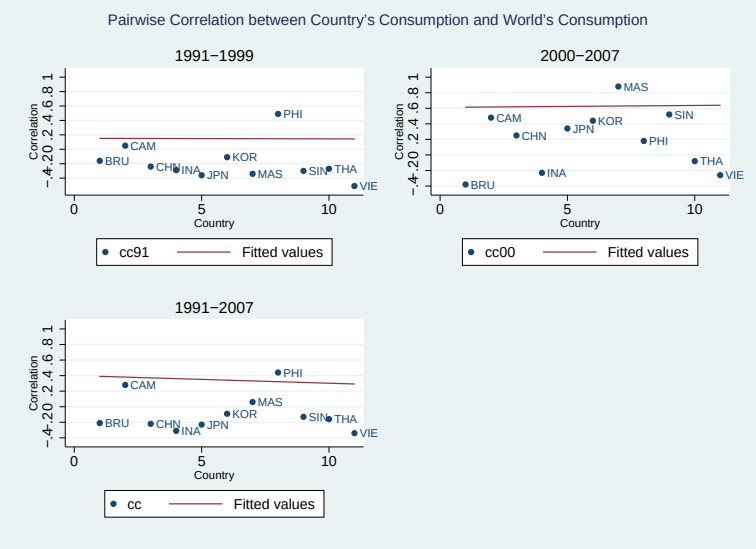


Figure 1.7: Pairwise Correlation of Country's Consumption and World's Consumption

tradicts the second prediction from theory. Moreover, the evidence shows that both regional and global cross-correlations of consumptions are slightly lower than those of output. The above findings contradicts the forth proposition suggested by Kose *et al.* (2007). ASEAN+3's domestic consumption still heavily depends on the countries' own national output rather than either regional or

global consumption. From preliminary study, countries in ASEAN+3 have low levels of both regional and global risk sharing, even during globalization periods when countries are more open to international financial markets.

1.4 Regional Risk Sharing

1.4.1 Research Methodology

To measure the degree of regional risk sharing among countries in ASEAN+3, I follow the risk sharing framework suggested by Kose *et al.* (2007) that involves running a regional risk sharing regression equation in a panel data framework.The regional risk sharing regression equation is expressed as:

$$\Delta \log c_{it} - \Delta \log C_{rt} = \alpha_t + \beta(\Delta \log y_{it} - \Delta \log Y_{rt}) + \varepsilon_{it}, \tag{1.1}$$

where c_{it} is per capita consumption of country i, C_{rt} is regional per capita consumption, y_{it} is per capita GDP of country i and Y_{rt} is regional per capita GDP. The difference between national and regional components represent the country-specificity of the variables. Kose *et al.* (2007) suggests that coefficient β, obtained from equation 1.1, represents the degree of idiosyncratic co-movement between consumption and GDP. Risk sharing is extracted by taking the value of β and subtracting it by one ,that is, degree of regional risk sharing is $(1 - \beta)$.The panel regression equation 1.1 covers the period 1990 to 2007.

1.4.2 Determinants of Regional Consumption Risk Sharing

In this section, I extend the standard model as exhibited in equation 1.1 to investigate how the cross-border investment and net position of current account should achieve in terms of risk sharing. According to Kose *et al.* (2007), financial openness allows countries to access international capital markets and that should foster the higher degree of consumption smoothing and risk sharing.[5] In particular, I estimate

$$\begin{aligned}\Delta \log c_{it} - \Delta \log C_{rt} &= \alpha_t + \beta_1(\Delta \log y_{it} - \Delta \log Y_{rt}) + \beta_2 \phi_{ij}(\Delta \log y_{it} - \Delta \log Y_{rt}) \\ &\quad + \beta_3 \phi_{ij} d_t(\Delta \log y_{it} - \Delta \log Y_{rt}) + \varepsilon_{it}, \end{aligned} \tag{1.2}$$

where ϕ_{ij} is measure of financial openness in country i, which is measured in j different ways. The first is proxied by the value of capital held abroad relative to domestic GDP. The variables d_t are time dummies that take a value of one for the year 2000 and forward. The purpose of adding time dummies is to capture for the structural change of degree of risk sharing after CMI has been implemented. Capital is decomposed into portfolio equity, portfolio debt, and FDI.The decomposed financial assets holdings are normalized in two ways. First, I normalize holdings of portfolio equity, portfolio debt, and FDI by GDP;

$$\phi_{i1} = \frac{k_i}{GDP_i}, \tag{1.3}$$

where $k = \{equity, debt, fdi\}$.

Second, I compute the shares of financial holdings to overall capital, that is:

[5] Kose *et al.* (2007) found that financial openness improves risk sharing among industrial economies but this risk sharing pattern is not found in cases of developing economies.

$$\phi_{i2} = \frac{k_i}{equity_i + debt_i + fdi_i}, \tag{1.4}$$

where $k = \{equity, debt, fdi\}$. Both measurements capture the importance of asset holdings in different ways. The first measure is normalized by the size of economies, whereas the second measure focuses on portfolio composition. Noting that both measures are time invariant, I compute averages over 1991 to 2007 and 2000 to 2007. Degree of risk sharing of country i is $(1-\beta_1-\beta_2\phi_{ij})$. If there exists a significant structural change during 2000-2007, the degree of risk sharing will be $(1-\beta_1-(\beta_2+\beta_3)\phi_{ij})$. I also use de jure capital openness index provided by Chinn & Ito (2008) and AREAER index as a measurement of financial openness.[6]

Risk sharing can be determined by the net position of current account. Recalling that current account is expressed as the difference between national (both public and private) savings and investment. A current account deficit may therefore reflect a low level of national savings relative to investment or a high rate of investment, or both. In other words, a current account surplus increases a country's net foreign assets by the corresponding amount, and a current account deficit does the reverse. By Controlling the position of net current account allows us the see the pattern of regional risk sharing given a net position of country members.

1.4.3 Scope of the Study and Source of Data

Panel regression with country and time fixed effect is used to estimate risk sharing equation. The sample period is 1991–2007. Sample countries are China,

[6]Please see Chinn & Ito (2008).

Korea, Japan, Indonesia, Malaysia, Philippines, Singapore, and Thailand.[7] Data are obtained from WDI, CPIS, IMF, and ASEAN Secretariat. Definition and data description are in the Appendix A.

1.4.4 Empirical Results

Table 1.1 represents the degree of regional risk sharing of ASEAN+3. Results are from full sample, that is, 1991–2007, and 2000–2007, using time dummies to define the structural break. Column 1 represents result without any interaction variables, results were obtained from suggesting the limited degree of risk sharing for the full sample.

Columns 2 through 8 indicate results where interaction variables are introduced into the model. The reason for doing so is to capture the extent to which regional financial market openness and regional financial investment should affect the degree of regional risk sharing. Different types of financial assets and liabilities, which are portfolio equity, portfolio debt, and FDI that individual countries in ASEAN+3 hold up against other countries in same region, are included as interaction terms. De jure capital openness provided by Chinn & Ito (2008) and AREAER are used to account for indicator of capital openness. Table 1.1, column 2 through 8, presents the results of regression with interaction terms where indicators of each financial assets holding were normalized with GDP. Results of each column are categorized in two sample sets which are full sample that is, 1991–2007, and 2000–2007. For the full sample, debt assets account for degree of regional risk sharing albeit their affects are offset by the

[7] Brunei , Cambodia, Vietnam, Laos PDR, and Myanmar are dropped because data on coordinated portfolio investment is not available.

high degree of co-movement between indyosyncratic consumption and output. De jure measurement of capital openness shows the sign of improvement of the degree of regional risk sharing while the other types of financial portfolio investment do not make the contribution. However, time dummies of the period 2000–2007 do not show any significance of structural break in any type of portfolio and FDI investment. Table 1.2 shows the results where financial assets and liabilities and FDI are normalized by total investment from 2000–2007. Among all other types of financial investment and FDI, only debt liabilities are conducive to promoting the degree of regional risk sharing. However, by taking the percentage of financial investment to total investment into account, the degree of risk sharing is deteriorated by the high degree of consumption and output co-movement which are higher than one in almost all cases.

The inability of ASEAN+3 markets to gain degree of risk sharing within a region as suggested by Kose *et al.* (2007) is related to the domestic conditions of the country. I examine the role of net savings position (ratio current account surplus to GDP), financial development (ratio of M_2 to GDP), and trade openness (ratio of sum of exports and imports to GDP). Results of regression, as exhibited in Table 1.3, suggest that for the full sample period, net savings position of country in ASEAN+3 is statistically significant and positive, which means that net savings position discourages regional risk sharing.[8] Other country characteristics do not show any significance. No strutural change is observed since the time dummies do not pick any significant effects. This implies that the role of regional financial investments as contributors to the degree of regional risk sharing has not changed since CMI was instituted.

[8]Net borrowing position are not statistically significant and, so, the results are suppressed.

Table 1.1: Regional Consumption Risk Sharing with Investment as Share of GDP

VARIABLES	(1) No Interactions 1991–2007	(2) Equity Assets 1991–2007	(3) Equity Liabilities 1991–2007	(4) FDI 1991–2007	(5) Debt Assets 2000–2007	(6) Debt Liabilities 2000–2007	(7) Chinn-Ito De Jure 1991–2007	(8) AREAER De Jure 1991–2007
GDP	0.829***	0.769***	0.869***	0.770***	1.353***	1.231***	0.879***	1.008***
	(0.110)	(0.118)	(0.128)	(0.130)	(0.229)	(0.332)	(0.117)	(0.132)
Equity (Assets)		9.498						
		(7.416)						
Equity(Assets) × 2000-2007 dummies		-6.843						
		(7.348)						
Equity(Liabilities)			-6.371					
			(6.118)					
Equity(Liabilities)× 2000-2007 dummies			2.178					
			(2.946)					
FDI				10.99				
				(19.30)				
FDI× 2000-2007 dummies				12.61				
				(28.28)				
Debt(Assets)					-3.483*			
					(2.353)			
Debt(Liabilities)						-7.846		
						(18.46)		
Ito-Chinn De Jure Measurement							-0.0907	
							(0.0815)	
Ito-Chinn De Jure Measurement × 2000-2007 dummies							0.137	
							(0.127)	
IMF De Jure Measurement								-0.562***
								(0.213)
IMF De Jure Measurement× 2000-2007 dummies								0.433
								(0.416)
Constant	-0.00398	-0.00191	-0.00457	-0.00232	-0.0897***	-0.0862***	-0.00605	-0.00789
	(0.00592)	(0.00611)	(0.00611)	(0.00626)	(0.00733)	(0.00903)	(0.00669)	(0.00607)
Observations	132	132	132	132	60	60	127	132
Adjusted R^2	0.950	0.950	0.950	0.950	0.992	0.991	0.949	0.953

Standard errors are in parentheses.
*** p<0.1, ** p<0.05, * p<0.01

Table 1.2: Regional Consumption Risk Sharing with Investment as Share of Total Investment

VARIABLES	(1) Equity Assets 2000–2007	(2) Equity Liabilities 2000–2007	(3) FDI 2000–2007	(4) Debt Assets 2000–2007	(5) Debt Liabilities 2000–2007
GDP	0.879***	1.354***	1.041***	1.503***	1.290***
	(0.365)	(0.248)	(0.205)	(0.424)	(0.197)
Equity (Assets)	0.778				
	(1.117)				
Equity (Liabilities)		-0.776			
		(0.600)			
FDI			0.386		
			(0.732)		
Debt (Assets)				-0.740	
				(0.737)	
Debt (Liabilities)					-0.643*
					(0.417)
Constant	-0.00417	-0.000404	-0.00668	-0.00144	-0.00917***
	(0.00764)	(0.00777)	(0.00576)	(0.00836)	(0.00490)
Observations	60	60	60	60	60
Adjusted R^2	0.991	0.991	0.991	0.991	0.992

*** p<0.1, ** p<0.05, * p<0.01
Standard errors are in parentheses.

1.5 Bilateral Risk Sharing

This section extends the prevalent model of risk sharing by introducing the idea of bilateral risk sharing into the analysis in order to measure the extent to which two individual member countries share risk bilaterally. A country agrees to smooth out the transaction with another country if their consumptions are correlated to each other, but there will be no reason to do so if the output fluctuations are also perfectly correlated. The bilateral risk sharing is given by the estimates of γ in the following equation:

Table 1.3: Regional Consumption Risk Sharing with Country Characteristics

VARIABLES	(1) $\frac{CurrentAccount}{GDP}$ 1991–2007	(2) $\frac{M_2}{GDP}$ 1991–2007	(3) $\frac{Trade}{GDP}$
GDP	0.725***	0.521***	1.012***
	(0.123)	(0.236)	(0.201)
$\frac{CurrentAccount}{GDP}$	3.909***		
	(2.025)		
$\frac{CurrentAccount}{GDP}$ × 2000–2007 dummies	-0.216		
$\frac{M_2}{GDP}$		0.369	
		(0.256)	
$\frac{M_2}{GDP}$ × 2000–2007 dummies		-0.0520	
		(0.160)	
$\frac{Trade}{GDP}$			-0.184
			(0.220)
$\frac{Trade}{GDP}$ × 2000–2007 dummies			0.177
			(0.182)
Constant	-0.00267	-0.00602	-0.00899
	(0.00585)	(0.00616)	(0.00559)
Observations	130	132	122
Adjusted R^2	0.953	0.950	0.970

Standard errors are in parentheses.
*** p<0.1, ** p<0.05, * p<0.01

$$\begin{aligned}\Delta \log c_{it} - \Delta \log c_{jt} &= \alpha_t + \gamma_1(\Delta \log y_{it} - \Delta \log y_{jt}) + \gamma_2 \phi'_{ij,t}(\Delta \log y_{it} - \Delta \log y_{jt}) \\ &\quad + \gamma_3 \phi'_{ij,t} d_t(\Delta \log y_{it} - \Delta \log y_{jt}) + \gamma_l \sum_3^l T^l_{ij,t} + \varepsilon_{ij,t}, \qquad (1.5)\end{aligned}$$

where the term $(\Delta \log c_{it} - \Delta \log c_{jt})$ and $(\Delta \log y_{it} - \Delta \log y_{jt})$ are cyclical components of consumption and income between country i and country j respectively. The interaction variables, ϕ'_{ij}, represents the bilateral portfolio investment between country i and country j, measured by the various types of capital assets (liabilities) that country i holds against country j relative to the GDP of country i. They are decomposed into portfolio equity and portfolio debt.[9] The decomposed financial assets holdings are normalized by taking the holdings of

[9]FDI is suppressed due to data unavailability.

portfolio equity, portfolio debt by GDP of country i:

$$\phi'_{ij} = \frac{k_{ij}}{GDP_i}, \tag{1.6}$$

where $k = \{equity, debt\}$.

Note that ϕ' is time invariant. I compute averages over 1991–2007 and 2000–2007. Degree of risk sharing of country i is $(1 - \gamma_1 - \gamma_2\phi'_{ij})$. If there exists the significance structural change during 2000–2007, the degree of risk sharing will be $(1 - \gamma_1 - (\gamma_2 + \gamma_3)\phi'_{ij})$. Controlled variables T_{ij}, comprise of distance, common language, and border. Details of variables are in the Appendix A. Panel regression with time and country pair fixed-effect is used to estimate coefficients.

Table 1.4 shows the estimates of equation 1.2. Column 1 exhibits the coefficients obtained from the whole data set without interaction. It shows that the degree of bilateral consumption risk sharing in ASEAN+3 is quite low. This corresponds to the results from the earlier section. The next three columns interact the extent of risk sharing with different types of portfolios and FDI investment. In bilateral terms, the results show that particular types of financial interaction have been associated with the degree of risk sharing. The de facto measurements of financial investment largely contribute to the degree of bilateral risk sharing. Share of equity assets and equity liabilities to output appear to support the bilateral risk sharing in the full sample period. However, debt stocks do not play a significant role in promoting bilateral risk sharing. Regarding the structural change during 2000–2007, results in columns 2 and 3 indicate that bilateral equity assets and liabilities investment worsen bilateral risk sharing by approximately the same amount as they contribute to bilateral risk sharing during 1990s. Debt liabilties coefficient remains insignificant. The result is con-

Table 1.4: Bilateral Consumption Risk Sharing

VARIABLES	(1) No Interactions 1991-2007	(2) Equity Assets 1991-2007	(3) Equity Liabilities 1991-2007	(4) Debt Liabilities 1991-2007
GDP	0.857***	0.875***	0.873***	0.857***
	(0.0389)	(0.0715)	(0.0708)	(0.0714)
Equity(*Assets*)		-30.01***		
		(8.940)		
Equity(*Assets*)× 2000-2007 dummies		30.20***		
		(12.75)		
Equity(*Liabilities*)			-23.12***	
			(9.048)	
Equity(*Liabilities*)× 2000-2007 dummies			28.75***	
			(13.89)	
Debt(*Liabilities*)				0.593
				(4.821)
Debt(*Liabilities*)× 2000-2007 dummies				1.680
				(4.165)
Distance	-0.00668	-0.00718***	-0.00713***	-0.00700***
	(0.00422)	(0.00196)	(0.00193)	(0.00218)
Language	0.00290	0.00291***	0.00297***	0.00279***
	(0.00576)	(4.17e-05)	(0.000154)	(0.00144)
Land Continuity	-0.00191	-0.00218***	-0.00216***	-0.00166
	(0.00611)	(0.00108)	(0.00107)	(0.00152)
Landlock	0	0	0	0
	(0)	(0)	(0)	(0)
Constant	0.0500	0.0535***	0.0537***	0.0521***
	(0.0332)	(0.0151)	(0.0148)	(0.0162)
Observations	882	882	882	882
Adjusted R^2	0.458	0.463	0.462	0.456

*** p<0.1, ** p<0.05, * p<0.01
Standard errors are in parentheses.

sistent with Kose *et al.* (2007) the results of which suggest that financial integration appears to have no significant impact on emerging market during the globalization period.

1.6 Degree of Risk Sharing and Regional Financial Markets

Based on the specifications that I have estimated, it is possible to obtain the degree of regional and bilateral risk sharing of a change in the level of regional financial integration. Tables 1.5 and 1.7 represent degree of regional and bilateral risk sharing and their relationships with various measures of financial openness. The measures of regional risk sharing ($(1-\beta_1-\beta_2\phi_{ij})$ and $(1-\beta_1-(\beta_2+\beta_3)\phi_{ij})$ if there exists a significant structural change during 2000–2007) are shown in Table 1.5. The degree of regional risk sharing varies across different financial investments and FDI as share of GDP. Without interaction, degree of regional risk sharing is 0.17 for the full sample period and is higher if equity assets, FDI, and IMF's de facto measurement of capital openness are incorporated. Degree of regional risk sharing were reduced with equity liabilities and Ito-Chinn measure. It becomes negative with debt assets and debt liabilities. Overall, focusing only on positive term, regional risk sharing varies in the range of 0.12–0.56. The next table (Table 1.6) represents the degree of regional risk sharing interaction with financial investments and FDI as share of total investment. To this context, the results vary across countries and type of financial investment. The regional risk sharing is negative in all countries with the interaction with equity investment and FDI. Debt liabilities as a share of total investment contribute positive risk sharing to Japan, Singapore, and the Philippines.

For the degree of bilateral risk sharing, Table 1.7 shows that the degree of bilateral risk sharing depends on country pair and the specification of financial investment, the degree of which ranges from -0.13 to 1. Most of the financial investments do not pick up the structural change after 2000, except equity assets which account for the huge dramatic change in some particular country pair (for

Table 1.5: Degree of Regional Risk Sharing With Investment as Share of GDP

No Interaction	1991–2007
China	0.17
Indonesia	0.17
Japan	0.17
Korea	0.17
Malaysia	0.17
Philippines	0.17
Singapore	0.17
Thailand	0.17

Equity Assets	1991–2007	2000–2007
China	0.23	0.23
Indonesia	0.23	0.23
Japan	0.23	0.23
Korea	0.23	0.23
Malaysia	0.23	0.23
Philippines	0.23	0.23
Singapore	0.23	0.23
Thailand	0.23	0.23

Equity Liabilities	1991–2007	2000–2007
China	0.13	0.13
Indonesia	0.13	0.13
Japan	0.13	0.13
Korea	0.13	0.13
Malaysia	0.13	0.13
Philippines	0.13	0.13
Singapore	0.13	0.13
Thailand	0.13	0.13

FDI	1991–2007	2000–2007
China	0.23	0.23
Indonesia	0.23	0.23
Japan	0.23	0.23
Korea	0.23	0.23
Malaysia	0.23	0.23
Philippines	0.23	0.23
Singapore	0.23	0.23
Thailand	0.23	0.23

	Debt Assets	Debt Liabilities
	2000–2007	2000–2007
China	-0.33	-0.35
Indonesia	-0.35	-0.35
Japan	-0.34	-0.35
Korea	-0.35	-0.35
Malaysia	-0.35	-0.35
Philippines	-0.34	-0.35
Singapore	0.29	-0.35
Thailand	-0.35	-0.35

	Ito-Chinn	AREAER (IMF)
	2000–2007	2000–2007
China	0.12	0.56
Indonesia	0.12	0.56
Japan	0.12	0.56
Korea	0.12	0.56
Malaysia	0.12	0.56
Philippines	0.12	0.56
Singapore	0.12	0.56
Thailand	0.12	0.56

Source: Author's Calculation

instance, Singapore and Malaysia which share the perfect risk sharing in the full sample period but are hit down to 0.01 during 2000-2007).

Taken all together both regionally and bilaterally, the results suggest that degree of risk sharing in ASEAN+3 countries is determined by three factors (1) consumption co-movement (2) risk sharing coefficient, and (3) magnitude of regional and bilateral financial investment. Negative risk sharing stems from the lack of any of the three determinants.

Table 1.6: Degree of Regional Risk Sharing with Investment as Share of Total Investment

	Equity Assets 2000-2007	Equity Liabilities 2000-2007	FDI 2000-2007	Debt Assets 2000-2007	Debt Liabitlies 2000-2007
China	0.121	-0.35	-0.04	-0.5	-0.15
Indonesia	0.121	-0.35	-0.04	-0.5	-0.21
Japan	0.121	-0.35	-0.04	-0.5	0.28
Korea	0.121	-0.35	-0.04	-0.5	0.17
Malaysia	0.121	-0.35	-0.04	-0.5	-0.17
Philippines	0.121	-0.35	-0.04	-0.5	0.20
Singapore	0.121	-0.35	-0.04	-0.5	-0.05
Thailand	0.121	-0.35	-0.04	-0.5	-0.20

Source: Author's Calculation

The results that I have presented thus far suggest that the degree of regional and bilateral risk sharing is limited. To explain why it is so, I look closely at each factor that contributes to degree of risk sharing. Exploring the first factor, consumption co-movement, I categorize the dependent variable, that is, the idyosyncratic component of regional consumption ($\Delta \log c_{it} - \Delta \log C_{rt}$), into different groups according to its corresponding year.[10] And then I generate interaction of idiosyncratic component of consumption with each category, run regression on the categories and interaction terms, and generate predicted values. I repeat the same steps with bilateral terms. The predicted value of the idiosyncratic component of regional and bilateral consumption is then plotted against time and exhibited in figures 1.6 and 1.6. According to Kose *et al.* (2007), risk sharing is observed if there exists a high degree of consumption co-movement between two parties, that is, a small number of component of consumption. Figure 1.6 shows that the idiosyncratic component of consumption is stable at a narrow range close to zero over time and there is no structural change in year 2000. The structural change becomes significant for 2005–2007, since the domestic consumption moves away from regional consumption causing the sharp increase of idiosyncratic component of consumption from almost null to 0.25 in

[10]During the sample period 1991–2001,the total number of group is 17.

Table 1.7: Degree of Bilateral Risk Sharing

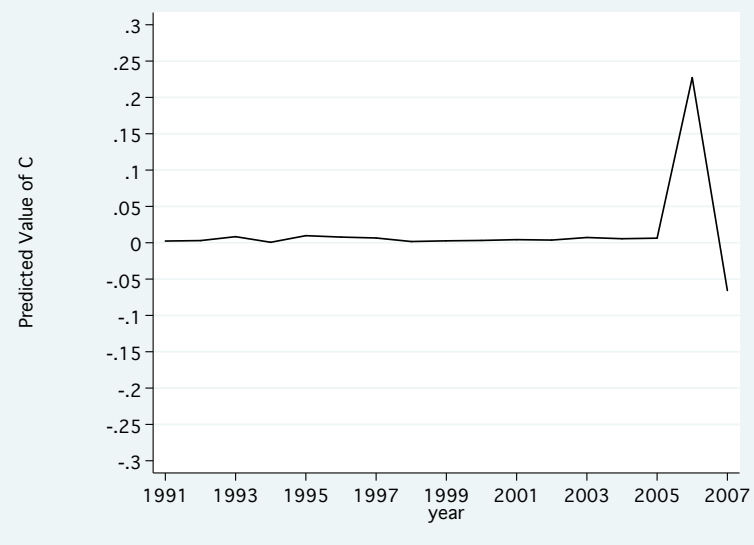
Country Pair	No Interaction 1991-2007	Equity Assets 1991-2007	Equity Assets 2000-2007	Equity Liabilities 1991-2007	Equity Liabilities 2000-2007	Debt Liabilities 1991-1999	Debt Liabilities 2000-2007
MI	0.14	0.13	0.12	0.13	0.12	0.14	0.14
MP	0.14	0.13	0.13	0.13	0.12	0.14	0.14
MT	0.14	0.13	0.12	0.13	0.13	0.14	0.14
MS	0.14	0.30	0.14	1.19	0.38	0.14	0.14
MC	0.14	0.13	0.12	0.13	0.12	0.14	0.14
MK	0.14	0.13	0.12	0.13	0.12	0.14	0.14
MJ	0.14	0.13	0.12	0.18	0.12	0.14	0.14
IM	0.14	0.13	0.12	0.13	0.12	0.14	0.14
IP	0.14	0.13	0.13	0.13	0.13	0.14	0.14
IT	0.14	0.13	0.12	0.13	0.13	0.14	0.14
IS	0.14	0.13	0.12	0.31	0.02	0.14	0.14
IC	0.14	0.13	0.12	0.13	0.13	0.14	0.14
IK	0.14	0.13	0.12	0.13	0.13	0.14	0.14
IJ	0.14	0.13	0.12	0.14	0.14	0.14	0.14
PM	0.14	0.13	0.13	0.13	0.13	0.14	0.14
PI	0.14	0.13	0.13	0.13	0.13	0.14	0.14
PT	0.14	0.13	0.12	0.13	0.13	0.14	0.14
PS	0.14	0.13	0.12	0.19	0.03	0.14	0.14
PC	0.14	0.13	0.13	0.13	0.13	0.14	0.14
PK	0.14	0.13	0.13	0.13	0.13	0.14	0.14
PJ	0.14	0.13	0.12	0.13	0.13	0.14	0.14
TM	0.14	0.13	0.12	0.13	0.12	0.14	0.14
TI	0.14	0.13	0.12	0.13	0.13	0.14	0.14
TP	0.14	0.13	0.13	0.13	0.13	0.14	0.14
TS	0.14	0.13	0.13	0.35	-0.44	0.14	0.14
TC	0.14	0.13	0.12	0.13	0.12	0.14	0.14
TK	0.14	0.13	0.12	0.13	0.13	0.14	0.14
TJ	0.14	0.13	0.12	0.16	0.04	0.14	0.14
SM	0.14	1.00	0.01	0.27	0.10	0.14	0.14
SI	0.14	0.30	0.01	0.13	0.13	0.14	0.14
SP	0.14	0.20	0.09	0.13	0.13	0.14	0.14
ST	0.14	0.53	-0.13	0.13	0.13	0.14	0.14
SC	0.14	0.58	-0.20	0.13	0.13	0.14	0.14
SK	0.14	0.51	-0.26	0.14	0.11	0.14	0.14
SJ	0.14	0.64	-0.32	0.45	-0.04	0.14	0.14
CM	0.14	0.13	0.12	0.13	0.13	0.14	0.14
CI	0.14	0.13	0.12	0.13	0.13	0.14	0.14
CP	0.14	0.13	0.13	0.13	0.13	0.14	0.14
CT	0.14	0.13	0.13	0.13	0.13	0.14	0.14
CS	0.14	0.13	0.13	0.15	0.10	0.14	0.14
CK	0.14	0.13	0.12	0.13	0.12	0.14	0.14
CJ	0.14	0.13	0.12	0.15	0.09	0.14	0.14
KM	0.14	0.13	0.13	0.13	0.13	0.14	0.14
KI	0.14	0.13	0.13	0.13	0.13	0.14	0.14
KP	0.14	0.13	0.13	0.13	0.13	0.14	0.14
KT	0.14	0.13	0.12	0.13	0.13	0.14	0.14
KS	0.14	0.13	0.12	0.17	0.01	0.14	0.14
KC	0.14	0.13	0.12	0.13	0.13	0.14	0.14
KJ	0.14	0.14	0.11	0.15	0.08	0.14	0.14
JM	0.14	0.13	0.13	0.13	0.13	0.14	0.14
JI	0.14	0.13	0.13	0.13	0.13	0.14	0.14
JP	0.14	0.13	0.13	0.13	0.13	0.14	0.14
JT	0.14	0.13	0.12	0.13	0.13	0.14	0.14
JS	0.14	0.14	0.12	0.15	0.12	0.14	0.14
JC	0.14	0.14	0.11	0.13	0.12	0.14	0.14
JK	0.14	0.13	0.12	0.13	0.13	0.14	0.14

Source: Author's Calculation

Note:See details of abbreviations in the Appendix A.

year 2006 before dropping sharply in year 2007. The same pattern of change in idiosyncratic component of consumption is observed in bilateral term (Figure 1.6) except that the structural change occurs in year 2001 and the degree is milder than what was presented in figure 1.6.

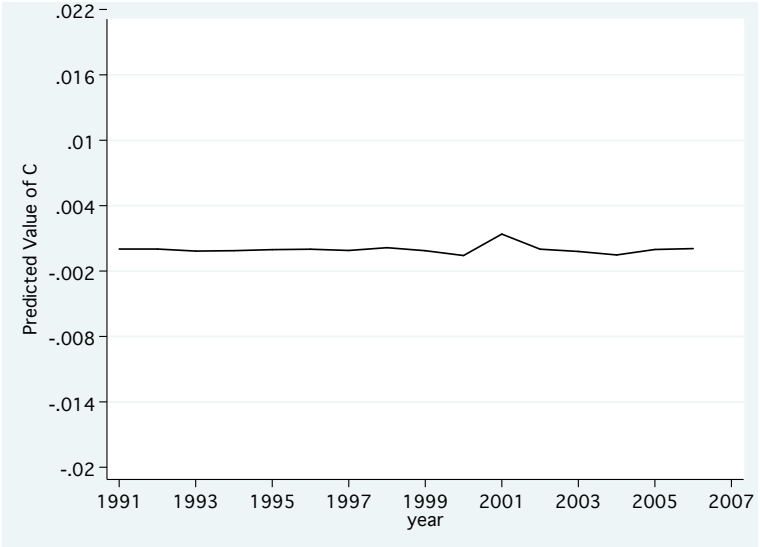
Both figures infer that regional and bilateral financial interactions are not able to pick up the improvement of risk sharing after year 2000, since the consumption co-movement has not changed much over time. In addition, the huge spike of regional consumption co-movement in year 2005 explains why the financial interactions with 2000–2007 time dummies for CMI are not significant in all cases.



Source: Author's Calculation

Figure 1.8: Piecewise Linear Idiosyncratic Component of Regional Consumption

Since the risk sharing coefficients were already mentioned, the next factor that is to be considered is the magnitude of regional and bilateral financial investment. Equity Markets in ASEAN+3 have grown, evidently, since the Asian crisis aftermath. After year 2003, stock markets in ASEAN (as shown in Ta-



Source: Author's Calculation

Figure 1.9: Piecewise Linear Idiosyncratic Component of Bilateral Consumption

ble 1.8) rose by 160.6 percent. Average daily turnover rose by 800 percent altogether with an impressive growth in capital due to both initial and secondary public offerings.

However, market capitalization is below industrial countries, and there is considerable diversity within the broad picture. Equity market in China remains illiquid and small relative to the size of its domestic economy. In China, the equity market reflects the dominance of state-own companies. In addition, many high performing firms in the region mostly do the cross-list through developed exchanges in the United States and Europe. The majority of China's successful companies are listed overseas, primarily in Hong Kong Oura *et al.* (2006). Cross-listing can be considered as channel for individual companies diverting away from regional capital markets.

As the source of financial funds, equities provide around 10 percent of corporate financing (see Table 1.9). In spite of the growth of equity financing, Asian

finance continues to reply on bank loans, and as shown in figures 1.10, 1.11, and Table 1.10, regional equity investment has yet to recover to pre-Asian crisis level (Oura *et al.* (2006)).

Table 1.8: Stock Market Indicators (billion USD, 2003 and 2007)

	Market Capitalization			Average Daily Turnover			IPOs			Secondary Public Offering		
	2007	2003	%△	2007	2003	%△	2007	2003	%△	2007	2003	%△
Asia												
Bursar Malaysia	325.3	161.0	102.0	0.7	0.2	250.0	0.3	0.8	-62.5	2.2	0.95	131.6
Hong Kong Exchanges	2,654.4	714.6	271.5	8.7	0.8	987.5	37.5	7.6	393.4	36.5	19.9	83.4
Indonesia SE	211.7	54.7	287.0	0.5	0.05	840.0	2.0	1.1	81.8	3.4	0.5	580.0
Korea Exchange	1,122.6	293.9	282.0	8.3	2.4	245.8	3.2	0.6	424.6	3.8	0.0	NA
Osaka SE	212.2	1,951.5	-89.1	1.1	0.5	120.0	0.2	0.04	400.0	NA	4.9	NA
Philippine SE	103.0	23.2	344.0	0.1	0.01	900.0	0.4	0.003	13,233.3	1.6	0.02	7900.0
Shanghai SE	3,694.3	360.1	925.9	16.8	0.9	1,766.7	57.8	5.5	950.9	29.4	1.3	2161.5
Shenzhen SE	784.5	152.9	413.1	8.7	0.6	1,350.0	5.7	0.6	850.0	7.4	0.4	1750.0
Singapore Exchange	539.2	173.8	210.2	1.5	0.3	400.0	5.2	1.1	372.7	4.6	0.2	2200.0
Thailand SE	197.1	115.4	70.8	4.1	0.2	1,950.0	0.3	NA	NA	0.6	NA	NA
Tokyo SE Group	4,330.9	3,557.7	21.7	26.4	6.4	312.5	NA	NA	NA	17.9	29.0	-38.3
ASEAN5	**1,376.3**	**528.1**	**160.6**	**6.9**	**0.8**	**803.9**	**8.2**	**3.0**	**173.1**	**12.4**	**1.7**	**642.5**
Industrial Countries												
Nasdaq	4,013.7	2,844.2	41.1	61.0	28.8	111.8	16.2	6.4	153.1	NA	NA	NA
NYSE Group	15,650.8	11,339.0	38.0	119.2	40.9	191.4	60.4	27.4	120.4	76.6	54.2	41.3
London SE	3,851.7	2,460.1	56.6	40.7	15.9	156.0	50.0	7.6	557.9	32.8	22.6	45.1

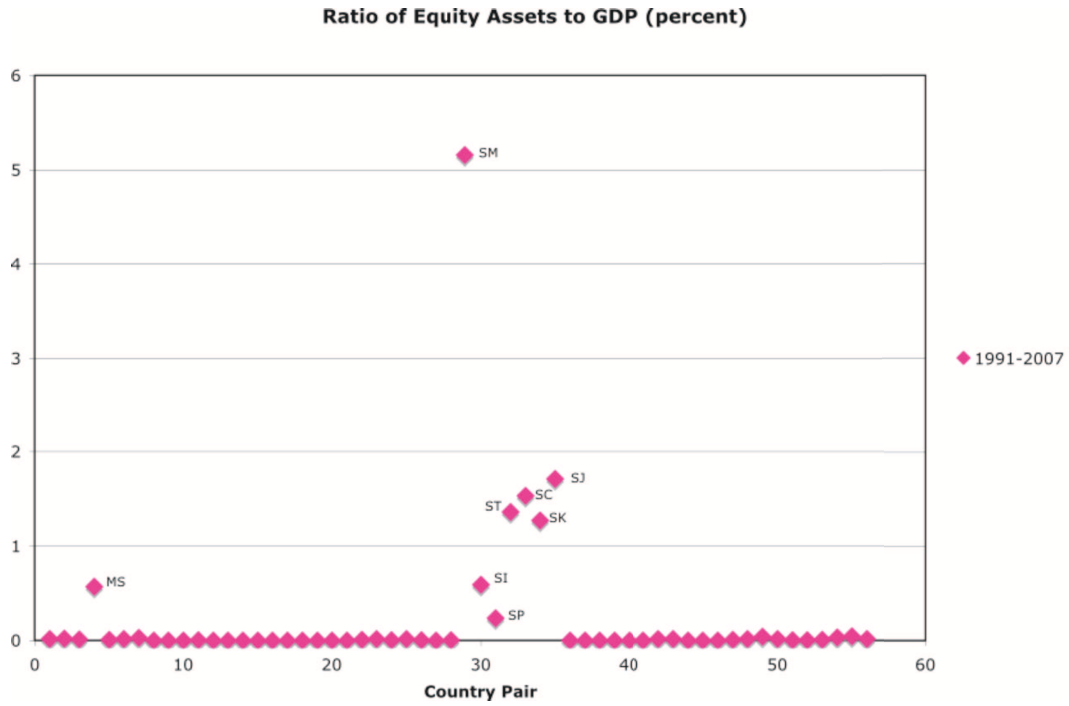
Source:World of Federation of Exchanges

Note: Average Daily Transaction is the sum of daily purchases and sales , average over a year.

Table 1.9: Role of Equity in Financial Sector as Source of Financing (percent of GDP)

	1996				2000				2005			
	Bank Deposits	Equity Market	Bond Market	Total Fin. Sector	Bank Deposits	Equity Market	Bond Market	Total Fin. Sector	Bank Deposits	Equity Market	Bond Market	Total Fin. sector
CHN	26.4	14.4	11.8	52.6	38.8	32.2	23.6	94.5	45.6	25.3	27.6	98.5
JPN	101.9	118.4	103.7	323.9	113.3	113.3	128.7	355.3	124.5	123.2	194.1	441.9
KOR	36.3	24.9	50.3	111.5	68.3	45.6	62.1	176.0	67.1	90.5	88.9	246.4
ASEAN												
INA	43.8	36.0	7.1	86.9	48.2	15.0	39.1	102.4	40.3	29.5	21.8	91.6
MAS	72.9	315.5	81.8	470.2	88.6	133.0	100.4	322.1	98.9	140.5	111.2	350.5
PHI	48.2	95.6	46.0	189.8	54.1	51.1	51.9	157.1	47.4	114.8	70.5	232.7
SNG	77.9	380.6	29.7	488.2	99.9	287.3	57.3	444.4	105.6	270.0	88.1	463.7
THA	73.9	54.9	16.9	145.7	93.8	36.3	36.3	166.5	83.6	73.7	51.2	208.5

Source:Oura *et al.* (2006)



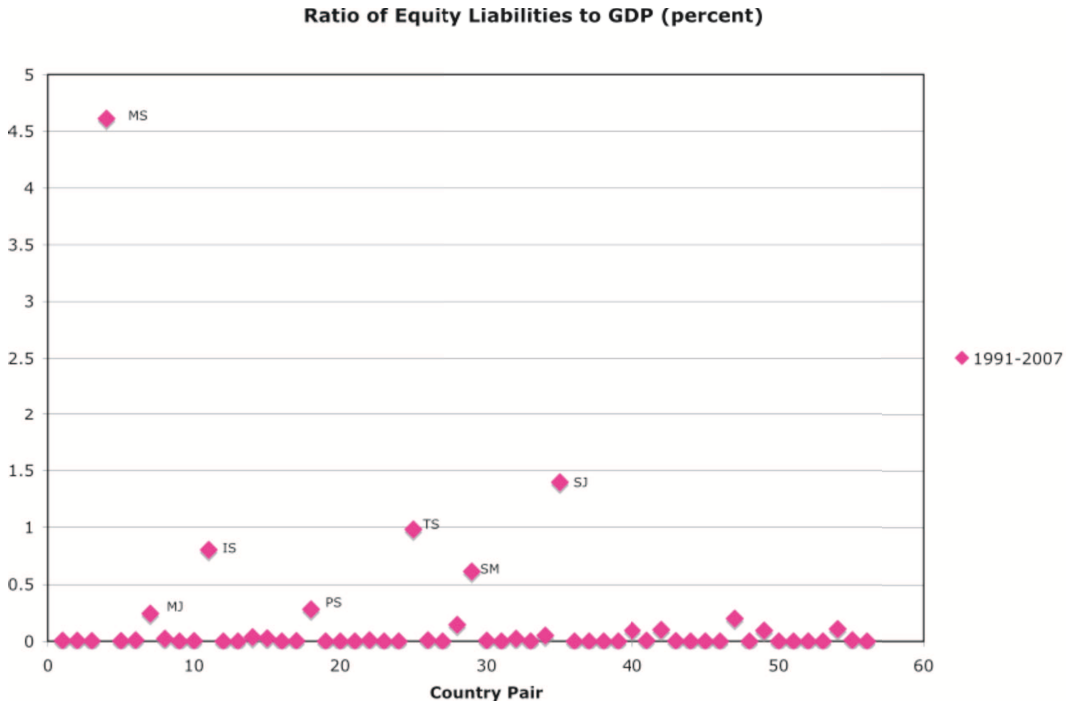
Source: CPIS, World Bank

Figure 1.10: Bilateral Equity Asset Holdings as Ratio to GDP

In addition to stock markets, bond markets have become one of the most important policy issues in the region. Bond market development is essential to avoid the maturity and currency mismatches and to channel regional savings from regional supplier to regional demander. Through the multilateral efforts, both from supply side, which is promoted by the Asian Bond Market Initiative (ABMI), and from demand side, which has resulted from the effort of the Executives' Meeting of East Asia Pacific Central Banks (EMEAP)[11] to promote the development of domestic and regional markets by purchasing bonds issued in the region. As a result, bond markets have developed in size from 4.6 trillion USD in 1997 to 13.7 trillion USD in 2008,[12] an almost threefold increase.

[11] This encourages regional bond trading by launching the Asian Bond Funds (ABF1 and ABF2 details in Appendix A).

[12] Data are as of May, 2008.



Source: CPIS, World Bank

Figure 1.11: Bilateral Equity Liabilities as Ratio to GDP

Table 1.11 shows that each country has seen remarkable bond market improvement in size.[13] The major composition of local bond markets is government bonds (as depicted in Figure 1.12). Corporate bonds do not play an important role in this region except in Korea and Malaysia where the corporate bond markets are relatively bigger that the rest of countries in region.

[13]Hong Kong does not join in ASEAN+3 dialogue but has participated in the EMEAP framework.

Table 1.10: Portfolio Investment Flows: Equity Securities (million USD)

(a) Year 2001

From / Into	HKG	INA	JPN	KOR	MAS	PHI	SIN	THA	UK	USA
China	5,449	0.03	789.45	15.48	7.97		1,035	4	1,462	2,370
Hong Kong		11.22	4,847.86	100.39	47.27		3,125	6	12,291	30,154
Japan	2,145	2.21	0.00	101.49	6.86	0.49	1,536	1	52,610	170,714
Korea	1,311	0.08	0.00	0.00	8.41		1,034		2,110	29,537
Indonesia			49.71	12.58	43.69		307	15	386	1,526
Malaysia	604		338.55	123.82			5,295		1,372	2,578
Philippines	60		212.82	3.48	60.56		420	1	300	1,344
Singapore	1,403	2.20	923.91	0.83	460.93	2.21		8	4,931	21,376
Thailand	488	0.01	289.72	20.29	14.71	0.80	1,520		1,481	1,916
Vietnam		0.76	6.48	10.40		25	3	10		
UK	22,698	0.06	29,479.89	51.51	23.68		2,688			350,014
USA	11,458		123,511.15	454.46	68.23	91.90	6,034	14	129,190	
ASEAN+3 (%)*	12.11	27.29	1.12	20.42	42.00	3.16	34.61	0.83	11.51	14.25
ASEAN+4(%)**	12.11	27.29	1.15	21.88	46.06	3.16	35.67	1.89	11.58	14.35
UK&USA(%)	36.10	0.37	67.29	38.93	6.90	82.92	27.85	0.83	23.14	21.70
ROW	51.79	4.62	29.43	31.46	43.49	13.92	26.50	96.93	63.08	62.08
Total	94,615	16.57	227,351.39	1299.77	1331.97	110.83	31,319	1,694	558,379	1,612,667

Source:CPIS

ASEAN+3 includes China ,Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

ASEAN+4 includes China , Hong Kong , Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

(b) Year 2006

From / Into	HKG	INA	JPN	KOR	MAS	PHI	SIN	THA	UK	USA
China	100,009		9,853	1,681	13		6,913	10	14,976	73,912
Hong Kong			11,014	4,156	441		18,719	7	29,315	85,833
Japan	6,918			1,809	217		4,534	7	173,596	543,506
Korea	2,254		3,358		113		4,530		28,197	114,155
Indonesia			456	3	39		1,336	1	3,184	11,490
Malaysia	751	1	493	48			7,771	111	4,201	10,781
Philippines	192		109	1	12		423	1	976	6,050
Singapore	2,858	7	3,772	490	1,558	2		80	12,277	43,911
Thailand	872	12	1,049	9	53	1	3,248		5,455	11,054
Vietnam				120			109	14	238	
UK	48,147		52,107	1,354	190		3,851	90		673,978
USA	15,537	3	224,136	5,180	236	95	15,801	113	340,777	
ASEAN+3(%)*	32.43	5.60	3.72	11.35	53.38	2.60	30.69	13.21	17.89	18.80
ASEAN+4(%)**	32.43	5.60	5.88	22.63	65.13	2.60	50.61	13.62	20.04	20.79
UK & USA(%)	18.2	0.8	54.1	17.7	11.4	81.2	20.9	12.0		
ROW	173,256	330	204,011	21,928	802	-65	26,664	1,234	748,796	2,754,270
Total	350,846	359	510,418	36,819	3,753	117	93,973	1,694	1,362,010	4,328,962

Source:Suk & Bum (2008),CPIS

ASEAN+3 includes China ,Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

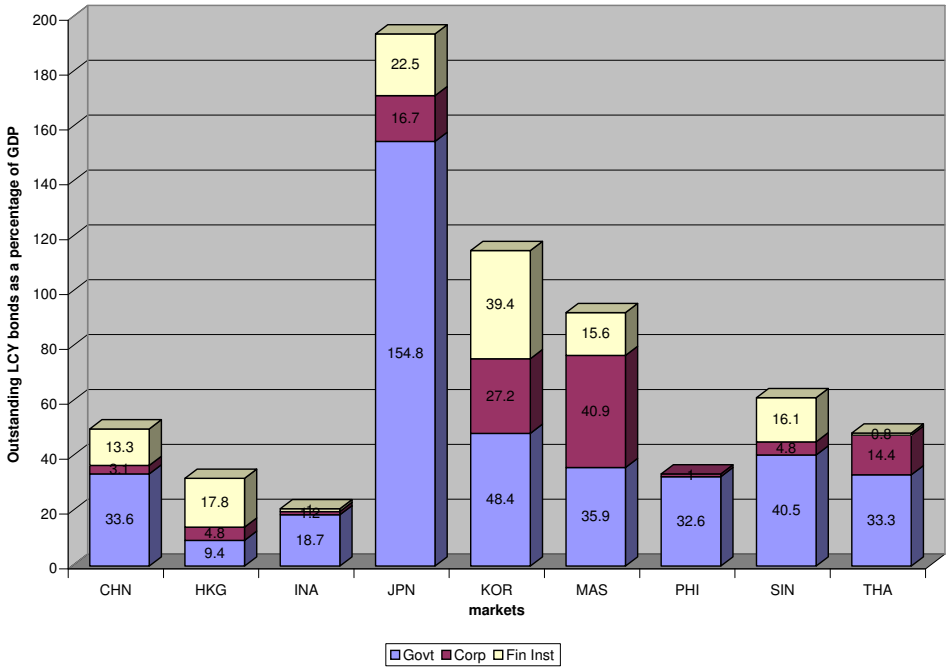
ASEAN+4 includes China , Hong Kong , Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

ASEAN+3 economies have carried out various international standards and reforms in order to create a good environment for bond investors. Improvements have been driven by government initiatives to develop bond markets. However, Asia's bond markets are still very small by international standards, particularly the corporate bond markets. Liquidity is still low and regional bonds are not popular among local investors. According to Figure 1.13, bond and equity markets in ASEAN+3 are still lagging behind other international

Table 1.11: Local Currency Bond Market Outstanding (billion USD)

	1997	2002	2003	2004	2005	2006	2008(Mar)
China	83.5	342.2	448.4	623.7	900.48	1,184.86	1,885.4
Hong Kong	41.3	58.1	60.5	62.9	65.8	65.7	50.6
Japan	4,202.8	6,416.9	7,882.4	8,945.0	8,451	8,493	10,144.9
Korea	153.21	538.2	759.9	751.3	847.7	1,010.4	1,052.9
ASEAN							
Indonesia	4.29	58.2	65.7	61.2	54.7	76.3	85.8
Malaysia	57	84.4	98.8	110.6	123.5	146.8	185.3
Philippines	16.59	27.6	30.7	35.6	41.2	44.9	57.6
Singapore	23.75	56.4	61.5	72.7	74.9	86.5	102.7
Thailand	10.43	48.3	59.6	68	80.5	111.4	156.1
Total	**4,592.7**	**7,630.3**	**9,467.5**	**10,731**	**10,639.78**	**11,219.86**	**13,721.3**

Source:Suk & Bum (2008),BIS

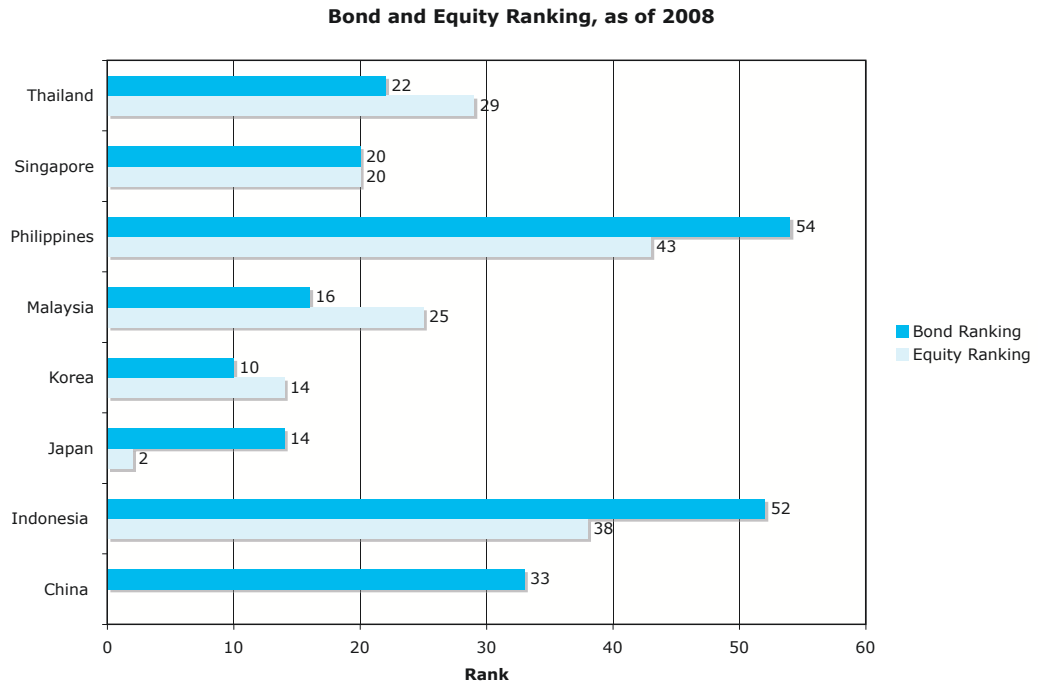


Source: Asianbondonline , ADB

Figure 1.12: Size and Composition of Local Currency Bond Market, as of December 2007 (percent of GDP)

markets.

Table 1.12 shows that regional savings have increased. Saving resources are abundant and under–utilized. Countries in ASEAN+3 have accumulated huge foreign exchange reserves since the financial crisis aftermath, and all countries'



Source: FSDI, World Bank

Figure 1.13: Bond and Equity Ranking among 56 Countries, as of 2008

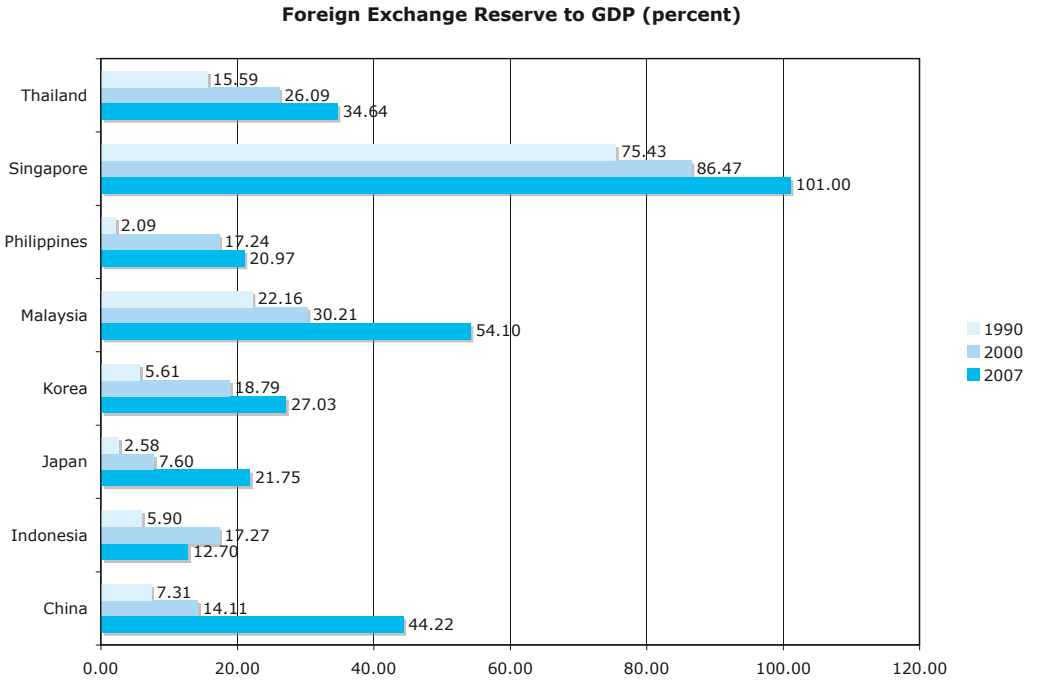
foreign exchange reserves grow more than twice as much as they did in 1990 (Figure 1.14). And unlike European investors who are in favor of pooling their savings in Europe, ASEAN+3 investors invest in other countries ADB (2008). This contributes to the exports of excess domestic savings from ASEAN+3 countries to developed countries and to the United States in particular. Excess regional savings has flooded to finance current account deficit in United States. As shown in Table 1.13, the amount of regional debt securities investment in 2006 fell slightly from 2001 in Japan, Korea, and Malaysia and rose slightly in the Philippines and Thailand. However, the major destination of debt securities investment is still the United States. According to Suk & Bum (2008), ASEAN+3 savings take a flight and invest in US treasury securities. The thinness of the regional bond markets thus implies limited regional risk sharing through this

channel.

Table 1.12: Domestic Savings, Capital Formation, and Resource Gap

	Gross Domestic Saving			Gross Domestic Investment			Resource Gap		
	1990	2000	2007	1990	2000	2007	1990	2000	2007
China	35.2	38	48.6	36.1	35.1	44.2	-0.9	2.9	4.4
Indonesia	32.3	31.8	28.2	30.7	22.2	24.9	1.5	9.6	3.3
Japan	33.8	26.9	25.5	32.9	25.4	23.8	0.9	1.6	1.7
Korea	37.3	33.9	30.8	37.5	31	29.4	-0.2	2.9	1.4
Malaysia	34.4	46.1	42.2	32.4	26.9	21.9	2	19.2	20.3
Philippines	18.7	17.3	20.9	24.2	21.2	15.3	-5.5	-3.9	5.7
Singapore	44	46.9	51.4	37.1	33.3	22.6	6.9	13.6	28.8
Thailand	34.3	30.4	33.9	41.4	22.8	26.8	-7.1	7.5	7.1

Source: ADB



Source: EIU

Figure 1.14: Foreign Exchange Reserve Holdings as a percent of GDP

Table 1.13: Portfolio Investment Flows: Long-term Debt Securities (million USD)

(a) 2001

From / Into	HKG	INA	JPN	KOR	MAS	PHI	SIN	THA	UK	USA
China	2,967		879.80	141.93			411.96		828	634
Hong Kong		96.21	1,268.42	305.85	27.87	25.03	1,621.53	119	8,597	1,893
Japan	7,103	0.96	0.00	74.84	15.40	4.98	9,013.88		41,480	27,125
Korea	3,877		5453.64	0.00	2.72	6.54	2,181.59		3,877	4,938
Indonesia			107.92	62.52	7.65	3.00	560.26		319	315
Malaysia	1,017	2.11	2,199.63	328.59		8.96	1,591.17		1,017	1,680
Philippines	1,179		1,347.05	106.46	41.26		761.35		712	2,671
Singapore	1,282	37.62	1,208.67	151.41	10.23	59.43		98	7,741	1,442
Thailand	659		748.20	159.02	21.27		841.10		425	782
Vietnam			29.92	15.31					23	21
UK	8,372	73.62	80,875.77	378.69	386.80	24.12	13,453.13	31		162,961
USA	27,795	248.95	366,688.98	3,309.40	140.09	1,752.31	11,977.07	278	179,796	
ASEAN+3 (%)	16.29	5.81	1.12	15.22	10.40	4.10	20.78	13.19	7.56	5.73
ASEAN+4(%)	16.29	5.81	1.13	15.44	10.40	4.10	20.78	13.19	7.57	5.73
UK&USA(%)	32.59	46.05	42.13	54.76	55.61	87.76	34.40	41.59	24.11	23.59
ROW	51.12	34.41	56.63	25.25	31.05	6.91	42.63	29.21	67.17	70.41
Total	110,985	700.53	1,062,402.65	6,734.61	947.46	2,024.14	73,922.58	743	745,665	690,936

Source:CPIS

ASEAN+3 includes China ,Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

ASEAN+4 includes China , Hong Kong , Japan, Korea, Indonesia, Malaysia, Singapore, Thailand, and Vietnam.

(b) 2006

From / Into	HKG	INA	JPN	KOR	MAS	PHI	SIN	THA	UK	USA
China	2,484	3	414	152			731		1,052	1,305
Hong Kong		26	701	2,444	29	198	2,653		6,022	1,660
Japan	2,247			793	37	8	1,658	3	54,978	35,499
Korea	8,864	8	5,752		132		5,611	127	6,766	9,507
Indonesia	171		435	77	108		2,341		1,243	2,582
Malaysia	3,621	7	1,038	204			2,790	59	4,876	4,605
Philippines	720		1,493	21	14		516		2,978	4,939
Singapore	3,692	89	3,136	300	29	502		449	4,052	8,518
Thailand	475		111	94		25	933		807	1,702
Vietnam	226		37	5			66		202	238
UK	19,414	30	90,660	2,759	833	489	5,071	322		245,365
USA	45,849	91	563,401	25,075	579	1,535	19,951	168	458,441	
ASEAN+3(%)*	11.91	11.74	0.66	3.57	9.53	11.46	17.83	20.80	4.91	5.35
ASEAN+4(%)**	11.91	14.60	0.70	8.83	10.40	15.70	21.06	20.80	5.30	5.48
UK & USA(%)	34.5	13.3	36.1	59.9	42.2	43.3	30.5	15.9		
ROW	101,493	627	1,144,771	14,498	1,532	1,854	39,786	1,908	1,017,883	959,591
Total	189,303	909	1,811,986	46,491	3,346	4,670	82,159	3,073	1,559,315	1,275,516

Source:Suk & Bum (2008),CPIS

ASEAN+3 includes China ,Japan, Korea, Indonesia, Malaysia, Philippines, Singapore, Thailand, and Vietnam.

ASEAN+4 includes China , Hong Kong , Japan, Korea, Indonesia, Malaysia,Philippines, Singapore, Thailand, and Vietnam.

1.7 Imperfect Regional Risk Sharing

Results in the previous section suggest the limited risk sharing within the region. In this section, the perfect risk sharing assumption is relaxed an economic agent is offered more investment choice. This analysis is done in order to compare the degree of regional risk sharing *vis-à-vis* the rest of the world. According

to, Crucini (1999), Crucini & Hess (2000), and Asdrubali & Kim (2003), if the representative agent in the region can pool fraction λ_{reg} regionally, and fraction λ_{row} of income goes to the rest of the world, with λ_y of income being unpooled, then the consumption of country i will change by the following process:

$$\Delta \log c_{it} = \alpha + \lambda_{reg,i} \Delta \log C_{reg,t} + \lambda_{row,i} \Delta \log C_{row,t} + \lambda_{y,i} \Delta \log y_{it} + \varepsilon_{it}, \qquad (1.7)$$

where α represents the difference of discount factor across countries and ε_{it} reflects the preference shock. Equation 1.7 describes how the individual country's consumption growth rate would co-move, either regionally or globally, only up to the level risk sharing is achieved, while the leftover portion of consumption should follow domestic output growth of that particular country. Expressing the risk sharing equation this way permits us to see to what extent that individual country smooths out consumption regionally and globally.

Equation 1.7 is estimated by using Zellner's seemingly unrelated regression since there is an evidence of correlated errors across equations. Table 1.14 presents the estimated regression coefficients of equation 1.7 using data from 1961–2007. Overall, the high, positive, and significant co-movement between consumption and output is observed in every individual ASEAN+3 country except the Philippines, which has the coefficient of 0.346 — relatively speaking, the lowest among the group. Considering the degree of regional and global consumption co-movement, one could infer that, given the limited degree of risk sharing, half of the ASEAN+3 countries (Japan, Korea, Singapore, and Thailand) tended to have higher regional consumption co-movement than global consumption co-movement. Coefficients belonging to the rest of country members were not significant.

Table 1.14: Imperfect Risk Sharing: SUREG

	CHN	INA	JPN	KOR	MAS	PHI	SIN	THA
$\Delta \log C_{reg,t}$	-0.076	-0.621*	0.233***	0.429***	0.049	-0.057	1.507***	0.261*
	(0.153)	(0.352)	(0.069)	(0.154)	(0.202)	(0.046)	(0.213)	(0.153)
$\Delta \log C_{row,t}$	-0.582*	-1.468**	0.126	-0.608**	-0.413	0.015	-0.762*	-0.241
	(0.353)	(0.705)	(0.131)	(0.298)	(0.398)	(0.102)	(0.407)	(0.254)
$\Delta \log y_{it}$	0.517***	0.974***	0.58***	0.8516***	1.021***	0.346***	0.546***	0.693***
	(0.052)	(0.233)	(0.062)	(0.113)	(0.149)	(0.036)	(0.137)	(0.111)
Constant	0.014***	0.023***	0.001	-0.003	-0.002	0.005***	-0.011**	-0.001
	(0.004)	(0.007)	(0.001)	(0.003)	(0.004)	(0.001)	(0.004)	(0.002)

*** p<0.1, ** p<0.05, * p<0.01
Standard errors are in parentheses.

1.8 Conclusion

This paper examines the degree of regional consumption risk sharing of ASEAN+3 countries and investigates the extent to which financial integration determines degree of regional consumption risk sharing. The basic intuition behind risk sharing through financial markets is that international portfolio diversification helps to reduce volatility on investment returns, which in turn helps smooth variations in consumption across countries.

There are three main questions that this paper attempts to answer. First, the paper tries to understand if consumption risk sharing exists in ASEAN+3. Second, if there exists a degree of regional consumption risk sharing then to what channels should they contribute to degree of regional consumption risk sharing. This question is answered by is examining specifically the role of financial integration, both de jure and de facto measurement, by focusing on different compositions of financial investment. The analysis is also done in bilateral terms to capture the interaction between two member countries. Finally, this paper examines to what extent the ASEAN+3 countries share the risk in the region,

vis-à-vis the rest of the world, by allowing an individual country to pool its consumption stream either within a region or with the rest of the world.

The preliminary data sets suggest a limited degree of regional consumption risk sharing. Summary statistics evidently show that an individual country's consumption moves closer with its own output as opposed to both regional and global consumption. Regression of regional idiosyncratic components of an individual country's consumption on regional idiosyncratic components of individual country's output confirms the finding.

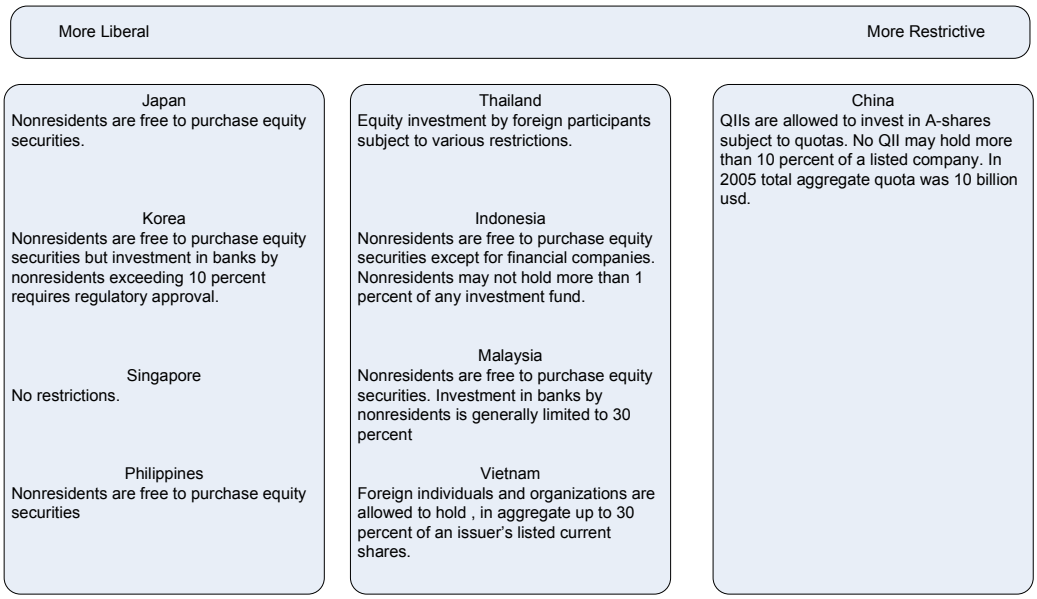
Extensions of this empirical analysis is done to investigate regional consumption risk sharing given the degree of financial openness. For the whole period of study, 1991–2007, I find limited evidence of risk sharing behavior through de facto financial openness. Results are robust to various compositions and ratios of portfolio investment. The explanation for this result would be the fact that financial markets in ASEAN+3 on average are too small and less conducive to attaining the risk sharing. Despite the above results, de jure financial openness seems to have a significant impact on regional consumption risk sharing while country characteristics do not provide any contribution to regional consumption risk sharing. Moreover, no structural change in risk sharing is observed after year 2000, indicating that the degree of risk sharing has stayed at the same level.

The analysis is extended further to explain the risk sharing in bilateral terms. Results agree with estimates obtained from regional risk sharing that the degree of risk sharing is limited among country members. However, statistical estimates suggest the role of bilateral equity and bilateral debt investment as main determinants of degree of bilateral risk sharing. The same analysis was done

using disaggregative data set, from 2000 to 2007 to see how the regional financial cooperation contributes to risk sharing when CMI was instituted in 2000. Results show that degree of bilateral consumption risk sharing varies across countries and the degree of bilateral risk sharing has not changed much during 2000–2007. However, despite the limited degree of regional risk sharing, countries that invest in ASEAN+3 in moderate proportion, that is, Singapore, Korea, and Thailand, tend to have a higher degree of regional consumption risk sharing than global consumption risk sharing.

The results from empirical analysis point to an interesting puzzle. The theory suggests that financial integration should induce the higher degree of risk sharing by diversifying the idiosyncratic consumption risk. However, countries in ASEAN+3 have not experienced the higher degree of regional risk sharing after CMI was instituted. In this context, I examine further the important determinants and found that the degree of risk sharing in ASEAN+3 are determined by three factors (1) consumption co-movement (2) risk sharing coefficients and (3) magnitude of regional and bilateral nancial investment. Negative risk sharing stems from the lack of any of these three. In order to reap the benefit of regional risk sharing, countries in ASEAN+3 should put the higher proportion of investment within the region.

ASEAN+3 governments put efforts to develop the financial markets (Figure 1.15); however, given the current stage of financial markets development, the markets are still very small compared to international standard. Liquidity is still low, and investors find the regional market difficult to access. In addition to that, unlike European investors who are in favor of pooling their savings in Europe, ASEAN+3 investors invest in other countries ADB (2008). The preference



Source:Oura et al. *(2006)*

Figure 1.15: Restrictions on Cross-Border Portfolio Investment in ASEAN+3, 2005

of regional investors is the main issue apart from the settings of financial markets. To approach investors' preferences, a sound environment must be created to attract regional investors and firms and the incentives should be provided to them. For the stock markets, preferences of investors are induced by developing a wider product base, increased liquidity, and lower transaction costs. Moreover, rating agencies are also important for promoting the soundness of individual issuers. Information disclosure, promoting more corporate governance, and the facilitation of governments to improve trading and settlements systems should be helpful in making regional stock exchanges a more attractive investment destination. More reforms and actions should be implemented for bond markets as well and these should be done on both demand side and supply side. On the demand side, regional investors would contribute volume and liquidity to regional market development. On the supply side, the regional bond market should provide more debt instrument menu for regional investors

in order to shift their preference from US dollars or Euro bonds. Clearly defined market regulations, degree of transparency, and supervision should be well established to bolster investor protection.

CHAPTER 2

INFLATION TARGETING IN THAILAND: SUCCESS AND CHALLENGES

2.1 Introduction

Inflation targeting has been adopted by an increasing number of central banks over the past fifteen years. It is the economic policy by which the central bank commits to the explicit target, that is, inflation rate allowing for some flexibility in order to achieve price stability, growth, and nominal exchange rate stability. In other words, inflation targeting lies between two extremes, policy rule and policy discretion.

Many supporters of inflation targeting believe that explicit inflation targets are able to eliminate fiscal dominance and increase degree of independence of the central bank. And informing the public of the economic situation, would promote accountability within the central bank system. Once the central bank is capable of achieving the target, and the public will believe that central banks can keep inflation rate at low level, and their expectation of inflation will be low accordingly. Whenever the central bank gains a degree of credibility and inflation expectation is at a low level, the inflation target will become manageable. Conceptually, inflation targeting sounds advantageous over other monetary frameworks. In reality, evidence was mixed across countries and country background.[1]

Thailand adopted inflation targeting in May 2002 under IMF's supervisory. The target rate was set within the range of 0 to 3.5 percent. Under the frame-

[1]Further details are in the literature review.

work, emphasis has been given to maintaining core inflation. The short term interest rate, that is, 14-day repurchase rate, was used as the policy instrument until January 2007, when the Monetary Policy Committee decided to replace it with a 1-day repurchase rate. After 6 years under inflation targeting, the Bank of Thailand is being challenged by many economic situations. A surging of capital flows in 2003–2004 triggered a policy dilemma between exchange rate management and inflation stabilization. Upward pressure of the exchange rate resulted in huge losses from exports, especially labor-intensive products. The Bank of Thailand decided to exercise sterilized intervention in the foreign exchange market. the Bank of Thailand incurred huge costs from sterilized intervention, the intervention was not sustainable. The role of exchange rate under inflation targeting has received much attention recently. Managing the exchange rate while pursuing inflation targets is not an easy task due to problem of trinity. Meanwhile, an exchange rate intervention through the foreign exchange market is costly and makes the public question the Bank of Thailand's priorities.

While the role of exchange rate under inflation targeting is unclear, the energy price crisis has created a new challenge to the Bank of Thailand. The oil price surge in 2008 put a lot of pressure on the Thai economy. And as a net-oil-importer, soaring oil prices are bad news for Thailand's economy. Higher oil prices caused headline inflation to rise to 8.9 percent in June, and even if core inflation does not take energy price into account,the effect of higher oil prices on other consumer goods pushed core inflation off the target. The Bank of Thailand had to raise key policy interest rates twice in 3 months to control inflation. This would be a case where global energy prices are increasing and influencing domestic consumer prices. Up to this point, this paper has focused on the

appropriateness of using core inflation as an intermediate target.I also consider whether or not inflation targeting is appropriate for Thailand given the current economic circumstances.

In this paper, I attempt to address the three major issues of inflation targeting in Thailand. The first part includes an analysis of the extent to which inflation targeting has contributed to price stability, output, and inflation expectation in Thailand. The second part explains the role of nominal exchange rate under inflation targeting and policy implication on exchange rate management. The third part examines the effectiveness of inflation targeting by utilizing dynamic simulations of SVAR models with and without inflation targeting, then oil price shock is introduced to evaluate inflation targeting using the counterfactual case as a benchmark. The final section is dedicated to policy implication and conclusion.

2.2 Literature Review

Inflation targeting initially started in New Zealand in 1990 to achieve low and stable inflation rates in this country and it has proved to be successful in reducing inflation rates and keeping the economy of New Zealand stable. Later, a number of countries started to adopt inflation targeting as monetary policies. As of 2008, twenty- two developed and developing countries have formally adopted inflation targeting, and no country that has adopted it has abandoned it.

The definition of inflation targeting varies in details. According to Svensson (n.d.) , inflation targeting is characterized by

(a) an announced numerical inflation target, (b) an implementation of monetary policy that gives a major role to an inflation forecast and has been called "inflation-forecast targeting," (c) a high degree of transparency and accountability.

Svensson (n.d.) described inflation targeting as "decision making under discretion." It is flexible in the sense that the central bank is given some room to aim at other economic variables, for instance, output gap, rather than focusing only on inflation rate. The policy instrument is set to make sure that inflation rate moves within a target range while other economic variables are at stable.

In most cases inflation targeting is characterized by a high degree of transparency, since the central bank publishes a periodic monetary policy report to the public. The economic report includes the bank's forecast of inflation, economic analysis, policy action, and the implications of these variables on the economic forecast. The communication from the central bank will give a clear picture to the public of what is going on and, in turn, anchor private-sector expectations on inflation for the next few quarters, a crucial precondition of actual inflation. And if the expectation of inflation is in the expected range and the central bank can control inflation rate so that is stays within target range, a degree of accountability and credibility will be finally achieved.

Economic studies express various outcomes inflation targeting. The empirical results vary according to the countries in the sample, scope of time, and methodologies used. Sterne (2002) used a survey of monetary framework design to quantify ten characteristics, including central banks' objectives, targets, independence, accountability, transparency, and analytical capacities. He found that inflation targets had been chosen over money targets and the number of countries that adopt inflation targeting had increased. He argued that the pos-

sible explanation of the popularity of inflation targeting is that it provides a visible vehicle for guiding private sector expectations and communicating with the government. The use of a target enhances the deeper level of communication between the central bank and the public. And also, an inflation target is relatively easy to obtain. Sterne showed that the number of inflation target misses was less than half of money target misses. The median inflation for countries that announce both inflation and money target was 1.5 percent, compared with 3.2 percent for broad money growth.

Agenor (2000) provided a survey of the analytical model for inflation targeting in both closed and open economies. He introduced some unresolved analytical issues in the design of inflation targeting regime, namely, the role of nonlinearities and asymmetric effects in the Phillips curve, the uncertainty regarding behavioral parameters and the transmission process of monetary policy. These features are relevant for monetary policy in developing countries, and according to his findings, inflation targeting is applicable to developing countries.

The applicability of inflation targeting to developing countries has received a lot of attention and Agenor's conclusion has been the subject of an interesting debate. Mishkin (2000) and Morande & Schmidt-Hebbel (1999) looked at this issue in more cautiously. They denied that inflation targeting can be used universally. They suggested that inflation targeting is possible for developing countries, but at least for the case of high and middle income developing countries, where the financial system is sufficiently developed to permit the use of indirect instruments monetary policy. Mishkin & Schmidt-Hebbel (2001) added that the success of inflation targeting depends on the level of fiscal dominance. The implementation of inflation targeting is associated with lower fiscal deficits,

which confirms the absence of fiscal dominance under this regime. The reseachers also found that the adoption of an inflation targeting regime is more likely when the initial level of inflation is relatively high.

However, some other economic studies look at inflation targeting differently. McCallum (2001) portrayed the criticism of inflation targeting, namely, that in countries that experience deflation, the nominal interest rate may approach zero. In addition, if the economy is in recession and requires an expansionary monetary policy, the central bank will face a liquidity trap since it is not able to place open market bonds at below-zero nominal rate. From the theoretical perspective, the dangers of an expectations trap and indeterminacy are created by variants of inflation targeting. Ball & Sheridan (2003a) evaluated the performance of inflation targeting in improving economy by comparing seven OECD countries that adopted inflation targeting in the early 1990s and they found that there is no evidence that inflation targeting improves performance. Levin *et al.* (2004) on the other hand, investigated the emerging economies that adopted inflation targeting in the early 1990s by looking at inflation persistence and stability of economic variables and by measuring the level of expectation on inflation. They found that the adoption of inflation targeting has generally not been associated with an immediate adjustment of inflation expectations. While most of the emerging economies have succeeded in reducing average inflation to very low levels, the volatilities of inflation still persist. The success of inflation targeting should come with some preconditions such as time length, since policy adoption, government 's fiscal discipline, and the central bank's effort to limit the movement of exchange rates, as proposed by Lin & Ye (2004).

The movement of exchange rate under inflation targeting has received much

attention, especially from central banks in developing countries that switch the monetary policies regime from rigid exchange rate to a combination of flexible exchange rate and "inflation targeting." The role of exchange rate has become less central in economic policy debate in most emerging countries. However, this does not mean that exchange rate is not a major issue. Some countries, In Asia for instance, governments launched exchange rate policy measures in 2003–2004 to curb currency appreciation and potential speculation due to capital flooding as a result of global imbalance. The central banks' policy actions have utilized exchange rates as shock absorbers. Many questions relating to exchange rate under inflation targeting have been raised; some academicians have tried to find tune between exchange rate and inflation targeting, while others strongly argue against policy mix and claimthat emerging countries exhibited the "fear of float[2] behavior."

Moreover, there are debates about oil shock as an indirect cause of recession through the triggering of monetary contractions in 1980s and 1990s. Even in the absence of monetary tightening, oil price-shock-induced-inflation reduces real balance (see Mork (1989)). Dotsey & Reid (1992) showed in a VAR model that in the case of the United States, federal funds rate and measure of oil price shocks, according to Mork (1989) are good predictors of output. However, Bernanke *et al.* (1997) concluded that according to their findings, oil price shocks do not cause economy-wide output decline once the impact of responses of monetary policy to oil shocks is accounted for.

Clarida *et al.* (2000) explained that the impact from oil price shock in the present time is not as severe as one in 1970s. The change in inflation expectation is one of the reasons why the impact is milder than in the past. They also added

[2]SeeCalvo & Reinhart (2000).

that the Federal Reserve credibility appears to be tied to this change in expectation. Their findings showed that during the 1970s, households and firms did not expect the Fed to act to offset the inflationary impulse created by a jump in the price of oil and consequently led to the jump in expected inflation. On the other hand, the Federal reserve is expected to act to counter the effect of oil price surge and that it is expected to curb the expected inflation. Hooker (2002) provided formal evidence of a change in the relationship between oil price and inflation between 1962 and 2000. Statistical tests find a structural break in the relationship. Estimated coefficients differ between 1962 and 1980 and between 1981 and 2000. Hooker found that oil price had a significant impact on inflation in the earlier period but not the later, and he observed that the pass through effect from oil price to core inflation is absent from 1981 to 2000. Results are robust to various types of inflation.

The issues of oil price shock and inflation are discussed differently in the case of a developing country. The surge of oil and food prices in the late 2000s put high pressure on commodity price and inflation rate worldwide. The higher of oil price has caused dramatic effects on the prices of other commodities, since oil is one of the important factors of production ,that in turn, lead to the rising of headline inflation. Headline inflation, however, is not the inflation that central banks keep track of. Core inflation[3] is instead in focus. McCauley (2001) studied the monetary policies in Thailand from 2000 to 2006. He argued that specifying the operational target is crucial especially when energy and food prices are soaring. The implementation of inflation targeting by only keeping track only of core inflation may limit the room that the Bank of Thailand has to properly respond to this upward trend in energy prices.

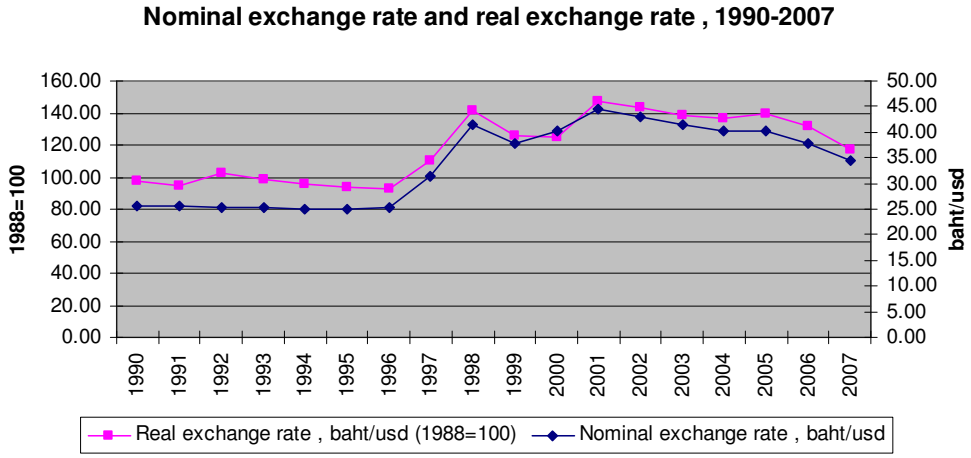
[3]Core inflation excludes energy prices and food.

2.3 Inflation Targeting in Thailand: Capital Flows and Exchange Rate Management

The development of the monetary policy framework in Thailand is divided into three periods. The first period was after Second World War to June 1997 when the Bank of Thailand started to adopt a pegged exchange rate regime. The value of the baht was initially pegged either to gold, a major currency, or to a basket of currencies. The basket regime was adopted from November 1984 until June 1997. The Thai baht was fixed at 25 baht/USD. According to Figure 2.1, the exchange rates were relatively stable from 1990 to 1996. Generally, the success of a basket-peg regime depends on strong economic fundamentals, investor confidence, and the amount of foreign reserves that the central bank has. Lacking of these fundamentals, a currency is prone to be attacked by speculators. Thailand, at that time, had liberalized the economy and set up the special body, the so called Bangkok International Banking Facility (BIBF) in 1990 to facilitate foreign capital flows initially aimed as serving the increasingly sophisticated needs of international trade and investment and at enhancing the capacity of the domestic banking business. Due to a weak financial system and a lack of appropriate regulation of the resource allocation, the surge of capital flows to Thailand did not go to real production and the productive sectors as initially planned, but went to unproductive sectors instead. Those foreign capital flows introduced the double mismatched loans, bubbling asset prices, and a greater capital account deficit, and later lead to a depletion of foreign reserves. Pressure on the Thai baht intensified in December 1996 and foreign investor confidence was shaken, prompting investors to withdraw funds from Thailand and speculation on the Thai baht was undertaken in February 1997. The bank of Thailand

intervened heavily to stabilize national currency, but they could not keep things under control since confidence in the Thai baht had been completely destroyed. The peg then was abandoned on July 2, 1997, and replaced by the managed-float exchange rate regime.

Unlike the peg exchange rate regime, the value of the baht is determined by market forces, that is, demand and supply in both the on–shore and off–shore foreign exchange markets. The Bank of Thailand will intervene in the market only when necessary, in order to prevent excessive volatilities and achieve economic policy targets. In Figure 2.1, we can see that right after the exchange rate policy switch, the Thai baht depreciated by almost two folds from 25 baht/USD to 31.36 baht /USD in 1997 and to 41.36 baht/USD in 1998.



Source: Bank of Thailand, National Social and Economic Development Board

Figure 2.1: Nominal Exchange Rate and Real Exchange Rate

After the financial crisis, monetary targeting was used by the Bank of Thailand for a couple of years by targeting the broad money supply level, that is, M2[4].Under this regime, the Bank targeted domestic money supply using the fi-

[4]M2 consists of the total of all physical currency, plus accounts at the central bank that can be exchanged for physical currency and most savings accounts, money market accounts, and small denomination time deposits (certificates of deposit of under 100,000 USD)

nancial programming approach in order to ensure macroeconomic consistency as well as to reach the ultimate objectives of sustainable growth and price stability. The Bank would set the daily and quarterly monetary base targets, on which its daily liquidity management was based. Daily liquidity management was essentially aimed at ensuring against excessive volatility in interest rates and liquidity in the financial system. This regime lasted until early of 2000.

Under the supervision of the IMF, the Bank of Thailand has adopted inflation targeting as a conduct of monetary policy since April 2000 by targeting core inflation[5] with a main objective of maintaining price stability. Given the institutional reforms required for an inflation targeting framework to operate successfully, it was envisaged that inflation targeting would help rebuild confidence and credibility of the central bank and monetary system, going forward.

The target rate has been set within the range of 0 to 3.5 percent. Under the framework, the emphasis has been given to maintaining core inflation. A 14-day repurchase rate was used as the policy instrument until January 2007 when the Monetary Policy Committee decided to replace it by a 1-day repurchase rate. Since then, the 1-day repurchase rate has been officially used to keep the quarterly average rate of core inflation within the target range. If there is an upward inflationary pressure, for instance, the 1-day repo rate will be raised in order to keep the inflation rate back in the target level. Figure 2.6 shows that the core inflation rates were volatile and fluctuated before 2000 and relatively were stable from 2000.

Thailand has seen a second surge of capital inflows after the first one during the bubble economy in 1994. The new surge of capital inflows this time

[5]Core inflation rate is rate of inflation of goods other than food, energy price, and all other items that have a high degree of price volatility.

started in 2002. With strong capital inflows and chronic pressure for appreciation during 2002–2003, the offshore rate was falling below onshore ones, but arbitrage kept the rates in line. The Bank of Thailand oversaw an asymmetric regime in the third quarter of 2003, with effective constraints on lending baht to nonresidents, but no measure preventing the flow of baht held by nonresidents into Thailand. Later in October 2003, the Bank of Thailand made its capital controls symmetric by limiting onshore financial institutions from borrowing more than 50 million baht from non-residents(BOT (2003b) and BOT (2003a)). Since then, overnight differentials have shown more symmetry. Market participants attempted to get around these restrictions on baht inflows by creating baht debt securities and marketing them to non-residents. After several efforts to limit particular forms of securities, the Bank of Thailand announced the unremunerated reserved requirements (URR) against portfolio inflows. The subsequent adverse reaction of the equity market led authorities to apply the reserve requirements only to fixed income inflows.[6]

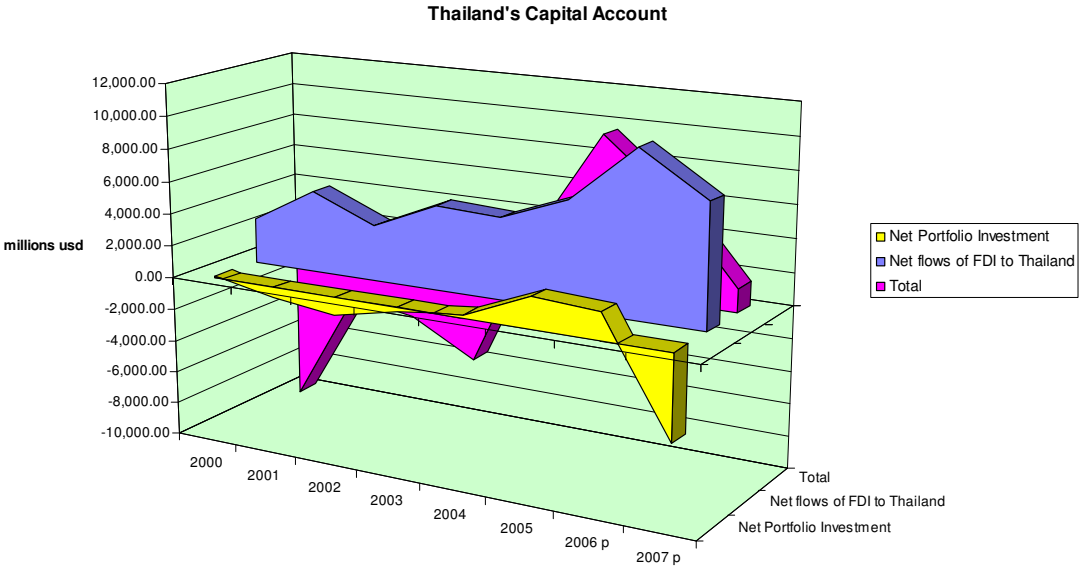
The measure led to a sharp slow down in capital inflows. In 2007, however, portfolio investment dropped and 5,179.73 million USD flowed out of the country. Together with foreign direct investment, net capital inflows in 2007 were 1,450.39 million USD. Reserves have risen sharply since 2000. In 2007, foreign exchange reserves amounted to 99.38 billion USD increasing by 300 percent from 2000.

According to impossible trinity, independent monetary policy cannot coexist with fixed exchange rate in the world of capital mobility. The surge of capital inflows and reserves accumulation introduced the rapid appreciation of the Thai baht. Figure 2.4 shows that, Thai baht has continually appreciated against USD

[6]See the Appendix B for more details.

Source: Bank of Thailand

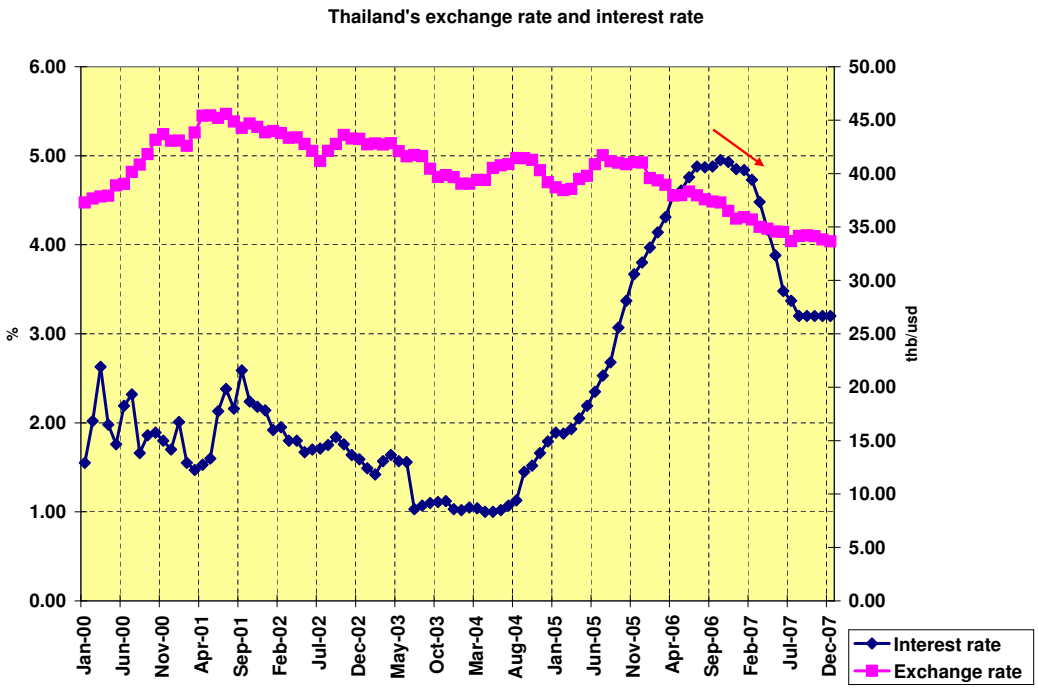
Figure 2.2: Thailand's Interest Rates Differentials (percent)



Source: Bank of Thailand

Figure 2.3: Thailand's Capital Account

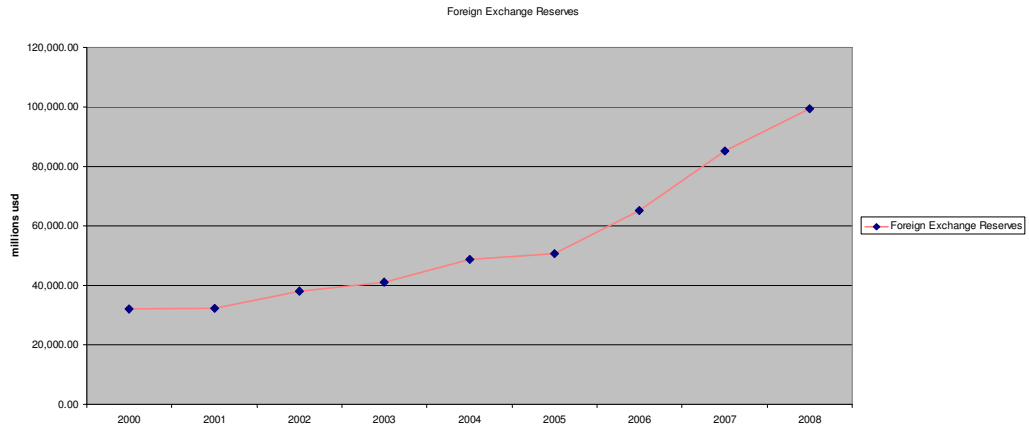
since 2005. And even though the short-term interest rate has fallen since the end 2006, Thai baht value has not stopped rising. Exchange rate intervention was used occasionally to stabilize the Thai baht exchange rate consequently resulting in an increase of foreign exchange reserves.



Source:Bank of Thailand

Figure 2.4: Thailand's Exchange Rate and Interest Rate

Analysts have debated to what extent the Bank of Thailand should manage the exchange rate market while implementing inflation targeting. As some analysts argue, one of the costs of inflation targeting is the increase in exchange rate volatility, which is not a good news for country, that relies on labor-intensive exports. Appreciation of the Thai baht means a huge loss of competitiveness over neighboring countries. The Bank of Thailand address this issue in the following way.A study by Pongsaparn (2007), an economist from the Bank of Thailand, points out that adjusting the exchange rate as one transmission to the economy is unlikely since exchange rate is not strongly linked to domestic interest rates. The efficacy of monetary policy through the exchange-rate adjustment can be greatly diminished. Her study thus supported the Bank of Thailand foreign exchange rate intervention in 2003–2004 is consistent with inflation targeting.



Source: EIU

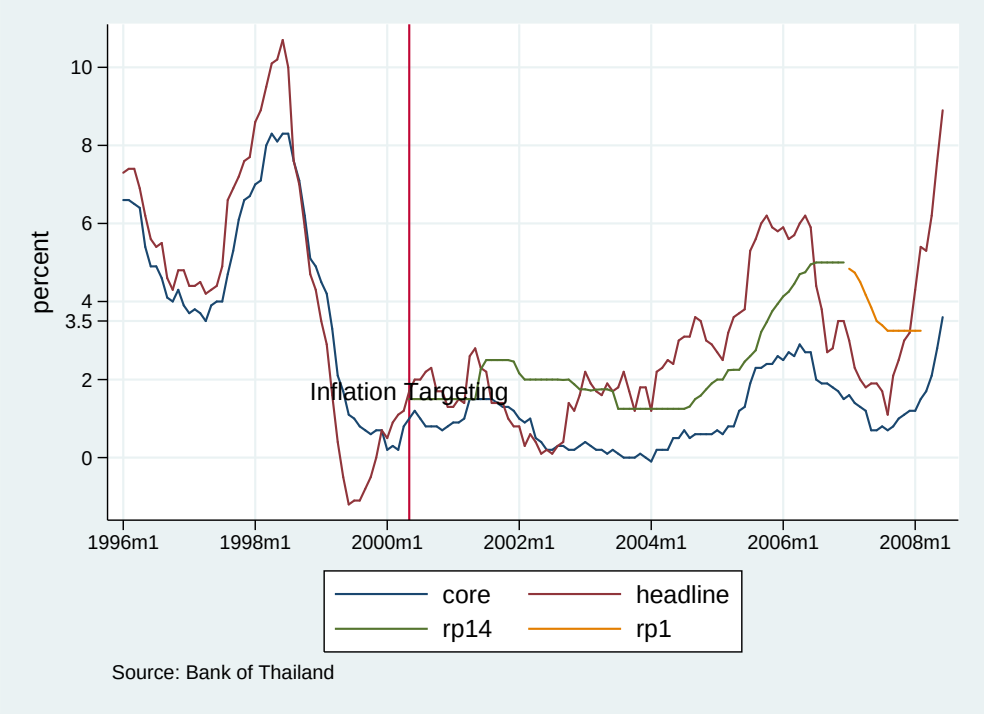
Figure 2.5: Thailand's Foreign Exchange Reserves

In addition to exchange rate management, recently Thailand has seen an increasing inflationary pressures as shown in Figure 2.6 and 2.7, resulting from the rising of oil prices. Figure 2.7 shows that benzine 95 and diesel prices rose from 19.37 and 14.59 baht/litre in January 2005 to 41.44 and 40.86 baht/litre in April 2008. On average the price of oil in early 2008 was almost 300 percent of the average price in 2005. Headline inflation and core inflation, consequently, rose to 7.5 and 2.8 percent compared with 2.8 and 0.7 percent, respectively, in 2005.

However, inflationary pressure in the Bank of Thailand's point of view is not the result of high energy costs alone. Added to that, they believed rising of oil price merely part of the story. According to S.Chuenchokesan & T.Thanaditsuwan (2008) and Ashvin Ajula, head of the Monetary Policy Team in the Bank of Thailand, domestic pressures in labor market and capacity utilization, instead, create inflationary pressure. And due to the same sources, inflation in Thailand at this moment is being pulled by demand side. Thailand has achieved a low unemployment rate, hovering around 1.5 percent in 2008

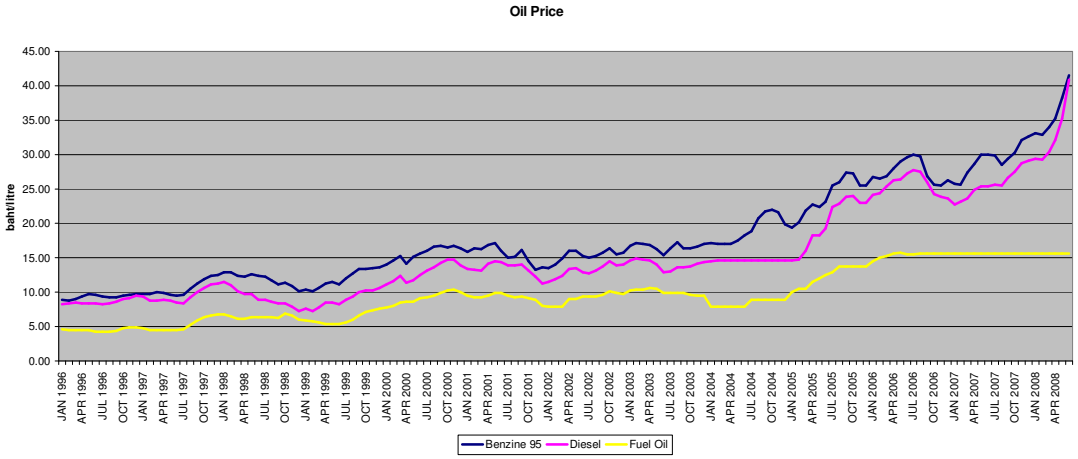
and a high capacity utilization rate ever, which in 2008 was the highest since the 1997 financial crisis.

Inflation rate was believed to be elevated for a while and the Bank of Thailand's reaction to the oil price surge was that they would not be too spontaneous to the high oil price as long as the oil price does not affect much on the core inflation. The bank would rather focus on longer–term objective and let the government's stimulus packages tackle short–term difficulties. However, the Bank of Thailand has raised the key interest rate twice in 2008: First 25 basis points in July and 25 basis points in August. Key interest rate now stands at 3.75 percent.



Source: Bank of Thailand

Figure 2.6: Inflation Rates and Interest Rates



Source: Bank of Thailand

Figure 2.7: Oil Price

2.4 Effectiveness of Inflation Targeting: Inflation Persistence, Output Growth, and Interest Rate Volatility

2.4.1 Inflation

The first part of the analysis starts by investigating the basic statistics of data on inflation. Table 2.1 represents mean and standard deviation of core and headline inflation for 1996q2–2008q2. The results in Table 2.1 suggest that inflation rates were relatively declining after inflation targeting was adopted. Overall, the mean of core and headline inflation were 2.22 and 3.42 percent ,respectively, whereas those during pre-inflation targeting were 4.24 and 4.56 percent. After inflation targeting was adopted, core and headline inflation were reduced to 1.08 and 2.75 percent, respectively.

Volatility of inflation rates also declined over the study period. Standard deviation of core and headline inflation were reduced to 1.79 and 0.81 percent

compared with 3.34 and 2.54 percent prior to inflation targeting.

Table 2.1: Basic Statistics: Inflation

	Core π	Headline π
Mean		
1996q1–2008q2	2.22	3.42
1996q1–2000q2 (Pre-IT)	4.24	4.56
2000q2–2008q2 (Post-IT)	1.08	2.75
Standard Deviation		
1996q1–2008q2	2.58	2.24
1996q1–2000q2 (Pre-IT)	3.34	2.54
2000q2–2008q2 (Post-IT)	1.79	0.81

Source: Bank of Thailand and Author's Calculation

In addition to mean and standard deviation, persistence of inflation explains to what extent inflation targeting is successful in keeping inflation rate in control. Inflation rate should be less persistent over time if the central bank has the ability to adjust the policy instrument so that they can achieve the inflation target and actively stabilize the inflation rate around a preset range. Monetary policies encountering inflation shocks will reduce inflation persistence.

To measure inflation persistence, I estimate a univariate autoregressive process for each inflation series:

$$\pi_t = \alpha + \Sigma_{i=1}^{j} \beta_i \pi_{t-j} + \varepsilon_t, \tag{2.1}$$

where ε is a serially uncorrelated, homoscedastic random error term. Persistence of inflation is measured by taking the summation of the autoregressive coefficients, $\beta \equiv \Sigma_{i=1}^{j} \beta_i$. I also construct a robustness check by performing bootstrap estimation with 1,000 replications. Results are exhibited in Table 2.2. Au-

toregressive lag order j is chosen for each inflation series according to Akaike information criterion. Inflation persistence estimates are reported in Table 2.2. The lag order chosen for each series is in brackets. Inflation persistence obtained from actual and bootstrap estimations are lower than prior to inflation targeting. Bootstrap estimation gives a little higher persistence than the actual estimates whose core inflation and headline inflation persistence is less than unity.

Table 2.2: Persistence Estimates for Inflation

	Core π		Headline π	
	Actual Estimates	Bootstrap Estimates	Actual Estimates	Bootstrap Estimates
1996q1–2008q2	1.09(12)	1.076	1.387(12)	1.388
1996q1–2000q2(Pre-IT)	-0.409(8)	17.119	9.367(8)	8.908
2000q2–2008q2(Post-IT)	0.887(5)	1.488	0.864(2)	3.89

Source: Bank of Thailand and Author's Calculation

2.4.2 Output Growth

Regarding the relationship between inflation targeting and output growth, Mishkin (1999) argued that

"A conservative conclusion is that, once low inflation is achieved, inflation targeting is not harmful to the real economy. Given the strong economic growth after disinflation was achieved in many countries that have adopted inflation targets, New Zealand being one outstanding example, a case can be made that inflation targeting promotes real economic growth in addition to controlling inflation..."

So I brought his idea to examine whether inflation targets spur growth. Table 2.3 represents the results of output growth statistics. On average, output

growth increased evidently from 2.86 percent prior to inflation targeting to 7.59 percent. Output volatility, on the other hand, did not change much.

2.4.3 Long-term Interest Rates and Short-Term Interest Rates Volatility

Long-term interest rates should reflect inflation expectation in the sense that targeting locks in low inflation permanently, while adverse events reignite inflation under"just do it" policies. If the public believes in this argument, the inflation targeting should reduce both inflation and inflation uncertainty, which can be reflected in low long-term interest rates. Table 2.3 shows that long term interest rates were lower after inflation targets.

Short-term interest rates, on the other hand, tells how activethe central bank are, by looking at how often short-term interest rates are adjusted. According to table 2.3, standard deviation of short-term interest rates declines from 6.7 in 1996–2000 to 1.23 in 2000–2008. That means the Bank of Thailand has been less activism while implementing inflation targeting. Noting that the Bank of Thailand switched key policy interest rates from the 14-day repurchase rate to the 1-day repurchase rate in January 2007 shows that the Bank of Thailand is inclined to use a more liquid and instantaneous policy instrument.

Table 2.3: Basic Statistics: Output Growth and Interest Rates

	Output Growth	Short–Term Interest Rates	Long–Term Interest Rates
Mean			
1996q1–2008q2	6.14	4.96	6.64
1996q1–2000q2(Pre-IT)	2.86	9.00	9.38
2000q2–2008q2(Post-IT)	7.59	2.50	5.17
Standard Deviation			
1996q1–2008q2	13.65	3.83	2.43
1996q1–2000q2(Pre-IT)	4.45	6.70	1.84
2000q2–2008q2(Post-IT)	2.35	1.23	.89

Source: Bank of Thailand and Author's Calculation

2.4.4 Mean Reverting Regression

Effectiveness of inflation targeting can be determined by considering how inflation targets affect dimensions of economic performance such as inflation, output growth, and long-term interest rates. The effectiveness of inflation targeting is measured by taking the performance of each variable, relative to its performance on average, prior to inflation targets. OLS regressions based on the general specification are as follows:

$$\Delta x_t = \alpha + \beta D + \varepsilon_t, \tag{2.2}$$

where x represents core inflation, headline inflation, output growth, long-term interest rates. $\Delta x_t = x_{post} - \bar{x}_{pre}$, x_{post} in a country's value of x is the post -targeting period, $\bar{x}_{pre}$ is the average value in the pre-targeting period, and D is a dummy variable equal to one after adopting inflation targeting and zero otherwise. If economic performance of each variable is relatively better, that is, lower infla-

tion, higher growth, and lower long-term interest rates.[7] Coefficients obtained from 2.2 should be negative in case of inflation and long-term interest rates and positive in case of output growth.

From Table 2.4, signs of estimated coefficients are as expected and all of them are 99 percent statistically significant except headline inflation, which is statistically significant at 95 percent level of confidence. The above results indicate that inflation targeting has performed relatively well in promoting higher growth while keeping inflation and inflation expectation low. R^2 produced from each estimate is moderate except for headline inflation for which R^2 is 0.12. One possible explanation is that inflation targeting in Thailand has hardly targeted headline inflation, only taking the pass-through effect from headline inflation to core inflation into account.

Table 2.4: Mean Reverting Regression

	Core π	Headline π	Output Growth	Long-Term Interest Rate
	b/se	b/se	b/se	b/se
Dummy	-1.844***	-1.978*	5.044***	-4.334***
	(0.337)	(0.867)	(1.286)	(0.463)
Constant	2.441***	0.168	-0.314	0.123
	(0.328)	(0.808)	(1.216)	(0.436)
N	50	50	45	50
F	30	5	15	88
$\bar{R}^2$	0.504	0.116	0.350	0.724
RMS error	0.867	2.430	3.089	1.275

$*p < 0.05; **p < 0.01; ***p < 0.001$
Standard errors are in parentheses.

The statistical analysis from the previous session suggested that Thailand experienced the lower volatility of inflation and degree of inflation persistence after adopting inflation targeting framework. Output growth improved on aver-

[7]Noting that a relatively lower long-term interest rate implies a low inflation expectation.

age while inflation expectation remained lower. Next I compare the results with non-inflation-targeting countries to see if the improvement was due to inflation targeting. The thirteen non-inflation targeting countries are selected based on a paper by Ball & Sheridan (2003b). The non-inflation- targeting-countries are the United States, Japan, Denmark, Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal, Norway, and Sweden. Data are from 2000–2008, since the quarterly data is not available for all countries. Figure 2.8(a) represents the comparison of average inflation rate and GDP growth rate among Thailand and non-inflation-targeters. The results do not show a significant difference between Thailand and the rest. In addition, the EMS countries[8] seem to have a lower average inflation than Thailand. Figure 2.8(b) examines the variability of inflation, which is measured by the standard deviation of inflation rate of sample countries using the same format as the average inflation figure. From the finding, there is no evidence to show that inflation targeting helps to reduce the inflation variability in Thailand. And in addition, inflation variability in Thailand is largest among sample countries.

I now ask whether inflation targeting affects the behavior of output. I examine the average and standard deviation of real GDP growth using annual data from 2000–2008. As exhibited in Figure 2.9(a), average GDP growth in Thailand is higher than most of non-inflation-targeters except Ireland. About output variability,Cecchetti & Ehrmann (1999) argued that inflation targeting makes output more variable. Figure 2.9(b) represents results about variability of annual output growth. The results show that Thailand's output growth is more volatile than non-inflation targeters which confirms the argument proposed by

[8]EMS countries are European countries that participated in the European Monetary System. They are Denmark, Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal, Norway, and Sweden.

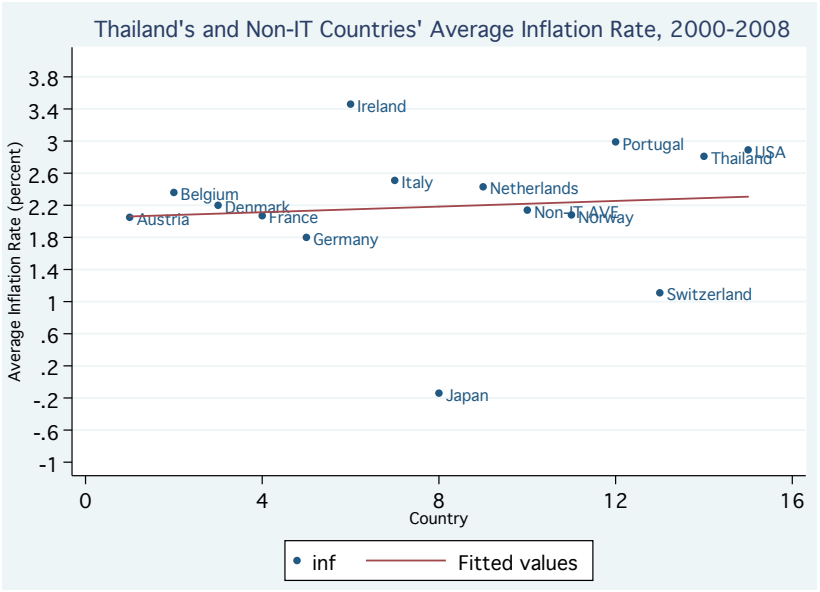
Cecchetti & Ehrmann (1999). That said, inflation targeting does not contribute any distinctively better economic outcomes to Thailand than other policies do to non-targeters.

2.5 Exchange Rates Management Under Inflation Targeting

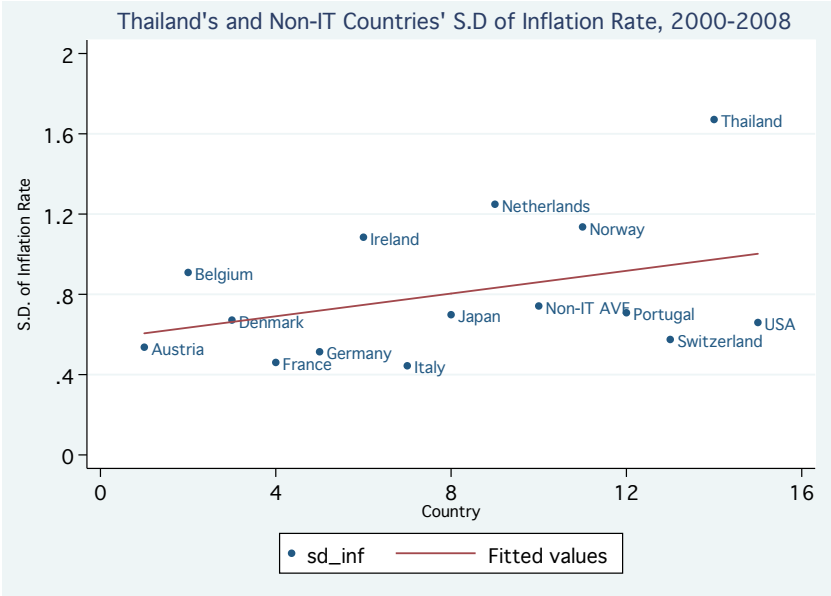
Exchange rate is a part of monetary mechanism under inflation targeting framework in two ways, through *the uncovered interest parity(UIP) channel* and through *the pass-through effect*. The first exchange rate channel connects exchange rate and inflation rate through the uncovered interest parity (indirect channel), where interest rate differentials between domestic and foreign economies induce change in foreign exchange rates which subsequently determine the level of trade transaction, that is, exports and imports, and in turn affect the level of the country's aggregate output and inflation (see Figure 2.16).

The second exchange rate channel (direct channel) can effect inflation directly through the so-called pass-through effect. Exchange rate depreciation would induce the imported inflation, since imported goods become relatively more expensive. Imported inflation passes the effect to the domestic consumption basket and consequently affects the domestic consumer price index.

In this section, I test the role of exchange rate under inflation targeting in order to assess the effectiveness of the exchange rate under both channels. In Evaluating the efficacy of exchange rate, I segmented the mechanism into two blocks, (1) Taylor's reaction function (indirect channel) and (2) pass-through effect model (direct channel).



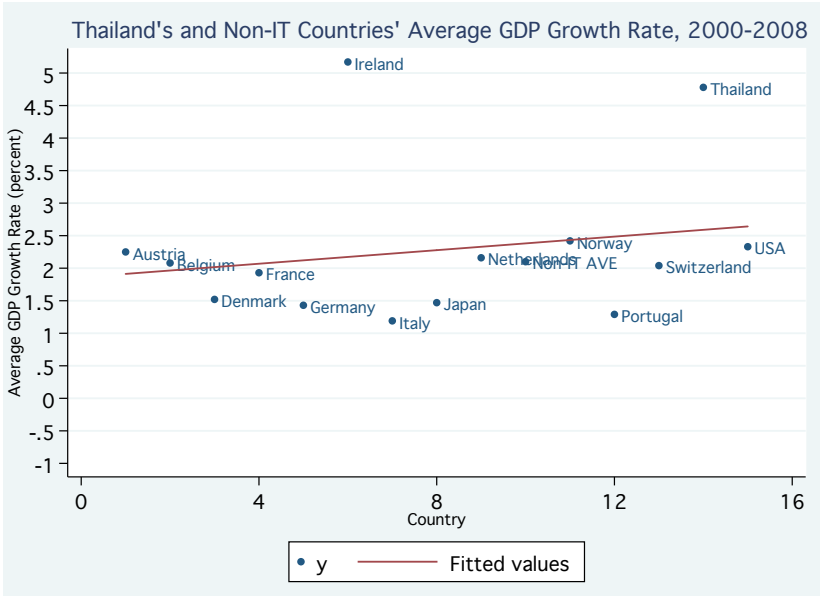
(a) Average Inflation Rate



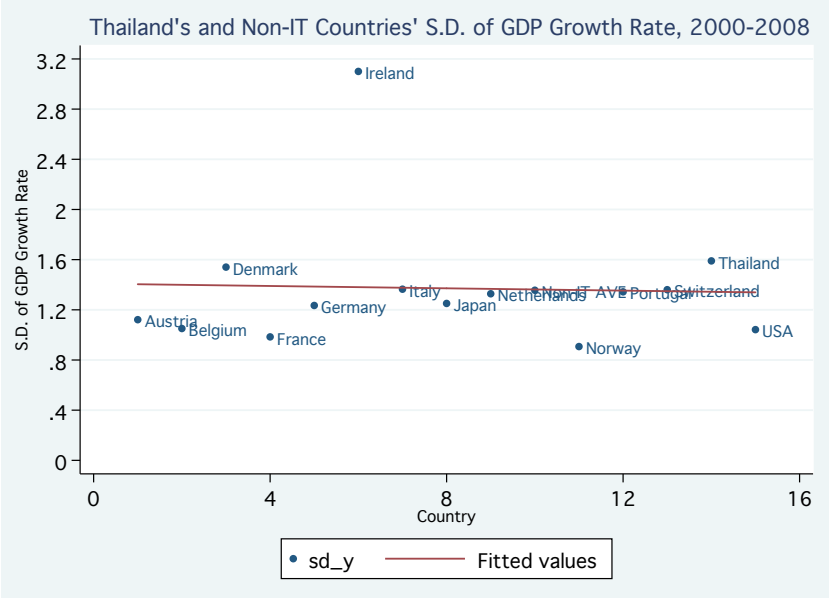
(b) Standard Deviation of Inflation Rate

Source: IMF

Figure 2.8: Thailand's and Non-IT Targeters' Average Inflation Rate and Standard Deviation, 2000–2008



(a) Average GDP Growth Rate



(b) Standard Deviation of GDP Growth Rate

Source: IMF

Figure 2.9: Thailand and Non-IT Targeters' Average GDP Growth Rate and Standard Deviation,2000–2008

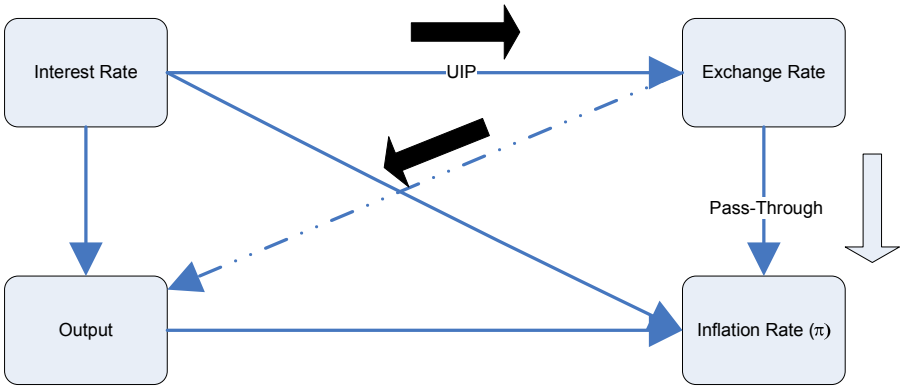


Figure 2.10: Monetary Policy Mechanism

2.5.1 Taylor's Reaction Function

One way to stabilize the exchange rate is to intervene in the market. Intervention could take two forms : *sterilized intervention* and *non-sterilized intervention*. While sterilized intervention is done through operations involving the issuance of domestic securities to absorb excess liquidity with the cost incurred to the central bank, non-sterilized intervention results in changing monetary aggregates, which might effect domestic inflation. Both types of intervention come with different drawbacks and central bank has choose which drawback is more acceptable.

Another way to manage foreign exchange rate is to include exchange rate into monetary policy rules. This is quite a controversial issue of policy implementation in many countries that adopt inflation targeting especially in Latin America and emerging countries (Edwards (2006)). There has been a discussion about appropriateness of prioritizing exchange rate under inflation targeting. To study to what degree instruments of monetary policy react to exchange rate, I use the central bank's reaction function incorporate with exchange rate as sug-

gested by Taylor (2001):

$$i_t = \gamma_0 + \gamma_1 E(\pi_t) + \gamma_2 y_t + \gamma_3 \Delta exr_t + \gamma_4 \Delta exr_{t-1} + \varepsilon_{t-1}, \tag{2.3}$$

where i_t is the short-term interest rate and $E(\pi_t)$ is the expected inflation. Expected inflation takes four measurements: realized inflation, one-period lead of inflation, long-term interest rate, and Bank of Thailand's estimates of expected inflation at the end of the current year and at the end of the following year.[9] y_t is the deviation from potential output.[10], Δexr_t is the first difference of exchange rates. The details of sources of data and descriptions are mentioned in the second chapter of appendix.

According to Taylor (2001), the exchange rate is likely to have only a marginal effect on interest rate since exchange rate does not have any significant impact on the central bank's inflation forecast. The central bank, however, in some cases may allow a certain degree of flexibility to adjust the interest rate in response to the change of exchange rate, but only in the very short term, since exchange rate by its nature is mean-reverting if inflation targeting is the major policy anchor. In an extreme case, if coefficients on exchange rate , that is, γ_3 and γ_4 are both zero, exchange rate development should not be incorporated in to policy rule and the Taylor rule reverts to its traditional form.

Equation 2.3 or the baseline model is estimated by OLS with robust HAC standard deviation to correct for first-order autocorrelation and heteroscedasticity.

[9] Estimates of expected inflation are given as fan charts. I use the expected weighted average in the estimation. Please see http://www.bot.or.th/English/MonetaryPolicy/Inflation/Pages/index_old.aspx for details.

[10] The output gap was derived using an HP filter. Smoothing parameter μ is set to equal 1600 for quarterly data.

Robustness check is performed to check whether the estimated relationship has undergone significant changes comparing with baseline model. There are major possible sources of instability due to the nature of data, for example, inflation and exchange incorporate sources of instabilities due to cyclical factors and noises. Due to unavailability of expected inflation rate, actual inflation is used to estimate the reaction function. That means the baseline estimates are obtained in the context of the central bank's response to an observed figure of inflation instead of the estimated one. This might not be valid with a forward-looking policy setting.

The alternation specification is estimated by replacing the absolute value of variables with (1) seasonally adjusted data and (2) de-trended data. In the latter case, trend components are removed by HP filter with smoothing parameter $\mu = 1,600$, and first difference of exchange rate remained unchange. Rolling recursive regression is performed to see the stability of coefficient estimates over time.

2.5.2 Empirical Results

Table 2.5 represents results of Taylor's reaction function for the whole period of 1996q1–2008q2. Columns 1–6 are models with core inflation with different specifications. According to column 1 of Table 2.5, core inflation does not significantly relate to short-term interest rate, while output gap has only marginal impact on short-term interest rate. Exchange rate, on the other hand, has a statistically significant relation with short-term interest rate, except that the signs are perverse. Short-term interest rate is highly determined by its previous quar-

ter value. The results obtained from de-trended and seasonally adjusted value of current and lead value of core inflation as presented in columns 2–6 give similar interpretations. Columns 7–12 of table 2.5 and columns 13–15 of Table 2.6 represent the results when using different specifications of headline inflation and long-term interest rate as expected value of inflation. Results are robust to the choice of core inflation.

Later I analyze the data with respect to two periods, prior to 2000q2 and after 2000q2, in order to see how inflation targeting changed the Bank of Thailand's decision on setting a short-term interest rate. Results prior to and after the adoption of inflation targeting are in Table 2.7– 2.8 and 2.9– 2.10, respectively.

Prior to inflation targeting, core inflation (columns 1–4 of Table 2.7) does not statistically determine short–term interest rate. Short–term interest rates were set according to exchange rate. As we can see in columns 1–4, both of the first differences between exchange rate for the current quarter and exchange rate for the previous quarter produce the perverse sign of the coefficients. Results are robust to deviation from trend and seasonally adjusted data, as shown in columns 2 and 3 of Table 2.5.

Noting that from 1997–2000, the Bank of Thailand maintained monetary targeting and floating exchange rate system. Under this regime, the Bank targeted domestic money supply in order to reach the ultimate objectives of sustainable growth and price stability. So I add the growth of money supply (M_2) to the original Taylor's open economy reaction function. Results are shown in column 4. As expected, growth of monetary aggregates is the major source of short-term interest rate determination prior to inflation targeting. Coefficients produced are high and statistically significant.

Table 2.5: Taylor's Reaction Function, Whole Period

Expected Inflation	(1) coreπ_t	(2) core$\pi_{t,hp}$	(3) core$\pi_{t,sa}$	(4) coreπ_{t+1}	(5) core$\pi_{t+1,hp}$	(6) core$\pi_{t+1,sa}$	(7) headπ_t	(8) head$\pi_{t,hp}$	(9) head$\pi_{t,sa}$	(10) headπ_{t+1}	(11) head$\pi_{t+1,hp}$	(12) head$\pi_{t+1,sa}$
coreπ_t	-0.272											
	(0.278)											
gdp_t	3.32e-05***	2.94e-05***	3.28e-05***	1.92e-05***	3.12e-05***	1.88e-05***	2.91e-05***	3.23e-05***	2.72e-05***	2.12e-05***	3.10e-05***	1.98e-05***
	(1.03e-05)	(8.97e-06)	(9.52e-06)	(9.77e-06)	(9.45e-06)	(1.04e-05)	(1.04e-05)	(9.61e-06)	(1.03e-05)	(9.49e-06)	(1.01e-05)	(1.00e-05)
Δexr_t	0.414***	0.392***		0.357***	0.415***		0.420***	0.406***		0.392***	0.414***	
	(0.155)	(0.153)		(0.131)	(0.154)		(0.156)	(0.158)		(0.147)	(0.152)	
Δexr_{t-1}	0.226	0.241		0.173	0.247		0.238	0.257		0.188	0.240	
	(0.173)	(0.157)		(0.175)	(0.194)		(0.180)	(0.173)		(0.183)	(0.203)	
i_{t-1}	0.944***	0.885***		0.610***	0.840***		0.816***	0.857***		0.777***	0.836***	
	(0.122)	(0.0585)		(0.166)	(0.0639)		(0.0721)	(0.0615)		(0.0766)	(0.0681)	
core$\pi_{t,hp}$		-0.286										
		(0.176)										
core$\pi_{t,sa}$			-0.222									
			(0.210)									
$\Delta exr_{sa,t}$			0.398***			0.351***			0.412***			0.380***
			(0.135)			(0.109)			(0.138)			(0.129)
$\Delta exr_{sa,t-1}$			0.205			0.165			0.218			0.173
			(0.171)			(0.173)			(0.175)			(0.176)
$i_{t-1,sa}$			0.932***			0.632***			0.806***			0.778***
			(0.105)			(0.173)			(0.0779)			(0.0792)
coreπ_{t+1}				0.656								
				(0.460)								
core$\pi_{t+1,hp}$					-0.0264							
					(0.212)							
core$\pi_{t+1,sa}$						0.608						
						(0.469)						
headlineπ_t							0.0568					
							(0.112)					
headline$\pi_{t,hp}$								-0.110				
								(0.124)				
headline$\pi_{t,sa}$									0.100			
									(0.110)			
headlineπ_{t+1}										0.224***		
										(0.107)		
headline$\pi_{t+1,hp}$											0.00825	
											(0.138)	
headline$\pi_{t+1,sa}$												0.237***
												(0.111)
Constant	0.603***	0.333	0.591***	0.400	0.544***	0.408	0.492	0.468***	0.431	0.174	0.566***	0.149
	(0.288)	(0.253)	(0.297)	(0.295)	(0.274)	(0.295)	(0.357)	(0.257)	(0.323)	(0.347)	(0.271)	(0.315)
Observations	46	46	46	46	45	46	46	46	46	46	45	46
Adjusted R^2	0.933	0.935	0.933	0.937	0.932	0.936	0.932	0.933	0.932	0.936	0.932	0.936

*** p<0.1, ** p<0.05, * p<0.01

Robust standard errors are in parentheses.

Table 2.6: Taylor's Reaction Function, Whole Period (continuted)

Expected Inflation	(13) bondi_t	(14) bond$i_{t,hp}$	(15) bond$i_{t,sa}$
bondi_t	0.0980		
	(0.118)		
gdp_t	2.92e-05***	3.05e-05***	2.83e-05***
	(8.87e-06)	(1.04e-05)	(8.91e-06)
Δexr_t	0.405***	0.417***	
	(0.154)	(0.157)	
Δexr_{t-1}	0.245	0.241	
	(0.173)	(0.179)	
i_{t-1}	0.802***	0.831***	
	(0.0866)	(0.0656)	
bond$i_{t,hp}$		0.0633	
		(0.231)	
bond$i_{t,sa}$			0.118
			(0.113)
$\Delta exr_{t,sa}$			0.392***
			(0.135)
$\Delta exr_{t-1,sa}$			0.225
			(0.170)
$i_{t-1,sa}$			0.801***
			(0.0880)
Constant	0.100	0.592***	-0.00160
	(0.575)	(0.266)	(0.535)
Observations	46	46	46
Adjusted R^2	0.933	0.932	0.933

Robust standard errors are in parentheses.
*** p<0.1, ** p<0.05, * p<0.01

I test the robustness of the results by using lead values of core inflation, headline inflation, and long-term interest rate as proxy for expected inflation rate. I also rerun the regression of each of the variables over HF filter and seasonalization. The results, as shown in columns 5–12 of Table 2.7 and columns 13–20 of Table 2.8 correspond to results produced by core inflation, except the lead value of core inflation (columns 5–8 of Table 2.7). The results suggest that the response of short-term interest rate to inflation is significant while the response of short-term interest rate to money supply is not.

Monetary policy responses to inflation rate are stronger right after inflation targeting was adopted. From Table 2.9 and table 2.10, coefficients representing relationships between various measures of expected inflation and short-term interest rate are positively significant in all columns except those of weighted expected core and headline inflation (columns 10–12 of Table 2.9 and columns 19–21 of Table 2.10, respectively). The results suggest that the Bank of Thailand react to realized inflation rather than the forecasted value of expected inflation. In addition, several findings show that a response of the short-term policy interest rate to the exchange rate is significant with the correct signs in most cases, which implies that short-term policy interest rate becomes more responsive to the exchange rate after inflation targeting is in place.

Results estimated from equation 2.3 suggest a significant relationship between short-term policy interest rate and exchange rate. Any upward interest rate adjustment as a means of controlling inflation rate would compromise the international trade competitiveness and aggregate output that results from domestic currency appreciation. In this section, I investigate further to what extent aggregate output has to be sacrificed if interest rate is raised to control inflation.

Table 2.7: Taylor's Reaction Function, 1996q1–2000q2

Expected Inflation	(1) coreπ_t	(2) core$\pi_{t,hp}$	(3) core$\pi_{t,sa}$	(4) coreπ_{t,m_2}	(5) coreπ_{t+1}	(6) core$\pi_{t+1,hp}$	(7) core$\pi_{t+1,sa}$	(8) coreπ_{t+1,m_2}	(9) headπ_t	(10) head$\pi_{t,hp}$	(11) head$\pi_{t,sa}$	(12) headπ_{t,m_2}
coreπ_t	0.948			1.253								
	(0.694)			(1.222)								
gdp_t	7.17e-05***	5.99e-05	7.75e-05***	3.18e-05	3.38e-05	7.26e-05***	4.45e-05***	6.00e-06	5.25e-05***	7.10e-05***	5.94e-05***	2.26e-07
	(2.04e-05)	(4.90e-05)	(1.73e-05)	(3.38e-05)	(1.99e-05)	(3.29e-05)	(1.82e-05)	(2.42e-05)	(1.77e-05)	(2.81e-05)	(1.48e-05)	(1.40e-05)
Δexr_t	0.478***	0.484***		0.365***	0.269	0.426***		0.255	0.496***	0.484***		0.389***
	(0.180)	(0.191)		(0.182)	(0.165)	(0.175)		(0.196)	(0.149)	(0.167)		(0.134)
Δexr_{t-1}	0.453***	0.330		0.451***	0.168	0.281		0.176	0.382***	0.344		0.348***
	(0.166)	(0.201)		(0.148)	(0.107)	(0.227)		(0.114)	(0.145)	(0.202)		(0.0738)
i_{t-1}	0.415	0.804***		0.157	0.00637	0.653***		0.0668	0.328	0.659***		0.118
	(0.298)	(0.280)		(0.475)	(0.236)	(0.205)		(0.300)	(0.217)	(0.170)		(0.206)
core$\pi_{t,hp}$		-0.0432										
		(0.856)										
core$\pi_{t,sa}$			0.989***									
			(0.541)									
$\Delta exr_{t,sa}$			0.503***				0.331***				0.498***	
			(0.142)				(0.108)				(0.122)	
$\Delta exr_{t-1,sa}$			0.484***				0.238***				0.409***	
			(0.125)				(0.106)				(0.119)	
$i_{t-1,sa}$			0.395				0.201				0.410***	
			(0.232)				(0.208)				(0.194)	
$m_{2,t}$				-39.24***				-24.26				-42.24***
				(9.515)				(13.63)				(7.585)
coreπ_{t+1}					2.235***			1.825***				
					(0.665)			(0.947)				
core$\pi_{t+1,hp}$						0.546						
						(0.763)						
core$\pi_{t+1,sa}$							1.672***					
							(0.569)					
headlineπ_t									0.939***			1.069***
									(0.413)			(0.407)
headline$\pi_{t,hp}$										0.340		
										(0.365)		
headline$\pi_{t,sa}$											0.763***	
											(0.358)	
Constant	0.445	0.677	0.412	340.0***	0.154	2.111	0.305	210.2	1.143	2.016	1.083***	366.8***
	(0.711)	(2.562)	(0.461)	(82.24)	(0.304)	(1.916)	(0.366)	(117.9)	(0.705)	(1.626)	(0.582)	(65.67)
Observations	16	16	16	14	16	16	16	14	16	16	16	14
Adjusted R^2	0.930	0.922	0.959	0.951	0.962	0.926	0.973	0.964	0.944	0.926	0.964	0.971

Robust standard errors are in parentheses.
*** p<0.1, ** p<0.05, * p<0.01

Table 2.8: Taylor's Reaction Function, 1996q1-2000q2 (continued)

Expected Inflation	(13) headπ_{t+1}	(14) head$\pi_{t+1,hp}$	(15) head$\pi_{t+1,sa}$	(16) headπ_{t+1,m_2}	(17) bondi_t	(18) bond$i_{t,hp}$	(19) bond$i_{t,sa}$	(20) bondi_{t,m_2}
headlineπ_{t+1}	0.721			0.822***				
	(0.447)			(0.407)				
gdp_t	3.16e-05	6.13e-05***	5.42e-05***	-4.01e-05	1.71e-05	6.16e-05***	4.32e-05	-3.26e-06
	(2.47e-05)	(2.23e-05)	(1.86e-05)	(3.52e-05)	(2.98e-05)	(2.22e-05)	(2.67e-05)	(2.61e-05)
Δexr_t	0.363***	0.465***		0.265	0.494***	0.483***		0.404***
	(0.180)	(0.194)		(0.181)	(0.203)	(0.189)		(0.198)
Δexr_{t-1}	0.172	0.309		0.108	0.397***	0.336		0.314***
	(0.225)	(0.231)		(0.160)	(0.167)	(0.199)		(0.146)
i_{t-1}	0.531***	0.765***		0.343***	0.534***	0.785***		0.592***
	(0.184)	(0.104)		(0.175)	(0.139)	(0.0824)		(0.135)
headline$\pi_{t+1,hp}$		0.102						
		(0.286)						
headline$\pi_{t+1,sa}$			0.322					
			(0.368)					
$\Delta exr_{t,sa}$			0.431***				0.493***	
			(0.141)				(0.153)	
$\Delta exr_{t-1,sa}$			0.286				0.389***	
			(0.191)				(0.140)	
$i_{t-1,sa}$			0.674***				0.641***	
			(0.142)				(0.120)	
$m_{2,t}$				-44.95***				-38.77***
				(13.17)				(20.22)
bondi_t					1.126***			0.297
					(0.393)			(0.706)
bond$i_{t,hp}$						0.0458		
						(0.492)		
bond$i_{t,sa}$							0.659***	
							(0.323)	
Constant	0.599	1.068	0.683	389.4***	-7.105***	0.832	-3.858***	334.1
	(0.692)	(0.959)	(0.540)	(113.8)	(2.544)	(0.596)	(2.080)	(179.1)
Observations	16	16	16	14	16	16	16	14
Adjusted R^2	0.933	0.922	0.952	0.958	0.935	0.922	0.954	0.942

Robust standard errors are in parentheses.
*** p<0.1, ** p<0.05, * p<0.01

Table 2.9: Taylor's Reaction Function, 2000q2-2008q2

Expected Inflation	(1) coreπ_t	(2) core$\pi_{t,hp}$	(3) core$\pi_{t,sa}$	(4) coreπ_{t+1}	(5) core$\pi_{t+1,hp}$	(6) core$\pi_{t+1,sa}$	(7) bondi_t	(8) bond$i_{t,hp}$	(9) bond$i_{t,sa}$	(10) $E(core\pi_t)$	(11) $E(core\pi_{t,hp})$	(12) $E(core\pi_{t,sa})$
coreπ_t	0.527***											
	(0.0963)											
gdp_t	-2.05e-07	1.43e-06	5.27e-06	1.52e-06	2.04e-06	7.13e-06	1.05e-05***	7.51e-06***	1.71e-05***	1.18e-05***	1.19e-05***	2.02e-05***
	(3.18e-06)	(2.77e-06)	(6.11e-06)	(3.76e-06)	(3.42e-06)	(9.83e-06)	(2.82e-06)	(2.80e-06)	(5.87e-06)	(3.10e-06)	(3.08e-06)	(6.38e-06)
Δexr_t	-0.0739***	-0.00359		-0.0949***	-0.0449		-0.120***	-0.0680		-0.107***	-0.107***	
	(0.0318)	(0.0359)		(0.0361)	(0.0403)		(0.0530)	(0.0420)		(0.0496)	(0.0493)	
Δexr_{t-1}	-0.00592	0.0336		0.0225	0.0387		0.0690	0.0794***		0.0999***	0.100***	
	(0.0373)	(0.0332)		(0.0462)	(0.0475)		(0.0438)	(0.0340)		(0.0565)	(0.0558)	
i_{t-1}	0.733***	0.855***		0.816***	0.904***		0.885***	0.889***		0.898***	0.897***	
	(0.0493)	(0.0379)		(0.0526)	(0.0414)		(0.0589)	(0.0506)		(0.0649)	(0.0651)	
core$\pi_{t,hp}$		0.454***										
		(0.0903)										
core$\pi_{t,sa}$			0.611***									
			(0.160)									
$\Delta exr_{t,sa}$			-0.0633			-0.110			-0.144			-0.148
			(0.0703)			(0.0857)			(0.0940)			(0.112)
$\Delta exr_{t-1,sa}$			-0.0927			-0.0555			-0.0595			-0.0251
			(0.0938)			(0.111)			(0.110)			(0.118)
$i_{t-1,sa}$			0.588***			0.693***			0.742***			0.739***
			(0.0808)			(0.0932)			(0.104)			(0.113)
coreπ_{t+1}				0.398***								
				(0.0930)								
core$\pi_{t+1,hp}$					0.403***							
					(0.0977)							
core$\pi_{t+1,sa}$						0.396***						
						(0.207)						
bondi_t							0.145***					
							(0.0592)					
bond$i_{t,hp}$								0.279***				
								(0.0811)				
bond$i_{t,sa}$									0.223***			
									(0.0963)			
$E(core\pi_t)$										-0.0173		
										(0.0858)		
$E(core\pi_{t,hp})$											-0.0131	
											(0.0880)	
$E(core\pi_{t,sa})$												0.0591
												(0.173)
Constant	0.163***	0.453***	0.437***	0.0877	0.312***	0.398	-0.404	0.352***	-0.459	0.345***	0.316***	0.583
	(0.0832)	(0.0993)	(0.245)	(0.107)	(0.105)	(0.330)	(0.302)	(0.118)	(0.627)	(0.189)	(0.146)	(0.382)
Observations	31	31	31	31	30	31	31	31	31	30	30	30
Adjusted R^2	0.973	0.968	0.870	0.962	0.962	0.828	0.945	0.958	0.830	0.933	0.933	0.807

Robust standard errors are in parentheses

*** p<0.1, ** p<0.05, * p<0.01

Table 2.10: Taylor's Reaction Function, 2000q2-2008q2 (continued)

Expected Inflation	(13) headπ_t	(14) headπ_{hp}	(15) headπ_{sa}	(16) headπ_{t+1}	(17) head$\pi_{t+1,hp}$	(18) head$\pi_{t+1,sa}$	(19) $E(head\pi_t)$	(20) $E(head\pi_{t,hp})$	(21) $E(head\pi_{t,sa})$
headπ_t	0.167***								
	(0.0517)								
gdp_t	2.13e-06	1.30e-06	8.48e-06	6.65e-06	4.59e-06	1.37e-05	1.23e-05***	1.23e-05***	2.20e-05***
	(3.81e-06)	(3.17e-06)	(8.23e-06)	(3.96e-06)	(4.24e-06)	(9.05e-06)	(3.04e-06)	(3.01e-06)	(6.69e-06)
Δexr_t	-0.0620	-0.0583		-0.0818***	-0.0799***		-0.106***	-0.0999***	
	(0.0416)	(0.0378)		(0.0433)	(0.0437)		(0.0479)	(0.0474)	
Δexr_{t-1}	0.0579	0.0377		0.0894***	0.0774		0.0921***	0.0898***	
	(0.0516)	(0.0500)		(0.0514)	(0.0545)		(0.0513)	(0.0482)	
i_{t-1}	0.865***	0.935***		0.896***	0.961***		0.885***	0.877***	
	(0.0460)	(0.0359)		(0.0554)	(0.0525)		(0.0653)	(0.0647)	
head$\pi_{t,hp}$		0.229***							
		(0.0522)							
head$\pi_{t,sa}$			0.162***						
			(0.0884)						
$\Delta exr_{t,sa}$			-0.0646			-0.110			-0.157
			(0.0954)			(0.0939)			(0.102)
$\Delta exr_{t-1,sa}$			-0.0190			-0.00786			-0.0719
			(0.114)			(0.129)			(0.129)
$i_{t-1,sa}$			0.743***			0.762***			0.702***
			(0.0966)			(0.115)			(0.113)
headπ_{t+1}				0.0955***					
				(0.0421)					
head$\pi_{t+1,hp}$					0.170***				
					(0.0611)				
head$\pi_{t+1,sa}$						0.0713			
						(0.0847)			
$E(core\pi_t)$							0.0370		
							(0.0549)		
$E(core\pi_{t,hp})$								0.0724	
								(0.0588)	
$E(core\pi_{t,sa})$									0.140
									(0.104)
Constant	-0.0301	0.219***	0.290	0.0702	0.158	0.466	0.265	0.364***	0.472
	(0.158)	(0.104)	(0.367)	(0.177)	(0.138)	(0.413)	(0.183)	(0.142)	(0.328)
Observations	31	31	31	31	30	31	30	30	30
Adjusted R^2	0.958	0.964	0.826	0.946	0.951	0.807	0.934	0.936	0.816

Robust standard errors are in parentheses
*** p<0.1, ** p<0.05, * p<0.01

The following simultaneous equations are estimated:

$$\ln exr_t = \gamma_0 + \gamma_1(\pi_t) + \gamma_2 \ln y_t + \Sigma_{i=0}^{2}\theta_i \ln i_{t-i} + \varepsilon_t$$

$$\ln Y_t = \beta_0 + \beta_1 \ln E(\pi_t) + \beta_2 \ln i_t + \Sigma_{i=0}^{4}\alpha_i \ln exr_{t-i} + \upsilon_t, \tag{2.4}$$

where $\ln Y_t$ is log of output growth and all other variables are the same as in earlier Taylor's reaction function. Time period of the study is from 2000q2 to 2008q2. Estimated results (Table 2.11) represent empirical results with different proxies for expected inflation: core inflation, lead value of core inflation, long-term interest rate, and weighted average of expected inflation as shown in columns 1–4 respectively. The results obtained from different specifications of expected inflation robustly illustrate the significant relationship between short-term policy rate and exchange rate and, thus, the exchange rate in turn results in output volatility since the signs of their coefficients are switched every period. Empirical results are consistent with the trinity problem.[11]

[11]The formal model for this hypothesis is the Mundell-Fleming model developed in the 1960s by Robert Mundell and Marcus Fleming. The trinity hypothesis suggests that central banks cannot attain three policy objectives, which are (1) an independent monetary policy, (2) free capital movement, and (3) fixed exchange rates at the same time. At least one of them has to be foregone.

Table 2.11: Estimated Results of Simultaneous Equation

DEPENDENT	(1)		(2)		(3)		(4)	
VARIABLES	ln exr_t	ln Y_t	ln exr_t	ln Y_t	ln exr_t	ln Y_t	ln exr_t	ln Y_t
ln i_t	0.299***	0.431***	0.278***	8.32e-05	0.291***	0.231***	0.375***	0.0829
	(0.0653)	(0.0781)	(0.0592)	(0.0937)	(0.0665)	(0.0559)	(0.0766)	(0.0804)
ln i_{t-1}	-0.629***		-0.675***		-0.495***		-0.628***	
	(0.138)		(0.117)		(0.144)		(0.171)	
ln i_{t-2}	0.197***		0.303***		0.120		0.182	
	(0.0929)		(0.0849)		(0.0949)		(0.114)	
ln $core\pi_t$	0.0351***	-0.142***						
	(0.0159)	(0.0324)						
ln exr_t		-0.749		-2.305***		-0.297		-3.375***
		(0.783)		(0.984)		(0.826)		(1.491)
ln exr_{t-1}		-1.369		-0.452		-0.935		0.498
		(0.874)		(1.011)		(0.944)		(1.447)
ln exr_{t-2}		2.401***		1.696***		1.919***		3.644***
		(0.593)		(0.663)		(0.583)		(1.043)
ln exr_{t-3}		-2.175***		-1.272***		-2.190***		-3.119***
		(0.560)		(0.594)		(0.539)		(0.964)
ln exr_{t-4}		2.564***		2.056***		2.359***		3.308***
		(0.448)		(0.475)		(0.433)		(0.709)
ln y_t	-0.00743		-0.0154***		-0.00217		-0.0118***	
	(0.00624)		(0.00518)		(0.00736)		(0.00668)	
ln $core\pi_{t+1}$			0.0621***	0.141***				
			(0.0192)	(0.0499)				
ln bondi_t					0.112***	-0.550***		
					(0.0568)	(0.111)		
ln $E(core\pi_t)$							-0.00767	-0.119***
							(0.0127)	(0.0596)
Constant	3.824***	11.27***	3.904***	14.94***	3.587***	11.52***	3.857***	10.43***
	(0.0537)	(1.300)	(0.0468)	(1.768)	(0.144)	(1.285)	(0.0582)	(1.938)
Observations	12	12	12	12	12	12	12	12
Adjusted R^2	0.942	0.967	0.954	0.960	0.933	0.967	0.921	0.935

*** p<0.1, ** p<0.05, * p<0.01
Standard errors are in parentheses.

2.5.3 Exchange Rate Pass-Through under Inflation Targeting

There has been a concern about nominal exchange rate changes under inflation targeting as shock absorbers of economy. The mechanism works through real exchange rate. Any appreciation or depreciation of nominal exchange rate affects real exchange and, consequently, creates the pass-through effect from exchange rates to domestic prices. If the inflationary effects created by changes of exchange rate are large, the monetary authorities have to implement either

monetary or fiscal policies to offset inflationary consequences of exchange rate changes. On the other hand, if exchange rates in one particular country can absorb most of the economic shock themselves and leave inflation rate marginally unaffected, the correction policy might be unnecessary.

To address this issue, I begin with the concept of real exchange rate which is the ratio between tradable and non-tradable goods:

$$\rho = \frac{P_t}{P_{nt}}, \tag{2.5}$$

where P_t is the domestic price of tradable goods and P_{nt} is the price of non-tradable goods. In order to have nominal exchange rate (E) as an effective shock absorber, we need real exchange rate to be responsive to change in the nominal exchange rate. For example, a depreciation of nominal exchange rate generates an increase in real exchange rate, which in turn leads to expenditure switching effect. Also three additional assumptions have to be imposed: (1) the "law of one price" holds for tradable goods; (2) P_n is the result of the clearing conditions in the non-tradable goods market; and (3) economic authorities pursue monetary and fiscal policies so that wages do not adjust automatically as a result of change in nominal depreciation. First two assumptions are written as:

$$P_t = EP_t^* \tag{2.6}$$

$$N^s\{\frac{W}{P_{nt}}\} = N^d(\rho, A), \tag{2.7}$$

where E is nominal exchange rate, P_t^* is international price of tradable goods; N^s, N^d, W, and A are supply and demand for non-tradable goods, nominal wages, and absorption. Absorption in addition, is affected by fiscal and monetary policies. Assuming that P_t^* is unchanged and taking differentiation on both equations with respect to nominal exchange rate:

$$\frac{d\log\rho}{d\log E} = 1 - \{\alpha_1 + \alpha_2\frac{d\log W}{d\log E} + \alpha_3\frac{d\log A}{d\log E}\}, \tag{2.8}$$

where $_1 = \frac{\eta}{\eta-\varepsilon}$, $\alpha_2 = \frac{-\varepsilon}{\eta-\varepsilon}$, $\alpha_3 = \frac{\phi}{\eta-\varepsilon}$, and $\eta \geq 0$, $\varepsilon \leq 0$, $\phi \geq 0$ are elasticities.

According to the theory, pass-through from exchange rates to domestic price of tradable goods is unitary and pass-through to domestic price of non-tradable goods depends on wage rate behavior and absorption policies. From equation 2.8, if $d\log W = d\log A = 0$ then $\frac{d\log\rho}{d\log E} > 0$ and nominal exchange rate is a shock absorber. On the other hand, if monetary authorities have low credibility and the labor union expects higher inflation, that is, $\frac{d\log W}{d\log E} > 0$, the effectiveness of nominal exchange rate as shock absorber will decline.

An empirical analysis of the pass-through from real exchange rate to inflation can be done in a way that tests to what extent nominal exchange rates affect domestic tradable and non-tradable goods. According to Campa & Goldberg (2005) and Gagnon & Ihrig (2001), an empirical studies on pass-through have estimated variants of the following equation:

$$logP_t = \beta_0 + \beta_1\log E_t + \Sigma\beta_{2i}x_{it} + \beta_3 logP_t^* + \beta_4\log P_{t-1} + \varepsilon_t, \tag{2.9}$$

where P_t is a price index, either of imported, tradable, or non-tradable goods, E_t is nominal exchange rate, P_t^* is an index of foreign prices, the βs are parameters to be estimated, x_is are other controls expected to capture changes in the markup, and ε_t is an error term conforming to standard econometric assumption. Short-run pass-through is β_1 while long-run pass-through is $\frac{\beta_1}{(1-\beta_4)}$.

I extend equation 2.16 by adding dummy variables that take a value of one, after Thailand adopted inflation targeting, and zero otherwise, to see if the pat-

tern of exchange rate pass-through would change if inflation targeting was implemented or not. The estimated regression equation is:

$$\begin{aligned} \log P_t &= \beta_0 + \beta_1 \log E_t + \Sigma\beta_{2i} x_{it} + \beta_3 \log P^* + \beta_4 \log P_{t-1} + \beta_5 \log E_t \times D \\ &\quad + \beta_6 \log P_{t-1} \times D + \varepsilon_t. \end{aligned} \tag{2.10}$$

From equation above, short-term pass-through in post-inflation targeting is $\beta_1 + \beta_5$ and long-term pass-through in post-inflation targeting is $\frac{\beta_1+\beta_5}{1-(\beta_4+\beta_6)}$. Long-term pass-through after adopting inflation targeting could be either higher or lower than prior-to inflation targeting depending on coefficient β_5 and β_6. Two equations are to be estimated; one that CPI used as proxy for non-tradable goods and another that PPI used as proxy for tradable goods. Zellner's seemingly unrelated regression is used to correct correlations of errors between CPI and PPI. Controlled variables are suppressed.[12] And since nominal exchange rate (E_t) potentially creates endogeneity problems and correlates with error terms , Equation 2.10 is estimated by using the three-stage least square method with nominal effective exchange rate as an endogenous variable. The results obtained are presented in Table 2.12 and results on exchange rate pass-through are presented in Table 2.13.

According to both tables mentioned earlier, results are robust to type of price index and time frame. Short-term exchange-rate pass-through increases from 0.018 to 0.40 and 0.153 to 0.27 for CPI and PPI equations, respectively. Long-term exchange rate pass-through coefficient in the CPI equation increases from 0.018 to 0.51, whereas PPI equation increases from -0.29 to 0.57 after the adoption of inflation targeting.

[12]Please see Gagnon & Ihrig (2001) for further explanation

In most cases, the pass-through effect from exchange rate changes to inflation is incomplete and declining. Several studies explain that low pass-through effect could result from low inflation environment and credibility gained from monetary policy.Amitrano *et al.* (1997), Hakura & Choudhri (2001), Taylor (2001) and Gagnon & Ihrig (2001) posited that whenever the country's inflation is low, the pass-through effect will be low as well. These findings are consistent for both developed countries (Gagnon & Ihrig (2001)) and emerging countries (Zorzi *et al.* (2007): Hakura & Choudhri (2001)). However, in the case of Thailand, the Bank of Thailand experienced an increase of exchange-rate pass-through after the adoption of inflation targeting.

Table 2.12: 3SLS Estimates: Exchange Rate Pass-Through

	CPI b/se	PPI b/se
$\log E_t$	0.018*	0.153***
	(0.009)	(0.045)
$\log P_t^*$	0.038*	0.582***
	(0.018)	(0.174)
$\log P_{t-1}$	0.955***	1.064***
	(0.022)	(0.115)
$\log E_t \times D$	-0.010	-0.439***
	(0.021)	(0.077)
$\log P_{t-1} \times D$	0.010	0.435***
	(0.021)	(0.078)
constant	-0.048	-3.656***
	(0.122)	(0.938)
N	49	49
$\bar{R}^2$	0.99	0.98
RMS error	.00445	.0232882

legend: $*p < 0.05; **p < 0.01; ***p < 0.001$

Endogenous Variable: Nominal Effective Exchange Rate

Table 2.13: Short-Term and Long-Term Exchange Rate Pass-Through

	Short-Run	Long-Run
CPI		
Pre-Inflation Targeting	0.018	0.018
Post-Inflation Targeting	0.40	0.51
PPI		
Pre-Inflation Targeting	0.153	-0.29
Post-Inflation Targeting	0.27	0.57

Source : Author's Calculation

2.5.4 Monetary Policy Transmission Mechanism and Oil Price Shock: Inflation Targeting and Counterfactual Scenario

This section studies the relationships among macroeconomic variables under the adoption of inflation targeting versus counterfactual scenario. The adoption of inflation targeting might change the responses of macroeconomic variables in the economy to inflationary shocks. For instance, as the commitment of price stability becomes a concern, the given one-time shock to inflation may introduce output loss resulting from raising interest rates in order to contain inflationary impulses and preventing them from affecting the trend or long-term inflation rate.

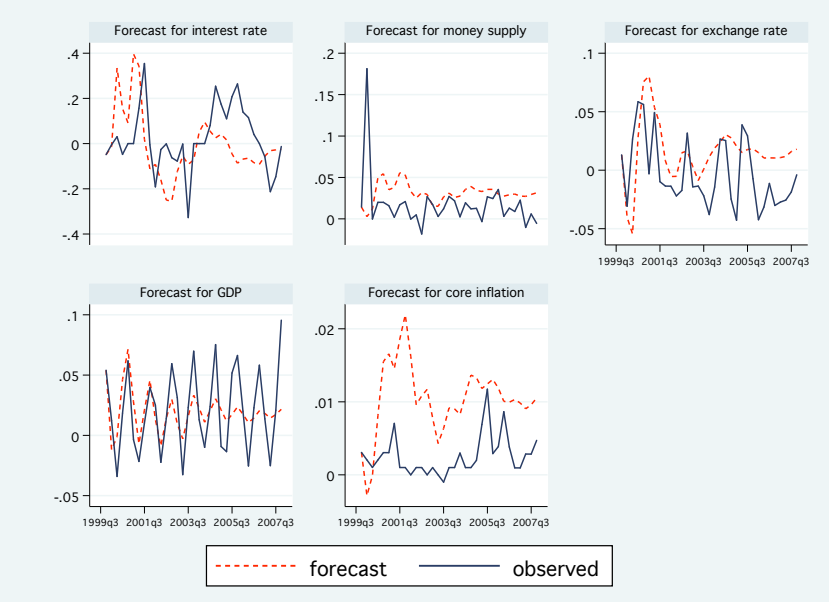
I provide evidence of this by estimating the statistical model of the joint behavior of inflation and related variables. Specifically, counterfactual scenario is constructed by using unrestricted vector autoregression (VAR) as suggested by McCallum (1997). The VAR model consists of first difference log of short-term interest rate , that is, the 14-day repurchase rate which is the policy instrument, money supply, exchange rate, GDP, and core inflation. Sample periods are from 1990q1 to 1999q4. I forecast the behavior of these five variables forward for

32 quarters. The forecast of each variable generated by statistical models can be thought of as representing how the system would have behaved if the pre-adoption policy regime had been retained. The predicted variables then can be compared with the actual post-adoption of the same variables.

Figure 2.11 shows the result of the simulation (dashed line) versus the actual paths of interest rate, money supply, exchange rate, GDP, and core inflation over the post-adoption period, that is, from 2000q1 onwards. From Figure 2.11, one can see that the forecasted inflation rate tends to be higher than the actual rate except during the early period of inflation targeting adoption where the forecasted inflation rate is a bit lower than that of the actual one. Importantly, the lower-than-forecasted inflation rate is accompanied by the more volatile GDP movement and a bigger money supply, while exchange rate and interest rate are pretty much the same. This pattern is another confirmation of the earlier finding that the adoption of inflation targeting is achieved at the expenses of short fall and more volatile output.

Next, I examine whether inflation targeting should be able to handle oil price surge using counterfactual scenario as a benchmark using structural vector autoregression model includes macroeconomic variables to describe inflation targeting in Thailand. Oil price is introduced into the SVAR system to examine to what extent oil price affects the entire economy and how the Bank of Thailand reacts to oil price surge. Considering a pth–order structural vector autoregression model that has $(N \times 1)$ vector of macroeconomic variables: GDP (y_t), Consumer Price Index (cpi_t), monetary aggregates $(m_{2,t})$, nominal short-term of interest rate (i_t), nominal exchange rate (exr_t), and oil price (oil_t).[13] For stationarity purpose, all variables are logged and taken first difference.

[13]Please see the Appendix B for details of variables.



Source: Author's Calculation

Figure 2.11: Dynamic Simulations

The reduced-form VAR model is the following:

$$Y_t = c + R(L)Y_t + u_t, \tag{2.11}$$

where $R(L) = R_1 + R_2L^2 + \ldots + R_pL^p$ is a matrix polynomial in the lag operator L, and u_t is the generalization of a white noise process with variance covariance matrix $u_t \sim i.i.d.(0, \Sigma_u)$.

According to equation 2.11, all variables are treated symmetrically, and there is no economic meaning attached to the model. Economic content has to be put on VAR to provide more meaningful results. The structure of identification restriction is imposed to make VAR more helpful in examining the relationship among economic variables. VAR with structure of residual terms or SVAR is described by:

$$A_0 Y_t = A_0 c + A_0 R(L) Y_t + \varepsilon_t, \tag{2.12}$$

where ε_t is a white noise vector with variance-covariance matrix given by the identity matrix. SVAR assumes that the disturbance terms u_t are related to white noise ε_t via matrix A_0 such that $A_0 u_t = \varepsilon_t$,

$$\begin{bmatrix} a_1 & 0 & 0 & 0 & 0 & a_2 \\ a_3 & a_4 & 0 & 0 & 0 & a_5 \\ a_6 & a_7 & a_8 & a_9 & 0 & 0 \\ 0 & a_{10} & a_{11} & a_{12} & a_{13} & a_{14} \\ a_{15} & a_{16} & a_{17} & a_{18} & a_{19} & a_{20} \\ 0 & 0 & 0 & 0 & 0 & a_{21} \end{bmatrix} \begin{bmatrix} u_t^y \\ u_t^{cpi} \\ u_t^m \\ u_t^i \\ u_t^{exr} \\ u_t^{oil} \end{bmatrix} = \begin{bmatrix} \varepsilon_t^y \\ \varepsilon_t^{cpi} \\ \varepsilon_t^m \\ \varepsilon_t^i \\ \varepsilon_t^{exr} \\ \varepsilon_t^{oil}. \end{bmatrix} \tag{2.13}$$

The above relations, as depicted in equation 2.13, are contemporaneous restrictions on the structural parameters of A_0 without further restrictions on the lagged structural parameters. The restriction identification follows what was suggested by Lee & Ni (2002), Gordon & Leeper (1994), and Kim & Roubini (2000). I assume that aggregate output is only contemporaneously influenced by oil price shocks, and the prices only react immediately to innovations in aggregate output and oil prices. The first two equations of the system 2.13 support the idea that the reaction of real sector to shocks in monetary sector is sluggish. The third equation of the system 2.13 is a money demand equation. Money demand is allowed to respond contemporaneously to output, prices, and interest rate. The fourth equation is the monetary policy reaction function. The monetary authority under flexible inflation targeting sets the interest rate after observing the current inflation, monetary aggregates, oil prices, and exchange rate. Oil price here is assumed to be contemporaneously exogenous. Restric-

tions are exactly identified.[14]

2.5.5 Empirical Results

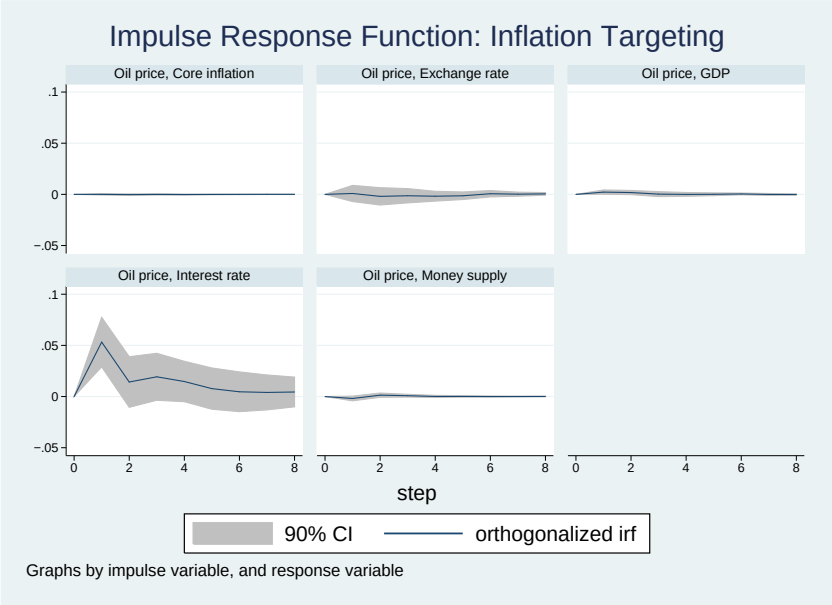
The analysis focuses on the response of macroeconomic variables, that is, aggregate output, money supply, short-term interest rate, and exchange rate, to the price of oil shock. Restriction identifications are imposed to represent monetary policy and the economic system in Thailand. According to results in Figure 2.12, an oil price increase produces only a slight impact on other macroeconomic variables. Output, money supply, exchange rate, and core inflation are unaffected. Short-term interest rate, on the other hand, is rising in the first two quarters before declining and reaches its original level in the sixth quarter.

Structural forecast-error variance decomposition (SFEVD) from oil price shock as shown in Figure 2.14, represents the extent to which oil price shock creates fluctuations in macroeconomic variables. It can be inferred that oil price shock does not play much role in explaining other variables' forecast error variance. However, given the obtained results (see Figure 2.14), aggregate output's, core inflation's, and interest rate's forecast error variance are mostly explained by oil price shock in the first quarter. Results obtained from SVAR are consistent with the counterfactual scenario in which Cholesky restriction is imposed (as shown in Figure 2.13) except that interest rate response under inflation targeting lasts longer than under the counterfactual scenario.

Results from SVAR indicate that oil price shock in Thailand is demand-driven. High oil prices have not so far had much of an impact on the Thai

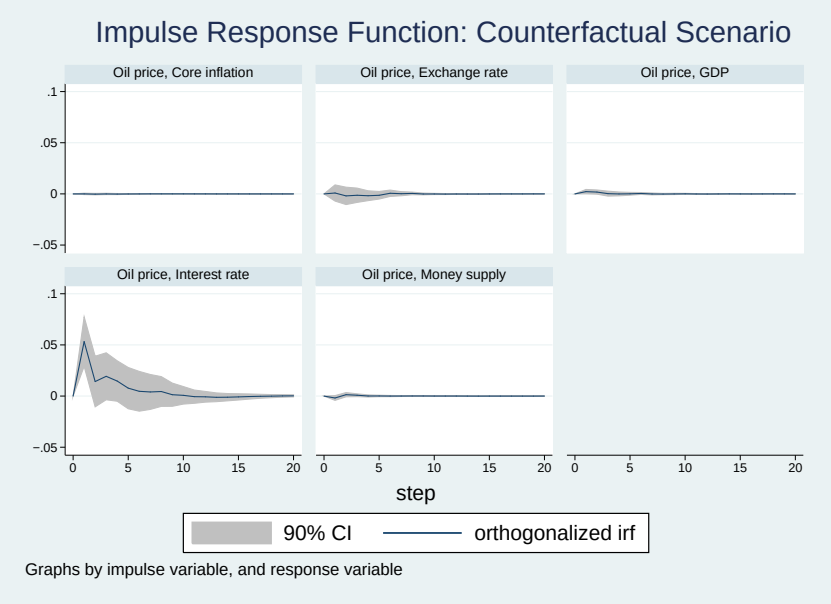
[14] $\frac{n(n-1)}{2}$ restrictions are necessary but not sufficient conditions to solve for variables in SVAR.

economy and inflation. The limited impact reflects the demand-driven nature of the run up in oil prices since 2002, as well as lower energy intensity, more-competitive labor markets, and the improved credibility of monetary policy frameworks. In the case of Thailand, short-term interest rate is adjusted to curb inflationary pressure from high oil prices and leave other macroeconomic variable unaffected. Impact of oil shock on interest rate persists for longer period than in the case of no inflation targeting.



Source: Author's Calculation

Figure 2.12: Impulse Response Function: Inflation Targeting



Source: Author's Calculation

Figure 2.13: Impulse Response Function: Counterfactual Scenario

step	(1) sfevd	(2) sfevd	(3) sfevd	(4) sfevd	(5) sfevd	(6) sfevd
0	0	0	0	0	0	0
1	7.9e-14	8.7e-13	1.2e-14	9.4e-14	1.3e-15	2.0e-12
2	2.5e-13	1.2e-12	1.6e-14	9.7e-13	5.1e-14	1.7e-12
3	2.1e-13	1.3e-12	3.5e-14	8.4e-13	3.8e-14	1.3e-12
4	1.9e-13	1.2e-12	3.7e-14	6.9e-13	4.1e-14	1.3e-12
5	1.6e-13	1.2e-12	3.7e-14	6.8e-13	6.0e-14	1.3e-12
6	1.5e-13	1.1e-12	3.7e-14	6.8e-13	6.2e-14	1.3e-12
7	1.5e-13	1.1e-12	3.7e-14	6.9e-13	6.2e-14	1.3e-12
8	1.5e-13	1.1e-12	3.7e-14	6.8e-13	6.2e-14	1.3e-12

(1) irfname = v9, impulse = dloil, and response = dlgdp_b
(2) irfname = v9, impulse = dloil, and response = dlcpi_core
(3) irfname = v9, impulse = dloil, and response = dlm2
(4) irfname = v9, impulse = dloil, and response = dli
(5) irfname = v9, impulse = dloil, and response = dlexr
(6) irfname = v9, impulse = dloil, and response = dloil

Source: Author's Calculation

Figure 2.14: Structural Forecast-Error Variance Decomposition from Oil Price Shock: Inflation Targeting

step	(1) fevd	(2) fevd	(3) fevd	(4) fevd	(5) fevd	(6) fevd
0	0	0	0	0	0	0
1	0	0	0	0	0	.580397
2	.043561	.000044	.028449	.173672	.000399	.497895
3	.04012	.002915	.03919	.150069	.002023	.426219
4	.039968	.002798	.042814	.150631	.002781	.394143
5	.037731	.004173	.042316	.129925	.003947	.387659
6	.036882	.004293	.041905	.121789	.004673	.383335
7	.036046	.004262	.041808	.114537	.004824	.381628
8	.036019	.00434	.041589	.111284	.00483	.381399
9	.03534	.004384	.041383	.110116	.004921	.37966

(1) irfname = cho1, impulse = dloil, and response = dlgdp_b
(2) irfname = cho1, impulse = dloil, and response = dlcpi_core
(3) irfname = cho1, impulse = dloil, and response = dlm2
(4) irfname = cho1, impulse = dloil, and response = dli
(5) irfname = cho1, impulse = dloil, and response = dlexr
(6) irfname = cho1, impulse = dloil, and response = dloil

Source: Author's Calculation

Figure 2.15: Forecast-Error Variance Decomposition from Oil Price Shock: Counterfactual Scenario

2.6 Conclusion and Policy Implication

Thailand's economy has undergone many economic reforms since the financial crisis. One of the policy reforms is the adoption of inflation targeting as monetary policy under the IMF supervision. Empirical evidence in the first section of this paper shows that the volatility of inflation and the degree of inflation persistence have dropped after adopting inflation targeting framework. Output growth has improved on average while inflation expectation have been lower than before inflation targeting was adopted. However there is no evidence that inflation targeting has contributed to such improvement since Thailand does not perform any better, and even worse in terms of output stability, than non-inflation-targeting countries.

As a small open economy, Thailand relies heavily on exchange rate and, thus, the exchange rate policy constitutes an important part of monetary policy even under inflation targeting. There are several reasons why exchange rate is important for inflation targeting in developing countries. First, exchange rate move-

ments provide an additional transmission channel of monetary policy. The exchange rate transmission channel operates both directly and indirectly. Changes in nominal exchange rate directly affect the domestic prices of imported final goods and core inflation and, also, indirectly affect those through domestic demand. Changes in real exchange rate affect domestic and foreign demand for domestic goods, thus enhancing standard aggregate demand channel. Second, the exchange is one channel through which foreign disturbances could be transmitted to the domestic economy especially for developing countries, which are more vulnerable to the large exchange rate movement.

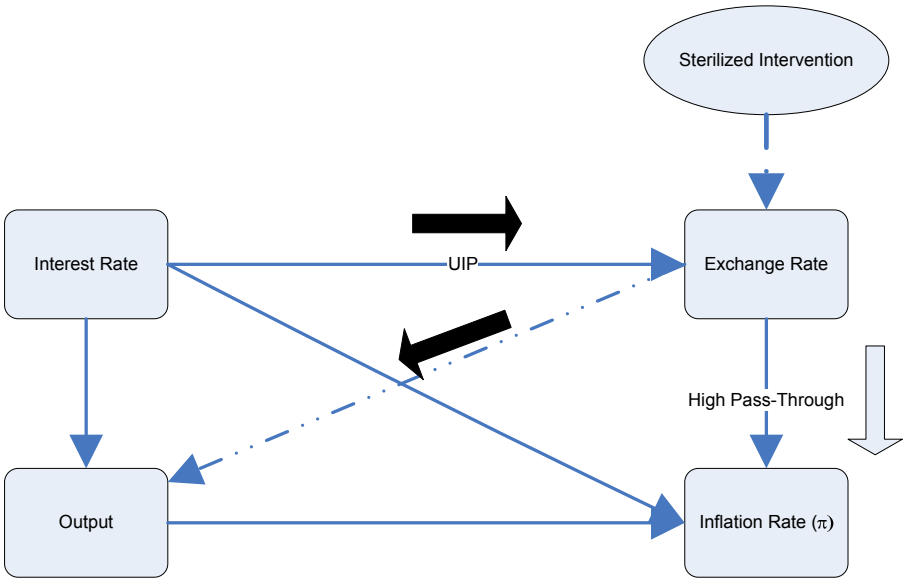


Figure 2.16: Monetary Policy Transmission Mechanism

On the indirect channel of policy transmission mechanism (please see Figure 2.16), econometric results reveal that there exists a significant relationship between exchange rate and interest rate after inflation targeting was adopted. The economic condition in Thailand does not meet criteria suggested by Taylor (2001). That means any increasing of interest rate to keep inflation rate in control would induce the exchange rate appreciation. Exchange rate appreciation

hurts exports due to declining of profits and deteriorating price competitiveness in the world markets and consequently affects output growth. The results obtained from different specifications of expected inflation robustly illustrate the significant relationship between short-term policy rate and exchange rate, and thus the exchange rate in turn results in output volatility since the signs of their coefficients are switched every period. The findings are consistent with *the Impossible Trinity Hypothesis*: that the Bank of Thailand has to forgo trade competitiveness and output stability to achieve inflation target.

Moreover, results show the validity of the direct channel between exchange rate and inflation, Thailand experiences higher pass-through than other countries[15] that show low exchange rate pass-through effects after adopting inflation targeting.

In the case of Thailand's economy, the Thai baht could not be used as a buffer against other economic shocks since the exchange rate itself would transmit shocks to inflation. High exchange rate pass-through would impose a difficult task to the Bank of Thailand to keep inflation rate in check while maintaining exchange rate at a competitive level. In addition, the indirect impact of exchange rate movement on aggregate output are too significant to be neglected. From empirical findings, exchange rate channel under the transmission mechanism plays a major role that contracts the inflation targeting framework and contradicts to traditional inflation targeting where exchange rate should have been decentralized and merely a messenger passing effect from interest rate to operating targets. Since exchange rate is a major concern, the role of exchange rate under a traditional inflation targeting framework, thus, does not fit Thailand's

[15]Please see Amitrano *et al.* (1997), Hakura & Choudhri (2001), Taylor (2001), Gagnon & Ihrig (2001) for details.

economy.

Likewise, forecasting exercises described by SVAR indicates that inflation rate is lower than the counterfactual case after inflation targeting. However, that disinflation is accompanied by decline and volatility in output, suggesting that the adoption of inflation is not free from expenses. Regarding the oil price surge, results obtained from SVAR estimation suggest that oil price rise is demand-driven. An active interest policy, not only inflation targeting, is able to help relieve the oil price shock and leave other variables unaffected while having a shorter duration than inflation targeting does.

The most critical aspect of the implementation of inflation targeting in Thailand is the role exchange rate, which affects both directly and indirectly through monetary mechanism. Moreover, the success of disinflation is challenged by unstable output growth. The Bank of Thailand should carefully weigh the costs and benefits of adopting inflation targeting, reconsidering the compatibility of inflation targeting with the Thai economy.

CHAPTER 3

FINANCIAL INSTITUTIONS, HOUSING MARKET, AND U.S. HOUSING BUBBLE SPILLOVER

3.1 Introduction

The subprime mortgage crisis in 2007 and 2008 is thought to have been the most severe financial crisis ever in U.S. history. The boom and bust in the housing markets threatened to have large economic repercussions. The role of the housing sector in the economic system has changed thanks to the innovation of financial instruments. These changes have broadened the spillovers and amplified their impact since U.S. mortgage markets are highly developed and closely linked to financial institutions.

To understand the mechanism by which the housing bust caused the economic crisis, it is useful to examine the evolution of financial institutions, the investment behavior of each economic agent, and the relationship between the financial and non-financial sectors over time. In the first part chapter 3, I allow the useful data, which the so called flow of funds to tell the story of the U.S. fund allocation and the shifting pattern of investment through uses and sources of funds from the 1950s to present.

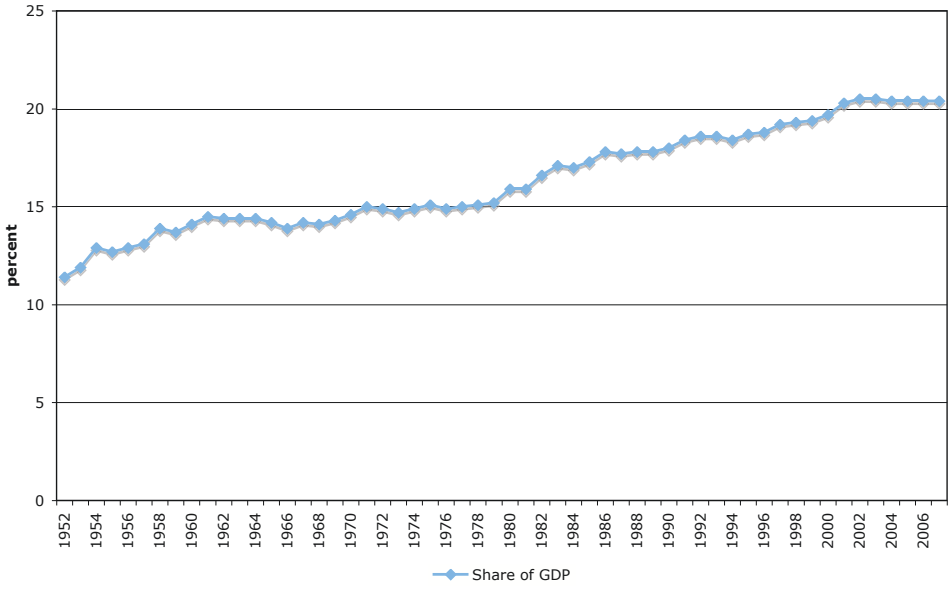
The second part of the paper shed some light on the key factors that form housing bubbles, and lead to the situation in which the bubble burst and which ended with the widespread damage to other financial institutions and the economy. The third part explores the dynamic of U.S. house price, its fluctuation due to changes of macroeconomic variables, the disequilibrium of house price

in the short-run and its convergence to the long-run equilibrium through the application of ECM estimation on panel data of 18 major cities in the U.S.

Last but not least, the fourth part explains how the housing sector bubble has created a ripple effect on the entire economy. The impact is explained through these three important channels: (1) *Wealth channel* arises when a homeowner 's wealth increases due to the home price bubble which in turns affects the homeowner's consumption. (2) *Credit channel* is leniently increasing when financial institutions, especially the non-banks, become more optimistic about housing markets. The unsustainablility of housing is later explained by the freezing of the third type of channel (3) *Balance sheet effect* occurs when financial institutions' asset prices drop and capital values worsen, causing "liquidity crunch." This difficult environment within the financial system cannot be relieved unless the housing situation is resolved. The empirical result in the fourth section indicates that the credit crunch within financial institution is relieved as more houses are sold. That said, the recovery of credit within the financial institution depends a lot on the extent to which excess houses inventories can be liquidated. The new round of demand for houses should increase when prices deflate enough. This will help to stabilize the uncertain value of home equity that is crucial as a buffer for all mortgages and as collateral for those mortgage-backed securities and, consequently, make the financial institution able to resume operations as its liquidity improves.

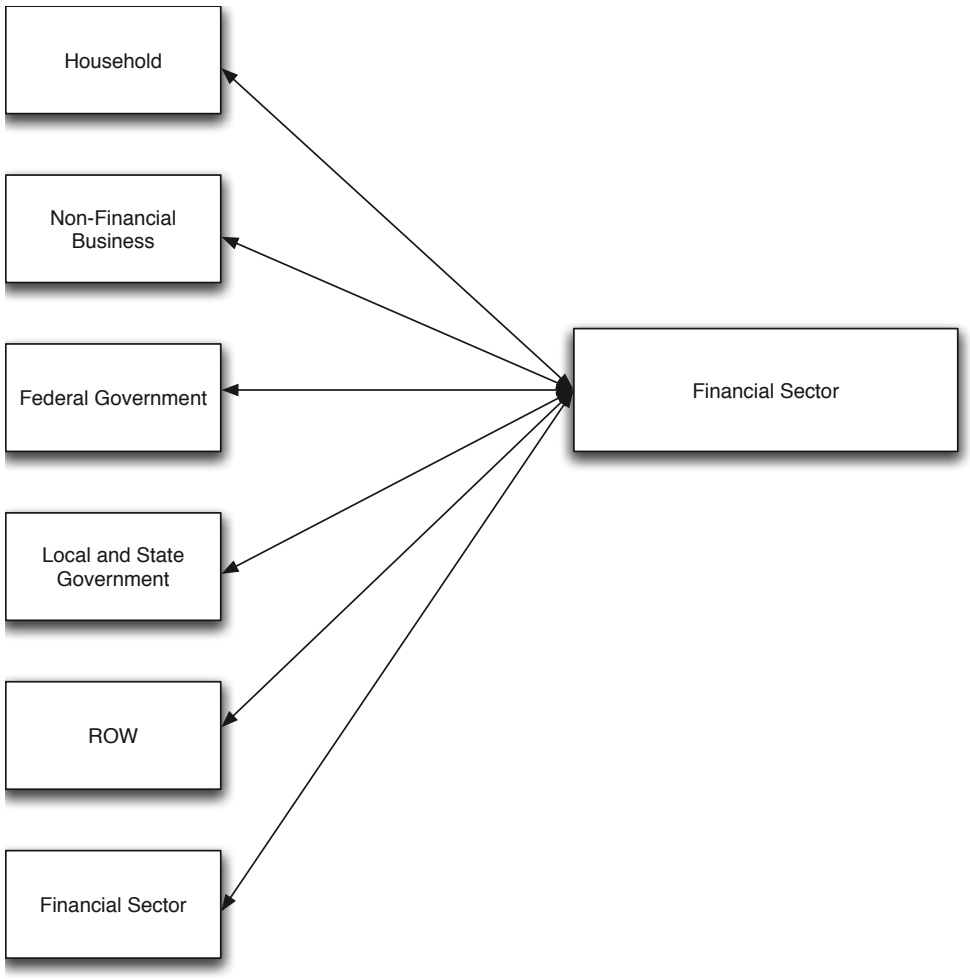
3.2 The U.S. Flow of Funds and Financial Institutions

The financial sector is known to be the intermediator among economic sectors. Its major role is to channel funds to household, government, and corporation. The financial sector's share of aggregate income reveals the value that the rest of the economy attaches to its services. Historical data shows that the financial sector in the U.S. has grown significantly. In 1952, the financial sector contributed to GDP value added by 11 percent of the U.S. GDP. As shown in Figure 3.1, in 2007, the fraction had risen to 20.4 percent. This shows an upward trend in the size of the financial sector and also the fact that the financial sector has become an important element of the U.S. economy. Not only the fast pace of growth in the financial sector itself, but the extent to which other economic sectors engage themselves in financial activities is also growing and expanding. To get a clearer picture of the interrelationship among financial sectors and other economic sectors, I utilize the information provided by U.S. flow of funds.



Source: BEA

Figure 3.1: Financial Sector as Value Added to GDP, 1952–2007



Source: U.S. Flow of Funds, Federal Reserve System

Figure 3.2: Flow of Funds

Basically, the emphasis of flow of funds has been on providing statements of total sources of funds flowing to economic sectors and the sectors' uses of funds. The structure of the flow of funds accounts reflects innovations in financial instruments and the emergence of a new institution. The simple chart below describes how the loanable funds are channeled. From the chart, flows among economic sectors were transferred by financial sector both ways, sources and uses.

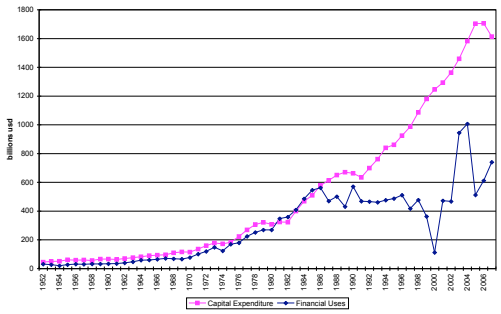
The flow of funds measures the acquisition of physical and financial assets

throughout the U.S. economy and the sources of funds used to acquire the assets. Figure 3.3 represents uses of funds of different sectors in the economy from year 1952–2007. Economic sectors spend their funds two ways. The first one is on capital expenditures, the second is on financial instruments. From Figure 3.3, uses of funds from all sectors were relatively low and stable during the early 1950s to the early 1970s. Capital expenditure was marginally bigger than financial uses in most cases except for the financial sector and the rest of the world, the biggest contributors to financial uses. Right after the 1970s, the pattern of uses of funds became more expansive. Capital expenditure had risen steadily and the growth of capital expenditure spent by all sectors was relatively stable. Uses of funds on financial instruments, on the other hand, were more unstable increasing after the 1980s due to the fact that financial markets were more open at that time. All economic sectors have participated more in financial investment. The pattern of increase in financial uses of funds stems from the fact that the financial sector has been growing both domestically and globally. Volatility of financial uses might be caused by the fact that financial investment is intangible and relatively easier to be liquidated and resold. So it is not surprising to see growth in financial uses reach its peak in one year and sink to the bottom in another year. In 2001, the U.S. economy was experiencing a recession in a decade when the September 11 terrorist attack occurred leading to sluggish and volatile capital investment in all sectors. The federal government's fiscal fund deficit has been widening due to tax cut. Right after the recession in 2001, the flow of fund data reflects a number of changes. The effect of tax cuts on the federal deficit can still be observed. Another major change is the sharp rise in mortgage financing which is a result of the interest rate cut. These domestic financial uses of funds are financed by the rest of the world. The foreign funds

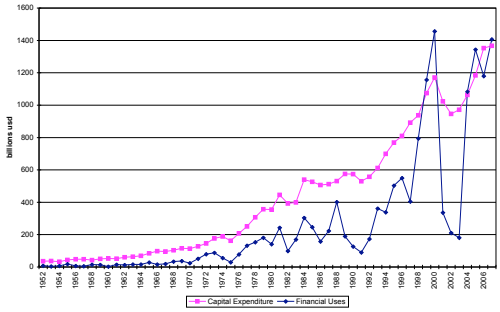
continually flow in as current account deficit grows causing a deteriorating of The United States' net foreign investment position.

Along with increasing of financial investment, Debt transactions of domestic non-financial sectors have increased since 1980. Figure 3.4 depicts flow of net borrowing by domestic non-financial sectors, net lending by financial sectors, and prime lending rate. The amount of borrowing was relatively stable during the period before 1980. However, right after that, net borrowing expanded instantaneously. The explosion was especially striking for non-financial corporations, for which the replacement of equity by debt led to a restructuring of the capital base. Household and governments also borrowed heavily, with individuals increasing their mortgage and consumer-credit indebtedness and governments issuing more debt securities.

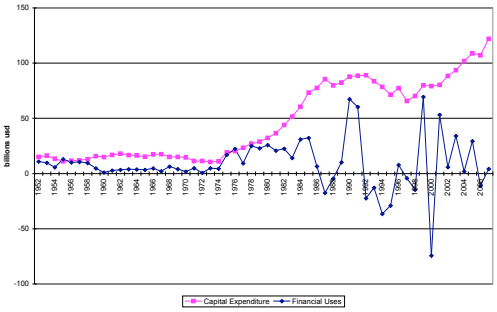
In 1990, one could observe the slowing of debt growth that accompanied economic recession. The borrowers during that period tried to reduce debt burdens by borrowing less, refinancing existing debt with the lower costs or longer maturities. However, debts started to rise again in 1992 due to a relatively low lending rate. Financial institutions are the major lender to the entire economy, while domestic non-financial sectors are the main borrower. Adding to that, financial institutions also started to lend to each other. Financial sectors' borrowing had never been significant until the early 1990s, which can be inferred from ,Figure 3.4, which depicts the large gap between net lending from financial sectors and net borrowing from domestic non-financial sectors. The gap was widest in the year 2000 and closed before getting wider again in year 2005–2006. That means part of the funds was lent and circulated among financial sectors and not released to the real sectors. Large borrowing by financial sectors were



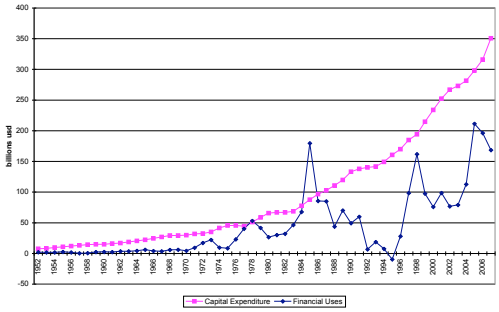
(a) Household Sector



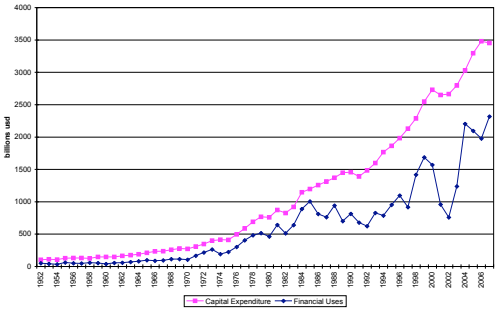
(b) Non-Financial Business



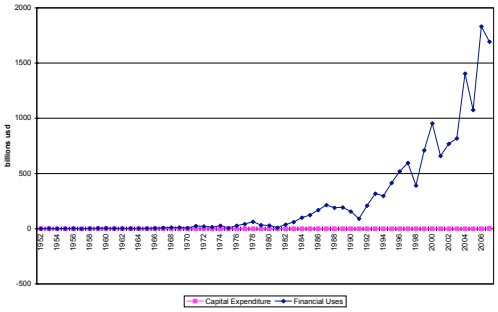
(c) Federal Government



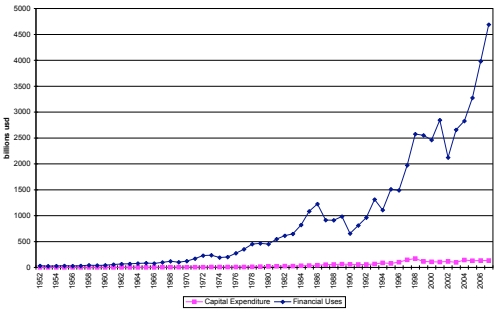
(d) Local and State Government



(e) Domestic Non-Financial Business



(f) Rest Of the World

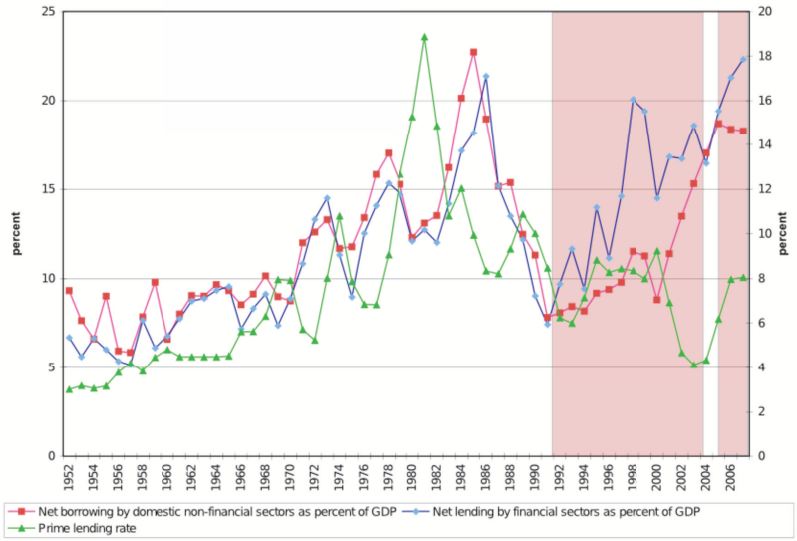


(g) Financial Sector

Source: U.S. Flow of Funds, Federal Reserve System

Figure 3.3: Uses of Funds (billion USD), 1952–2007

observed in two periods as highlighted in Figure 3.4. The first is the beginning of 1990s until 2004, the second is during 2005–2007. The first period fell into the stock bubble of the 1990s resulting from an information technology boom, the rapid expansion of the dot-com industry, and the growing of long term capital management (LTCM). The latter period corresponded to the housing boom. Both economic bubbles involved heavy borrowing from financial sectors.



Source: Flow of Funds, Federal Reserve System

Figure 3.4: Lending and Borrowing Among Economic Sectors, 1952–2007

There has been a significant evolution of financial intermediation over the past fifty years. The interactions of changes in regulation, tax law, introduction of international financial services, and the development of new types of financial instruments have changed the pattern of savings flow and major fund suppliers. Table 3.1 exhibits the total credit assets held by financial sectors. Depository institutions, that is, commercial banks were the major suppliers of funds in the United States during the 1950s–1970s, holding almost 50 percent of the total credit market. The introduction of other types of financial institutions and financial instruments, for instance, pension funds, investment funds, and debt secu-

ritization, increased the degree of competition within the industry and shrank the percent of credit held by depository institutions. In the 1990s and 2000s, the share of credit assets held by commercial banks decreased to about 25 percent. Debt securitization has become the alternative sources of credit. Home mortgage loans were increasingly financed by the issuance of securities backed by pools of loans and that increased the share of credit held by agency- and GSE-backed mortgage pools and also induced the expansion of mortgage markets. From the information here, we could infer that source of credit becomes more diversified across different financial institutions instead of centering at depository institutions as it did in the 1950s.

The change in pattern is noticeable in the dimension of credit borrowers as well. Finance companies as a major borrower in the 1950s were defeated by government-sponsored enterprise, agency- and GSE-backed mortgage pools, and ABS issuers in the 1980s–2000s. The most popular instruments have fallen into the category of agency- and GSE-backed mortgage pool and corporate bonds. Bank loans only accounted for 1 percent of total instruments in the 2000s compared with 30 percent in the 1950s. This reflects the growth of new financial services and instruments and also the changing of lending/borrowing practice in the United States. Instead of obtaining a loan from commercial banks as in the past, loans were given out by special agencies. Later, those special agencies pooled the bundle of debts and created some kind of securities backed by stream of debt income and sold it out to the market. This explains the popularity of ABS and GSE- mortgage pool securities in the 2000s.

Resulting from this innovation, non-financial sectors from which major share of loans comes from to mortgages could obtain loans through the new channel

of financial servicing or the so called parallel banking system. Krugman (2008) used this term to name the set of institutions and arrangements that are non-bank financial institutions. Securitization of home mortgages offered by those financial institutions provided the liquidity to mortgage lending, while low-level interest rates made houses attractive since house prices kept rising, as can be seen in Figure 3.5, which shows the ratio of average U.S. home prices to average rents. Due to the expectation of a rise in house prices, borrowers can get away with the traditional principle of lending practices Krugman (2008).The lenders require little or no down payment. Much of those lendings go under the "subprime" category (as shown in Figure 3.6 and Table 3.2). And risks associate with those lenient lending are transferred from financial institutions to investors through the securities the earning of which are backed by subprime loan payment. Table 3.4 describes the rising trend of mortgage borrowing by the non-financial sector. In the 2000s, mortgage loans are 40 percent, or twice as much, as compared with the Figure in 1950s.

Mortgage borrowing and lending do not limit themselves to the parallel banking system, thanks to the *1999 repeal of the Glass-Steagall Act*, which paves the way for commercial banks and depository institutions to participate in these cobweb financial transactions. They both lend and issue mortgage-backed securities. Their assets are held in terms of those mortgage-backed securities as well. Putting it all together explains the booming housing market and the increasing of mortgage lending in most of financial institutions in the 2000s, as shown in Figure 3.7. Financial institutions, unlike in the past, become a dominant player in the economic system. Their functions and activities are complicated and inevitably involve the rest of the society. They provide a great contribution to the economy, aswell as cause damage when thing goes wrong.

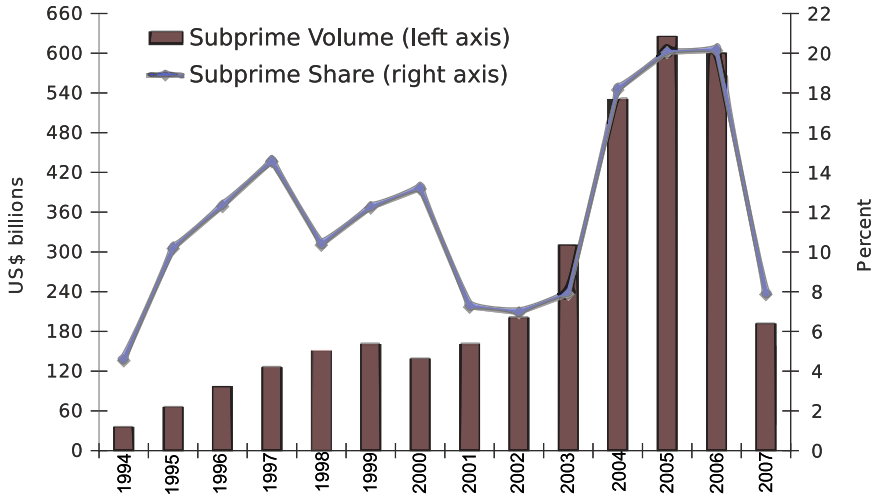
Table 3.1: Total Credit Assets Held by Financial Sectors (billion USD)

	1950–1959	1950–1959 (%)	1960–1969	1960–1969 (%)	1970–1979	1970–1979 (%)	1980–1989	1980–1989 (%)	1990–1999	1990–1999 (%)	2000–2007	2000–2007 (%)
Financial sectors	**378.62**	**100**	**794**	**100**	**2030.54**	**100**	**6170.19**	**100**	**13534.46**	**100**	**27565.61**	**100**
Monetary authority	24.46	6.46	40.02	5.04	91.34	4.50	182.81	2.96	365.51	2.70	667.64	2.42
Commercial banking	156.87	41.43	298.47	37.59	769.84	37.91	1922.42	31.16	3516.36	25.98	6558.14	23.79
U.S.-chartered commercial banks	154.92	40.92	294.23	37.06	731.39	36.02	1762.33	28.56	3065.62	22.65	5827.13	21.14
Foreign banking offices in U.S.	1.47	0.39	3.24	0.41	30.68	1.51	138.34	2.24	398.53	2.94	615.65	2.23
Bank holding companies	0	0.00	0.39	0.05	5.02	0.25	10.31	0.17	20.53	0.15	34.04	0.12
Banks in U.S.-affiliated areas	0.51	0.13	0.63	0.08	2.75	0.14	11.45	0.19	31.71	0.23	81.34	0.30
Savings institutions	61.63	16.28	163.31	20.57	426.78	21.02	1045.04	16.94	973.51	7.19	1352.44	4.91
Credit unions	1.98	0.52	8.18	1.03	32.41	1.60	96.81	1.57	254.13	1.88	526.56	1.91
Property-casualty insurance companies	10.84	2.86	20.67	2.60	60.95	3.00	194.11	3.15	449.36	3.32	666.15	2.42
Life insurance companies	78.4	20.71	135.23	17.03	242.2	11.93	651.17	10.55	1527.04	11.28	2492.04	9.04
Private pension funds	10.93	2.89	27.8	3.50	67.12	3.31	292.86	4.75	585.72	4.33	671.59	2.44
State and local govt. retirement funds	10.07	2.66	30.87	3.89	80.02	3.94	254.92	4.13	521.07	3.85	708.38	2.57
Federal govt. retirement funds	0	0.00	0	0.00	0	0.00	0.87	0.01	20.63	0.15	65.71	0.24
Money market mutual funds	0	0.00	0	0.00	3.63	0.18	169.64	2.75	609.93	4.51	1517.53	5.51
Mutual funds	0.9	0.24	3.55	0.45	8.69	0.43	146.41	2.37	740.92	5.47	1589.10	5.76
Closed-end funds	0.71	0.19	1.96	0.25	2.84	0.14	10.14	0.16	83.18	0.61	144.41	0.52
Exchange-traded funds	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	10.70	0.04
Government-sponsored enterprises	5.38	1.42	19.47	2.45	85.95	4.23	279.18	4.52	775.66	5.73	2419.73	8.78
Agency- and GSE-backed mortgage pools	0.11	0.03	1.19	0.15	35.94	1.77	413.9	6.71	1569.88	11.60	3378.45	12.26
ABS issuers	0	0.00	0	0.00	0	0.00	59.09	0.96	632.92	4.68	2672.19	9.69
Finance companies	14.91	3.94	39.66	4.99	105.86	5.21	328.87	5.33	577.15	4.26	1302.03	4.72
REITs	0	0.00	0.28	0.04	7.37	0.36	11.19	0.18	31.99	0.24	150.30	0.55
Brokers and dealers	1.35	0.36	2.72	0.34	8.01	0.39	43.48	0.70	146.18	1.08	445.84	1.62
Funding corporations	0.09	0.02	0.6	0.08	1.58	0.08	67.32	1.09	153.41	1.13	226.65	0.82

Source: Flow of Funds, Federal Reserve System

Source: Case-Shiller Home Price Index, BEA

Figure 3.5: Ratio of Mortgages Price to Rent, 1987–2007



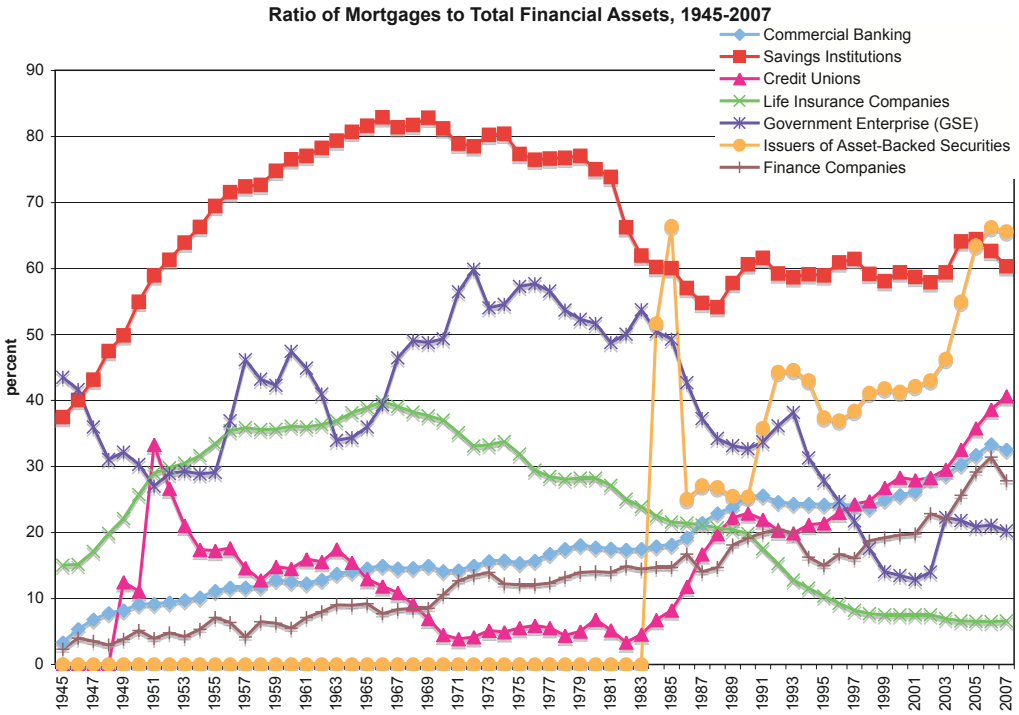
Source: Jaffee (2008)

Figure 3.6: Subprime Mortgage Originations, Annual Volume, and Percentage of Total

Table 3.2: Home Sales, Total and Attributable to Subprime Loans

Year	Existing home sales (thousands)	New home sales (thousands)	Total home sales (thousands)	Subprime originations (percent)	Subprime home sales (thousands)
2000	4,603	877	5,480	13.2	722
2001	4,734	908	5,642	7.2	408
2002	4,975	973	5,948	6.9	412
2003	5,443	1,086	6,529	7.9	513
2004	5,959	1,203	7,162	18.2	1,300
2005	6,180	1,283	7,463	20	1,495
2006	5,677	1,051	6,728	20.1	1,355
2000-2006	37,571	7,381	44,952		6,204

Source:Jaffee (2008)



Source: U.S. Flow of Funds, Federal Reserve System

Figure 3.7: Ratio of Mortgages to Total Financial Assets, 1952–2007

Table 3.3: Credit Market Debt Owed by Financial Sectors (billion USD)

	1950–1959	1950–1959 (%)	1960–1969	1960–1969 (%)	1970–1979	1970–1979 (%)	1980–1989	1980–1989 (%)	1990–1999	1990–1999 (%)	2000–2007	2000-2007 (%)
By instrument	**15.69**	**100**	**61.03**	**100**	**269.71**	**100**	**1326.52**	**100**	**4348.06**	**100**	**11690.33**	**100**
Open market paper	2.55	16.25	13.92	22.81	59.74	22.15	252.62	19.04	583.28	13.41	1124.10	9.62
GSE issues	3.34	21.29	15.31	25.09	75.36	27.94	255.51	19.26	803.59	18.48	2464.40	21.08
Agency- and GSE-backed mortgage pool s.e.c.	0.11	0.70	1.19	1.95	35.94	13.33	413.9	31.20	1569.88	36.11	3378.45	28.90
Corporate bonds	3.61	23.01	15.41	25.25	53.79	19.94	255.76	19.28	1114.66	25.64	3851.74	32.95
Bank loans n.e.c.	4.81	30.66	10	16.39	23.58	8.74	43.98	3.32	73.19	1.68	176.03	1.51
Other loans and advances	1.26	8.03	5.12	8.39	19.81	7.34	102.13	7.70	173.86	4.00	572.34	4.90
Mortgages	0	0.00	0.06	0.10	1.48	0.55	2.59	0.20	29.5	0.68	119.25	1.02
By sector	**15.69**	**100**	**61.03**	**100**	**269.71**	**100**	**1326.52**	**100**	**4348.06**	**100**	**11690.33**	**100.00**
Commercial banks	0.82	5.23	4.56	7.47	22.17	8.22	75.82	5.72	118.98	2.74	388.36	3.32
Bank holding companies	0	0.00	0.43	0.70	17.08	6.33	95.15	7.17	147.81	3.40	382.30	3.27
Savings institutions	1.31	8.35	5.36	8.78	21.42	7.94	112.49	8.48	142.45	3.28	327.60	2.80
Credit unions	0	0.00	0	0.00	0	0.00	0	0.00	0.66	0.02	12.70	0.11
Life insurance companies	0	0.00	0	0.00	0	0.00	0	0.00	1.04	0.02	10.53	0.09
Government-sponsored enterprises	3.43	21.86	15.43	25.28	75.99	28.17	260.42	19.63	805.51	18.53	2464.40	21.08
Agency- and GSE- backed mortgage loans	0.11	0.70	1.19	1.95	35.94	13.33	413.9	31.20	1569.88	36.11	3378.45	28.90
ABS issuers	0	0.00	0	0.00	0	0.00	61.94	4.67	685.62	15.77	2773.39	23.72
Brokers and dealers	0	0.00	0	0.00	0	0.00	3.07	0.23	28.37	0.65	53.63	0.46
Finance companies	10.03	63.93	33.82	55.42	89.9	33.33	239.18	18.03	510.03	11.73	1020.83	8.73
REITs	0	0.00	0.23	0.38	7.19	2.67	11.49	0.87	67.58	1.55	292.16	2.50
Funding corporations	0	0.00	0	0	0	0	53.03	4.00	270.05	6.21	581.94	4.98

Source:U.S. Flow of Funds, Federal Reserve System

Table 3.4: Credit Market Debt Owed by Nonfinancial Sectors(billion USD)

	1950–1959	1950–1959 (%)	1960–1969	1960–1969 (%)	1970–1979	1970–1979 (%)	1980–1989	1980–1989 (%)	1990–1999	1990–1999 (%)	2000–2007	2000–2007 (%)
Domestic	**534.86**	**96.89**	**994.11**	**96.53**	**2,305.99**	**95.91**	**6,796.94**	**96.61**	**13,616.71**	**96.16**	**24,099.81**	**94.67**
By instrument	**534.86**	**96.89**	**994.11**	**96.53**	**2,305.99**	**95.91**	**6,796.94**	**96.61**	**13,616.71**	**96.16**	**24,099.81**	**94.67**
Commercial paper	0.39	0.07	2.02	0.20	11.46	0.48	60.53	0.86	148.52	1.05	135.33	0.53
Treasury securities	224.39	40.65	256.7	24.93	438.79	18.25	1,469.09	20.88	3,357.9	23.71	4,167.26	16.37
Agency- and GSE-backed securities	1.45	0.26	5.87	0.57	8.56	0.36	7.91	0.11	26.12	0.18	25.13	0.10
Municipal securities	42.44	7.69	98.57	9.57	231.33	9.62	757.85	10.77	1314.17	9.28	2,003.29	7.87
Corporate bonds	53.95	9.77	103.11	10.01	247.21	10.28	603.5	8.58	1,422.93	10.05	2,918.56	11.47
Bank loans n.e.c.	32.76	5.93	79.19	7.69	217.18	9.03	560.42	7.97	876.31	6.19	1,273.76	5.00
Other loans and advances	14.51	2.63	38.46	3.73	123.24	5.13	433.05	6.16	715.17	5.05	1,169.98	4.60
Mortgages	**125.56**	**22.75**	**320.13**	**31.08**	**807.98**	**33.60**	**2,341.37**	**33.28**	**4,640.3**	**32.77**	**10,251.41**	**40.27**
Home	83.74	15.17	209.04	20.30	503.32	20.93	1,529.77	21.74	3,481.96	24.59	7,969.10	31.31
Multifamily residential	13.37	2.42	36.12	3.51	98.25	4.09	203.76	2.90	286.91	2.03	576.66	2.27
Commercial	19.62	3.55	54.66	5.31	155.2	6.45	514.26	7.31	797.82	5.63	1,609.33	6.32
Farm	8.83	1.60	20.31	1.97	51.18	2.13	93.57	1.33	73.62	0.52	96.30	0.38
Consumer credit	39.58	7.17	91.72	8.91	221.34	9.21	563.42	8.01	1,115.34	7.88	2,155.14	8.47
By sector	**534.86**	**96.89**	**994.11**	**96.53**	**2,305.99**	**95.91**	**6,796.94**	**96.61**	**13,616.71**	**96.16**	**24,099.81**	**94.67**
Household sector	130.25	23.60	322.95	31.36	769.85	32.02	2,210.56	31.42	4,801.97	33.91	10,221.88	40.15
Nonfinancial business	135.64	24.57	307.24	29.83	865.58	36.00	2,488.27	35.37	4,341.13	30.66	8,029.10	31.54
Corporate	101.2	18.33	212.29	20.61	570.55	23.73	1,585.24	22.53	3,044.3	21.50	5,342.40	20.99
Nonfarm noncorporate	20.87	3.78	63.59	6.17	210.76	8.77	744.68	10.58	1,162.85	8.21	2,508.10	9.85
Farm	13.55	2.45	31.37	3.05	84.28	3.51	158.34	2.25	133.95	0.95	178.64	0.70
State and local governments	43.14	7.82	101.36	9.84	223.19	9.28	621.1	8.83	1,089.62	7.70	1,656.45	6.51
Federal government	225.83	40.91	262.56	25.49	447.38	18.61	1,477.02	20.99	3,384	23.90	4,192.40	16.47
Credit market held in U.S.	17.17	3.11	35.76	3.47	98.38	4.09	238.35	3.39	543.21	3.84	1,356.46	5.33
Commercial paper	0	0.00	0	0.00	1.14	0.05	30.75	0.44	69.82	0.49	308.80	1.21
Bonds	3.67	0.66	9.16	0.89	26.61	1.11	74.29	1.06	372.31	2.63	931.45	3.66
Bank loans n.e.c.	1.51	0.27	5.54	0.54	23.87	0.99	35.56	0.51	36.3	0.26	77.98	0.31
Other loans and advances	12	2.17	21.06	2.04	46.76	1.94	97.73	1.39	64.81	0.46	38.26	0.15
Domestic and foreign	**552.01**	**100**	**1,029.88**	**100**	**2,404.36**	**100**	**7,035.32**	**100**	**14,159.93**	**100**	**25,456.26**	**100**

Source: U.S. Flow of Funds, Federal Reserve System

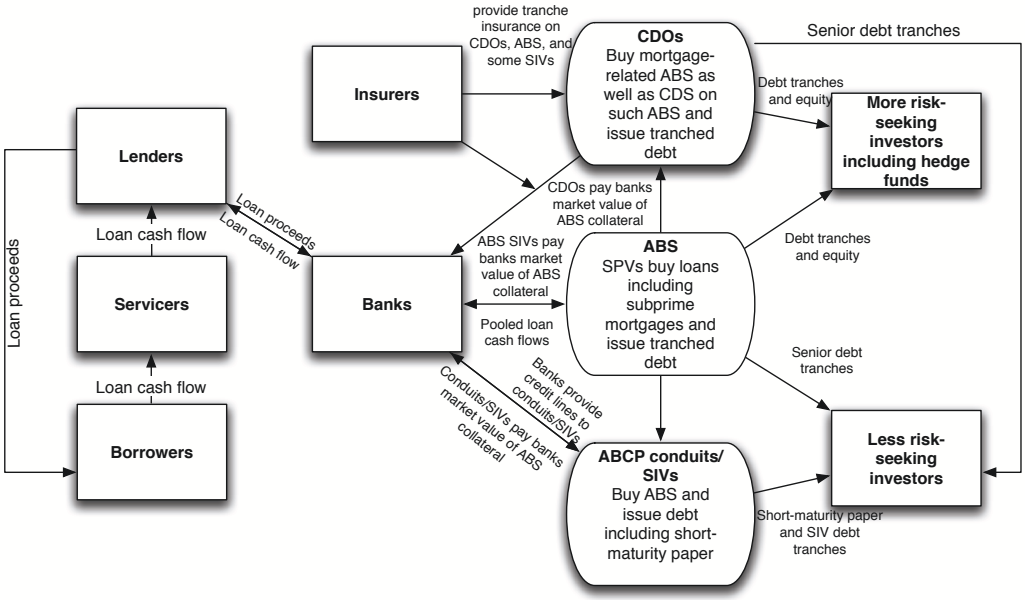
3.3 Mortgages Markets and Subprime Crisis

Trends in the banking industry contributed significantly to the lending boom. This section explains in details the mechanism in the banking industry that laid the foundation for the crisis. Unlike in the past when banks held loans on their own balance sheet, banks moved to an "originate and distribute" system that is, banks created financial innovations that passed loans to various investors, thereby off-loading risk. To do that , banks created "collateralized debt obligations (CDOs)" by forming portfolios of mortgages and other types of loans, corporate bonds, and other assets including credit card receivables. Next, they sliced portfolios into tranches. Each tranche carried different payment priority. For example, the super-senior tranche offered to pay investors first, at a relatively low interest rate. While the most junior tranche would be paid only after tranches were paid. Investor groups thereby could invest in a particular tranche that matches their risk appetite while the bottom tranches was mostly kept at the banks to ensure that they adequately monitor loans. With assistance by rating agencies, the top tranches received a AAA rating, which would later be found to be attractive to pension funds or certain money market funds that were allowed to invest only in AAA- rated fixed–income securities. Investors could protect themselves against loss from tranches by purchasing "credit default swaps (CDSes)", contracts insuring against default on particular bonds or tranches. This is how the insurer, AIG, for instance, got involved with the situation.

Banks do not limit themselves to repacking loans, they seek the profit opportunity to earn more profits by setting up a special entity that separates them from their major banking transactions. These entities are "special investment

vehicles (SIVs)." SIVs may be thought of as "virtual bank" which instead of gathering deposit from public, borrows money by selling short maturity (often less than a year) commercial papers (CPs) in money market. They then use the gathered fund to purchase long-term (longer than a year) bonds with higher interest and they earn profits by spread between CPs they issue and long term bonds they invest in. The ambiguity of SIVs doings and the way that they are set up introduces a large amount of risk into financial system. First of all, most of the SIVs' primarily source of profits are from maturity mismatch investment leading to maturity and funding liquidity exposures, since investors might suddenly stop buying their CPs and prevent these vehicles from rolling over their short-term debt. Second of all, as mentioned earlier, these vehicles act as if they are banks, except that they provide funds for mortgages, credit cards, and student loans through securitized bonds. Unlike traditional banks which have expertise in screening borrower applicants and have personal oversight with borrowers, SIVs lending is conducted through a process known as securitization. Instead of assessing individual credit risk, each loan (for example, mortgage or credit card) are bundled with thousands (or tens of thousands or more) of the same loans. So there are no ways for SIVs' manager to keep track of the borrowers and instead rely entirely on the risk assessment provided by the rating agencies. This exposes SIVs to *default risk* since in most cases, mortgage loans put in a bundle turn out to be liar's loans with some borrower essentially being NINJA (No Income No Job No Assets). And last but not least, to ensure enough liquidiy for SIVs, the sponsoring banks grants a credit line to the vehicles which is a"liquidity backstop," to support their off-balance sheet vehicles. Turns out bankings system could not get rid of *liquidity risk* from asset and liability mismatching, even though they do not appear on the bank's balance

sheet. Figure 3.8 sums up the interlinkage among mortgage, financial innovations, banks and financial institutions, insurance companies, and investors. The flows seem to work fine as long as liquidity is ample enough to be channelled to all counter-parties. Prior to the crisis that began in 2007, since banks are so vulnerable in funding liquidity, sooner or later liquidity would dry up and this would unfold into crisis.



Source: IMF (2007)

Note: ABS = asset-backed security; ABCP = asset-backed commercial paper; CDO = collateralized debt obligation; CDS = credit default swap; SIV = structured investment vehicle; SPV = special purpose vehicle.

Figure 3.8: Mortgage Market Flows

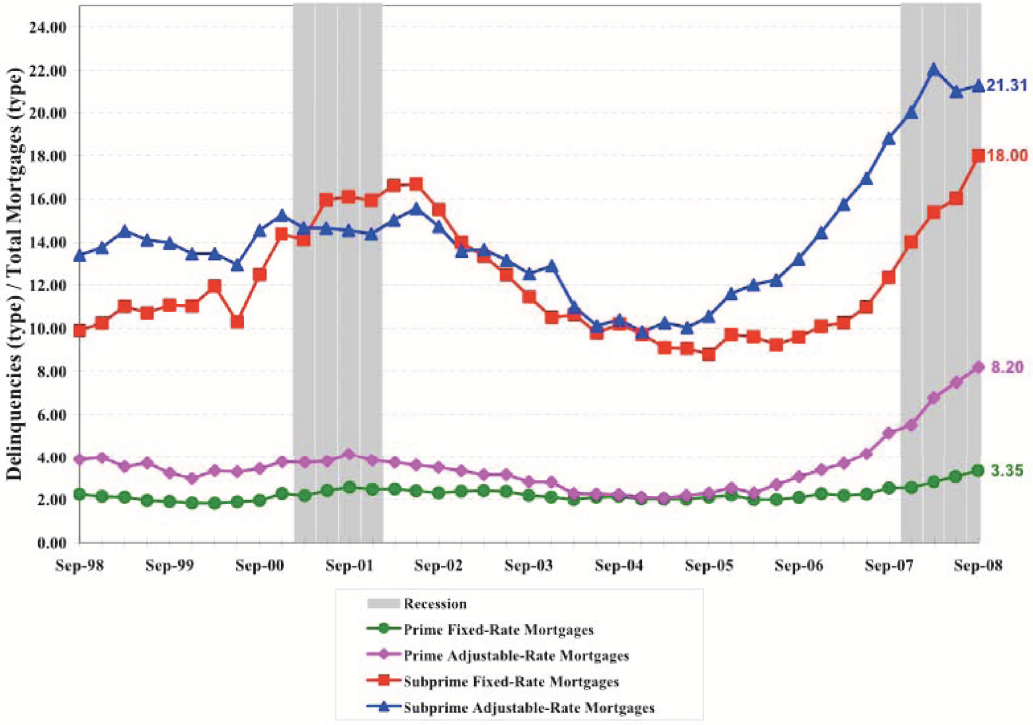
The trigger for the crisis was an increase in subprime mortgage default. Typically more borrowers stop paying their mortgage payments, foreclosures and the supply of homes for sale increase. As shown in Figure 3.9, the delinquency rate of subprime mortgages rose dramatically from year 2004 and stood at 21.31 and 18 percent for adjustable and fixed rates respectively. This placed downward pressure on house prices, which further lowered homeowners' equity. The

decline in mortgage payments also reduced the value of mortgage-backed securities, which eroded the net worth and financial health of banks. This vicious cycle is at the heart of the crisis. Table 3.5 represents the selected financial institutions that were negatively affected and suffered from huge capital loss. The first and the second column show the total assets prior to recapitalization and the off-balance sheet commitments to lend that were in commitment. The next four columns in the table present information about the exposure of the banks to the real estate market and other activities. These measures are all ratios, in which the denominators are the sum of total assets plus total commitments. The last column is the ratio of total bank equity to total assets. From Table 3.5 we can infer that U.S. major financial institutions put a high proportion of their assets in off-balance sheet activities and most of them were in real estate sectors. Thus, when housing loans and the related investment instruments started to defaults, the financial institutions had to write down their holdings in subprime-related securities and consequently Lehman Brothers and other financial institutions failed in September 2008. In effect, the money market was subject to the bank run since the liquidity dried up. The TED spread (see Figure 3.10), a measure of the risk of interbank lending, quadrupled shortly after the Lehman failure. This credit freeze brought the domestic and global financial system to the collapse, not to mention the insurers who provided the credit default swaps (CDSes), upon the losses of the mortgage subprime-related securities. Hedging proved to be useless when insurance companies, such as American International Group (AIG), MBIA, and Ambac, faced ratings downgrades because widespread mortgage defaults increased their potential exposure to CDSes losses.[1]

In terms of indirect economic effects, the subprime crisis convey tremendous

[1]Timeline of subprime crisis is in the Appendix C.

adverse effects to US economy.The subprime crisis has had a number of adverse effects on the overall U.S. economic situation. GDP contracted at a 5.5 percent annual rate during the last quarter of 2008. U.S. employers laid off 2.6 million jobs during 2008. There were significant job losses in the financial sector, with over 65,400 jobs lost in the U.S. as of September 2008. In addition to that, declining house prices reduced household wealth and the collateral for home equity loans, which is still placing downward pressure on consumption. The credit and liquidity shortage in financial institutions has caused a major decline in the business sector and investment.



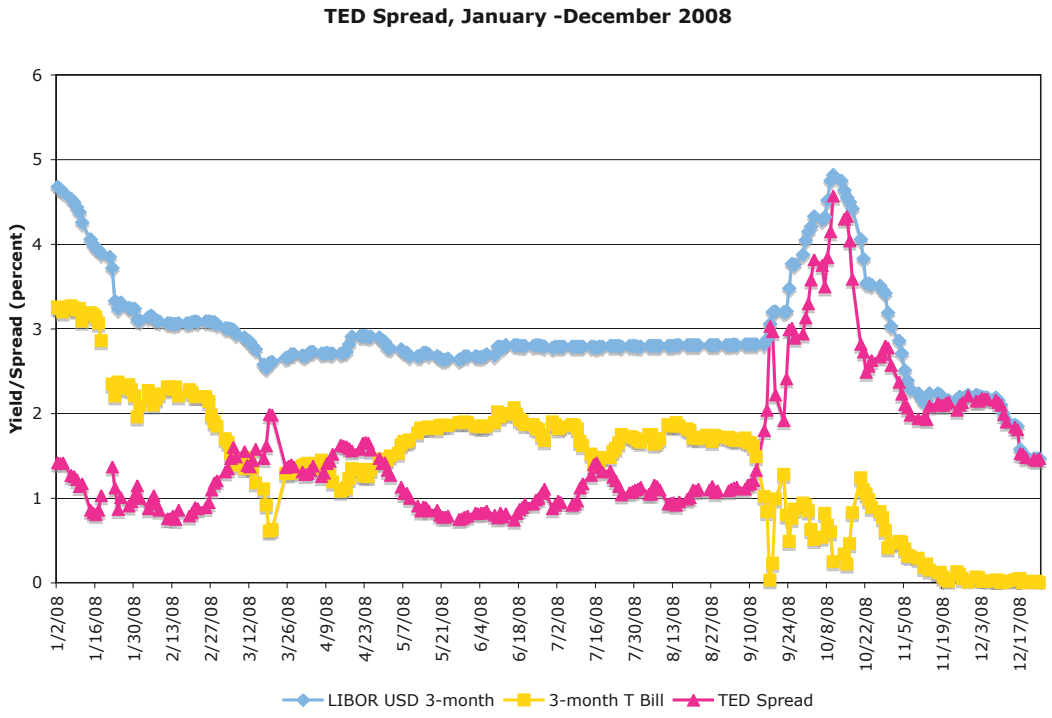
Source: Federal Reserve Bank of Richmond

Figure 3.9: Residential Mortgage Delinquency Rate, as of September 2008

Table 3.5: Major Leveraged Financial Institutions with Exposures

Data as of September 2008 (billion USD) except Morgan Stanley and Goldman Sachs as of August			Exposure to (percent)				
Name	Total Assets	Total Commitment	Lending	Real Estate	Credit Card	Other Consumer	$\frac{Equity}{Asset}$ (percent)
JP Morgan Chase	2,251.5	1,223.6	57.8	19.2	25.3	1.8	6.5
Bank of America	1,836.5	1,836.5	73.3	29.4	28.8	3.0	8.8
Merrill Lynch	875.8	123.7	20	8.8	0	0.5	4.4
State Street Corp	286.7	50.9	20.3	7.4	1.1	2.7	4.6
Citi Group	2,050.1	1,560	65.0	12.4	32.9	4.3	6.1
Bank of NY Mellon	267.6	45.5	33.4	9.9	0.2	0.4	10.3
Wells Fargo	1,382.9	476.9	75.5	45.7	6.2	5.2	7
Morgan Stanley	987.4	162	15.8	21.9	0	0	3.6
Goldman Sachs	1,081.8	78.5	9.3	8.3	0	0	4.2
Total	11,020.3	5,144.3	54.5	21.1	19.3	2.6	6.3

Source: Hoshi & Kashyap (2008)



Source: Federal Reserve System

Figure 3.10: TED Spread, January -December 2008

3.4 House Price in the United States

In this section, I develop the model that explains U.S. house prices before the mortgage crisis, during 1991–2006. The model is based on the asset market approach introduced by Buckley & Ermisch (1982), Dougherty & Order (1982), Poterba (1984),Meen (1990), and Garcia *et al.* (2007). Notations here is related to Dougherty & Order (1982), assuming there are two goods, housing h, and non-durable consumer goods, c, with a price p_h and p, respectively. In this case p is treated as numeraire. Relative price is defined as q. The variable a_t represents the non-housing assets net of loans, earning a nominal interest rate i. Household has to pay income tax on real value of labor income y. Tax rate is θ. The

budget constraint is

$$c_t + s_t + q_t x_t = (1-\theta)y + (1-\theta)ia_t, \tag{3.1}$$

where x_t and s_t are real gross housing purchases and real financial saving. Both of them are defined by

$$\dot{h} = x_t - \delta h_t, \tag{3.2}$$

$$\dot{a} = s_t + \pi a_t, \tag{3.3}$$

where δ is the depreciation rate and π is inflation rate.

Household maximizes a standard utility function;

$$U(c_0, c_1, \cdots c_n; h_0, h_1, \cdots h_n), \tag{3.4}$$

taking all budget constraints 3.1- 3.3. First-order conditions of the utility maximization implies

$$\left[(1-\theta)i - \pi + \delta - \frac{\dot{q}}{q_t}\right] q_t = \frac{U_h}{U_c} \tag{3.5}$$

Meen (1990) rewrote equation 3.5 as

$$R_t = \left[(1-\theta)i - \pi + \delta - \frac{\dot{q}}{q_t}\right] q_t, \tag{3.6}$$

where equation 3.6 represents the "real rental price," which can be defined as the value of compensation given to household to give up one unit of housing. From equation 3.6, house price under capital market equilibrium can be defined as;

$$q_t = \frac{R_t}{\left[(1-\theta)i - \pi^e + \delta - \frac{\dot{q}^e}{q_t}\right]}, \tag{3.7}$$

where π^e and q^e are expected inflation and expected relative price.

Note that the derivation as stated in equation 3.7 is under the assumption that there are no credit constraints, households can borrow and lend at nominal rate *i*. However, in most empirical studies, typically some measure of mortgage rationing is added to housing demand equations. Dougherty & Order (1982) and Ermisch (1984) demonstrated that the user cost of capital may be higher than in equation 3.7 in the presence of capital market constraints. Suppose that there exists the differential interest rates on borrowing (i_m) and lending (i_a), the budget constraint as presented in equation 3.6 should separate net financial assets (a_t) into gross assets and loan outstanding (m_t). Dougherty & Order (1982) and Ermisch (1984) showed further that the effect of borrowing constraint depends on the form of credit rationing constraint, for instance, whether there is a limit on the total volume of borrowing ($m_t \leq \bar{m_t}$) or whether there is a limit on the loan-to-value-ratio. In this case I assume that the credit rationing, which takes form of the ceiling to borrowing exists and treat that ceiling as an equality. In this case the user cost of capital becomes

$$q_t = \frac{R_t}{\left[(1-\theta)i_m - \pi^e + \frac{\lambda_{1t}}{U_c} + \delta - \frac{\dot{q^e}}{q_t}\right]}, \tag{3.8}$$

where λ_1 is the credit constraint and U_c is marginal utility of non-durable consumer good. Equation 3.8 implies that real rental price R_t increases by $\frac{\lambda_{1t}}{U_c}$. Empirically, equation 3.8 can be expressed as;

$$q_t = f(R_t, \left[(1-\theta)i_m - \pi^e + \frac{\lambda_{1t}}{U_c} + \delta - \frac{\dot{q^e}}{q_t}\right]). \tag{3.9}$$

Meen (1990) suggested that the unobservable real rental price of housing (R_t) is proxied by real income (ry_t), demographic variables (POP_t), and real housing

stock (h_t^s);

$$R_t = f(ry_t, POP_t, h_t^s). \tag{3.10}$$

The reduced form of equation 3.9 is expressed as

$$q_t = f(ry_t, pop_t, h_t^s, (1-\theta)i_m, \pi^e, m_t, \frac{\dot{q^e}}{q_t}) \tag{3.11}$$

where m_t is credit variable, which is proxy for credit constraint.

3.4.1 Econometric Estimation

As shown in the previous section, house prices relate to personal income, mortgage interest rates, expected inflation, housing supply and constraints, and demographic variables. To determine the dynamics of the house price bubble in the U.S., the error correction model is applied in the context of multi-city data to determine the short-term behavior of house prices and the adjusting process toward long-term equilibrium. Assume an autoregressive distributed lag (ADRL) $(p, r_1, r_2, ..., r_k)$ dynamic specification of the form

$$\ln(q_{it}) = \alpha_i + \Sigma_{j=1}^{p} \lambda_k^{ij} ln(q_{it-j}) + \Sigma_{j=0}^{r} \delta_{ij}^{'} \ln(X_{it-j}) + \varepsilon_{it}, \tag{3.12}$$

where the number of groups i is the number of msa; the number of periods t is the number of months; δ_{it} is the $k \times 1$ coefficient vectors; λ_{ij} is a scalar; and μ_i is the group specific effect. Variable q_{it} is the dependent variable that in this case is house price. X_{it} is $k \times 1$vector of explanatory variables consisting of

i = post-tax real mortgage lending rate

π^e = expected inflation rate

h^s = housing stock

m = mortgage credit constraint

ry = real personal income

pop =total population

u = unemployment rate.

If the variables in 3.12 are $I(1)$ and cointegrated, then the error term is $I(0)$ process for all i. The cointegrated variables will response to any deviation from long-run equilibrium. This implies an error correction model in which the short-run dynamics of the variables in the system are influenced by the deviation from the equilibrium. Thus the equation 3.12 can be rewritten in simple ECM form as follows:

$$\Delta \ln(q_{it}) = \alpha_i + \phi_i(\ln(q_{it}) - \theta_i' X_{it}) + \Sigma_{j=1}^{p-1} \lambda_{ij}^* \Delta \ln(q_{it-1}) + \Sigma_{j=0}^{r-1} \delta_{ij}'^* \Delta \ln(X_{it-j}) + \varepsilon_{it}, \quad (3.13)$$

where $\phi_i = -(1 - \Sigma_{j=1}^{p} \lambda_{ij})$; $\theta_i = \Sigma_{j=0}^{r} \frac{\delta_{ij}}{(1-\Sigma_k \lambda_{ik})}$; $\lambda_{ij}^* = -\Sigma_{m=j+1}^{p} \lambda_{im}$ $j = 1, 2, ..., p-1$; and $\delta_{ij}^* = -\Sigma_{m=j+1}^{r} \delta_{im}$ $j = 1, 2, ...r-1$.

The parameter ϕ_i is the error-correcting speed of the adjustment term. It shows how the house price adjusts back to the equilibrium state. In the simple ECM, the parameter ϕ_i is expected to be negative in order to adjust the short-term disequilibrium back to long-term equilibrium condition. The vector θ_i' contains the long-run relationships between variables. The long-run relationship of inverted housing demand is assumed to be

$$\ln(q_{it}) = \alpha_i + \theta_i' \ln(X_{it}) + \varepsilon_{it}. \quad (3.14)$$

The data includes monthly figures for 18 major metropolitan areas from 1991m1 to 2006m12. The variables include post-tax real mortgage lending rate, expected inflation rate,[2] housing stock, loan-to-value ratio, real personal income, total population, and unemployment rate. Details of data description and sources are in the Appendix C. I follow the estimation technique proposed by Pesaran & Smith (1995) and Pesaran *et al.* (2004) that develop the maximum likelihood method to estimate nonstationary dynamic panels for the case in which the panel data is incorporated into with a large number of cross-sectional observation (N) and a large number of time-series (T). Dynamic fixed effect are used in the estimation. This methods restricts the speed of adjustment ϕ_i coefficient and keeps the short-term coefficients across panel groups equal.

3.5 Data Snapshot

Table 3.6 represents the summary statistics of variables both in values and in log form. Figure 3.11 gives the overall picture of housing conditions of 18 metropolitan statistical areas (MSAs) in the U.S.[3] Panels (a) and (b) represent the mean of variable housing stock, Case-Shiller index, and loan-to-value ratio by MSAs during 1991–1999 and 2000–2006 respectively. The first diagram of panel (a) shows that housing stocks, measured by building permits, of 6 major cities (Atlanta, Dallas, Chicago, New York, Phoenix, and Washington) were above the fitted line while the rest of the cities were below the fitted line. The number of housing stocks of each city in this period stayed within close range. However, during 2000–2006 as depicted in the first diagram of panel (b) there was greater

[2]Expected inflation rate is obtained from the surveys of consumers, University of Michigan.
[3]Definition of MSA abbreviation can be found in the Appendix C.

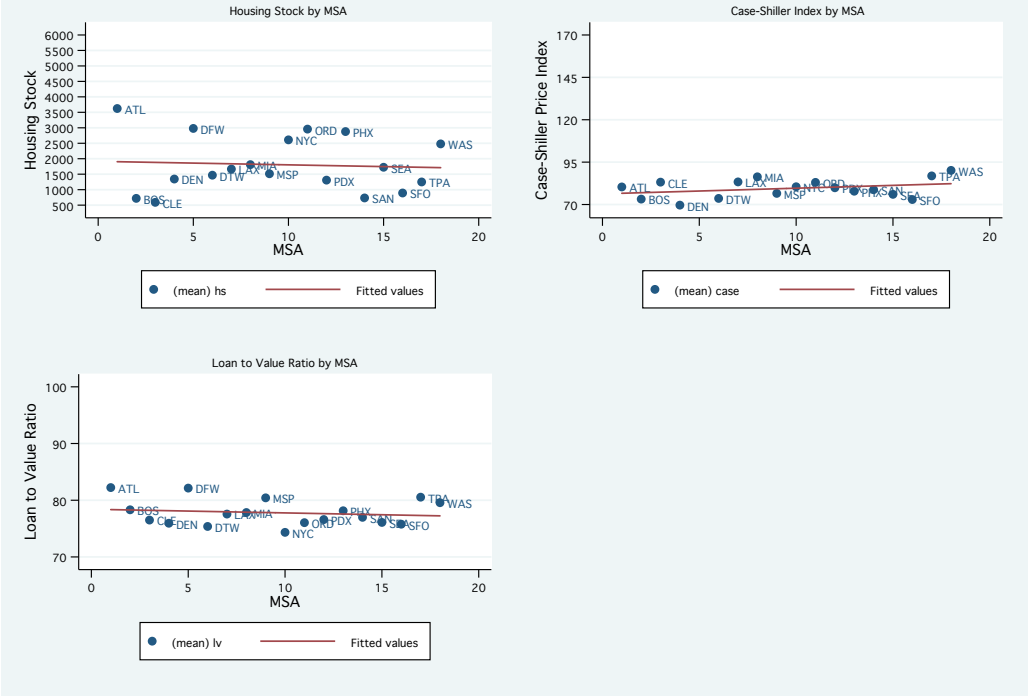
variation in of housing stocks. The average number of housing stocks grew significantly in Atlanta, Dallas, Chicago, New York, Phoenix, and Washington, while the housing stocks of cities below the fitted line did not change much over time.

The second diagram at the right of each panel represents the mean of the Case-Shiller index, which represents repeated sale house price index. In 1990–1999, as shown in the top right diagram of panel (a), house prices were pretty much the same in all cities. The Case-Shiller indices were between 80 and 90, and the fitted line was relatively flat during this period. All cities experience a great price rise in 2000–2006 especially cities in the southwest and the west, that is, Los Angeles, Miami, San Francisco, and Washington. Case-Shiller indices are pushed upward from 80 to 90 in the 1990s to above 120.

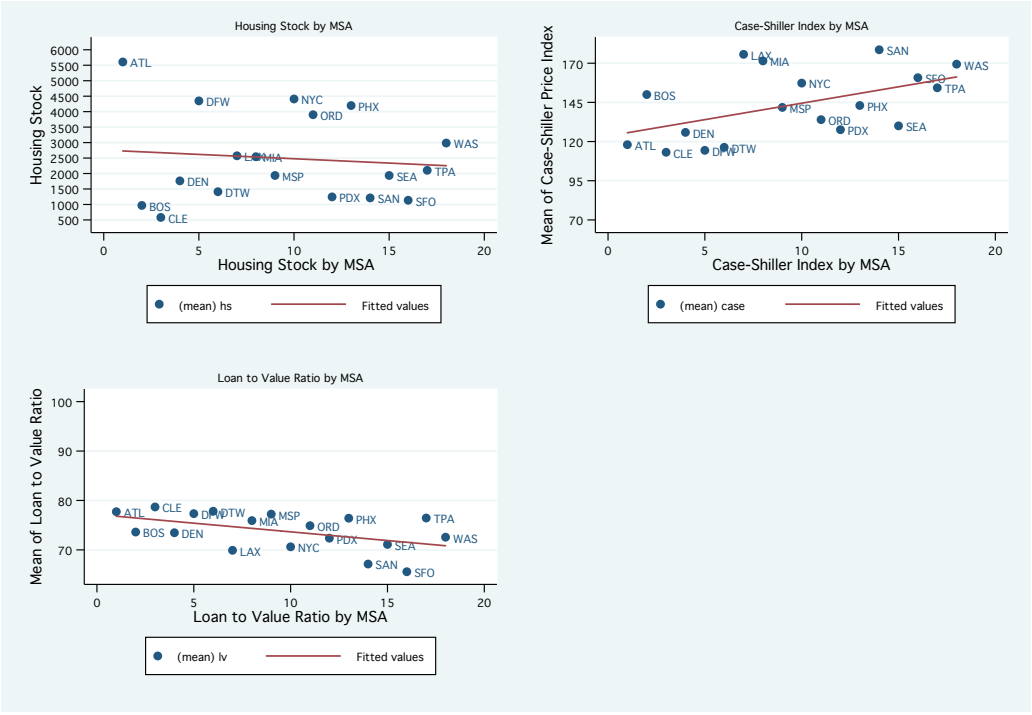
The diagram at the bottom left of each panel shows the loan to value ratio. That is the ratio of the amount of a first mortgage lien as a percentage of the total appraised value of real property, do not change much over time. The ratio stays around 70 to 80 percent. This implies that the amount of loans for first time borrowers increased as the price of houses increased in 2000–2006 in most cities.

3.6 Empirical Results

A panel unit root test was performed on each variable. This test was introduced by Levin *et al.* (2002). The test assumes that each unit in the panel shares the same AR(1) coefficient, but allows for individual effects, time effects, and possibly a time trend with the corresponding null hypothesis of non-stationarity



(a) 1991m1–1999m12



(b) 2000m1–2006m12

Figure 3.11: Housing Stock, Case-Shiller Index, and Loan to Value Ratio by MSA, 1991m1–2006m12

Table 3.6: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Case-Shiller House Price Index (*case*)	108.4	43	48.94	280.16	3,348
Tax-Adjusted Real Mortgage Rate, percent (i)	4.01	0.72	2.52	5.5	3,456
Expected Inflation Rate, percent (π^e)	2.87	0.42	0.4	4.60	3,456
Housing Stock, unit (h^s)	2107.42	1356.62	160	7734	3,456
Loan to Value Ratio, percent (m)	76.17	4.06	60.7	84.60	3,420
Per Capita Real Personal Income, USD (ry)	32,157.4	4,678.40	23,511.79	49,327.59	3,456
Total Population (*pop*)	5,016,119.99	4,018,932.87	1,555,084	19,000,000	3,456
Unemployment Rate, percent (u)	5.13	1.58	1.8	10.8	3,456
ln(*case*)	4.62	0.34	3.89	5.64	3348
ln(i)	1.37	0.19	0.93	1.71	3456
ln(π^e)	1.04	0.2	-0.92	1.53	3456
ln(h^s)	7.44	0.67	5.08	8.95	3456
ln(m)	4.33	0.05	4.11	4.44	3420
ln(ry)	10.37	0.14	10.07	10.81	3456
ln(*pop*)	15.21	0.6	14.26	16.76	3456
ln(u)	1.59	0.31	0.59	2.38	3456

Source: Author's Calculation

I(1) behavior. The series of tests on panel data do not reject the null hypothesis except ln(*pop*) which is used as a control variable. Following the panel VECM specification developed in the previous section, I estimated the changes in real house prices on macroeconomic variables. The regression estimates, as shown in Table 3.7, represents the long-term equation and short-term adjustment for the house price. Results without controlled variables, with all controlled variables, and with controlled variables except population are presented in column (1), (3), and (5), respectively. When estimating the long-term equation for the house price I find that all coefficients are significant except tax-adjusted real mortgage rate. After controlling for MSA-specific variables, that is, personal income, population, and unemployment rate, the tax-adjusted real mortgage rate becomes significant. The exclusion of population, due to the stationarity issue, does not change the degree of coefficients while the signs are still the same. So I stick with the results as shown in column (5). All coefficients in column (5) are statistically significant at 99 percent level of confidence except expected inflation. That said, in the long-term, all the variables' coefficients are

consistent with economic theory except the relationship between housing stock and house prices which, according to Meen (1990) and Muellbauer & Murphy (1997), should be negative. The possible explanation for positive housing stock and house price is that during the bubble period, there is always a housing demand as a respond to an increasing of housing supply.

In addition, I found that house price has a negative relationship with tax-adjusted real mortgage rate and ratio of loan-to-value of the first-time buyer. This suggests that the historically low interest rates have encouraged buyers to borrow more money, which drives up the house price, and the buyer who possesses the low loan-to-value ratio are obliged to pay at higher house price. The error correction term for the short-term basis, in addition, is significantly negative (-0.004), indicating that in the long run house price moves in line with its fundamentals. However, the adjustment process may take time since only about 0.4 percent of deviation from the long-term value is corrected each month. Noting that the selected lag of all variables appears to have a significant influence on house price in the short run as well. The high significance of house price in all lags indicates the "sticky" pricing process in U.S. housing market.

Next, I performed the panel ECM by regions– the midwest, the northeast, the south, the west, and the southwest.[4] Results as shown in Table 3.9 show the low-adjusting parameter in all regions. Given the results, the midwest seems to adjust back to long-run equilibium quicker than the rest, whereas the southwest takes the longest time to convert back to long-run equilibrium. Taking half-life, it will take approximately 7, 9, 15, 16, and 18 years for the midwest, the northeast, the south, the west, and the southwest respectively.[5] Region-wise,

[4]Southwest U.S. in this context consists of cities in Arizona, California, Colorado, Nevada, and Texas.

[5]Half-life or $t^* = -\frac{\ln(0.5)}{\lambda}$, where λ is the rate of decrease per year. In this case $\lambda = (1+\phi)^{12} - 1$,

Table 3.7: Panel ECM Regression of House Prices

	(1)		(3)		(5)	
VARIABLES	LR	SR	LR	SR	LR	SR
Long-Run						
$\ln(i)_{it}$	-0.108		-0.365**		-0.376***	
	(0.315)		(0.143)		(0.143)	
$\ln(h^s)_{it}$	1.025***		0.249***		0.266***	
	(0.205)		(0.0845)		(0.0810)	
$\ln(\pi^e)_{it}$	-0.798**		-0.0195		-0.0212	
	(0.397)		(0.138)		(0.139)	
$\ln(m)_{it}$	-4.999***		-2.692***		-2.673***	
	(1.177)		(0.514)		(0.517)	
$\ln(ry)_{it}$			2.223***		2.307***	
			(0.417)		(0.373)	
$\ln(pop)_{it}$			0.0459			
			(0.328)			
$\ln(u)_{it}$			-0.251***		-0.246***	
			(0.0863)		(0.0867)	
Short-Run						
Adjusting Parameter (ϕ)		-0.00157***		-0.00392***		-0.00388***
		(0.000321)		(0.000539)		(0.000534)
$\Delta \ln(case)_{it-1}$		0.626***		0.615***		0.616***
		(0.0171)		(0.0171)		(0.0171)
$\Delta \ln(case)_{it-2}$		0.247***		0.245***		0.244***
		(0.0197)		(0.0196)		(0.0196)
$\Delta \ln(case)_{it-3}$		-0.265***		-0.262***		-0.263***
		(0.0194)		(0.0193)		(0.0193)
$\Delta \ln(case)_{it-4}$		0.255***		0.252***		0.252***
		(0.0169)		(0.0169)		(0.0169)
$\Delta \ln(i)_{it}$		0.000716		0.00171		0.00176
		(0.00144)		(0.00146)		(0.00146)
$\Delta \ln(i)_{it-1}$		0.00174		0.00264*		0.00262*
		(0.00147)		(0.00149)		(0.00149)
$\Delta \ln(i)_{it-2}$		-0.00275*		-0.00180		-0.00179
		(0.00148)		(0.00149)		(0.00149)
$\Delta \ln(i)_{it-3}$		-0.00109		-0.000387		-0.000438
		(0.00148)		(0.00150)		(0.00150)
$\Delta \ln(i)_{it-4}$		0.000183		0.00117		0.00115
		(0.00143)		(0.00146)		(0.00146)
$\Delta \ln(\pi^e)_{it}$		0.00136***		0.000547		0.000554
		(0.000491)		(0.000527)		(0.000526)
$\Delta \ln(\pi^e)_{it-1}$		0.00226***		0.00152***		0.00156***
		(0.000467)		(0.000496)		(0.000494)
$\Delta \ln(\pi^e)_{it-2}$		0.00183***		0.00110**		0.00116**
		(0.000455)		(0.000475)		(0.000472)
$\Delta \ln(\pi^e)_{it-3}$		0.00149***		0.000977**		0.00103**
		(0.000406)		(0.000423)		(0.000421)
$\Delta \ln(\pi^e)_{it-4}$		-0.000133		-0.000549		-0.000502
		(0.000383)		(0.000395)		(0.000394)
$\Delta \ln(h^s)_{it}$		-0.00124***		-0.000720**		-0.000758**
		(0.000300)		(0.000322)		(0.000313)
$\Delta \ln(h^s)_{it-1}$		-0.000908***		-0.000510*		-0.000538*
		(0.000290)		(0.000308)		(0.000301)
$\Delta \ln(h^s)_{it-2}$		-0.000519*		-0.000276		-0.000297
		(0.000276)		(0.000289)		(0.000283)
$\Delta \ln(h^s)_{it-3}$		-0.000382		-0.000246		-0.000260
		(0.000256)		(0.000265)		(0.000261)
$\Delta \ln(h^s)_{it-4}$		-0.000380*		-0.000240		-0.000257
		(0.000223)		(0.000229)		(0.000227)
Constant		0.0315***		-0.0321		-0.0334
		(0.00782)		(0.0256)		(0.0226)

*** p<0.01, ** p<0.05, * p<0.1
Standard errors are in parentheses.

Table 3.8: Panel ECM Regression of House Prices (continued)

VARIABLES						
	LR	SR	LR	SR	LR	SR
$\Delta \ln(m)_{it}$		0.00323		0.00710		0.00695
		(0.00647)		(0.00666)		(0.00665)
$\Delta \ln(m)_{it-1}$		0.0112*		0.0173***		0.0173***
		(0.00647)		(0.00669)		(0.00668)
$\Delta \ln(m)_{it-2}$		0.0102		0.0115*		0.0115*
		(0.00648)		(0.00672)		(0.00671)
$\Delta \ln(m)_{it-3}$		-0.000378		0.00293		0.00298
		(0.00649)		(0.00672)		(0.00671)
$\Delta \ln(m)_{it-4}$		0.00503		0.00453		0.00429
		(0.00641)		(0.00666)		(0.00665)
$\Delta \ln(ry)_{it}$				-0.00340		-0.00351
				(0.00638)		(0.00634)
$\Delta \ln(ry)_{it-1}$				0.00393		0.00343
				(0.00763)		(0.00759)
$\Delta \ln(ry)_{it-2}$				0.0176**		0.0170**
				(0.00795)		(0.00792)
$\Delta \ln(ry)_{it-3}$				0.0110		0.0106
				(0.00771)		(0.00767)
$\Delta \ln(ry)_{it-4}$				0.0143**		0.0145**
				(0.00651)		(0.00645)
$\Delta \ln(pop)_{it}$				-0.0185		
				(0.0222)		
$\Delta \ln(pop)_{it-1}$				-0.0350		
				(0.0282)		
$\Delta \ln(pop)_{it-2}$				-0.0417		
				(0.0299)		
$\Delta \ln(pop)_{it-3}$				-0.0341		
				(0.0288)		
$\Delta \ln(pop)_{it-4}$				-0.00545		
				(0.0239)		
$\Delta \ln(u)_{it}$				0.000263		0.000272
				(0.000802)		(0.000801)
$\Delta \ln(u)_{it-1}$				-0.000588		-0.000544
				(0.000806)		(0.000804)
$\Delta \ln(u)_{it-2}$				-0.000304		-0.000259
				(0.000784)		(0.000781)
$\Delta \ln(u)_{it-3}$				-0.00169**		-0.00167**
				(0.000790)		(0.000788)
$\Delta \ln(u)_{it-4}$				1.01e-05		1.27e-05
				(0.000767)		(0.000766)

*** p<0.01, ** p<0.05, * p<0.1
Standard errors are in parentheses.

tax-adjusted real mortgage rate is not significant in all cases. Housing stock has the positive relation with house price and is significant in the northeast and the west. Loan-to-value ratio is negatively significant in all regions and its effect is greatest in the southwest. Personal income is the major price determinant in the midwest and the south while its effect on house price is smallest in the southwest. The finding indicates that the housing bubble are significantly experienced due to rising demand, income gain, and the relaxation of mortgage

where ϕ is adjusting parameter.

credit constraint.

Table 3.9: Panel ECM Regression of House Prices by Region: Adjusting Parameter and Long-Run Equation

VARIABLES	(1)	(2)	(3)	(4)	(5)
	Midwest	Northeast	South	West	Southwest
Adjusting Parameter (ϕ)	-0.00861***	-0.00623***	-0.00384***	-0.00360***	-0.00328***
	(0.00232)	(0.00208)	(0.00101)	(0.000762)	(0.000820)
$\ln(i)_{it}$	-0.0661	-0.258	-0.260	-0.396	-0.299
	(0.135)	(0.236)	(0.319)	(0.261)	(0.318)
$\ln(h^s)_{it}$	0.566***	0.142	0.265	0.294***	0.255*
	(0.160)	(0.108)	(0.184)	(0.144)	(0.168)
$\ln(\pi^e)_{it}$	0.0903	-0.221	-0.00105	-0.0375	-0.339
	(0.116)	(0.287)	(0.284)	(0.249)	(0.334)
$\ln(m)_{it}$	-1.463***	-3.804***	-2.453***	-2.613***	-3.024****
	(0.674)	(1.050)	(1.463)	(0.778)	(0.913)
$\ln(ry)_{it}$	3.167***	2.041***	2.863***	2.106***	1.878***
	(0.364)	(0.696)	(1.287)	(0.566)	(0.711)
$\ln(u)_{it}$	-0.161***	-0.364***	-0.0294	-0.208	-0.180
	(0.0845)	(0.192)	(0.211)	(0.157)	(0.184)

*** p<0.1, ** p<0.05, * p<0.01
Standard errors are in parentheses.

3.7 Housing Bubble and Its Spillover

The fourth part of this paper explains how the housing sector bubble has created a ripple effect in the entire economy. The impact is explained through three important channels: (1) *wealth channel* arises when a house owner's wealth increases due to the home price bubble, and this, in turn affects his or her consumption; (2)*credit channel* rises when financial institutions, especially non-banks become more optimistic about housing markets. The unsustainability of housing is later explained by the freezing of the third type of channel; (3) *balance sheet effect* occurs when financial institutions' asset prices drop and capital values worsen, causing "liquidity crunch." In this section, I use vector error cor-

rection model (VECM) to assess the presence of crisis mechanisms. The vector error correction model is similar to the single error correction equation as presented in the previous section, except that it is presented in multivariate system. Consider the system of equations in vector autoregressive (VAR) form

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + \varepsilon_t, \tag{3.15}$$

where y_t is a $K \times 1$ vector of variables, v is a $K \times 1$ vector of parameters, $A_1 - A_p$ are $K \times K$ matrices of parameters, and ε_t is a $K \times 1$ vector of disturbances. Any VAR(p) can be written as VECM, which is as follows:

$$\Delta y_t = v + \Pi y_{t-1} + \Sigma_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t, \tag{3.16}$$

where $\Pi = \Sigma_{j=1}^{p} A_j - I_k$ and $\Gamma_i = -\Sigma_{j=i+1}^{p} A_j$. According to Engle & Granger (1987), for the case where variables y_t are I(1) if the matrix Π has reduced rank $r < k$, then there exists $k \times r$ matrices ϕ and θ, each with rank r such that $\Pi = \phi\theta'$ and $\theta' y_t$ is I(0). The variable r is the cointegration rank and θ is the cointegrating vector. Variable ϕ is adjustment parameter. In order to form the basis of the VECM specification, at least one cointegrating relationship must exist. In this step, Johansen's estimation is used to estimate the Π matrix.

In addition, Engle & Granger (1987) suggested that all variables within the cointegration relationship must have the same order of integrations and should not be integrated at order zero. According to them, the linear combination of non stationary-series may produce the stationarity if data are I(1). And if that stationary linear combination exists, the non-stationary time series are said to be cointegrated. Therefore, the unit root test and Johansen's cointegrating rank estimation of VECM have to be performed on each variable to check to see if the

series were I(1) and to determine the cointegrating relationship.

In this context, vector y_t consists of house price index, number of houses sold, GDP per capita, and consumption per capita, which represent housing market condition and wealth effect. The ratio of mortgage loans by non-bank financial institutions over total mortgage loans is also included. This variable is used in the analysis of lending and credit channel since the majority of housing loans in the U.S. are obtained through non-bank financial institutions. The next variables to be included are CDX index, and spread between LIBOR and T-Bill with equivalent maturity reflecting the degree of liquidity in financial markets, Appropriate number of lags is determined by series of information criterion provided by the *-varsoc-* routine in STATA. Impulse response function is calculated from VECM to show whether the house price shock would have an impact on the aforementioned channels and macroeconomic varibles. Monthly national data from 2003m10 to 2008m12 in log form are used in this section. Details of variables and sources of data are in the Appendix C.

3.7.1 Empirical Results

Augmented Dickey-Fuller unit root tests were performed on the log of the variables and their first differences. The tests suggest that all variables were I(1). The results from cointegration tests indicate that there were two cointegrating vectors under the chosen 1 lag in VECM form. Table 3.10 shows the coefficients obtained from ECM estimation. Series of test on residuals, as shown in the Appendix C insured that the residuals are I(0). Note that the adjustment parameters are relatively low, this implies that the adjustment to long-run cointegration

may not have been made in a fashion.

Table 3.10: Time Series ECM Regression of Housed Price Spill over Effect

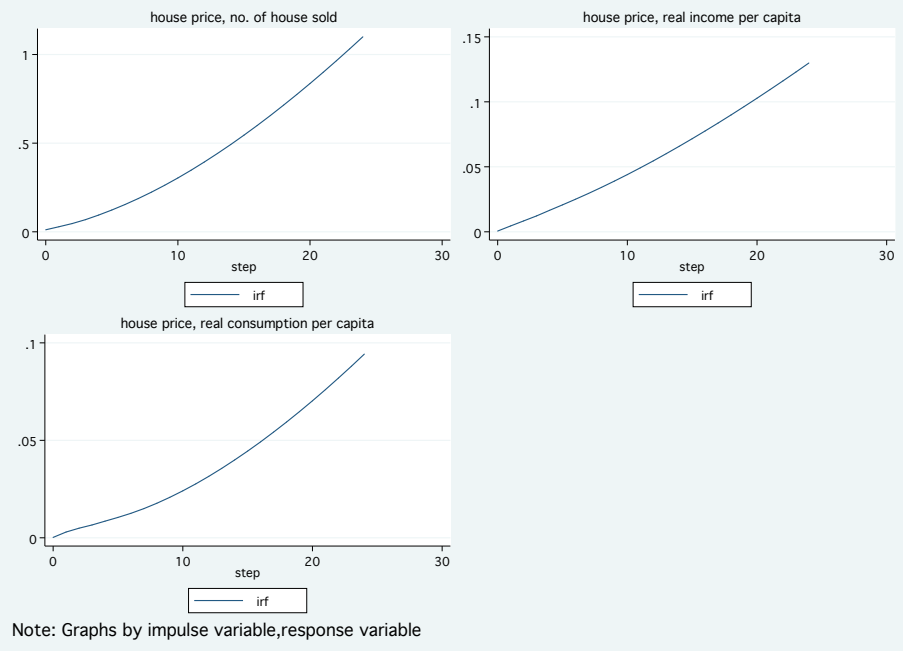
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES							
	$\Delta \ln(hp)$	$\Delta \ln(mort)$	$\Delta \ln(spread)$	$\Delta \ln(cdx)$	$\Delta \ln(ry)$	$\Delta \ln(rc)$	$\Delta \ln(hsold)$
α_1	-0.0530	0.0239	5.071***	-2.889***	0.0458	0.0235	-0.408
	(0.0349)	(0.0463)	(1.932)	(0.776)	(0.0534)	(0.0529)	(0.494)
α_2	0.238***	-0.300**	3.217	-1.159	-0.390***	-0.291**	0.342
	(0.0922)	(0.122)	(5.106)	(2.052)	(0.141)	(0.140)	(1.307)
$\Delta \ln(hp)_{t-1}$	0.591***	0.480***	-9.183	4.918*	0.887***	0.767***	2.833
	(0.131)	(0.174)	(7.255)	(2.915)	(0.200)	(0.199)	(1.856)
$\Delta \ln(mort)_{t-1}$	-0.277***	-0.522***	2.416	2.576	0.178	0.109	-0.397
	(0.0978)	(0.130)	(5.420)	(2.178)	(0.150)	(0.148)	(1.387)
$\Delta \ln(spread)_{t-1}$	-0.00548**	-0.00536*	0.0858	-0.172***	0.000183	0.00183	-0.00996
	(0.00222)	(0.00295)	(0.123)	(0.0494)	(0.00340)	(0.00337)	(0.0315)
$\Delta \ln(cdx)_{t-1}$	-0.00277	-0.00465	0.145	0.339***	0.0108	0.00968	-0.0805
	(0.00549)	(0.00729)	(0.304)	(0.122)	(0.00840)	(0.00833)	(0.0778)
$\Delta \ln(ry)_{t-1}$	-0.419	0.364	-0.756	23.26***	0.205	-0.605	1.069
	(0.344)	(0.457)	(19.05)	(7.656)	(0.526)	(0.522)	(4.876)
$\Delta \ln(rc)_{t-1}$	0.350	-0.351	-17.32	-26.03***	-0.479	0.291	-1.088
	(0.341)	(0.453)	(18.91)	(7.597)	(0.522)	(0.518)	(4.838)
$\Delta \ln(hsold)_{t-1}$	-0.00974	-0.000295	-0.0684	0.0439	0.0242	0.0218	-0.428***
	(0.0107)	(0.0142)	(0.593)	(0.238)	(0.0164)	(0.0162)	(0.152)
Constant	-0.00243*	0.00332*	0.0178	0.0361	0.00456**	0.00341*	-0.0328*
	(0.00131)	(0.00175)	(0.0728)	(0.0293)	(0.00201)	(0.00199)	(0.0186)
Observations	60	60	60	60	60	60	60

*** p<0.01, ** p<0.05, * p<0.1
Standard errors in are parentheses.

Figure 3.12 shows the responses of variables of interest to the positive house price shock using monthly data from 2003m10 to 2008m12. I use the cumulative impulse response function (CIRF) to determine all impulse responses. Recall that data used in the model are I(1), the possible effect from innovations can be either transitory or permanent. In this case, all responses do not dies out through out time, then shocks are said to be permanent.[6] The first impulse response function of Figure 3.12 shows the increase of the number of houses sold which rose as a response to the positive innovation of house price. This indicates the strong demand of house price during the bubble period, and the finding is consistent with the previous section. The rest two subfigures of Figure 3.12 represents the response of real GDP per capital and real consumption per capita. Both per capita GDP and real consumption increases almost instantaneously af-

[6]On the other hand, the shocks are transitory if the effects taper off to zero

ter house price shock. According to WEO (2008), the marginal propensity of consumption out of housing is high in the United States compared with other developed countries. The importance of home values as a share of household total wealth suggests that fluctuations in house prices may affect consumer spending, and in turn, income through wealth effect channel in the United States.



Source: Author's Calculation

Figure 3.12: Impulse Response Function Estimated From VECM

The analysis of the ratio of mortgage loan obtained through non-bank financial institution supports the strong credit channel in U.S. non-bank financial institutions are actively giving out mortgage loans as mortgage prices climb up. This is represented by the first impulse response shown in Figure 3.13. The rising mortgage prices contributes to the collateral benefits to borrowers and resulting in easier mortgage loan approvals. The next two diagrams in Figure 3.13 display how the positive innovation of house price generates the spill-over effect to other financial markets. The analysis is done on CDX index and TED spread. CDX index is used as benchmarks for credit default swap. From the

finding, the one standard deviation increases in house price causes CDX index to decline further. The negative response of CDX index indicates that insurers charge the cheap premium for credit default swap on any subprime related investment transaction as house price rises. This implies a positive expectation on housing market during times of higher housing prices. However the housing bubble proves to be unsustainable. In addition, housing bubble in the first month caused the rising of TED spread to decline starting in the fifth month, which reflects the liquidity dry up among financial institutions since the asset side of their balance sheets worsen. The rising of house price in the United States was not sustainable and, consequently, resulted in a deepening of liquidity shortage in the U.S. financial markets and the economy.

Figure 3.13 suggests on a strong effect of the housing bubble to the liquidity condition and credit channel of financial institutions. Next, I determine the 2-way relation between credit channel and housing market by asking whether the credit channel has a pronounced effect on housing market condition. The left panel of Figure 3.14 reports that the total number of houses sold declines in response to a widening TED spread, that is, credit crunch. Financial institutions decided to cut the supply of mortgage loans as liquidity shortage advanced. In fact, this is the normal practice among financial institutions when they experience a liquidity problem. They were unable to find enough capital to cover their high level of leverage. And eventually the shrinkage asset put a pressure on mortgage credits and so they aggressively applied more rigid criteria to all new potential borrowers.

This difficult environment of the financial system will continue unless the housing situation is resolved. The right panel of Figure 3.14 indicates that the

credit crunch among financial institutions is relieved as number of houses are sold. This implies that the recovery of credit among financial institutions depends a lot on to what extent excess houses inventories can be liquidated. The new round of demand for houses should pick up when prices fall enough. This will help stabilize the uncertain value of home equity, which is crucial as buffer for all mortgages and as collateral for those mortgage-backed securities.

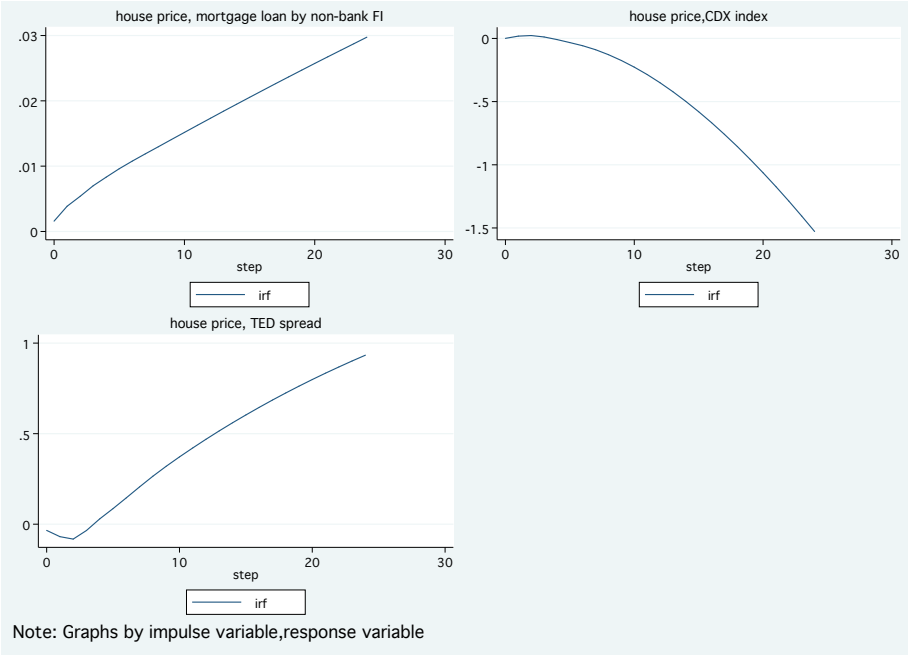


Figure 3.13: Impulse Response Function Estimated From VECM (continued)

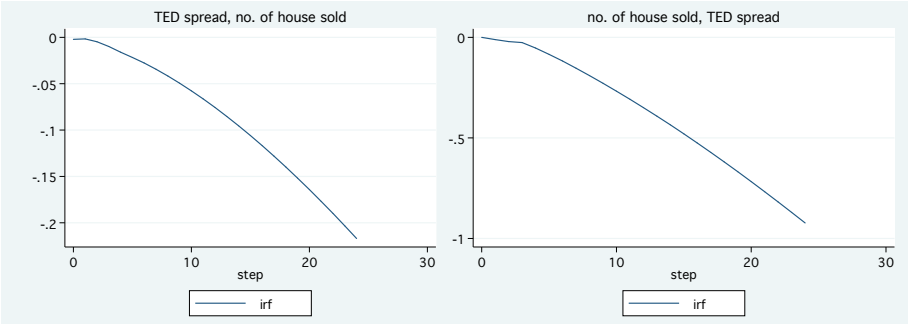


Figure 3.14: Impulse Response Function Estimated From VECM (continued)

3.8 Conclusion

The sharp drop of the housing sector over the past few years and the increasing defaults in the subprime mortgage market that triggers the financial turbulence in the United States, have raised concerns that, as a result of innovations in the mortgage market and the related products and services offered by financial institutions, the housing sector could be a source of macroeconomic instability.

I have carried out a deep analysis of the interrelation between financial institutions and housing sector in the United States. This paper makes use of flow of funds data to disentangle the pattern of uses and sources of fund and the role of financial investment over time. The evidence presented in the first section suggests that all economic sectors have increasingly participated into financial investment and have exposed to the higher degree of volatility in financial investment. The financial institutions, in addition, have experienced a significant evolution of financial intermediation over the past fifty years. The interactions of changes in regulation, tax law, introduction of international financial services, and the development of new types of financial instruments have changed the pattern of flows of savings and fund suppliers. As financial service providers have been growing and offering wider ranges of sources of financing, borrowers do not have to limit themselves to "old fashioned" commercial banks. Combining all these factors with low interest rate and abundance of capital from lenders and investors, these created the boom in the U.S. housing markets during the late 1990s and early 2000s.

However, the housing bubble was not sustainable. According to the second section, the high foreclosure rate in late 2005, the inappropriate securitization,

and improper credit ratings, and pervasive weaknesses of financial regulations led to the collapse of underlying financial securities and caused the major adverse consequences to the entire U.S. economy.

The third section sheds light on the dynamics of house price through the panel error correction formulation. The empirical results suggest that house price during 1990–2006 was sensitive to the movements of general economic conditions. There was always a demand for an increase of housing supplies during the bubble period. Income gain and low mortgage constraint were also the contributors to the housing price inflation. The econometric estimation shows the sticky price process in the U.S housing market and the slow adjustment towards long-run equilibrium.

The last section examines the spill-over effects of housing markets on other financial institutions and macroeconomic conditions through housing-related channels. The estimated results obtained from VECM indicate a strong and statistically significant effect of all three channels: wealth effect, credit effect, and balance sheet effect. The rising of house price in the United States was not sustainable, as mentioned earlier, and consequently resulted in an increasing of default risk and liquidity shortage in U.S. financial markets and caused the undesirable effects to the rest economy. As the findings suggest, financial institution recovery from liquidity shortage largely depends on how much the number of houses sold could be after house prices deflate, that is, this depends on the new round of demand for houses after house prices slump. As more houses are resold, the value of home equity is restored and that would help to stabilize the uncertain value of home equity, which is crucial as a buffer for all mortgages and as collateral for those mortgage-backed securities, resolving

the credit crunch ,and consequently, making the financial institution able to get back to operation again.

APPENDIX A

A.1 List of Abbreviations

- **ABMI**: Asian Bond Market Initiative
- **ABF1**: The first Asian Bond Fund initially amounted to 1 billion USD. The ABF invests in a basket of USD-denominated bonds issued by sovereign and quasi-sovereign Asian issuers in EMEAP economies (other than Japan, Australia , and New Zealand).
- **ABF2**: The ABF2 invests in local currency bonds issued by sovereign and quasi-sovereign issuers in EMEAP economies (other than Japan, Australia, and New Zealand). It consists of two components, a Pan-Asian Bond Index Fund (PAIF) and Fund of Bond Funds (FoBF).
- **ASEAN**: Association of South East Asian Nations
- **ASEAN+3**: A forum that functions as a coordinator of cooperation between ASEAN and the three East Asian nations of China, Japan, and South Korea.
- **EMEAP**: Executives Meeting of East Asia Pacific Central Banks which includes the Reserve Bank of Australia, the People's Bank of China, the Hong Kong Monetary Authority, Bank Indonesia, the Bank of Japan, the Bank of Korea, Bank Negara Malaysia, the Reserve Bank of New Zealand, Bangko Sentral Ng Phillipinas, the Monetary Authority of Singapore, and the Bank of Thailand.
- **FoBF**: Fund of Bond Funds is a two-tiered structure with a parent fund investing in eight single-market funds, each of which will invest in local

currency sovereign and quasi-sovereign bonds issued in their respective markets.

- PAIF: Pan-Asian Bond Index Fund is a single bond fund index investing in sovereign and quasi-sovereign local currency bonds issued in eight EMEAP.

A.2 Country Abbreviations

- **BRU**: Brunei
- **CAM**: Cambodia
- **CHN or C**: China
- **JPN or J**: Japan
- **KOR or K**: Korea
- **INA or I**: Indonesia
- **JPN or J**: Japan
- **MAS or M**: Malaysia
- **PHI or P**: Philippines
- **SIN or S**: Singapore
- **THA or T**: Thailand
- **VIE**: Vietnam

A.3 Financial Sector Regulations and Reforms in Selected ASEAN+3 Countries (information gathered from ADB (2008))

A.3.1 China

Regulations

- By mid-2005, financial restructuring of three of the four major commercial banks was completed through capital injection and sales of nonperforming loans.
- Foreign financial institutions were permitted to provide services in foreign currency without restrictions since WTO accession to the World Trade Organization (WTO) in 2001.
- Lowered restrictions to foreign exchange transactions and cross-border capital inflows.
- In August 2005, the People's Bank of China announced that banks satisfying certain requirements will be permitted to conclude foreign exchange forward and swap transactions in the interbank market.

Further Reforms

- The government to reform the equity market by easing restrictions on the sale of government-owned shares in listed companies and allowing the pricing of initial public offerings to be more market determined.

- Also, the newly revised Securities Law has streamlined and reduced financial requirements for stock-exchange listing (making it easier for firms with less capital to list), strengthening disclosure requirements for firms.
- Established a special working group in February 2004 to improve regulatory practices including access of non-government enterprises, relaxing approval limits on issuance, and easing interest rate controls, although there is still a cap on the interest rate that can be paid on corporate bonds.
- Significant progress achieved in developing the short-end of the bond market by opening the short-term corporate bill market, which has become very active as a number of the People's Republic of China's largest corporations, has tapped this segment of the market.
- Establishment of the interbank market for asset-backed securities with maturities of 110 years has been announced.
- New Securities Act for the bond market has removed some of the legal impediments that had kept the market from expanding, although the current merit-based bond issuance system, requiring government selection of each bond issue, remains a hurdle.

A.3.2 Indonesia

Regulations

- Strengthening of regulations regarding loan classification and provisioning
  - legal lending limits,

  - net open positions,
  - liquidity monitoring,
  - capital adequacy,
  - bank management and ownership, and
  - risk management practices.

Supervision

- Implemented risk-based supervision.
- Improved information systems and technology in banks.

Disclosure

- Pursued consolidation through mergers.
- Pursued privatization of state-owned banks.

Further Reforms

- Scope remains for strengthening state-owned banks.
- Resolve controversy in setting up the Financial Services Authority.
- With respect to Basel II, there is uncertain capability of enforcing risk weights for holdings of government securities.

A.3.3 Malaysia

Regulations

- Enhanced safety and soundness through expanded and more frequent disclosure.
- Reduced limits on exposure to a single customer.
- Introduced market risk-based capital adequacy rules and accreditation requirements in credit risk management.
- Introduced measures to improve competition and efficiency including benchmarking, mergers of finance companies into commercial bank groups, and the creation of an investment banking industry.
- Introduced measures to enhance consumer protection.

Supervision

- Reforms focused on enhancing supervisor capacity, including supervisory techniques, such as, regular stress testing, risk-based consolidated supervision, more rigorous on-site examination.

Disclosure

- To enhance market discipline, BNM undertook an educational program for consumers and introduced the Financial Mediation Bureau for consumer protection and redress.

Further Reforms

- Inability of domestic banks to integrate information on exposures to borrowers and related parties and on collateral pledged for risk mitigation purposes.
- BNM is preparing for a more-effective supervisory process by developing an enhanced methodology to assess internal models and advanced risk management systems.

A.3.4 Philippines

Regulations

- Focused on corporate governance reforms (board oversight of compliance and internal risk management systems), ownership limitations, operational limitations on many aspects of banking operations, including on open foreign exchange positions.
- Introduced Basel I capital adequacy ratio for credit risk (in 2001) and market risk (in 2002).
- Rationalized regulations to promote mergers and consolidation, microfinance, role of external auditors, and new accounting and disclosure standards.

Supervision

- Introduced consolidated supervision of bank groups and shifted to risk-based approach to supervision, introducing a risk assessment system to

supplement the risk-based examination approach and a new rating system for branches of foreign banks.

Disclosure

- Bangko Sentral Ng Pilipinas (BSP) made mandatory disclosure of information such as capital adequacy ratios, credit concentration, quality of loans, adequacy of loss provisions, and related party transactions in quarterly published statements and annual reports.
- BSP also introduced safeguards to ensure independence of auditors. Also recognized credit rating agencies for bank supervision purposes and accredited five rating agencies (two national and three international).

A.3.5 Singapore

Regulations

- Reforms foster competition and strengthen bank governance.
- Liberalized access to the domestic banking sector required banks to focus on core activities to limit risk of contagion from nonfinancial business to the bank: issued rules on corporate governance.
- Embarked on review to enhance the management of concentration risk to a single counterparty.
- Reduced the minimum capital adequacy ratio to give banks incentives to better manage their risks.

- Minimum liquidity requirements were made forward-looking, taking into account supervisory reviews of banks' liquidity policies and practices.
- Rules and regulations made more transparent and policy changes become subject to public consultation

Supervision

- Focused on risk-based supervision of financial institutions and examination of banks' internal controls and risk management systems.
- Authorities harmonized risk assessment frameworks applied to all classes of institutions (banks, insurance companies, capital market intermediaries, trust companies and payment systems), aiming to enhance ability to assess large, complex financial groups.
- Authorities also enhanced macro-financial surveillance capabilities.

Disclosure

- Banks raised their disclosure standards in line with industry developments and international best practice. In their annual reports, banks disclose information on corporate governance practices, financial performance, risk exposure, risk management practices and risk-taking philosophy.

Further Reforms

- Monetary Authority of Singapore (MAS) considers management of supervisory resources for Basel II implementation a major challenge. MAS has

therefore embarked on several initiatives to raise the awareness of management and staff within MAS and embarked on a major training program of its staff.

A.3.6 Thailand

Regulations

- Issued new rules and procedures for loan classification and provisioning; accrual of interest; collateral valuation; debt restructuring; loan portfolio review; related lending; capital adequacy; capital requirements for market risk; eligible capital; management of interest and currency risk, including interest rate risk in the banking book; and limits on net open forex positions (for single and aggregate currency positions).
- Bank of Thailand (BOT) issued rules on auditing and disclosure, conforming with Thai Accounting Standards.
- BOT required banks to disclose uniform financial statements, items that have material effects on their financial conditions, and payments to directors and senior management.

Supervision

- Management encouraged reorganization of the Supervision Group at BOT to support new risk-based supervision approach.
- BOT also strengthened capacity for off-site supervisory risk assessments at both macro and micro levels.

- BOT also supported the creation of a Bank Examiner School to increase competency and commission examiners, particularly those involved in risk-focused examinations, and a financial institutions data base to support all supervisory activity.

Disclosure

- BOT strengthened regulations and guidelines on accounting and disclosure, requiring more frequent audits of financial statements.
- BOT also issued guidelines on the scope of audit work for internal and external auditors.
- BOT required banks to appoint audit committees with the majority of members being independent directors.

A.4 Data and Source of Data

Table A.1: Variables Definitions and Sources

Variable	Definition	Source
Consumption	Real consumption per capita (2000 USD)	WDI
Income	Real GDP per capita (2000 USD)	WDI
Portfolio equity and debt: asset	Average asset holdings of source country i to ASEAN+3	CPIS, IMF
Portfolio equity and debt: liability	Average asset holdings of source country i to ASEAN+3	CPIS, IMF
FDI	FDI stock assets holdings of source country i in ASEAN+3	ASEAN Secretariat
Current account	Current account as a percentage of GDP	WDI
Financial development	Ratio of M_2 over GDP	WDI
Trade openness	Ratio of trade over GDP	WDI
De jure measure of capital openness	1.Chinn-Ito index	Chinn & Ito (2008)
	2. Dummy variable takes value of 1 for no restrictions on capital movement and zero otherwise.	AREAER
Bilateral Trade	Ratio of total exports from country i to country j over the GDP of country i	UN Comtrade
Distance	Distance between country i and j	CIA's World Fact Book
Border	Dummy variable which takes value of 1 if i and j share a land border	CIA's World Fact Book
Language	Dummy variable which takes value of 1 if i and j have a common language	CIA's World Fact Book

APPENDIX B

B.1 Sources of Data and Data Descriptions

Scope of the study is from 1996q1 to 2008q2 using quarterly data. Sources of data are as follows: [1]

1. *Core Inflation*. Core inflation excludes raw food and energy from the consumer price index basket.Core inflation indexes at 2002 price. Data were obtained from the Bank of Thailand .Core CPI represents 79 percent of Headline Consumer Price Index.
2. *Headline Inflation*. Headline inflation indexes at 2002 price. Data were obtained from the Bank of Thailand.
3. *Expected Inflation Rate*. Estimates of expected inflation rate are obtained from the probability distribution of forecasted value of inflation rate. The data are provided by the Bank of Thailand.
4. *Rate of Change in Producer Price Index*. The rate of change in the Producer Price Index is obtained by taking the percentage change from the previous quarter of Producer Price Index from Thailand and the U.S. (PPI). Both are obtained from quarterly data in the CEIC database in. PPI is calculated by into account the total product being produced in that particular country.
5. *GDP*. Nominal Gross Domestic Product is in billion baht including statistical discrepancies.Data were obtained from EIU and IFS.
6. *Exchange Rate*. Nominal exchange rate is quoted in terms of local currency: baht per USD. Data were obtained from EIU and IFS.

[1] All the index variables were indexed at year 2002 , i.e., year 2002=100

7. *Nominal Effective Exchange Rate (NEER)*. NEER is quoted against basket of currencies. Rising of NEER means the relative appreciation of domestic currency against basket, and vice versa. NEER is obtained from the Bank of Thailand.

8. *Short-Term Interest Rate*. There are two types of interest rates being used in the study according to the decision from the Monetary Policy Committee to change the key interest rate under the inflation targeting regime.A 14-day REPO rate was used prior to 2007q1 and a 1-day REPO rate since then. Data were obtained from the Bank of Thailand.

9. *Long-Term Interest Rate*. Government bond yield was used as proxy for long-term interest rate. Source of data is IFS.

10. *Unemployment*. Rate of unemployment was calculated by the National Statistical Office. Series of data are available from Bank of Thailand.

11. *Money Supply*. M2 , that is, M1 plus quasi money at the end of period was used as proxy for money supply. M2 is quoted in billion baht. Data were obtained from EIU and IFS.

12. *Oil Price*. Diesel oil price in baht/litre is used in the model. Source of data is the Bank of Thailand.

Table B.1: Thailand Policy Measures

Date	Policy Measures
19-Dec-06	**RR 30%**
	1. Foreign currencies bought or exchanged against baht for investments in debt securities,foreign currency borrowings from Dec 19th onwards, are subject to the 30 percent foreign currency reserve requirement.
	2. Balances in Non-resident Baht Accounts are allowed to exceed 300 million baht without limit until 8 January 2007. After that, the balances shall not exceed 300 million baht.
24-Jul-07	**Relaxation of Foreign Exchange Regulations on Foreign Currency Deposits and Transfers**
	1. Allow companies registered in the Stock Exchange of Thailand, most of which are high-performance businesses and subject to supervision by government agencies, to purchase foreign currencies to invest abroad in an amount up to 100 million USD per year.
	2. Provide Thai residents, both juristic persons and individuals, with greater flexibility in depositing foreign currencies with financial institutions in Thailand.
	3. Adjust the limit of fund remittances by Thai residents for various purposes.
	4. Relax the repatriation requirement for Thai residents with foreign currency receipts by extending the period in which such receipts must be brought into Thailand from within 120 days (if exceeding 120 days but not exceeding 360 days, a financial institution may provide approval on behalf of the Competent Officer) to within 360 days.
	5. Abolish the surrender requirement for Thai residents with foreign exchange receipts from abroad to sell or deposit such receipts within period of 15 days.
	6. Relax the regulation on foreign portfolio investment by the institutional investors by allowing institutional investors to invest in the form of deposits with financial institutions abroad without seeking approval from the Competent Officer.
3-Aug-07	**Small and Medium Enterprises (SMEs) Fund**
	A 5,000-million baht fund was launched by BOT in an attempt to provide the liquidity support to SMEs which faces the liquidity shortage due to appreciation in baht
15-Aug-07	**Savings Bonds Issuance**
	40,000 million baht semi-annual BOT savings bonds with 4- year and 7- year maturity were launched as saving alternatives for individual, foundation , non-profit organization. Rate was offered at government bond rate with the same maturity date + ¡15% of return.
3-Mar-08	**Capital Control Measure Removal**

Source: Bank of Thailand

APPENDIX C

C.1 Data and Source of Data

- **ATL** Atlanta
- **BOS** Boston
- **ORD** Chicago
- **CLE** Cleveland
- **DFW** Dallas
- **DEN** Denver
- **DTW** Detroit
- **LAX** Los Angeles
- **MIA** Miami
- **MSP** Minneapolis
- **NYC** New York
- **PHX** Phoenix
- **PDX** Portland
- **SAN** San Diego
- **SFO** San Francisco
- **SEA** Seattle
- **TPA** Tampa
- **WAS** Washington

Table C.1: Variables Definitions and Sources

Variable	Definition	Source
City Data		
House Price Index	Case-Shiller Index by MSA	http://www.macromarkets.com
Mortgage Rate	Mortgage rate by MSA	Federal Housing Finance Board(FHFB) and author's calculation
Real Personal Income	Per capita real disposable income by MSA	U.S.Bureau of Economic Analysis (BEA)
Inflation Rate	Urban inflation rate (year 2000 =100)	U.S. Bureau of Labor Statistics (BLS)
Expected Inflation Rate	Median expected price change next 12 months	Surveys of Consumers, University of Michigan
Housing Stock	Building permits by MSA	U.S. Census Bureau
Mortgage Credit Constraint	Loan-to-value ratio for first time borrower by MSA	Federal Housing Finance Board(FHFB)
Unemployment Rate	Unemployment rate by MSA	U.S. Bureau of Labor Statistics (BLS)
Income Tax	Average tax rate	Internal Revenue Services
Population	Total population by MSA	U.S.Bureau of Economic Analysis (BEA)
Country Data		
House Price Index	U.S. Monthly House Price Index	Office of Federal Housing Enterprise Oversight (OFHEO)
Number of Houses Sold	Number of House Sold (units)	U.S. Census Bureau
TED Spread	Difference between LIBOR USD 3-month and 3-month T-Bill rate	Federal Reserve Statistical Release
Ratio of Housing Loans	Ratio of mortgage loans by non-bank financial institutions to total mortgage loans	Flow of Funds, Federal Reserve Statistical Release
Credit Default Swap	CDX Index	Bloomberg
GDP per capita	Interpolate series of real GDP per capita (2000 price)	U.S.Bureau of Economic Analysis (BEA)
Household Consumption per capita	Interpolate series of real household consumption per capita (2000 price)	U.S. Bureau of Labor Statistics (BLS)

C.2 City Data: Panel Unit Root Test

The test is not performed on mortgage rate and expected inflation since there is no variation across groups of MSA.

```
. local var lcase lry lu lpop lhs lm

. foreach x of local var {
  2. levinlin `x´, lags(4)
  3. }

Levin-Lin-Chu test for lcase      Deterministics chosen: constant
Pooled ADF test, N,T = (18,186)   Obs = 3258
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.00191       -3.804       0.85944      0.8050

Levin-Lin-Chu test for lry        Deterministics chosen: constant
Pooled ADF test, N,T = (18,192)   Obs = 3366
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.00704       -1.723       1.44658      0.9260
```

```
Levin-Lin-Chu test for lu         Deterministics chosen: constant
Pooled ADF test, N,T = (18,192)   Obs = 3366
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.03692       -7.269      -1.26346      0.1032

Levin-Lin-Chu test for lpop       Deterministics chosen: constant
Pooled ADF test, N,T = (18,192)   Obs = 3366
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.01123      -11.269     -14.03667      0.0000

Levin-Lin-Chu test for lhs        Deterministics chosen: constant
Pooled ADF test, N,T = (18,192)   Obs = 3366
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.23116      -12.742      -0.39991      0.3446

Levin-Lin-Chu test for lm       Deterministics chosen: constant
Pooled ADF test, N,T = (18,190)   Obs = 3330
Augmented by 4 lags (average)     Truncation: 18 lags
coefficient    t-value        t-star       P > t
 -0.02246       -5.788       0.38533      0.6500
```

C.3 National Data: Tests on Unit Root Test, Residual Stability , Autocorrelation, and Estimation of Impulse Response Function

C.3.1 Unit Root Test of Log Form

```
. local var lhp  lmort_ratio lspread lcdx lry lrc  lhsold

. foreach x of local var{
  2. dfuller `x´ , lag(3) trend
  3. }
```

Augmented Dickey-Fuller test for unit root Number of obs = 59

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	1.006	-4.130	-3.491	-3.175

MacKinnon approximate p-value for Z(t) = 1.0000

Augmented Dickey-Fuller test for unit root Number of obs = 58

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.877	-4.132	-3.492	-3.175

MacKinnon approximate p-value for Z(t) = 0.6664

Augmented Dickey-Fuller test for unit root Number of obs = 59

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.336	-4.130	-3.491	-3.175

MacKinnon approximate p-value for Z(t) = 0.0606

Augmented Dickey-Fuller test for unit root Number of obs = 59

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.075	-4.130	-3.491	-3.175

MacKinnon approximate p-value for Z(t) = 0.9934

Augmented Dickey-Fuller test for unit root Number of obs = 59

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	0.134	-4.130	-3.491	-3.175

MacKinnon approximate p-value for Z(t) = 0.9954

Augmented Dickey-Fuller test for unit root Number of obs = 59

	Test Statistic	Interpolated Dickey-Fuller 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	2.000	-4.130	-3.491	-3.175

MacKinnon approximate p-value for Z(t) = 1.0000

```
Augmented Dickey-Fuller test for unit root         Number of obs   =        59

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test            1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -0.841            -4.130            -3.491            -3.175
------------------------------------------------------------------------------

MacKinnon approximate p-value for Z(t) = 0.9621

.
.
. local var lhp  lmort_ratio lspread lcdx lry lrc  lhsold

. foreach x of local var{
  2. dfuller d.`x´,  lag(3) drift
  3. }

Augmented Dickey-Fuller test for unit root         Number of obs   =        58

                                 ------------ Z(t) has t-distribution ------------
                 Test            1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -1.362            -2.399            -1.674            -1.298
------------------------------------------------------------------------------

p-value for Z(t) = 0.0894

Augmented Dickey-Fuller test for unit root         Number of obs   =        57

                                 ------------ Z(t) has t-distribution ------------
                 Test            1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -5.187            -2.400            -1.675            -1.298
------------------------------------------------------------------------------
```

p-value for Z(t) = 0.0000

Augmented Dickey-Fuller test for unit root Number of obs = 58

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Z(t) has t-distribution		
Z(t)	-5.102	-2.399	-1.674	-1.298

p-value for Z(t) = 0.0000

Augmented Dickey-Fuller test for unit root Number of obs = 58

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Z(t) has t-distribution		
Z(t)	-3.891	-2.399	-1.674	-1.298

p-value for Z(t) = 0.0001

Augmented Dickey-Fuller test for unit root Number of obs = 58

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Z(t) has t-distribution		
Z(t)	-3.357	-2.399	-1.674	-1.298

p-value for Z(t) = 0.0007

Augmented Dickey-Fuller test for unit root Number of obs = 58

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Z(t) has t-distribution		

Z(t)	-3.412	-2.399	-1.674	-1.298

p-value for Z(t) = 0.0006

Augmented Dickey-Fuller test for unit root Number of obs = 58

		Z(t) has t-distribution		
	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-3.647	-2.399	-1.674	-1.298

p-value for Z(t) = 0.0003

C.3.2 Test on Residual Stability

```
. vecstable, graph
```

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
1	1
.9630396	.96304
.5215825 + .2799811*i*	.591978
.5215825 - .2799811*i*	.591978
.1310107 + .5717102*i*	.586529
.1310107 - .5717102*i*	.586529
-.5056534	.505653
-.2586157 + .390979*i*	.468771
-.2586157 - .390979*i*	.468771
-.3197164	.319716

The VECM specification imposes 5 unit moduli.

C.3.3 Test of Autocorrelation of Residuals

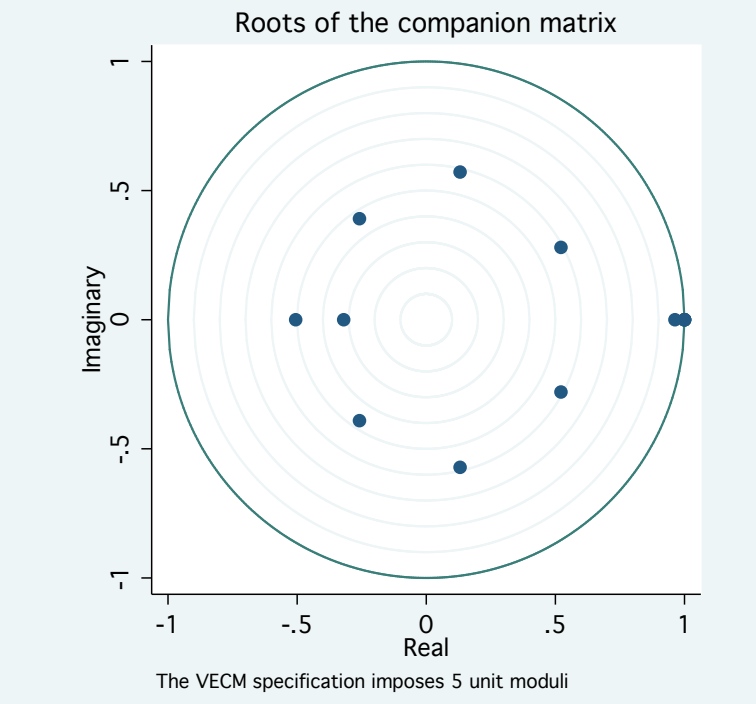
```
. veclmar

  Lagrange-multiplier test
```

lag	chi2	df	Prob > chi2
1	76.3271	49	0.00748
2	61.5405	49	0.10776

```
  H0: no autocorrelation at lag order
```

Figure C.1: Roots of Companion Matrix



Source: Author´s Calculation

C.3.4 Impulse Response Function

```
. irf table coirf, irf(vec1) impulse(lhp) ;
response(lmort_ratio_i lspread lcdx lry_i lrc_i  lhsold)
```

step	(1) coirf	(2) coirf	(3) coirf	(4) coirf	(5) coirf	(6) coirf
0	.001581	-.03416	.000645	.000559	.000211	.011276
1	.003862	-.068617	.018337	.004487	.002979	.028407
2	.00539	-.081916	.023062	.00834	.004952	.046397
3	.006996	-.034601	.011934	.012213	.006593	.068494
4	.008322	.029599	-.008689	.016505	.008543	.094275
5	.009607	.086315	-.032539	.020714	.010454	.12292
6	.010775	.145687	-.057735	.025014	.012565	.153995
7	.011884	.206562	-.089067	.029502	.014995	.18744
8	.012975	.265101	-.128235	.034158	.017727	.22359
9	.014072	.320018	-.174394	.038996	.02076	.262399
10	.015167	.371736	-.226894	.044017	.02408	.303726
11	.016256	.421312	-.28564	.049212	.027669	.347456
12	.017337	.469257	-.350565	.054578	.031515	.39352
13	.018413	.515546	-.421427	.060105	.035605	.441839
14	.01948	.560213	-.497901	.065785	.039928	.492326
15	.02054	.603388	-.579734	.071614	.044475	.54489
16	.021591	.645162	-.666739	.077584	.049237	.599455
17	.022635	.685569	-.758737	.08369	.054207	.655947
18	.023671	.724636	-.855543	.089928	.059378	.714295
19	.0247	.762402	-.956974	.096293	.064742	.774431
20	.025723	.798916	-1.06286	.10278	.070293	.836288
21	.026739	.834227	-1.17304	.109384	.076022	.899803
22	.027748	.868377	-1.28736	.116101	.081924	.964915
23	.028752	.901409	-1.40566	.122928	.087992	1.03156
24	.02975	.933365	-1.52779	.129859	.09422	1.0997

(1) irfname = vec1, impulse = house price, and response = Mortgage ratio

(2) irfname = vec1, impulse = house price, and response = TED Spread

(3) irfname = vec1, impulse = house price, and response = CDX index

(4) irfname = vec1, impulse = house price, and response = Real GDP per capita

(5) irfname = vec1, impulse = house price, and response = Real consumption per capita

(6) irfname = vec1, impulse = house price, and response = Number of house sold

Table C.2: Subprime Crisis in Chronological Order, 2006–2007

Late 2006	The U.S. housing market slows after 2 years of increases in official interest rates. Delinquencies rise, a wave of bankruptcies.
Feb 7	Europe's biggest bank HSBC holdings blamed soured U.S. subprime loans for its first-ever profit waning.
Feb 13	Country-wide shares drop as Fremont General Corp., one of the largest providers of subprime loans, says it has stopped offering some second mortgages.
Apr 2	Subprime lender New Century Financial Corp. files for bankruptcy.
Jun 20	Two Bear Stearns funds sell 4 billion USD of assets to cover redemptions and expected margin calls after making bad bets on securities backed by subprime mortgages.
Jul 10	Standard & Poors said it may cut ratings on some 12 billion USD of subprime debt.
Jul 17	Bear Stearns says two hedge funds with subprime exposure have very little value; credit spreads soar.
Jul 20	Home foreclosures rise 9 percent in July from June and soar 93 percent from the previous year.
Aug 9	French bank BNP Paribas bars investors from redeeming cash in 2.2 billion USD worth of funds, telling the markets it is unable to calculate the value of the asset-backed securities funds.
Aug 10	Central banks pump billions of dollars into banking systems in a concerted effort to beat back a credit crisis.
Aug 17	Fed surprises by cutting its discount rate by half a percentage point to 5.75 percent, cites tightening credit markets.
Sep 13	UK mortgage lender Northern Rock seeks emergency financial support from the Bank of England. The report sparked a run on the banks deposits by worried savers.
Oct 1	Swiss bank UBS says it would write down 3.4 billion USD in its fixed-income portfolio and elsewhere, first quarterly loss in 9 years.
Oct 15	Bank of America, Citigroup, and JP Morgan Chase plan fund to pool assets from stressed SIVs to prevent a fire sale of these assets.
Oct 30	Merrill Lynch ousts Chairman and Chief Executive Stan ONeal after reporting biggest quarterly loss in company's history.
Nov 4	Citigroup announces a further 8–11 billion USD of subprime-related writedowns and losses. Charles Prince resigns as CEO.
Dec 6	Treasury, lenders set plan to bring reset relief to many of the 2 million homeowners facing higher rates.
Dec 12, 2007	Central banks coordinate the launch of a new temporary term auction facility to address pressures in short-term funding markets.
Mar 16, 2008	Bear Stearns is acquired for 2 USD a share by JP Morgan Chase in a fire sale avoiding bankruptcy. The deal is backed by the Federal Reserve,
	providing up to 30 billion USD to cover possible Bear Stearn losses.
Jul 17	Major banks and financial institutions had borrowed and invested heavily in mortgage backed securities and report losses of approximately 435 billion USD.
Sep 14	Merrill Lynch is sold to Bank of America amidst fears of a liquidity crisis and Lehman Brothers collapse.
Sep 15	Lehman Brothers files for bankruptcy protection.
Sep 17	The U.S. Federal Reserve lends 85 billion USD to American International Group (AIG) to avoid bankruptcy.
Oct 3	President George W. Bush signs the Emergency Economic Stabilization Act, creating a 700 billion USD Troubled Assets Relief Program to purchase failing bank assets.
Oct 6	Fed announces that it will provide 900 billion USD in short-term cash loans to banks.
Oct 7	Fed makes emergency move to lend around 1.3 trillion USD directly to companies outside the financial sector.
Nov 24	The U.S. government agrees to rescue Citigroup after an attack by investors causes the stock price to plummet 60 percent over the previous week under a detailed plan that
	including injecting another 20 billion USD of capital into Citigroup bringing the total infusion to 45 billion USD.
Nov 25	The U.S. Federal Reserve pledges 800 billion USD more to help revive the financial system. 600 billion USD will be used to buy mortgage bonds issued or guaranteed by
	Fannie Mae, Freddie Mac, and Ginnie Mae, and the Federal Home Loan Banks.

Source: Longstaff (n.d.)
and Author's Compilation

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