FINANCIAL INTERMEDIATION COSTS: EFFECTS ON BUSINESS CYCLES, DELAYED RECOVERIES AND RELATIVE CONSUMPTION VOLATILITY

By

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To my family... Ülkü, Nurettin and Onur Şapçı

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TABLE OF CONTENTS

Page

LIST OF TABLES

Table Page

CHAPTER II

CHAPTER III

CHAPTER IV

LIST OF FIGURES

Table Page

CHAPTER II

CHAPTER III

CHAPTER IV

CHAPTER I

INTRODUCTION

Banks have an indispensable role in the US economy. According to the FDIC's National Survey in 2011, only 8.2% of all US households are unbanked. Five commercial banks made the top 25 of Fortune 500's most profitable companies in 2011. In profitability, the number of commercial banks in the top 25 surpassed even the petroleum refining industry, which had four companies. Moreover, two of the most catastrophic economic crises in the US history, the Great Depression and the Great Recession, were initiated and magnified by disruptions in the financial sector.

Although the impact of banks on the US economy is critical, scholarly attention has been lacking. Macroeconomic theory has generally treated them as empty buildings in which lenders and borrows come together and exchange funds costlessly. Only recently banks have been thought of as profit maximizers just like other non-financial firms in dynamic general equilibrium models (see Gertler and Karadi (2011) and Gertler and Kiyotaki (2010)).

Even though the literature have recognized the importance of banks, they still maintained the costless intermediation assumption. However, like non-financial firms, banks incur real costs such as wages, litigation expenses, professional service fees, etc. and expend great efforts to keep them under control. For instance, in March 2009 the president and the CEO of Bank of America, Kenneth D. Lewis, began his "Letter to Shareholders" by highlighting the adverse effects of the 2008 recession on company's profits. Notably, the first factor Lewis identified with respect to declining profits was increasing intermediation

cost: "Credit costs, which had been rising steadily all year, escalated as unemployment and underemployment rose sharply. We expect credit costs to continue to rise this year." Lewis's letter tells us what economists have often ignored: Intermediation costs are vital.

Several studies have incorporated intermediation costs into general equilibrium models. For instance, Cook (1999) and Antunes et al. (2008 and 2013) use the idea of costly intermediation to generate a wedge between deposit and lending rates. While Cook (1999) finds that intermediation cost magnifies the monetary shocks, Antunes et al. (2008) show that these costs account for part of the differences in international income levels. Additionally, Antunes et al. (2013) show that a one percent reduction in intermediation costs leads to a 1.9 percent increase in the US consumption.

Despite a step forward, these studies had limitations because they did not have a micro level, high frequency data which is important to capture the characteristics of intermediation costs and their effects on business cycles. They use an annual dataset covering the period 1993-2009 across countries. Because of this data limitation, they only use the intermediation cost as a static mechanism (more like a ratio that does not change over time) that creates a spread between deposits and lending rates.

This dissertation fills the gap in the literature by constructing a micro level dataset containing intermediation cost breakdowns for large and mid-sized banks in a quarterly frequency. This dataset allows me to focus on the characteristics of intermediation costs in great detail and to study their effects on business cycles more accurately. Using this new dataset and combining it with the previously annualized international data, this dissertation also highlights the role of intermediation costs in extending recoveries from recessions and increasing consumption volatility across countries.

The second chapter of this dissertation analyzes financial intermediation costs

in detail using this unique quarterly dataset. These costs entail four characteristics. First, intermediation costs are strongly countercyclical. Second, the probability of having a large increase in intermediation costs is much greater than the probability of having a same magnitude decrease. Third, an international comparison shows that developed countries generally have lower intermediation cost per asset than their less developed counterparts which can suggest an efficiency measure for financial intermediaries. Finally, intermediation costs co-move with bank lending rates very closely across countries.

After presenting the characteristics of intermediation costs, this chapter then estimates the size and nature of the dynamic relationship between business cycles and financial intermediation costs using a VAR framework. This chapter also constructs a theoretical model targeting the VAR estimates to understand how these effects take place in an economy. This model is based on the financial accelerator mechanism (Bernanke et al. (1999)) and relies on the feedback effect between this mechanism and financial intermediation costs. Simulated results of the model fit the data very well and show that financial intermediation costs create and magnify recessions significantly by triggering the financial accelerator mechanism.

The third chapter turns to the role of intermediation costs in extending recoveries from recessions. Using the model developed in the first chapter, I explore three questions: (1) Why do recessions take place suddenly, whereas recoveries are gradual? (2) Why do banks tend to increase their lending rates in recessions immediately, but they are reluctant to decrease them even after recoveries take place? and (3) Why are the first two empirical facts more pronounced in financially less developed countries? By incorporating the costly intermediation, the model proposed in the second chapter can answer all three questions. In this chapter, I show the accuracy of the mechanism by conducting simulations

of the model and comparing them across countries.

The fourth chapter highlights the role of intermediation costs on preventing consumption smoothing. The model proposed in this chapter introduces housing market interactions to explain relative consumption volatility differences between developed and emerging countries using the costly intermediation framework. In the final chapter I summarize my findings.

CHAPTER II

FINANCIAL INTERMEDIATION COSTS

Financial intermediation costs consist of all non-interest costs that a bank undertakes to operate. These costs range from personnel, marketing, litigation to data processing expenses and are sometimes called overhead costs. Table 2-1 presents intermediation costs of Fifth Third Bank to provide a breakdown of the types of expenses that a bank could incur.[1]

The unique dataset of this chapter contains all financial intermediation cost breakdowns and assets of individual banks. They are obtained from Mergent Online's collection of bank income statements and balance sheets. This micro level data covers most of the commercial banks with asset sizes larger than 50 billion dollars (large banks) and between 5 and 10 billion dollars (mid-sized banks) for the period of 1992:1-2011:4.[2] With over 3200 observations, this dataset represents all commercial banks well by capturing a large share of total assets in the sector. For instance, total assets of banks in this sample account for 55 percent of all commercial banks in the US.[3] Additionally, the heterogeneity created by mid-sized banks causes the dataset to represent the real world better. While quarterly frequency of the data allows the study of the relationship between intermediation costs and business cycles, cost breakdowns helps to introduce a non-trivial banking sector. To the

[1]Fifth Third Bank is chosen for its detailed cost decomposition. Most of the other banks report their aggregate costs without providing much detail except the large items such as salaries, litigation and occupancy.

[2]To maintain the consistency across time and banks, some banks are deducted from the analysis.

[3]Data for total assets of all commercial banks is obtained from FRED, Federal Reserve Economic Data of St. Louis.

Table 2-1: Intermediation Costs of Fifth Third Bank

in millions	**2007**	**2008**	**2009**	**2010**	**2011**
Salaries, Wages & Incentives	1239	1337	1339	1430	1478
Employee Benefits	278	278	311	314	330
Net Occupancy	269	300	308	298	305
Technology & Communications	169	191	181	189	188
Card & Processing	244	274	193	108	120
Equipment Expenses	123	130	123	122	113
FDIC Insurance	-	73	269	242	201
Loan Processing	119	188	234	211	195
Marketing Expenses	84	102	63	77	58
Affordable Housing Investments	57	67	83	100	85
Professional Services Fees	35	102	63	77	58
Travel Expenses	54	54	41	51	52
Postal & Courier	52	54	53	48	49
Operating Lease Expenses	22	32	39	41	41
Recruitment & Education	-	33	30	31	31
Data Processing	-	-	33	30	31
Insurance	-	-	21	24	29
Intangible Asset Amortization	42	56	57	43	22
Supplies	31	31	25	24	18
Visa Litigation Reserve	172	(99)	(73)	-	-
Provision for Unfunded Commitments	-	98	99	(24)	(46)
Other Noninterest Expense	298	298	277	166	186
Total Other Noninterest Expense	1012	2054	1395	1614	1387
Total Noninterest Expense	3311	4564	3826	3855	3758

Notes: Data is obtained from Mergent Online. Some of the accounts are organized for consistency purposes.

best of my knowledge, this is the first study that examines the business cycle properties of financial intermediation costs using high frequency data.

This dataset uncovers four empirical facts about financial intermediation costs. First, financial intermediation costs increase sharply during recessions. Second, costs are fairly sticky. They increase easily during recessions however it takes a very long time to return their previous level, creating an asymmetry. Third, an analysis of these costs across countries support the first fact for not only the US but also for other countries. Moreover, as one country becomes more developed, its banks operate at lower cost to asset ratio than the ones in less developed countries. Finally, bank lending rates and intermediation costs co-move closely for all countries in the sample. In other words, when intermediation becomes costly, banks reflect this increase in their lending rates.

The next four sections introduce these characteristics of financial intermediation costs. The cyclicality of costs are examined in the first section, whereas the sticky behavior of costs are studied in the next. While the third section compares intermediation costs across countries, the fourth section covers the relationship between lending rates and costs. The fifth section introduces a time series analysis focusing on VAR estimations to compute the magnitude of the effects of costs on business cycles. The last section introduces a theoretical model capturing the effects of financial intermediation costs on the economy that is motivated in the fifth section.

Cyclicality of Financial Intermediation Costs

Figure 2-1 demonstrates the cyclical behavior of financial intermediation cost. It plots the total costs of three largest commercial banks with respect to asset sizes on the

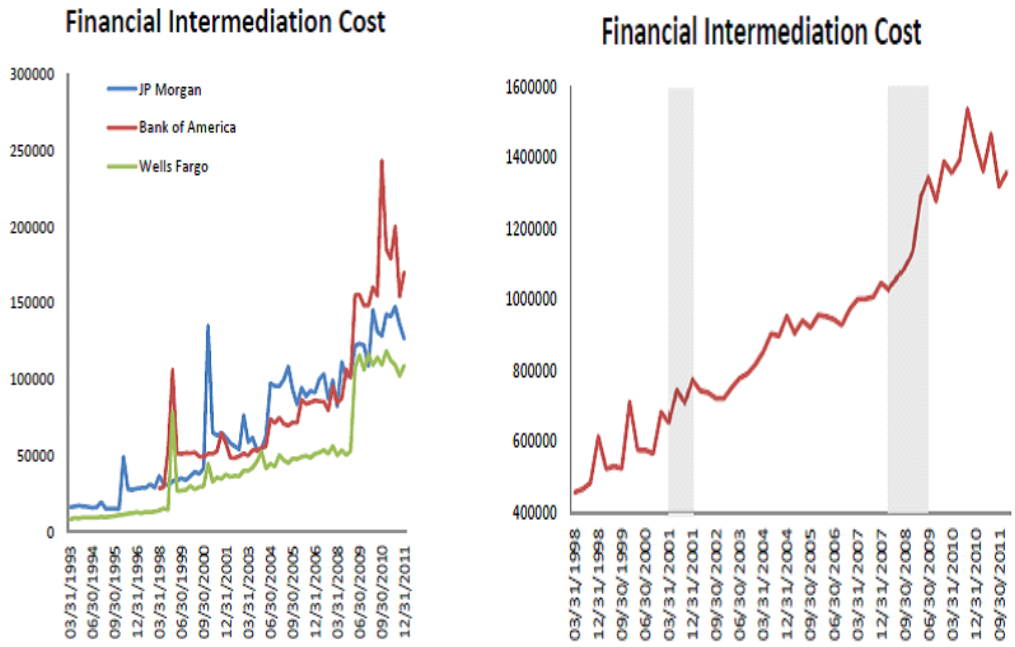

Figure 2-1: Total Intermediation Cost: Largest Three Banks and the Aggregate

left panel and the aggregation of all banks on the right panel. Costs tend to increase beyond the trend during recessions which are denoted with gray shades. They return to their normal trend with a delay after recoveries peak up.

Although almost all cost items increase during recessions, some of them cause a major spike in total intermediation costs. These are loan processing expenses, professional service fees, litigation expenses, and marketing expenses. During recessions, banks usually have increasing difficulties in collecting accurate information about borrowers due to the uncertainty in the economy, and therefore incur higher loan processing expenses. To overcome these difficulties, banks hire analysts, consultants, attorneys and accountants that inflate their professional service expenses. For instance, the professional service fees, which are normally stable, increased more than three times for International Bank of Commerce during the recent recession. Additionally, as more and more borrowers declare bankruptcy

due to unfavorable economic conditions, bank litigation expenses increase dramatically as well. Only First Bank had more than four times increase in its legal costs from 2007 to 2009. During recessions, banks also try to regain their lost reputation by investing more on marketing. For instance, Old National Bank's marketing expenses tripled during the recent recession.

However, a cost increase is not necessarily bad for the economy. In particular, an increase in costs can be a result of an enhancement in assets. For instance, as assets increase (e.g., as banks provide more loans or open new branches) it is natural to expect a proportional increase in intermediation costs as well. Figure 2-2 plots the real aggregate intermediation cost and real total assets for the sample. Both series are detrended with Hodrick-Prescott filter. Grey shaded areas again indicate the 2001:1-2001:4 and 2007:4-2009:3 recessions, respectively. The Figure shows that the financial intermediation cost and total assets move very closely. In fact, the correlation between the intermediation cost and assets is above 90 percent. Therefore, it is not easy to understand whether a cost increase is due to growing assets or due to the uncertainty created by the recession.

The ratio of intermediation cost to total assets solves the problem addressed above and provides an efficiency interpretation by showing how much a bank has to pay in order to raise one dollar worth of assets. The left panel of Figure 2-3 shows this ratio for the biggest and smallest banks in both large and mid-sized bank groups. The right panel shows the same measure for the aggregated sample. As Figure 2-3 indicates, individual banks and the entire banking sector in the US become less cost efficient during recessions. Cost efficiency generally increases during recoveries.

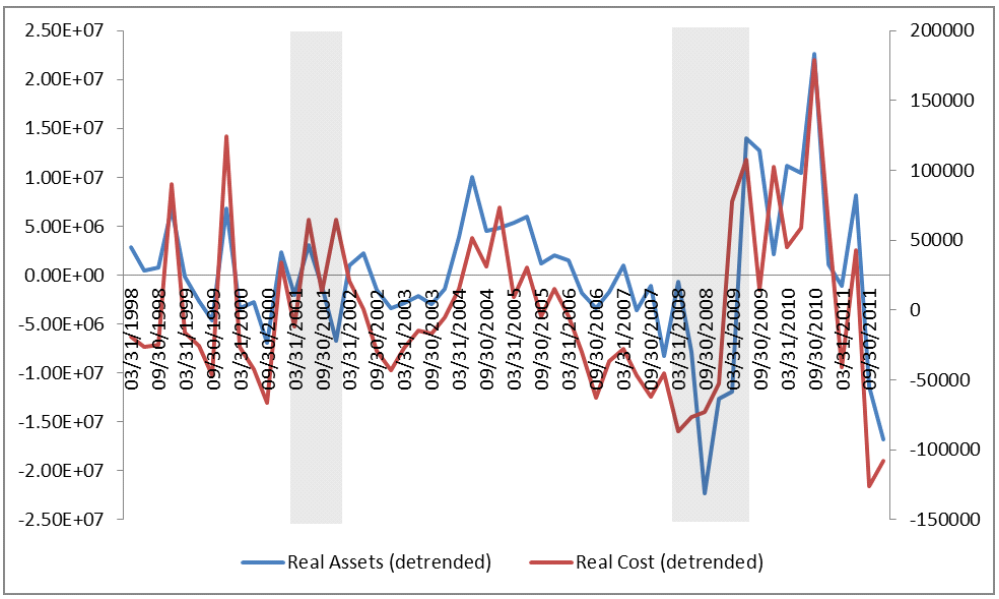

Figure 2-2: Comparison of Total Costs with Total Assets:

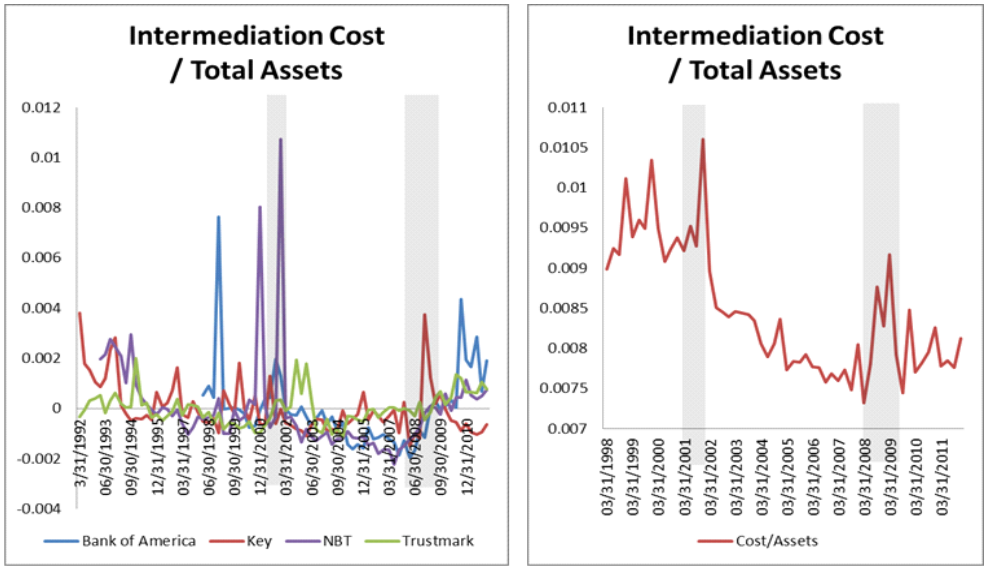

Figure 2-3: Intermediation Costs / Total Assets for Some Banks and for the US

Asymmetry in Financial Intermediation Costs

The second empirical fact related to the financial intermediation cost is its sticky behavior during recoveries. As Figure 2-1 shows, the total intermediation cost increases sharply during recessions, however it takes quite long time to return to its trend. Figure 2-3 demonstrates that the intermediation cost per asset also shows the same asymmetry with the aggregate measure. Cost per asset increases quickly as a recession hits the economy, however its recovery is very gradual over time which creates an asymmetry in the financial sector.

As commonly used in the business cycle asymmetry literature, I compute the skewness of the growth rate of costs to assets ratio to account for the asymmetry. In this analysis, I detrended the data with Hodrick Prescott filter and computed the growth rate of detrended series. I used the adjusted Fisher-Pearson standardized moment coefficient according to the following formula. In this formula, T corresponds to number of quarters in the sample; x_t is the growth rate of the detrended aggregate cost to assets ratio; and $\bar{x}$ denotes the sample mean of the series.

$$Skewness = \frac{T}{(T-1)(T-2)} \frac{\sum_{t=1}^{T} (x_t - \bar{x})^3}{\left[\sum_{t=1}^{T} (x_t - \bar{x})^2\right]^{\frac{3}{2}}}$$

If this ratio is more likely to experience larger jumps than reductions of the same magnitude, the skewness of its growth rate must be positive. In fact, the skewness of the cost per asset is found to be 3.95 which is outside of the 90 percent interval of $[-0.539, 0.539]$. This strongly positive skewness suggest that the financial intermediation cost to total asset ratio is more likely to increase than to decrease. Moreover, this fact holds if the individual bank level data is examined rather than the aggregate data.

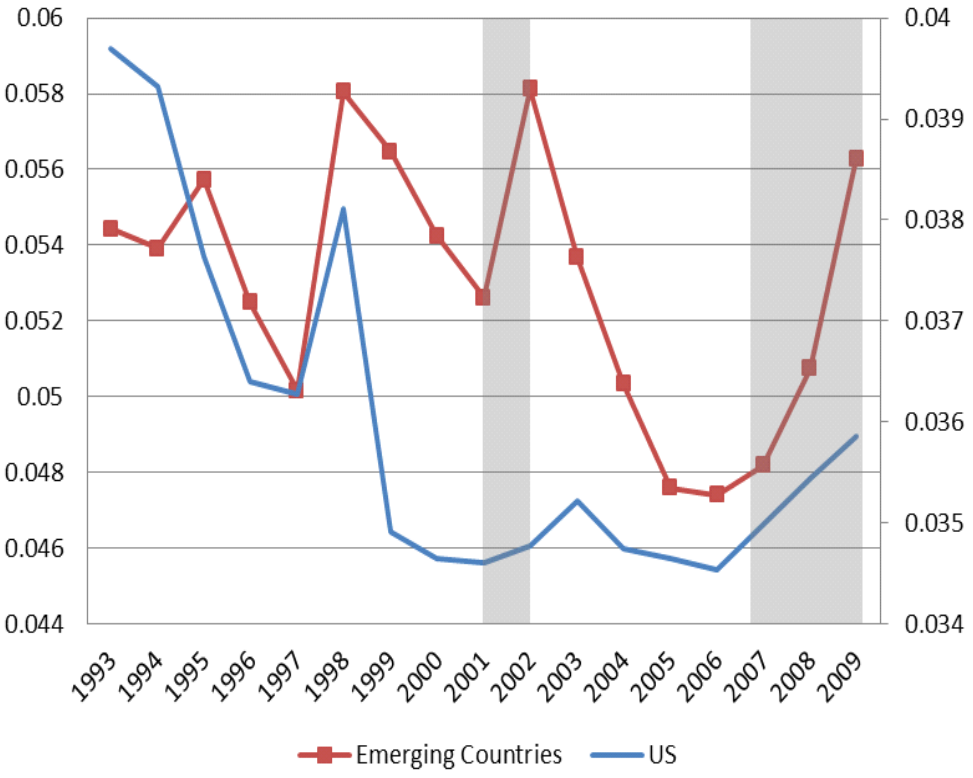

Figure 2-4: Financial Intermediation Costs / Total Assets for the US and Emerging Countries

Notes: The shaded areas show the recessionary periods since 1993. While the values for the US corresponds to the right scale, emerging countries are subject to the left scale. For the list of the emerging countries see footnote 3.

Comparison of Financial Intermediation Costs across Countries

Beck et al. (2010) aggregates financial intermediation costs at country level and reports them annually as a ratio to total assets for 77 countries between 1993 and 2009. Using a subset of their dataset, Figure 2-4 compares intermediation costs to total assets ratios for the US and the average of the 16 emerging countries over time. [4] Even though the ratio decreased over time as a result of financial development, it increased significantly both in 2001 and 2007-2009 recessions.

This ratio can also be translated into financial development as more developed financial sectors should have lower ratio of intermediation costs to total assets. In fact, this

[4]Emerging countries included to the analysis are Argentina, Brazil, Chile, Colombia, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Peru, Philippines, Russia, South Africa, Turkey and Venezuela.

Table 2-2: Intermediation Costs / Total Assets for Different Income Groups

Costs / Assets			
G-7	3.3	**Emerging**	5.3
Germany	4.3	Argentina	8.4
UK	3.1	Brazil	8.7
US	3.5	Turkey	6.3

Notes: Data is obtained from Beck et al. (2010). Values represent simple averages across countries in percentages.

ratio is around 3.5 percent in the US, but is above 8 percent in some emerging countries, such as Argentina and Brazil. Table 2-2 provides more information on financial intermediation costs per assets across country groups. According to this Table, developed countries have much lower cost to asset ratios (about 3 percent) than emerging countries (around 5 percent) on average. In other words, an average bank in a developed country pays 3 cents to raise one dollar worth of assets, whereas an average bank in an emerging country pays around 5 cents. Improving upon existing models, the comparison of intermediation costs allows me to forecast the impact of a financial crisis on countries with different development levels.

Relationship between Financial Intermediation Costs and Lending Rates

When it becomes more costly for banks to intermediate, they either raise their lending rates and/or cut their loans, both of which create distortions in an economy. Therefore, an increase in intermediation costs can have a direct impact on lending rates. While Table 2-3 demonstrates the relationship between lending rates (prime rates) and costs using the descriptive statistics of country groups, Figure 2-5 shows this relationship for all countries in the sample.[5] Table 2-3 displays the strong positive correlation between lending rates and intermediation costs. Their correlation ranges from 50 percent for least developed countries to 98 percent for most developed countries. The relatively low cross correlation

[5]The data for prime rates is obtained from Economists Intelligence Units, Country Data.

Table 2-3: The Relationship between Lending Rates and Financial Intermediation Costs for Different Country Groups: Descriptive Statistics

		Lending Rate	Intermediation Cost
All	Corr	0.666	
	Average	15.403	0.042
	Stn Dev	10.449	0.023
Developed	Corr	0.544	
	Average	6.466	0.031
	Stn Dev	1.919	0.009
G-7	Corr	0.979	
	Average	6.463	0.033
	Stn Dev	2.722	0.009
Nondeveloped	Corr	0.579	
	Average	20.223	0.049
	Stn Dev	10.525	0.026
Emerging	Corr	0.742	
	Average	17.048	0.046
	Stn Dev	8.390	0.025
Developing	Corr	0.492	
	Average	22.794	0.052
	Stn Dev	11.537	0.027

for least developed countries is a result of the heterogeneity among this group. Because of the data availability for lending rates, 52 countries are used in this analysis. The data consist of 15 developed, 16 emerging, and 21 developing countries. Table 2-3 also gives more detail about intermediation costs for a broader sample of countries. It particularly demonstrates intermediation costs differences in magnitudes between developed and less developed countries.

Figure 2-5 also shows the positive correlation between lending rates and financial intermediation costs for the entire sample of 52 countries. Countries with higher intermediation costs experience higher lending rates as well. Any increase in intermediation costs, therefore, should trigger less favorable interest rates for borrowers, causing deterio-

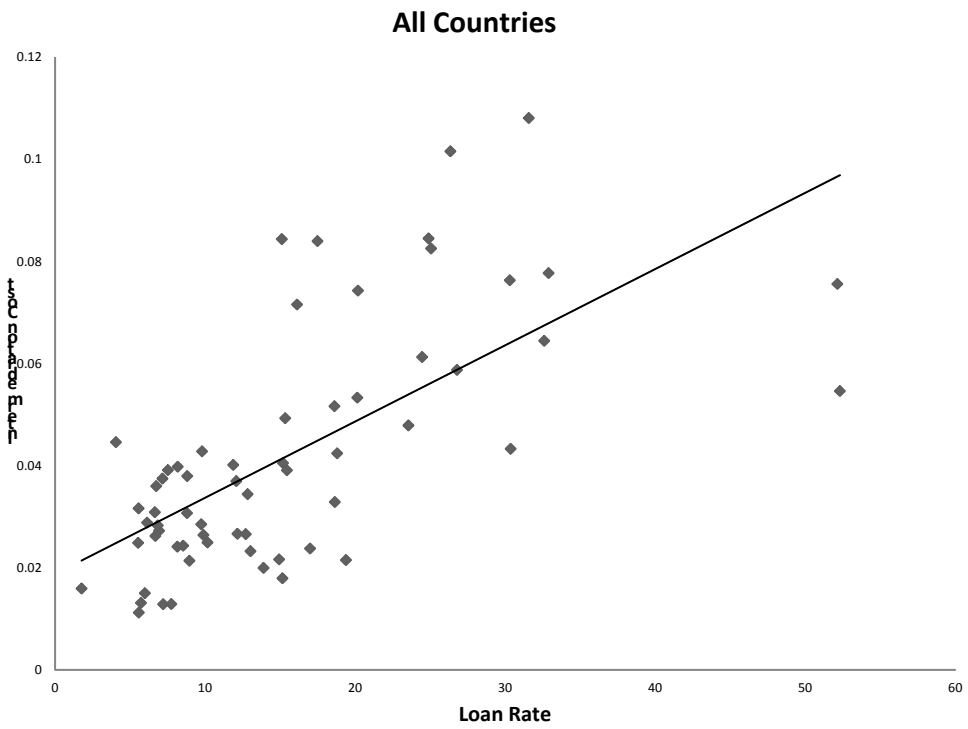

Figure 2-5: Lending Rates and Financial Intermediation Costs: All Countries in the Sample

rations in the economy. Models that are constructed in other chapters of this dissertation will be based on this relationship and its role in creating and magnifying recessions.

Impacts of Financial Intermediation Costs on Business Cycles: A Time Series Analysis

After presenting the characteristics of the dataset, I turn to explore the size and the nature of the dynamic relationship between real sector activity and financial intermediation costs. To do so, I use the vector autoregressive (VAR) framework which allows me to investigate their dynamic interactions in a multivariate system. It involves estimating a separate regression equation for each variable on its own lags and on those of the other variables in the system. Particularly, the following three variable system is used in this

analysis.

$$x_{1,t} = a_1 + \sum_{i=1}^{k} b_{1,i} x_{1,t-i} + \sum_{i=1}^{k} c_{1,i} x_{2,t-i} + \sum_{i=1}^{k} d_{1,i} x_{3,t-i} + u_{1,t}$$

$$x_{2,t} = a_2 + \sum_{i=1}^{k} b_{2,i} x_{1,t-i} + \sum_{i=1}^{k} c_{2,i} x_{2,t-i} + \sum_{i=1}^{k} d_{2,i} x_{3,t-i} + u_{2,t}$$

$$x_{3,t} = a_3 + \sum_{i=1}^{k} b_{3,i} x_{1,t-i} + \sum_{i=1}^{k} c_{3,i} x_{2,t-i} + \sum_{i=1}^{k} d_{3,i} x_{3,t-i} + u_{3,t}$$

Here x_1, x_2, and x_3 represent the real GDP, the real money stock, and the financial intermediation cost to total asset ratio, respectively. k denotes the number of lags used in the system. The lag is chosen optimally according to Akaike Information Criteria and Nested Likelihood Ratio tests. As a second set of analysis, GDP is replaced with the gross private investment to retrieve the direct effect of intermediation costs on external finance opportunities of borrowers. Money stock controls financial development levels across time.

Because stationarity is very important to have a stable VAR system, unit root tests were applied on each time series. Table 2-4.a summarizes the findings for Augmented Dickey Fuller tests (ADF) and Philips Perron tests. The lag used in the ADF test is chosen according to the Akaike information criterion. For Phillips-Perron test statistic, Bartlett kernel spectral estimation method is used and bandwidth is selected by Newey- West. The hypothesis of no unit root cannot be rejected in levels for at least one of the tests for all of the variables used in the system. However, the system is first difference stationary.

Sims, Stock, and Watson (1990) show that as long as there exist a single cointegrating relationship among variables, the error terms of the system are stationary in tri-variate VARs even in the presence of unit roots. Cointegration implies that there is a

Table 2-4: Augmented Dickey-Fuller and Phillips Perron Test Statistics

Macroeconomic Indicators:	ADF Statistic		PP Statistic	
	Level	First Difference	Level	First Difference
GDP	-0.850	-3.817**	-0.585	-5.515***
Money Stock	0.053	-2.608	2.441	-3.446***
Intermediation Cost /Total Assets	-2.110	-7.491***	-4.167**	-13.067***
Investment	-2.512	-3.277**	-1.757	-5.367***

All variables are in logs. *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 3.a: Unit Root Tests

	Maximum Eigenvalue			Trace			Cointegrating Vector [GDP lending cost]
	r=0	r<1	r<2	r=0	r<1	r<2	
GDP Money Stock Intermediation Cost/ TA(lags=3)	25.5898***	13.5945	1.5582	40.7425***	15.1527	1.5582	[1 -0.413 0.55]
Investment Money Stock Intermediation Cost /TA(lags=2)	32.9267***	8.3076	0.1849	41.4192***	8.4925	0.1849	[1 -4.39 -1.97]

Table 3.b: Cointegration Tests

Notes: *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels respectively.

linear combination of non-stationary variables that makes the series stationary. To test the existence of one cointegration vector in the system, I used the Johansen test. Table 2-3.b summarizes the results of this test. Rejection of the null hypothesis of no cointegration (r=0) and a failure to reject the null of at most one cointegrating vector (r=1) provides evidence of a single cointegrating relationship among variables. According to the Johansen test statistics, the null of no cointegration is rejected at 5 percent in both systems and the null of one cointegration cannot be rejected for any. Thus, the stationarity of error terms has been maintained with this cointegration result.

Next, I proceed to Granger Causality test to see the joint evaluation of both short- and long-term effects of movements in one variable upon the others which creates each system. Indeed, as the financial intermediation cost per asset increases, or in other words, as banks get more inefficient over time the loans will be distributed inadequately as well. This will cause distortions on the real activity since the loan distribution departs from the optimal distribution.

Table 2-5 shows the results of this test. When intermediation costs per assets increases, it causes a strong decline in GDP as the representative of economic real activities. The causality works in the opposite direction as well. Although the effect is not strong, an increase in GDP leads to a decrease in costs per assets. However, when GDP is replaced with the investment results are not statistically significant. The notion of causality must be interpreted cautiously here as it does not denote the economic causality. In the VAR system, the Granger causality assumes full information sets which most likely would be violated in any case. It, however, shows a strong linkage among the variables, particularly from cost per asset to GDP.

After characterizing a causal ordering, orthogonalized impulse responses of

Table 2-5: F-statistics for Granger-Causality in VARs with GDP and Investment

		Levels VAR Granger tests			
		GDP	Money Stock	Intermediation Cost/ Total Assets	R^2
lags 1	1a (GDP)	0.897 **(0.000)**	0.03 **(0.0075)**	-0.051 **(0.001)**	0.99
	1b (Money Stock)	0.105 **(0.0192)**	1.099 **(0.000)**	0.1197 **(0.021)**	0.98
	1c (Cost)	-0.57 **(0.0006)**	-0.0313 (0.7408)	0.346 **(0.009)**	0.70
		Levels VAR Granger tests			
		Investment	Money Stock	Intermediation Cost/ Total Assets	R^2
lags 4	1a (Investment)	0.994 **(0.000)**	0.263 **(0.0872)**	0.153 (0.2695)	0.94
	1b (Money Stock)	-0.042 (0.1829)	1.049 **(0.000)**	-0.015 **(0.0977)**	0.99
	1c (Cost)	-0.133 (0.3124)	-0.203 **(0.000)**	0.742 **(0.000)**	0.82

each variable in the system to one time shocks in others would give an idea about the magnitude of nonlinear dynamic effects. Figure 2-6 presents impulse responses to one standard deviation shocks in the system. In this analysis, the identification assumption is that the cost per asset determines the financial development level which is controlled by the money stock. Consequently, financial sector development affects the real activity represented by GDP. This assumption is consistent with the Granger causality results above. As a robustness check, I also reversed the ordering from GDP to financial development and finally to the ratio of intermediation costs per total assets. Results are robust to this reverse ordering as well.

According to the Figure 2-6, when the intermediation cost increases one standard deviation, GDP decreases by half of a percentage. Given that the change in the cost ratio is a very small one, this result is very strong. As expected from the causality results, a change in GDP has a less significant negative effect on cost per asset. An increase in cost also decreases investment, whereas a rise in investment has negative effects after a delay. These results demonstrate that the financial intermediation shock has a significant negative effect on GDP.

Financial Intermediation Costs in a Theoretical Framework: Enhanced Financial Accelerator Mechanism

In this section, I examine the role of intermediation costs in a financial accelerator framework (Bernanke et al. (1999), BGG thereafter) targeting the impulse responses generated by the VAR analysis above. To do this, I use a modified model based on financial accelerator mechanism with financial frictions. Financial frictions are added to economic models through an agency problem, as lenders cannot always trust borrowers to pay their

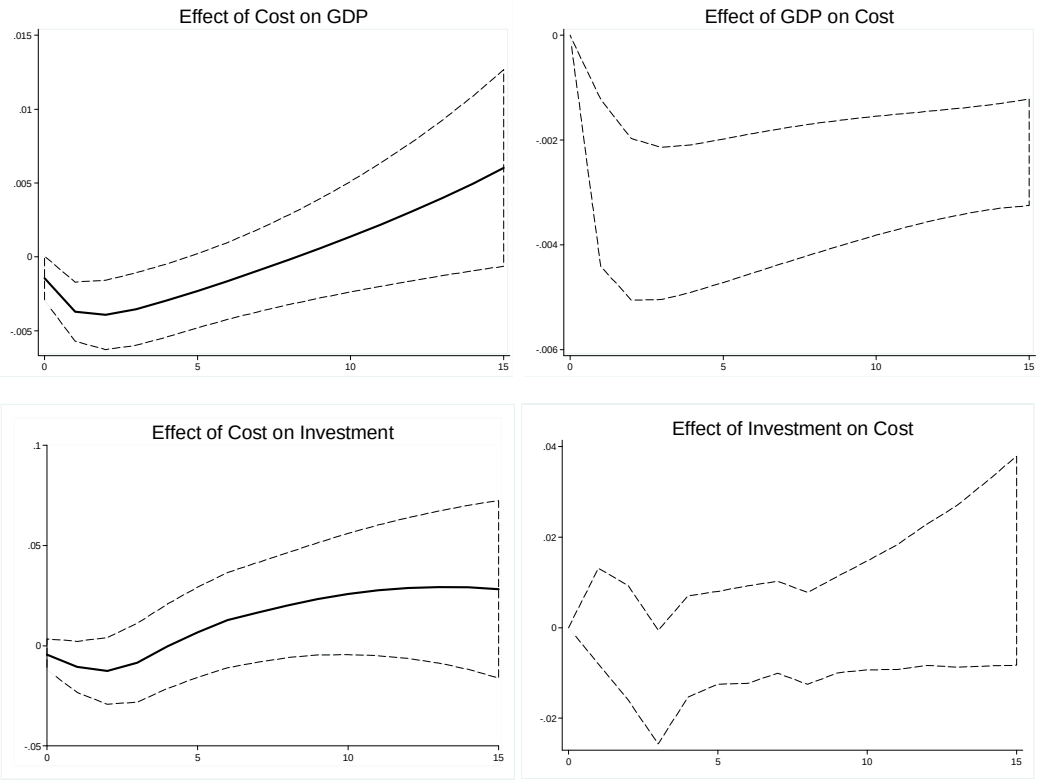

Figure 2-6: Selected Impulse Responses to One Standard Deviation Shock

loans back. This problem creates inefficiencies in the financial market which in turn amplifies the effect of negative shocks in the economy. This amplification mechanism is called "financial accelerator". Financial accelerator mechanism suggests that a negative shock in the economy decreases the total income and causes the demand for capital to decline. Lower demand pushes capital prices down and consequently assets are worth less. This intensifies the agency problem between banks and firms causing the external finance premium to rise. Growing pressure on firms' borrowing eventually leads to bankruptcies. These bankruptcies increase the external premium even more, creating an accelerator effect that amplifies recessions. Among many others, Christiano, Motto and Rostagno (2009) found that the financial accelerator mechanism accounts for a greater proportion of aggregate output fluctuations in the US and the Euro Area (27 percent and 50 percent, respectively) than the commonly used technological shock in standard models (22 percent).[6]

Despite being an important step forward, most of the financial accelerator literature does not model banks and thus cannot account the spillover of financial shocks to the economy. This model with financial intermediation costs thus provides two unique improvements in order to study the real world behavior. First, I add a realistic bank sector with their own balance sheet effects into the financial accelerator framework. This allows me to model financial intermediation between borrowers and lenders. Second, the costly intermediation allows me to introduce a new and tangible way to form financial shocks that directly affect the financial sector instead of simply amplifying the impact of other shocks. Particularly, when there is a financial shock, i.e. an increase in intermediation cost, banks either raise their lending rates and/or cut their loans, both of which create difficulties in borrowing. As borrowing becomes more costly, firms demand less capital and the price of

[6]See Christensen and Dib (2008), Gertler, Gilchrist and Natalucci (2007), and Christiano, Trabandt and Walentin (2011).

capital decreases. Net worth of firms loses value due to low asset prices and subsequently the financial accelerator mechanism emerges. Therefore, intermediation cost triggers the financial accelerator mechanism and amplifies the effects of ordinary recessions.

The Model

The dynamic stochastic general equilibrium (DSGE) model in this chapter consists of a representative household, capital builders, ex-ante similar entrepreneurs and financial intermediaries. It also introduces costly intermediation between borrowers and savers.

Households

There is a continuum of households of length unity. The total endowment of time is normalized to one. Each household works, consumes, and saves. The representative household maximizes utility over consumption, C_t, and leisure, $1-L_t$ according the following objective function.

$$\max_{C_t, D_{t+1}, L_t} E_t \left\{ \sum_{k=0}^{\infty} \beta^k \left[\ln(C_{t+k}) + \xi \ln(1 - L_{t+k}) \right] \right\} \tag{1}$$

The household chooses C_t, L_t and D_{t+1} using the objective function (1) and the budget constraint (2).

$$C_t = W_t L_t + R_t D_t - D_{t+1} \tag{2}$$

Here D_t denotes the deposits that households hold at time t which pay the riskless rate of return, R_t, and W_t is the wage rate that they get from working at non-financial firms.

The first order conditions that characterize the Euler equations for consumption and labor supply of household's problem are given in equation (3) and (4), respectively.

$$E\{C_{t+1}\} = R_{t+1}\beta C_t \tag{3}$$

$$\frac{W_t}{C_t} = \xi \frac{1}{1 - L_t} \tag{4}$$

Capital Builders

Capital builders rent the capital stock, K_t, from entrepreneurs and use it to produce new capital. Since this takes place within the period, the rental rate is zero. Capital producers maximize their profit, Π_t using the objective function below.

$$\max_{I_t} \Pi_t = \max E_t\{Q_t\theta_t I_t - I_t - \frac{\chi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t\} \tag{5}$$

While I_t represents the gross investment, δ and χ denote the depreciation rate and the adjustment cost of capital, respectively. θ_t is a shock to the marginal efficiency of investment as in Greenwood, Hercovitz Huffman (1988) which has the following AR(1) process.

$$\log \theta_t = \rho^\theta \log \theta_{t-1} + \varepsilon_t^\theta \tag{6}$$

with $\varepsilon_t^\theta \sim iid\ N(0, \sigma^2)$.

The solution to capital builders' profit maximization problem yields the following rule for capital price setting.

$$E\{Q_t\theta_t - 1 - \chi\left(\frac{It}{K_t} - \delta\right)\} = 0 \tag{7}$$

The evolution of capital satisfies:

$$K_{t+1} = \theta_t I_t + (1-\delta)K_t \tag{8}$$

Entrepreneurs

Entrepreneurs acquire physical capital, K, from capital producers at the price of Q in each period. Entrepreneurs finance the new investment either by using their net worth, N_t, or by issuing financial securities, S_{t+1}. The following equation summarizes this balance sheet condition for the entrepreneur j.

$$Q_{jt}K_{jt+1} = S_{jt+1} + N_{jt} \tag{9}$$

As in BGG, an idiosyncratic shock, ω_{jt}, affects the gross return on capital averaged across firms. ω is iid across time and across firms with a lognormal cumulative distribution function, $F(\omega)$. BGG shows that there is a cutoff value of the idiosyncratic shock , $\bar{\omega}_{jt}$, which makes the return to capital just equal to the total amount of entrepreneur $j's$ debt.

$$\bar{\omega}_{jt+1}R^k_{t+1}Q_tK_{jt+1} = Z_{jt+1}S_{jt+1} \tag{10}$$

Here R^k_{t+1} and Z_{jt+1} denote the gross return on capital and the gross non default rate, respectively. When the entrepreneur cannot pay his debt, in other words, if the realization of ω_{jt} is lower than the threshold value, he defaults. The financial intermediary overtakes all the remaining assets of the firm and tries to fire sale them. A fraction, μ, of the bankrupt firm's total assets is lost during fire sales. Notice that μ has a different meaning than in BGG. This fraction is used to denote the costly state verification in BGG, and

decreases in recessions as it is multiplied with total assets. However, costs tend to increase during recessions as can be captured in this model. μ is not contained in the intermediation costs used in the model or data.

Given that firms are ex-ante same the aggregate net worth evolves according to the equation (11).

$$N_{t+1} = \gamma \left[R^k_{t+1} Q_t K_{t+1} - R^s_{t+1}(Q_t K_{t+1} - N_t) \right] + (1-\gamma) g_t \tag{11}$$

where R^s_{t+1}denotes the external finance premium as follows.

$$R^s_{t+1} = \left(R_{t+1}(1+c_t) + \frac{\mu \int_0^{\bar{\omega}} \omega f(\omega) d\omega R^k_{t+1} Q_t K_{t+1}}{Q_t K_{t+1} - N_t} \right) \tag{12}$$

γ symbolizes the constant survival probability of firms to the next period. The constant survival probability introduces dynamics to the life of entrepreneurs by implying an expected lifetime equal to $\frac{1}{1-\gamma}$. It also guarantees that an entrepreneur cannot accumulate enough wealth to self finance his projects. g_t is the start up money transfer from exiting to new entrepreneurs. As Equation (12) shows the intermediation cost increases the gap between the external premium and the risk free rate. c_t,the financial intermediation cost, follows the AR(1) process shown in equation (13).

$$\ln c_t = (1-\rho^c) \ln \bar{c} + \rho^c \ln c_{t-1+} \varepsilon^c_t \tag{13}$$

Notice that the intermediation cost does not become zero in the steady state. Instead it is equal to its long run average $\bar{c}$, because in reality costs never diminish entirely.

Financial Intermediaries

There are many identical financial intermediaries that operate in a perfectly competitive environment. They can purchase securities by using their own net worth and deposits collected from households. The balance sheet equation for intermediaries can be expressed as:

$$(1 + c_t)S_{t+1} = N_t^b + D_{t+1} \tag{14}$$

Here c_t represents the intermediation cost of financial intermediaries. A portion equal to c_t of total intermediary assets are lost to create the optimal contract which satisfies the following condition.

$$\left[(1 - F(\bar{\omega}_t))\bar{\omega}_t + (1 - \mu)\int_0^{\bar{\omega}_t} \omega f(\omega) d\omega\right] R_{t+1}^k Q_t K_{t+1} = R_{t+1}(1 + c_t)S_{t+1} \tag{15}$$

According to (15), the optimal contract must satisfy a condition that guarantees the equality of the expected return of providing funds to firms given by the left hand side to its opportunity cost represented by the right hand side.

The net worth of intermediaries is given by:

$$N_{t+1}^b = R_{t+1}^s S_{t+1} - R_{t+1} D_{t+1} \tag{16}$$

The first term in the right hand side of (16) shows the expected return form financial intermediation, whereas the second term denotes the repayment of debt to households.

Entrepreneur's Problem

Entrepreneurs maximize their expected return subject to the credit constraint from optimal contract condition in Equation (15).

$$\underset{K_{t+1},\bar{\omega}}{max} \left\{ \Gamma R_{t+1}^{k} Q_t K_{t+1} \right\} \tag{17}$$

Profit maximization problem of entrepreneurs yields equation (18) and (19). While the former shows the role of the intermediation cost on the external premium, as Equation (12), the latter shows the financial accelerator mechanism and the amplification effect of the cost.

$$s_t = \frac{R_{t+1}^{k}}{R_{t+1}} = \frac{\Phi(1+c_t)}{(\Phi\Pi - \Gamma)} \tag{18}$$

where

$\Gamma = \int_{\bar{\omega}}^{\infty} \omega f(\omega) d\omega - \bar{\omega} \int_{\bar{\omega}}^{\infty} f(\omega) d\omega$, $\Pi = (1-\mu) \int_{0}^{\bar{\omega}} \omega f(\omega) d\omega + \bar{\omega}(1 - F(\bar{\omega}))$, and $\Phi = \frac{1-F(\bar{\omega})}{(1-F(\bar{\omega})-\mu\bar{\omega}f(\bar{\omega}))}$

Γ represents the expected gross share of profits for the entrepreneur, and Π denotes the financial intermediaries' net share of profits (net of monitoring costs).

$$\frac{Q_t K_{t+1}}{N_t} = \Psi\left(s_t, c_t\right) \tag{19}$$

or equivalently Equation (18) and (19) can merge into the following form.

$$E_t\left(R_{t+1}^{k}\right) = s\left(\frac{N_t}{Q_t K_{t+1}}, \frac{1}{c_t}\right) R_{t+1} \tag{20}$$

where $\Psi'() > 0$ and $s'() < 0$

Intermediation cost has direct positive effects on the external finance premium. Moreover, as in BGG, when net worth decreases the external finance premium increases as well, creating a financial accelerator mechanism by affecting the borrowing capacity of firms.

Production

Entrepreneurs use their accumulated capital and labor in the production of a homogenous good, Y_t, in competitive markets. The aggregate production can be expressed as:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{21}$$

where $\alpha \geq 0$ is the capital share in production and A_t is total factor productivity (TFP) that follows the AR (1) process in (22).

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_t^A \tag{22}$$

where ρ_A is the persistency of shock, and $E(\varepsilon_t^A) = 0$.

Solving the profit maximization problem for entrepreneurs yields Equations (23) and (24). They represent the demand of labor and expected gross return on holding one unit of capital, respectively.

$$W_t = \frac{Y_t(1-\alpha)}{L_t} \tag{23}$$

and

$$E\{R_{t+1}^k\} = E\left\{\frac{\frac{\alpha Y_{t+1}}{K_{t+1}} + Q_{t+1}(1-\delta)}{Q_t}\right\} \tag{24}$$

Resource Constraint and Labor Market Clearing Condition

The economy-wide resource constraint shows that the total output is equal to the sum of total consumption, investment and deadweight loss due to fire sales.

$$Y_t = C_t + I_t + \mu \int_0^{\bar{\omega}} \omega f(\omega) d\omega R_t^k Q_{t-1} K_t \tag{25}$$

The labor market clearing condition imposes an equality to the demand for and supply of labor as follows.

$$\frac{Y_t(1-\alpha)}{L_t C_t} = \xi \frac{1}{1-L_t} \tag{26}$$

Results

Calibration

I choose standard values for the taste and technology parameters. I set the capital share in production to 0.35, the quarterly depreciation rate to 2.5 % and the discount factor to 0.99 which pins down the risk-free rate in the steady state. Persistence of TFP and investment efficiency shock are set to 0.95 and 0.66 with standard deviations equal to 0.009 and 0.0331, respectively. The parameters for investment efficiency shock and the capital adjustment cost are estimated by Christensen and Dib (2008) using Bayesian methodology. These values are similar to the estimates of Ireland (2003). As in Christensen and Dib, I choose capital adjustment cost to be around 0.59, which is close to the estimates of Meier and Muller (2006). The capital adjustment cost has a significant role on the financial accelerator mechanism. For instance, high values of capital adjustment costs cause stronger

capital price responses, and therefore affects the net worth of firms and the external finance premium. Furthermore, high adjustment costs make the investment more expensive and less responsive to shocks. Therefore, it is important to choose a realistic estimate for the adjustment cost. The weight of leisure in the utility function is chosen so that households devote one third of their entire time to work.

The death rate of firms is chosen to be 3 percent, which is consistent with the data obtained from US Small Business Administration (SBA). The fraction of fire sales losses is 0.10. The standard deviation of the iid shock is chosen to make the capital net worth ratio equal to 2 in the steady state. What is unique about this chapter is the estimation of the financial intermediation cost. Using the AR(1) process in Equation (13), the persistence and standard deviation of the cost is computed. The intermediation cost equals to its long-run average in the steady state. This long-run average is 3 times smaller in my sample as I am only looking at the largest banks. In fact, if the entire banking sector is used in this analysis than the long run average would have been more than 3 times higher. Therefore the results in this model is significantly underestimated. Nonetheless, it gives an idea about how strong the effect of cost is on key macroeconomic variables. Table 2-6 summarizes all the calibrated values of the parameters.

Simulations

Figure 2-7 shows the effects of one standard deviation decrease in total factor productivity (TFP) on the economy simulated for the US. A decrease in TFP brings the financial accelerator mechanism into work. In particular, it leads to lower output and consumption in the economy. This causes firms to demand more capital. High demand pushes up the capital prices and consequently assets are worth more. This leads to a

Table 2-6: Calibration of Parameters

Description	
capital share in production	$\alpha = 0.35$
discount factor	$\beta = 0.99$
depreciation rate	$\delta = 0.025$
weight of leisure in utility function	$\xi = 1.64$
loss in fire sales	$\mu = 0.10$
survival probability	$\gamma = 0.97$
capital adjustment cost	$\chi = 0.59$
standard deviation of iid shock	$\sigma = 0.30$
persistence of TFP	$\rho_A = 0.95$
standard deviation of TFP	$\sigma^A = 0.009$
persistence of investment shock	$\rho_\theta = 0.66$
standard deviation of investment shock	$\sigma^\theta = 0.033$
average intermediation cost/total assets	$\overline{c} = 0.013$
persistence of intermediation cost	$\rho^c = 0.026$
standard deviation of intermediation cost	$\sigma^\theta_{US} = 0.01$

Notes: One period in the model corresponds to one year. Thus, the values in the table match the annual frequency.

decrease in net worth of firms and an increase in the agency problem between firms and banks. As a result, the external finance premium increases that tightens the borrowing constraint of entrepreneurs. As borrowing goes down they cannot find a room to expand their business and their net worth declines further which creates a negative feedback loop, or in other words, a financial accelerator. This feedback between the external premium and the net worth of firms causes more firms to bankrupt. As the number of bankruptcies increases, intermediation costs increase as well. High costs inflate lending rates making borrowing even more difficult for entrepreneurs. Therefore, there is also a feedback between the intermediation cost and the financial accelerator mechanism. This relationship makes the effects of intermediation cost more significant on business cycles.

Figure 2-8 demonstrates the responses of key macroeconomic variables to a standard deviation decrease in investment efficiency. In particular, when the efficiency decreases the output and investment immediately decreases. This decreases the amount borrowed leading to lower interest rates. The decrease in interest rates pushes the households

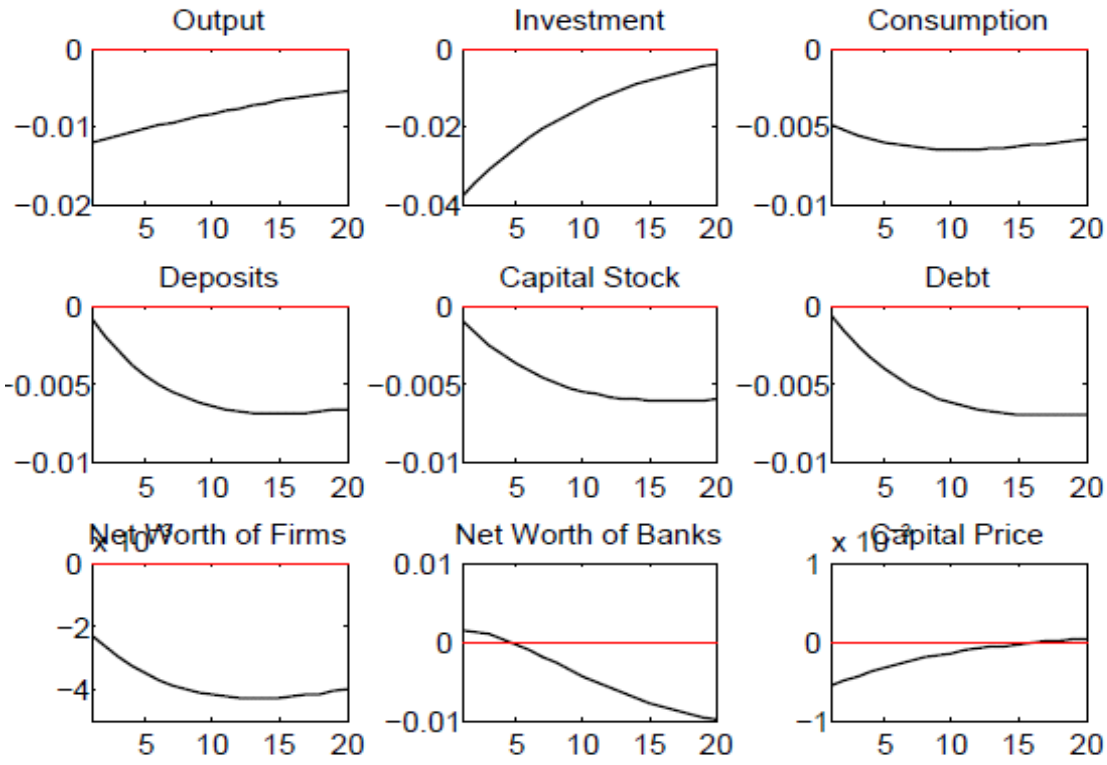

Figure 2-7: One Standard Deviation Shock to Total Factor Productivity

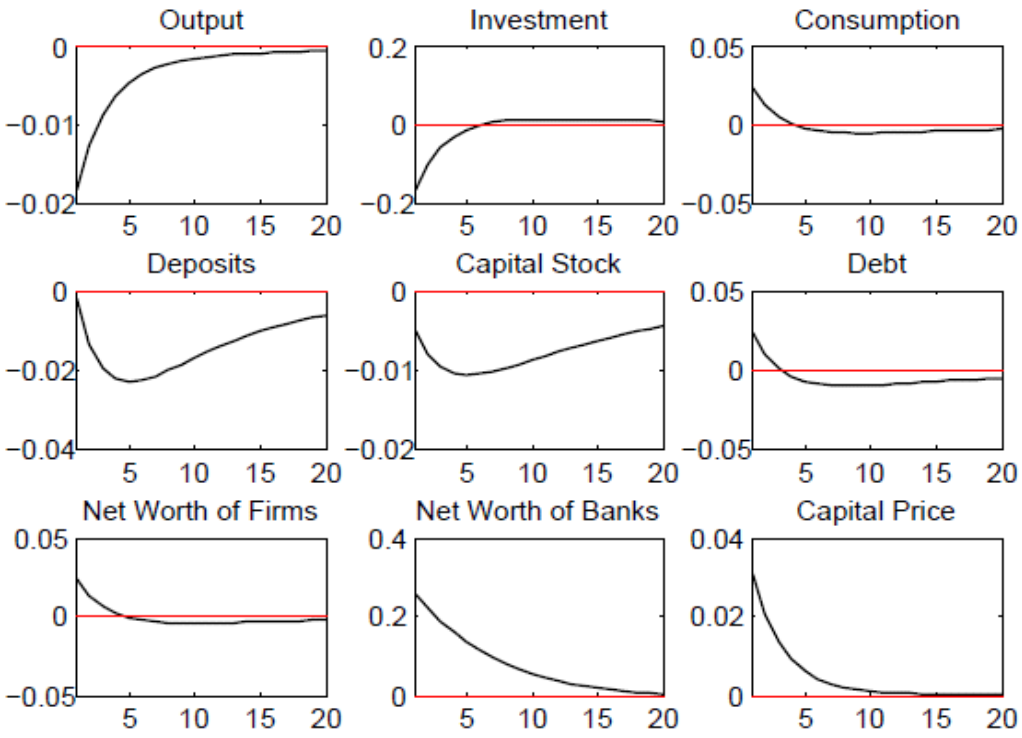

Figure 2-8: One Standard Deviation Shock to Investment Efficiency

away from saving which leads to a decrease in deposits and increases their consumption. Eventually lower interest rates increase the demand for borrowing which also has a positive effect. These positive effects after the shock corrects the distortions in the economy gradually.

The main contribution of this chapter is introducing intermediation cost shocks. Figure 2-9 shows the effects of a standard deviation increase in intermediation costs on the simulated economy. As the financial intermediation becomes more costly banks do not lend as much as before. The scarcity of the loan supply drives up the lending rates which leads to a decrease in the investment demand of firms. The low demand pushes the capital prices down. As capital prices drop, the value of firms' net worth decreases as well. This increases

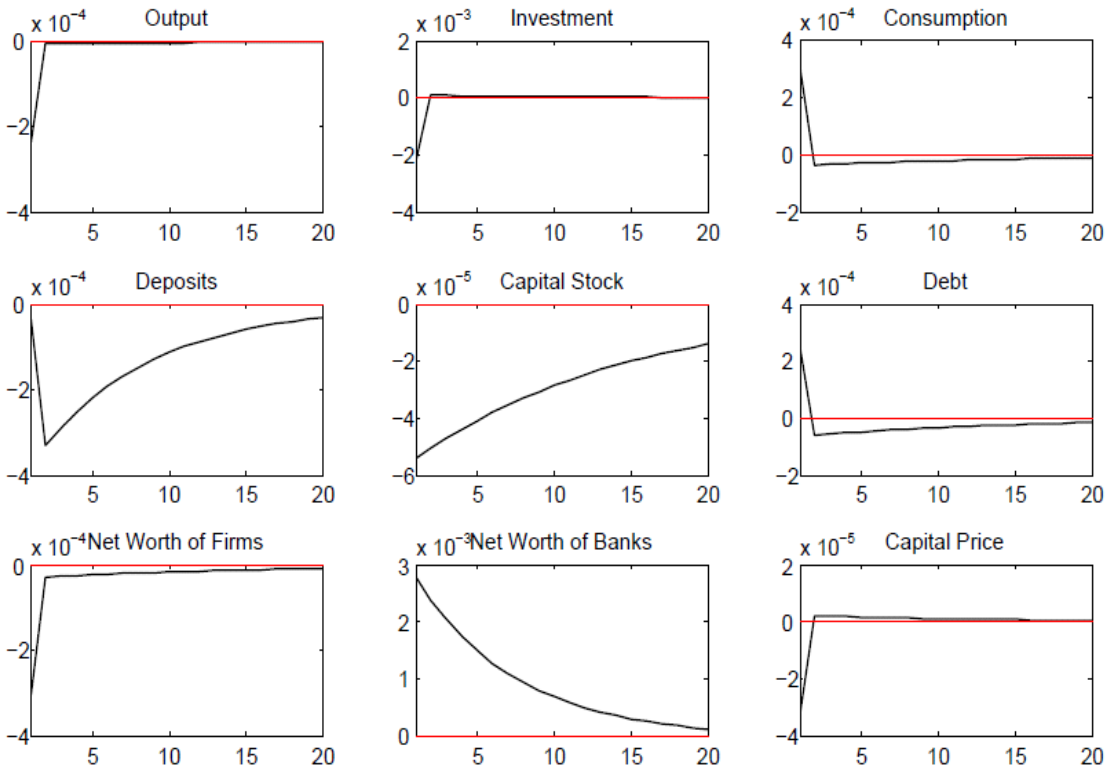

Figure 2-9: One Standard Deviation Shock to the Financial Intermediation Cost

the agency problem between entrepreneurs and intermediaries leading to a financial accelerator mechanism which results in stronger credit crunches and lower output levels. Once again, the impulse responses here is underestimated as the data only has larger and more efficient banks in the sample. This sample has three times lower cost to asset ratio than the entire financial sector in the US. Keeping this downward bias in mind, the simulation results are very similar to the VAR results.

Conclusion

This section of the dissertation analyzes financial intermediation costs in great detail using a unique quarterly dataset. This dataset consists of large and mid-sized banks'

cost breakdowns and their total assets. The micro level, high frequency data allows the study of the intermediation cost characteristics and its effects on the business cycles. The cost entails four characteristics. First, as a largely ignored phenomenon, financial intermediation costs is strongly countercyclical. Second, it tends to have large increases rather than decreases. Third, an international comparison shows that developed countries generally have lower intermediation cost per asset than their less developed counterparts which can suggest an efficiency measure for financial intermediaries. Lastly, financial intermediation costs and lending rates co-move very closely.

According to the US data, a one standard deviation increase in cost causes a 50 percentage points decrease in GDP. By introducing a nontrivial banking sector and costly intermediation, this model can estimate the effects very closely to the data. Moreover, GDP also affects intermediation costs however this effect is relatively weak.

The second main contribution of this chapter besides costly intermediation is giving a realistic role to banks. In particular, their balance sheets have as significant role as any other firm in the economy. The model in this chapter enhances the financial accelerator mechanism by adding costly intermediation and a non-trivial banking sector. In particular, when there is a recession in the economy, generated from financial sector or not, causes the intermediation costs go up. As intermediation becomes costly banks either provide less loans or increase their lending rates. In fact, the financial intermediation cost and lending rates co-move very closely in the data as well. Both of these actions of banks borrowing becomes increasingly more difficult. Less borrowing causes lower investments and output. Low investment, in other words, low demand for capital, decreases the asset prices leading to smaller net worth. This increases the agency problem between banks and firms which inflates the external premium and consequently borrowing becomes even more

difficult creating a financial accelerator mechanism. Therefore, intermediation cost and financial accelerator mechanism triggers each other.

CHAPTER III

FINANCIAL INTERMEDIATION COSTS AND BUSINESS CYCLE ASYMMETRIES

The recent financial crisis that began in late 2007 has subsequently turned into the worst recession of the post-war period with its exceedingly long recovery. A sudden and deep crisis followed by a slow recovery -an asymmetry in business cycles- is true for almost every recession in US history. For instance, the Great Depression bottomed out after less than three years but took eight more years until the economy returned to its previous level. As Keynes (1936) stated; "the substitution of a downward for an upward tendency often takes place suddenly and violently, whereas there is, as a rule, no such sharp turning point when a[n] upward is substituted for a downward tendency" (p. 314). Moreover, the financial sector experiences a similar asymmetry in bank lending rates during economic downturns. Many researchers have documented that lending rates increase sharply during crises but decrease gradually during recoveries.[1] This chapter connects the two asymmetries observed in business cycles and the financial sector by accounting for costly intermediation in a "financial accelerator" (Bernanke et al. (1999), BGG thereafter) framework. In particular, when intermediation cost per asset increases, financial intermediaries become less efficient and struggle to absorb the distortions in the sector. This leads to greater credit crunches followed by economy-wide recessions with slow recoveries.

As the recovery of an economy takes longer, more people suffer from the consequences of the recession.[2] For instance, in the first year of the recent recession around four

[1] See Veldkamp (2005), Thompson (2006), Magud (2008), Gambacorta and Ianotti (2008) , Ordonez (2010).

[2] Federal Reserve chairman Ben Bernanke commented on the long recovery of recent financial crisis as:

hundred thousand workers left the labor force; by 2011 the number of discouraged workers exceeded one million.[3] Because of the negative impacts of slow recoveries, many economists have attempted to understand the causes of business cycle asymmetries. In the literature, this asymmetry is associated with skill requirement mismatches of new technologies (Acemoglu and Scott (1997)); with difficulties in extending firm capacity limits (Hansen and Prescott (2005)); with delays in production and hiring decisions due to unclear predictions of the future (Veldkamp (2005)); and with disproportionalities of monetary policy effectiveness during recoveries (DeLong and Summers (1988), Cover (1992), Macklem et al. (1996), Ravn and Sola (2004), and Lo and Piger (2005)).

However, these explanations of the business cycle asymmetry do not address three important points: (1) The asymmetry is stronger for recessions associated with financial crises. Reinhart and Rogoff (2008 and 2009), Bordo and Haubrich (2010), and many others have found that an economic downturn accompanied by a financial crisis is more severe and protracted than an ordinary recession.[4] (2) The financial sector shows a similar asymmetry in lending rates. Many studies have documented that the lending rates of banks (i.e., the interest rates that banks charge their most favorable costumers) increase sharply during crises but decrease gradually during recoveries (See Veldkamp (2005), Thompson (2006), Magud (2008), Gambacorta and Ianotti (2008), and Ordonez (2009)). For instance, in 1994, Mexican lending rates took 4 months to rise 70 percentage points but more than 30 months to return to their pre-crisis levels.[5] (3) The business cycle and the lending rates

"The financial crisis of 2008 and 2009, together with the associated deep recession, was a historic event– historic in the sense that its severity and economic consequences were enormous, but also in the sense that the crisis seems certain to have profound and long-lasting effects on our economy, our society, and our politics" (October 18, 2011).

[3]Data are obtained from Bureau of Labor Statistics.

[4]For instance, Reinhart and Reinhart (2010) Cecchetti, Kohler, and Upper (2009).

[5]Ordonez (2010), "Larger Crises, Slower Recoveries: The Asymmetric Effects of Financial Frictions on Lending Rates"

asymmetries are greater in less developed countries. Claessens et al. (2012) show that recoveries in emerging countries take almost two times longer than recessions, whereas it takes on average 1.3 times longer for their developed counterparts. Moreover, Ordonez (2009) finds that while lending rates in developed countries take twice as long to return to pre-recession levels, it takes 3 to 15 times longer for the less developed countries depending on their development levels. Incorporating a nontrivial banking sector and costly intermediation into the financial accelerator framework, this chapter fills the gap in the literature by explaining all three points above.

Although the recent recession highlighted the role of the financial sector, the literature largely ignored bank balance sheets. Furthermore, banks have been treated as places in which borrowers and lenders can costlessly exchange funds. However, in reality, banks maximize their net worth like other non-financial firms and accrue many costs associated with wages, marketing, litigation and data processing among others. These costs increase significantly during recessions and vary substantially across countries. For instance, banks in developed countries operate at 75 percent lower cost to asset ratio than those in emerging countries.[6]

In this chapter, the interaction between intermediation costs and the financial accelerator mechanism delays recoveries from economic downturns. The financial accelerator mechanism suggests that a negative shock in the economy decreases the total income and causes the demand for capital to decline. Lower demand pushes capital prices down and consequently assets are worth less. This intensifies the agency problem between banks and firms causing the external finance premium to rise. Growing pressure on firms' borrowing eventually leads to bankruptcies. These bankruptcies increase the external premium

[6]Beck et al. (2010) "A new database on financial development and structure."

even more, creating an accelerator effect that amplifies recessions. However, the financial accelerator mechanism alone cannot account for the three points addressed above. By incorporating a nontrivial financial sector, this model fills the gap in the literature. When there is a financial shock, i.e. an increase in intermediation cost, banks either raise their lending rates and/or cut their loans, both of which create difficulties in borrowing. As borrowing becomes more costly, firms demand less capital and the price of capital decreases. Net worth of firms loses value due to low asset prices and subsequently the financial accelerator mechanism emerges. Therefore, intermediation cost triggers the financial accelerator mechanism and delays the recovery more than an ordinary recession that is not originated from the financial sector. This feedback loop between intermediation cost and financial accelerator prevents banks from charging more favorable rates to borrowers. Although banks can increase their lending rates as a response to an increase in the intermediation cost fairly quickly, they cannot decrease them as fast because of the delay in recovery which creates an asymmetry in lending rates as well. Moreover, if the financial sector of a country operates with higher intermediation costs, the feedback loop would be stronger. Therefore, countries with high financial intermediation costs experience larger asymmetries than countries with lower costs.

Incorporating a banking sector and costly intermediation into the financial accelerator framework, this model shows that a financial shock causes output and bank lending rates to take 10 and 5 quarters to fully recover, respectively. In line with the data, the model indicates that recessions are around 3 times deeper for financially less developed countries and their recovery last 67 percent longer compared to their developed counterparts.

The chapter is organized as follows. In the next section, I describe highlights

of the model, while following sections the calibration and simulation results, respectively. I provide concluding comments in the closing section.

The Model:

The model of this chapter is identical with the model introduced in the second chapter. I will only highlight its important aspects in this section. For the full layout of the model, please refer to "Financial Intermediation Costs in a Theoretical Framework: Enhanced Financial Accelerator Mechanism" section in the second chapter.

The model builds upon the idea that entrepreneurs acquire physical capital, K, by using their net worth, N_t, or by issuing financial securities, S_{t+1}. The following equation summarizes this balance sheet condition for the entrepreneur j.

$$Q_{jt}K_{jt+1} = S_{jt+1} + N_{jt} \tag{1}$$

An idiosyncratic shock, ω_{jt}, which is iid across time and firms, affects the gross return on capital. The cutoff value, $\bar{\omega}_{jt}$,equates the gross return to capital to the total amount of entrepreneur j's debt as in Equation (2). A realization of ω_{jt} that is lower than this threshold value causes the entrepreneur to default as his capital return is lower than his debt repayment.

$$\bar{\omega}_{jt+1}R^k_{t+1}Q_tK_{jt+1} = Z_{jt+1}S_{jt+1} \tag{2}$$

Here R^k_{t+1} and Z_{jt+1} denote the gross return on capital and the gross non default rate, respectively. Given that firms are ex-ante same the aggregate net worth evolves according to the equation (3).

$$N_{t+1} = \gamma \left[R^k_{t+1} Q_t K_{t+1} - R^s_{t+1}(Q_t K_{t+1} - N_t) \right] + (1-\gamma) g_t \tag{3}$$

where R^s_{t+1}denotes the external finance premium as follows.

$$R^s_{t+1} = \left(R_{t+1}(1+c_t) + \frac{\mu \int_0^{\bar{\omega}} \omega f(\omega) d\omega R^k_{t+1} Q_t K_{t+1}}{Q_t K_{t+1} - N_t} \right) \tag{4}$$

γ symbolizes the constant survival probability of firms to the next period. As Equation (4) shows the intermediation cost increases the gap between the external premium and the risk free rate. Here c_t represents the intermediation cost of financial intermediaries with the following AR(1) process.

$$\ln c_t = (1-\rho^c) \ln \bar{c} + \rho^c \ln c_{t-1+} \varepsilon^c_t \tag{5}$$

Financial intermediaries can purchase securities issued by entrepreneurs by using their own net worth and deposits collected from households. The balance sheet equation for intermediaries can be expressed as:

$$(1+c_t) S_{t+1} = N^b_t + D_{t+1} \tag{6}$$

A portion equal to c_t of total intermediary assets are lost to create the optimal contract which satisfies the following condition:

$$\left[(1 - F(\bar{\omega}_t))\bar{\omega}_t + (1-\mu) \int_0^{\bar{\omega}_t} \omega f(\omega) d\omega \right] R^k_{t+1} Q_t K_{t+1} = R_{t+1}(1+c_t) S_{t+1} \tag{7}$$

According to (7), the optimal contract must satisfy a condition that guarantees the equality of the expected return of providing funds to firms given by the left hand side

to its opportunity cost represented by the right hand side. Entrepreneurs maximize their expected return subject to the credit constraint from optimal contract condition above. Profit maximization problem of entrepreneurs yields:

$$\frac{Q_t K_{t+1}}{N_t} = \Psi\left(s_t, c_t\right) \tag{8}$$

or equivalently;

$$E_t\left(R^k_{t+1}\right) = s\left(\frac{N_t}{Q_t K_{t+1}}, \frac{1}{c_t}\right) R_{t+1} \tag{9}$$

where $\Psi'\left(\right) > 0$ and $s'\left(\right) < 0$

Intermediation cost has direct positive effects on the external finance premium. Moreover, as in BGG, when net worth decreases the external finance premium increases as well, creating a financial accelerator mechanism by affecting the borrowing capacity of firms.

Results

Calibration

I choose standard values for the taste and technology parameters. I set the capital share in production to 0.35, the annual depreciation rate to 10% and the discount factor to 0.96 which pins down the risk-free rate in the steady state. Persistence of TFP and investment efficiency shock are set to 0.95 and 0.66 with standard deviations equal to 0.009 and 0.0331, respectively. The parameters for investment efficiency shock and the capital adjustment cost are estimated by Christensen and Dib (2008) using Bayesian methodology.

Table 3-1: Calibration of Parameters

Description	
capital share in production	$\alpha = 0.35$
discount factor	$\beta = 0.96$
depreciation rate	$\delta = 0.1$
weight of leisure in utility function	$\xi = 1.66$
loss in fire sales	$\mu = 0.12$
capital adjustment cost	$\chi = 0.59$
elasticity of external finance premium	$\nu = 0.89$
persistence of TFP	$\rho_A = 0.95$
standard deviation of TFP	$\sigma^A = 0.009$
persistence of investment shock	$\rho_\theta = 0.66$
standard deviation of investment shock	$\sigma^\theta = 0.033$
average intermediation cost/total assets	$\overline{c}_{US} = 0.0356$
persistence of intermediation cost	$\rho^c_{US} = 0.99$
standard deviation of intermediation cost	$\sigma^\theta_{US} = 0.072$

Notes: One period in the model corresponds to one year. Thus, the values in the table match the annual frequency.

These values are similar to the estimates of Ireland (2003). As in Christensen and Dib, I choose capital adjustment cost to be around 0.59, which is close to the estimates of Meier and Muller (2006). The capital adjustment cost has a significant role on the financial accelerator mechanism. For instance, high values of capital adjustment costs cause stronger capital price responses, and therefore affects the net worth of firms and the external finance premium. Furthermore, high adjustment costs make the investment more expensive and less responsive to shocks. Therefore, it is important to choose a realistic estimate for the adjustment cost. The weight of leisure in the utility function is chosen so that households devote one third of their entire time to work.

The death rate of firms is chosen to be around 4 percent, which is consistent with the data obtained from US Small Business Administration (SBA). The fraction of fire sales losses is 0.12, which is within the range of empirical estimation of $[0.1, 0.15]$. The standard deviation of the iid shock is chosen to make the capital net worth ratio equal to 2 in the steady state. Table 3-1 summarizes all the calibrated values of the parameters.

Simulations

Claessens et al. (2012) show that less developed countries need longer time to recover from recessions. In particular, they find that a single one month 10% jump in lending rates recovers in two months for most developed countries, whereas it takes 3 to 15 months for less developed countries. In other words, we observe stronger financial sector asymmetries in less developed countries.

Many problems can trigger long recoveries in less developed countries such as lack of institutional quality and management skills, etc. However, this chapter focuses on the role of financial intermediation costs in creating recovery length differences across countries. To pin down the effects of intermediation cost, both countries are assumed to have same economic conditions except their financial sector. In the rest of the chapter I ask the following question. How would the effects change if the US had the same financial intermediation structure with the median emerging country. In the analysis below, the US is called "the North" and the median emerging country is called "the South".

Figure 3-1 shows the effects of a standard deviation increase in total factor productivity. An increase in TFP brings the financial accelerator mechanism into work. Particularly, when TFP goes up output increases as well, causing firms to demand more capital. High demand pushes up the capital prices and consequently assets are worth more. This leads to an increase in net worth of firms and a decline in the agency problem between firms and banks. As a result, the external finance premium decreases that creates more room for firms to borrow. As firms borrow more, their net worth grow further which creates a positive feedback loop, or in other words, a financial accelerator.

According to Figure 3-1, the asymmetry in recovery length only comes from the financial accelerator effect. Because the intermediation cost is assumed to be exoge-

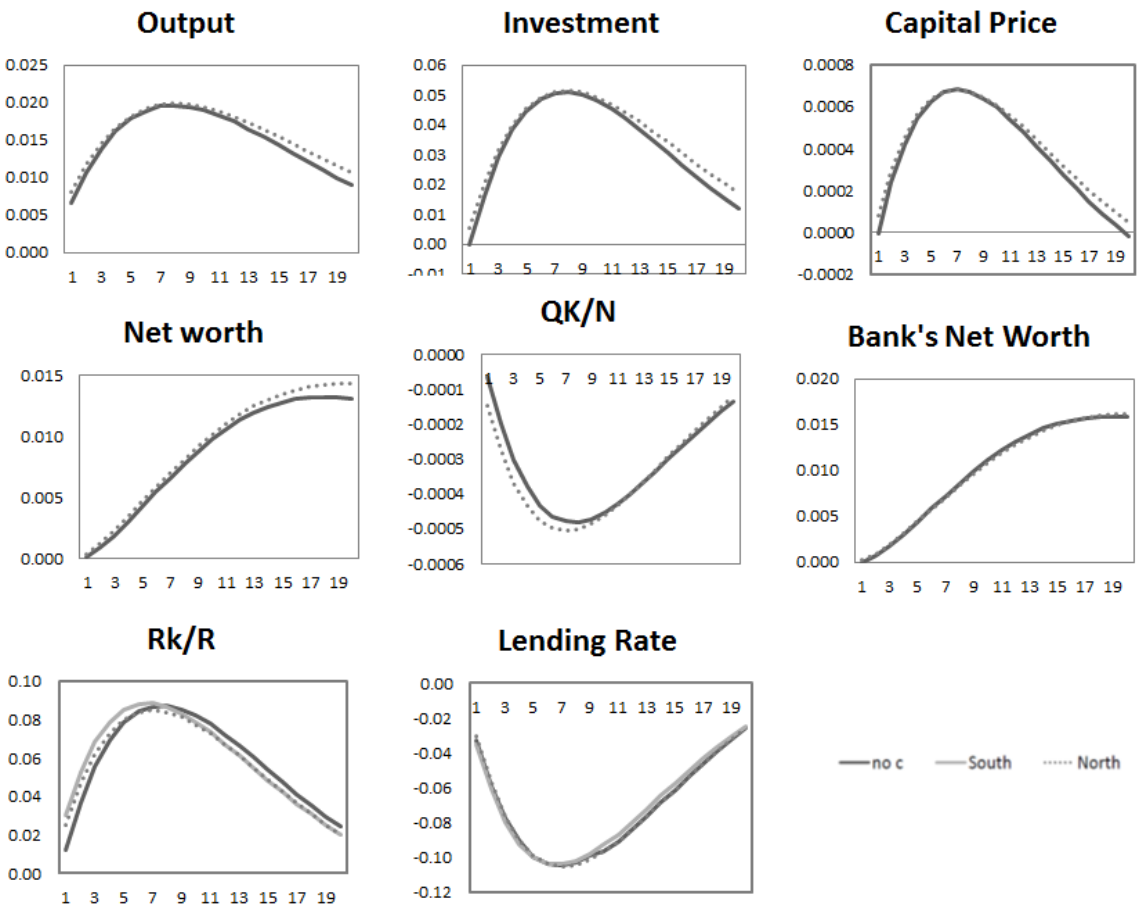

Figure 3-1: One Standard Deviation Shock to TFP

nous, a TFP increase does not have real effects on the intermediation cost. Moreover, the North and the South are assumed to have identical economic conditions except their cost structures. Therefore, responses of the North and the South to a positive TFP shock are identical.

Financial accelerator mechanism also has a significant role in amplifying the recession when there is an investment specific shock. Figure 3-2 shows a standard deviation increase in the efficiency of investment. Variables such as output, investment, and lending rates have stronger initial responses to investment specific shock in countries with high intermediation costs. Because the positive investment shock directly expands the borrowing capacity of firms, the South can benefit from a positive shock more due to less tight borrowing constraints. This shows that high intermediation cost magnifies the initial effects of recessions.

In addition to the amplification mechanism created by intermediation costs, Figure 3-2 also shows the asymmetry in line with the data. The investment specific shock creates a large and sudden response in key macroeconomic variables such as output, investment, capital price, risk premium, etc. Moreover, the responses capture the asymmetry in lending rates and also account for the differences between the North and the South. From the figure, it takes 4 quarters longer for the lending rates to recover in the South.

However, when a shock to financial sector, i.e. an increase in intermediation costs, leads the Souther economy to have stronger asymmetries as observed in the data. Figure 3-3 shows the impulse responses to a standard deviation increase in the cost of intermediation.

In Figure 3-3, as the financial intermediation becomes more costly banks do not lend as much as before. The scarcity of the loan supply drives up the lending rates which

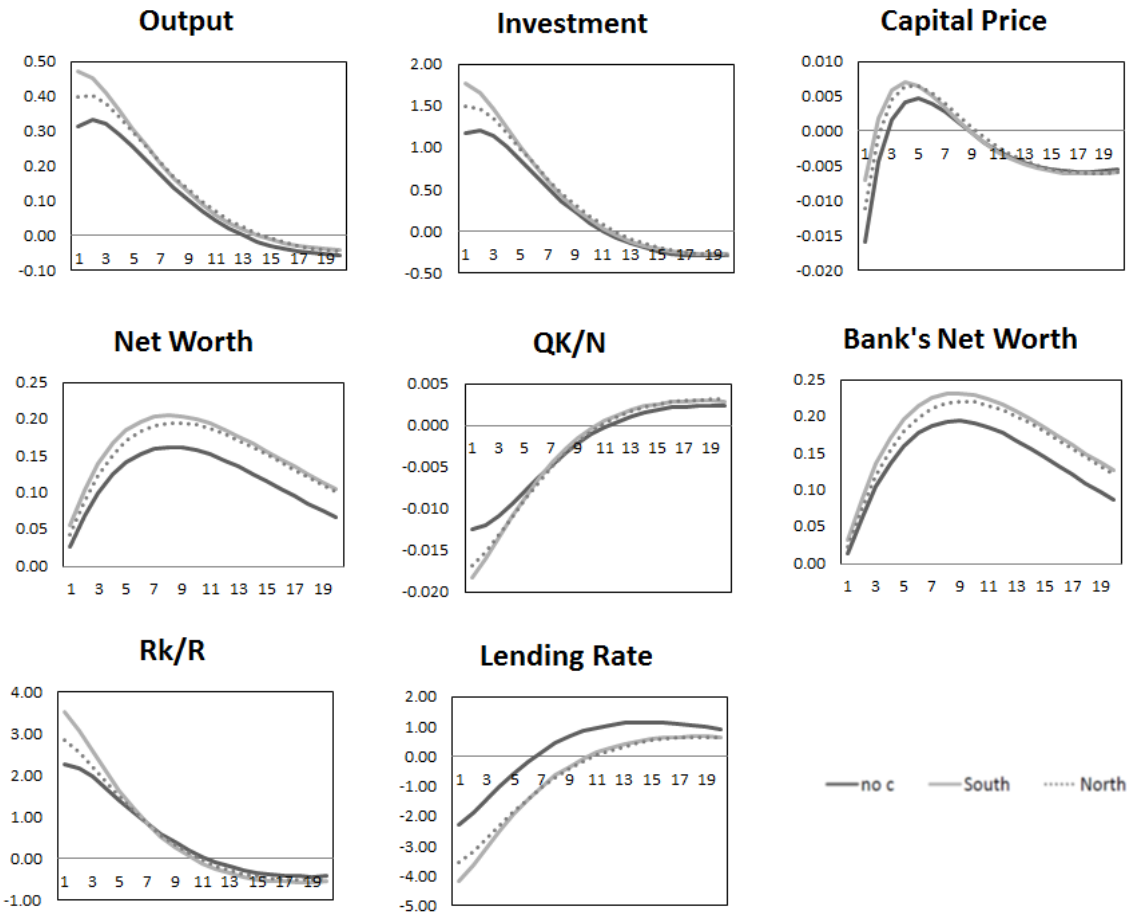

Figure 3-2: One Standard Deviation Shock to the Efficiency of Investment

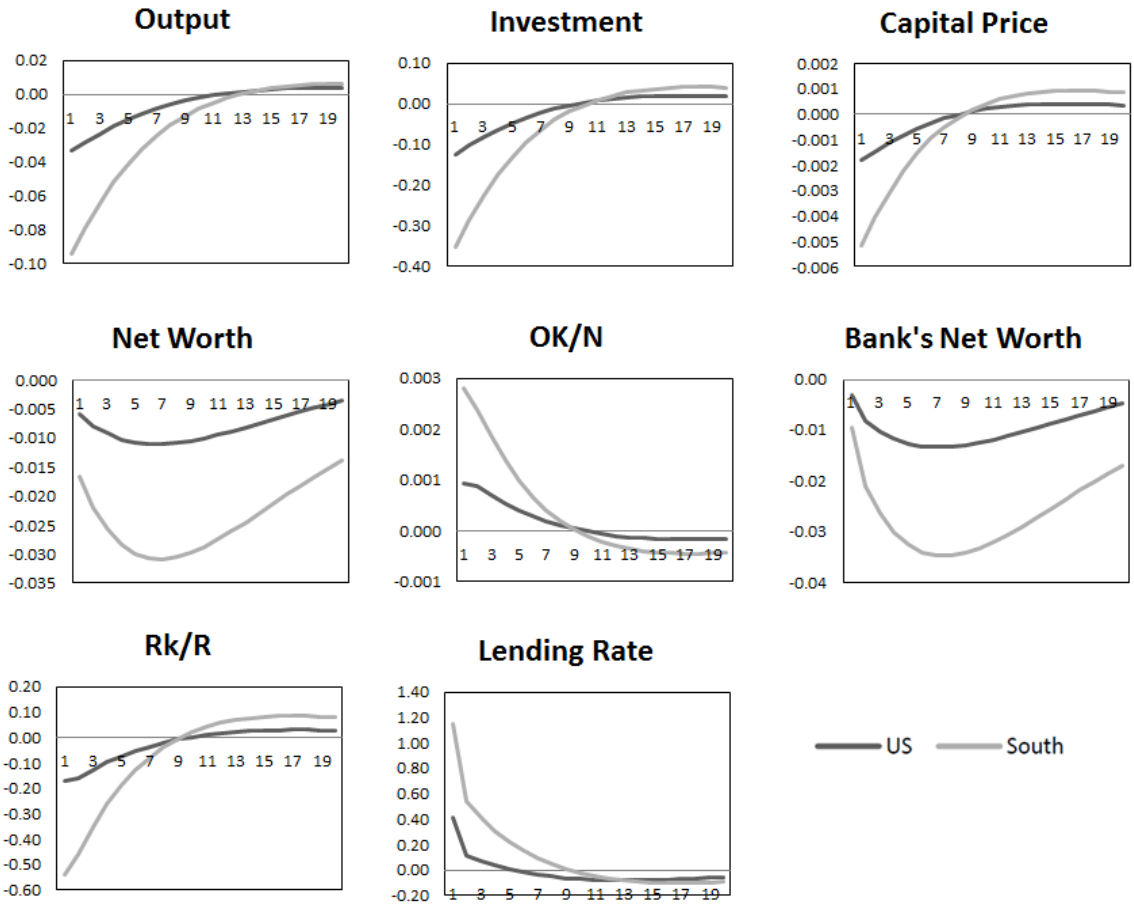

Figure 3-3: One Standard Deviation Shock to the Cost of Financial Intermediation

leads to a decrease in the investment demand of firms. The low demand pushes the capital prices down. As capital prices drop, the value of firms' net worth decreases. This increases the agency problem between entrepreneurs and intermediaries leading to a financial accelerator mechanism which results in stronger credit crunches. This negative loop in the economy prevents banks from lowering their lending rates and causes asymmetries in both the financial sector and business cycle asymmetries.

Conclusion

Incorporating a nontrivial banking sector and costly intermediation, this chapter focuses on the business cycle and financial sector asymmetries particularly when the recessions are originated from financial crisis. These asymmetries refer to sudden and deep crisis followed by slow recoveries in business cycles and lending rates. The chapter fills the gap in the literature by explaining the following empirical facts: (1) The asymmetry is stronger for recessions associated with financial crises. (2) The financial sector shows a similar asymmetry in lending rates. (3) The business cycle and the lending rates asymmetries are greater in less developed countries.

As an uncovered phenomenon in the literature, intermediation cost generates strong business cycle asymmetries when recessions are originated from a financial shock. Asymmetries generated from the intermediation cost is stronger than a regular recession originated with a neutral technology shock. The reason of this is that when a TFP shock hits the economy only financial accelerator mechanism causes delays in recoveries. Whereas, when a financial shock hits the economy, the recovery delays occur because of the feedback effect of intermediation cost on the financial accelerator mechanism. Particularly, when cost

increases banks either increase their lending rates or cut their loans both of which create difficulties in firms' borrowing. This leads to a decrease in capital demand and in capital prices. Lower capital prices reduce the value of firms' net worth and eventually the financial accelerator mechanism emerges.

An increase in intermediation costs does not create an asymmetry only for business cycles, but also for lending rates. As a response to an increase in intermediation cost, banks immediately increase their lending rates. However, the financial accelerator mechanism prevents the economic conditions from becoming favorable; therefore banks cannot decrease their lending rates to relieve the stress in the economy. Therefore, lending rates decrease gradually causing the asymmetry in financial sector.

Furthermore, the business cycle and financial sector asymmetries are stronger for financially less developed countries. For instance, recessions are around 3 times deeper for them and their recovery last 67 percent longer than their developed counterparts. Because less developed countries also have less efficient financial sectors in terms of cost to asset ratios, banks cannot insure against risk in recessions well compared to developed countries.

CHAPTER IV

FINANCIAL INTERMEDIATION COSTS AND RELATIVE CONSUMPTION VOLATILITY

The volatility of macroeconomic variables, particularly that of consumption, has a detrimental nature on the economy through creating uncertainty and risk. Among others, Ramey and Ramey (1995) and Laursen and Mahajan (2005) show that it leads to lower economic growth and social welfare.[1] These negative effects are more pronounced in emerging economies than their developed counterparts even after controlling for crises by normalizing consumption with output.[2] Using a sample of 75 countries, Crucini (1997) finds that the standard deviation of consumption relative to output is 3.5 times higher in less developed countries. This chapter explains the disparity in relative consumption volatilities between developed and emerging countries by accounting for differences in their financial intermediation costs. Because banks in emerging countries have higher intermediation costs, their economy experience greater credit crunches which leads to more dramatic macroeconomic fluctuations.

The literature typically attributes the consumption volatility of a country to either the degree of the international financial integration or the development of the domestic financial sector. Baxter and Crucini (1995), Sutherland (1996), and Agenor (2003) suggest that financial integration decreases the consumption volatility by enhancing a nation's ability to transfer domestic risk to world markets. Studies considering the relationship

[1] Behrman (1988), Rose (1994), and Foster (1995) show that the lack of consumption smoothing cause significantly negative effects on the life expectancy, nutrition intake and education of households.

[2] Pallage and Robe (2003) find that the median welfare cost of aggregate fluctuations in poor countries is at least 10 times what it is in the United States.

between consumption volatility and financial development find that a developed domestic financial sector can decrease economic volatility through better risk insurance (see Aghion et al. (1999, 2004); Easterly et al. (2001); Denizer et al. (2002); Ferreira da Silva (2002) and Fanelli (2008)). Specifically, if credit markets are complete, income shocks should be smoothed away by borrowing and saving, and they should not affect the consumption pattern. Therefore, more financially developed and integrated countries should have lower consumption volatility.

Consumption volatility in emerging countries, however, should naturally be higher than their developed counterparts because of frequent crises experienced in the former group. Therefore, the consumption volatility does not provide a clear comparison between countries unless the effects of crises are eliminated. To overcome this problem, Kose, Prasad and Terrones (2003) study the relative consumption volatility to output and find that countries who experienced greater financial integration during the 1990s also had an increase in their relative consumption volatility.[3] They show, however, that development of domestic financial sector reduces the relative consumption volatility significantly. This chapter focuses on explaining relative consumption volatility differences between countries by letting costly financial intermediation determine the level of financial development of a country in a DSGE setting with a housing sector. Real estate market interactions have an important role in the model to connect household consumption decisions with loan market conditions.

This chapter improves upon existing models by including a nontrivial financial sector with costly intermediation. In the literature, financial intermediaries (i.e. banks) have been treated as places in which borrowers and lenders can costlessly exchange funds.

[3]Davis and Kahn (2008) reviewed evidence on the Great Moderation in conjunction with evidence about volatility trends at the micro level. Their results suggest that the volatility of consumption did not decrease even though the economic environment become stable during this time.

However, in reality, banks accrue many costs such as wages, marketing expenses, litigation expenses and data processing expenses. These costs affect consumption because households take out loans to purchase real estate. Therefore, any change in financial intermediation costs alters the borrowing contract between households and banks. For instance, as intermediation becomes more costly, banks would either cut their loans or increase the lending rates causing households to adjust their consumption decisions accordingly. Antunes et al. (2013) show that a one percent reduction in financial intermediation cost leads to a 1.9 percent increase in the US consumption. Moreover, these costs increase significantly during recessions and vary substantially across countries. For instance, banks in developed countries operate at 75 percent lower cost to asset ratio than those in emerging countries.[4] In this way, the financial intermediation costs seem to be a reasonable proxy of financial sector development.

Models that include the housing market interactions but not the intermediation costs, such as Campbell and Hercowitz (2005) and Iacoviello and Pavan (2011) tend to overshoot the consumption volatility.[5] However, the model in this chapter explains the volatility differences between developed and emerging countries better by incorporating costly financial intermediation. The model suggests that as intermediation cost decreases households find better consumption smoothing possibilities. Thus, countries with lower intermediation cost, or equivalently more developed financial sector, should have lower aggregate and relative consumption volatilities.

The remainder of the chapter is organized as follows. The next section lays out the empirical motivation by introducing relative consumption volatility. The next section

[4]Beck et al. (2010) "A new database on financial development and structure."

[5]Among those models, Iacoviello (2011) emphasizes the importance of the financial sector as well. In his model, banks have losses when borrowers default on their debt. Yet, these defaults take the form of a positive wealth shock for borrowers. In other words, households can increase their consumption and housing while going bankrupt, which is not necessarily what one may expect from a crisis.

outlines the model, while following sections discuss the calibration and simulation results. The last section of the chapter concludes.

Relative Consumption Volatility to Output

After the puzzling results of Kose, Prasad and Terrones (2003), who finds positive correlation between the relative consumption volatility and the degree of financial integration, the recent literature has paid greater attention to relative consumption volatilities. Because of the severe and frequent crises that emerging countries experience, their consumption and output are more volatile than that of developed countries. However, the relative consumption volatility (i.e. the standard deviation of the consumption to output ratio, $\sigma\left(\frac{C}{Y}\right)$) eliminates the effects of economic crises as a shock to a country should decrease both consumption and output. In this way, the relative consumption volatility can be thought of as excess consumption volatility compared to output.

Using the consumption data from the Central Bank of the Republic of Turkey and the U. S. Bureau of Economic Analysis (BEA), and output and GDP deflator data from the OECD, Table 4-1 compares the volatility of macroeconomic variables in the US and Turkey from 1998:1 to 2012:1. Turkey and the US are the median countries in terms of financial intermediation costs in their respective groups which is why they have been chosen in this analysis. I chose to represent each group with one country as opposed to aggregating developed and emerging country groups because aggregation can lead to losses of some characteristics in the data.[6] I use X-12 ARIMA method to seasonally adjust the

[6]Emerging countries included to the analysis are Argentina, Brazil, Chile, Colombia, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Peru, Philippines, Russia, South Africa, Turkey and Venezuela. Some of the other countries that could have been classified as emerging markets are not included because of data availability.

Table 4-1. Volatility of Macroeconomic Variables

in percent	*with housing*		*no housing*	
	US	**TURKEY**	**US**	**TURKEY**
$\sigma(C)$	1.24	4.35	1.52	3.55
$\sigma(Y)$	1.34	3.83	1.34	3.83
$\sigma\left(\frac{C}{Y}\right)$	0.43	2.19	0.52	2.13

Notes: Values are in percent. The consumption data is obtained from Central Bank of the Republic of Turkey and BEA. The GDP and GDP deflator data are obtained from the OECD. The values are deflated with GDP deflators of the corresponding country and detrended with HP filter.

Turkish consumption data for maintaining the consistency with BEA and OECD.

Traditionally, housing consumption, i.e. housing services and utilities, are included in aggregate consumption. To differentiate the sources of volatility and make the data consistent with the model, I deduct housing consumption from aggregate consumption for both countries and report them separately on the "no housing" part of the table.

According to Table 4-1, the consumption and output volatility in the US is around 2.5 (3.5) times lower than those in Turkey when housing consumption is separated from (included to) aggregate consumption. On the other hand, the relative volatility of consumption share is 2.1 percent for Turkey, whereas it is only 0.52 for the US. This stark difference between the two countries creates the main empirical target of this model.

The housing consumption of Turkey and the US share different characteristics. First and third columns of Table 4-1 indicate that housing services and utilities are fairly stable for the US because when the housing sector is deducted from the aggregate consumption, the consumption volatility increases from 1.24 to 1.52. Conversely, Turkey's consumption volatility decreases from 4.35 to 3.55 when housing consumption is not included in the aggregate measure. This suggests that housing consumption is much more volatile in Turkey compared to the US. Because of these differences in housing market characteristics of the two countries, the model in this chapter separates aggregate consumption

from housing consumption.

The Model

The model is a version of Iacoviello (2005). In this model, there are patient and impatient households, a representative firm, and a bank. The bank intermediates between borrowers and savers at a cost and requires some of borrower's real estate to be collateralized. To simplify the model and focus on relative consumption volatility, only impatient households can get loans from banks to engage in housing market activities, and therefore they are the only agents who face collateral constraints. If other agents, such as firms, were also constrained in borrowing with their accumulated real estate, then any housing shock would have a direct effect on the production. However this assumption helps prevent the model from overestimating the role of the housing sector.

Households

There are two fundamental differences between the households in the model. First, patient households give greater value to the future than impatient households. Specifically, I assume that the discount factor of patient households is larger than that of impatient households.[7] This assumption guarantees an equilibrium in which the borrowing constraint of impatient households always binds. Second, only impatient households can engage in housing market activities. This assumption helps accounting for individuals who do not want to buy (or not capable of buying) real estate.

[7] I assume that $\beta_p > \beta(1+c_t)$ where c_t denotes the financial intermediation cost as a ratio to total assets. Since this ratio is very small, the assumption holds for any reasonable value used in the literature.

Patient Households

Denoted with superscript p, patient households make their consumption, C_t^p, and leisure, $1 - L_t^p$, decisions at time t and their total endowment of time is normalized to one. They also decide how much to save, D_{t+1}, at the bank for a return of the gross deposit rate, R_{t+1}. The patient households use the following objective function to maximize their lifetime utility from consumption and leisure.

$$\max_{C_{p,t}, L_{p,t}, D_{t+1}} E_t \left\{ \sum_{k=0}^{\infty} \beta_p^k \left[\ln(C_{t+k}^p) + \xi \ln(1 - L_{t+k}^p) \right] \right\} \tag{1}$$

The maximization is subject to the following Walrasian budget constraint that equates households' spending to their income.

$$C_t^p + D_{t+1} = R_t D_t + W_t L_t^p \tag{2}$$

First order conditions to the problem of patient households are given by the following standard consumption Euler equation and the labor supply decision, respectively.

$$1 = E_t \left\{ \frac{\beta_p C_t^p}{C_{t+1}^p} \right\} R_{t+1} \tag{3}$$

$$\frac{\xi}{1 - L_t^p} = \frac{W_t}{C_t^p} \tag{4}$$

Impatient Households

Impatient households engage in housing market activities by making a mortgage contract with the bank. They buy real estate, H_{t+1} for the price, Q_t^h, at time t. However, the bank requires some of the assets to be collateralized which restrains the available credit to borrowers.

Impatient households maximize their utility from consumption and leisure as well as the utility that they get from housing services. They use the following objective function subject to their flow of funds constraint in equation (6) and the collateral constraint in equation (7).

$$\max_{C_t, H_{t+1}, B_{t+1}} E_t \left\{ \sum_{k=0}^{\infty} \beta_i^k \left[\ln(C_{t+k}^i) + \Gamma \ln(H_{t+k}) + \xi \ln(1 - L_{t+k}^i) \right] \right\} \tag{5}$$

Represented with the subscript i, impatient households can use the amount borrowed from banks, B_{t+1}, their labor income, $W_t L_t$, and the return from previous investment, $Q_t^h H_{jt}$, to finance their consumption, new housing investment, and repayment of their debt. In equation (6), while ϕ shows the adjustment cost of housing, Z_t denotes the gross lending rates. In the model, the housing depreciation rate is assumed to be zero.

$$C_t^i + Q_t^h H_{t+1} + \frac{\phi}{2} \left(\frac{H_{t+1} - H_t}{H_t} \right)^2 Q_t^h H_t = Q_t^h H_{jt} - Z_t B_t + B_{t+1} + W_t L_t^i \tag{6}$$

Banks require some of the real estate assets to be used as collateral. With this collateral constraint households can borrow up to a limit. Specifically:

$$Z_{t+1} B_{t+1} \leq E \left\{ Q_{t+1}^h H_{t+1} \right\} \tag{7}$$

First order conditions to the problem of impatient households are given by equations (8), (9) and (10) that show labor supply, consumption and housing demand decisions, respectively.

$$\frac{\xi}{1 - L_t^i} = \frac{W_t}{C_t^i} \tag{8}$$

$$\frac{1}{C_t^i} = E_t \left\{ Z_{t+1} \left(\lambda_t + \frac{\beta_i}{C_{t+1}^i} \right) \right\} \tag{9}$$

$$\beta_i E_t \left[\left\{ \frac{\Gamma}{H_{t+1}} + \frac{Q^h_{t+1}}{C^i_{t+1}} \left[1 + \left(\phi g_{t+1} (1 + \frac{1}{2} g_{t+1}) \right) \right] \right\} + \lambda_t Q^h_{t+1} \right] = \frac{Q^h_t}{C^i_t} (1 + \phi g_t) \quad (10)$$

where λ_t is the Lagrangian multiplier and

$$g_t = \frac{H_{t+1} - H_t}{H_t} \quad (11)$$

Finally, the equation (12) gives the rule for house price setting. It can be thought that there are house producers that maximize their profits, Π_t, where $\Pi_t = Q^h_t \Delta H_t - \Delta H_t - \frac{\phi}{2} \left(\frac{\Delta H_t}{H_t} \right)^2 H_t$. Here $\Delta H_t = H_{t+1} - H_t$ denotes the housing investment. The first order condition to this problem gives $Q^h_t = 1 + \phi \left(\frac{\Delta H_t}{H_t} \right)$ which is equivalent to the equation (12).

$$Q^h_t = (1 + \phi g_t) \quad (12)$$

Firms

Firms produce a homogenous good, Y_t, using capital and labor in the following aggregate Cobb-Douglas production function.

$$Y_t = A_t K^\alpha_t L^{1-\alpha}_t \quad (13)$$

$\alpha \geq 0$ denotes the capital share in production and A_t is the total factor productivity (TFP) that follows the AR (1) process in equation (14).

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon^A_t \quad (14)$$

where ρ_A is the persistency of shock, and $E(\varepsilon_t^A) = 0$. Notice that the housing is not in the production function like other housing market models because its presence would overestimate the role of housing market in the economy as discussed in the beginning of the Section 3. By solving the profit maximization problem for firms, we obtain equations (15) and (16). They represent the demand of labor and expected gross return on holding one unit of capital, respectively.

$$W_t = \frac{Y_t(1-\alpha)}{L_t} \tag{15}$$

and

$$R_t^k = \frac{\alpha Y_t}{K_t} + (1-\delta) \tag{16}$$

where R_t^k is the gross return on capital. The capital evolves according to the following rule.

$$K_{t+1} = I_t + (1-\delta)K_t \tag{17}$$

Banks

Banks operate in a perfectly competitive market and are identical. Due to the arbitrage, an optimal contract between the representative bank and borrowers must satisfy the following condition

$$Z_{t+1}B_{t+1} = R_{t+1}(1+c_t)B_{t+1} \tag{18}$$

where c_t represents the financial intermediation cost as a ratio to total assets. The left hand side of the equation (18) captures the bank's expected return on lending,

whereas the right hand side represents how much could the bank have gained if it accepted the riskless rate instead of lending. Therefore, equation (18) suggests that arbitrage would equate the bank's expected return from lending to its opportunity cost. Notice that the bank has to pay $1+c_t$ to provide a dollar worth of loans to borrowers. c_t is multiplicative to B_{t+1} because the cost itself is observed as a ratio to total assets in the data. From equation (18), higher cost of intermediation increases the opportunity cost of lending.

Finally, c_t follows the AR(1) process shown in equation (19).

$$\ln c_t = (1-\rho^c)\ln \bar{c} + \rho^c \ln c_{t-1+}\varepsilon_t^c \tag{19}$$

Notice that the intermediation cost does not become zero in the steady state. Instead it is equal to its long run average $\bar{c}$, because in reality costs never diminish entirely.

Resource Constraint and Market Clearing Conditions

The economy-wide resource constraint is shown below where I_t denotes the gross investment.

$$Y_t = C_t + I_t \tag{20}$$

where aggregate consumption is a sum of patient and impatient household consumptions as shown in Equation (21).

$$C_t = C_t^p + C_t^i \tag{21}$$

The following labor market clearing condition guarantees that the demand for and supply of labor would be equal.

$$L_t = L_t^p + L_t^i \tag{22}$$

Lastly, equation (23) shows that the loans market clears when supply (deposits) is equal to the demand (borrowing).

$$B_t = D_t \tag{23}$$

Model Parametrization

I choose standard values for the taste and technology parameters as listed in Table 4-2. The capital share in production and the depreciation rate are set to 0.35 and 0.10 respectively, whereas the weight of leisure in the utility functions are chosen so that the aggregate labor supply is one third of the endowed time.

Lawrance (1991) and Samwick (1997) estimated the discount factor for patient and impatient households. While Lawrance (1991) estimates the quarterly discount rate of impatient households to be between 0.95 and 0.98, Samwick (1997) finds the discount factors for all agents to be between 0.91 and 0.99. I choose 0.95 and 0.99 for the discount rates of impatient and patient households, respectively, because these are the values commonly used in other studies as well.

As is common in the literature, the persistence of the TFP is set to 0.95 with a standard deviation of 0.009. The weight of housing in the utility function is chosen so that in equilibrium the ratio of housing stock to output is 1.4 which is in line with data from the Flow of Funds accounts. Lastly, I vary capital adjustment costs, ϕ, in the $[0, 0.4]$

Table 4-2: Calibration of Parameters

Description	
capital share in production	$\alpha = 0.35$
discount factor for impatient households	$\beta_i = 0.83$
discount factor for patient households	$\beta_p = 0.96$
depreciation rate	$\delta = 0.1$
housing adjustment cost	$\phi = [0, 0.4]$
persistence of TFP	$\rho_A = 0.95$
standard deviation of TFP	$\sigma^A = 0.009$
average intermediation cost/total assets	$\overline{c}_{US} = 0.0356$
	$\overline{c}_{TR} = 0.0634$
persistence of intermediation cost	$\rho^c_{US} = \rho^c_{TR} = 0.99$
standard deviation of intermediation cost	$\sigma^\theta_{US} = 0.072$
	$\sigma^\theta_{TR} = 0.24$

Notes: One period in the model corresponds to one year. Thus, the values in the table match the annual frequency.

range.

Results

Model's Fit

Table 4-3 shows that the model fits the data for the US and Turkey even when the economic conditions in both countries are assumed to be identical except for their financial intermediation costs. If TFP was also calibrated to the Turkish case, results reported would be even larger for Turkey; however, then in this case it would not be possible to pin down the effects of intermediation costs.

The model captures the differences between the US and Turkey particularly well. Intermediation costs alone account for the higher macroeconomic volatility in Turkey. Moreover, the relative consumption volatility findings are also in line with the data. Specifically, the relative volatility of consumption is observed to be 0.73 and 3.6 for the US and Turkey, respectively, while the model predicts them to be 0.6 and 2.51. These predictions

Table 4-3. Model's fit

in percent	**Data**				**Model**			
	Quarterly		Annual		($\phi = 0$)		($\phi = 0.4$)	
	US	**TUR**	**US**	**TUR**	**US**	**TUR**	**US**	**TUR**
$\sigma(C)$	1.44	3.55	2.3	3.98	0.82	2.32	0.79	1.71
$\sigma(Y)$	1.36	3.8	1.99	5.1	1.13	2.44	1.01	1.81
$\sigma\left(\frac{C}{Y}\right)$	0.48	2.25	0.73	3.6	0.6	2.51	0.42	1.75

Notes: Values are in percent. To be consistent with the model estimates, the aggregate consumption does not include the housing consumption. The period of the data is aligned to the period used to estimate intermediation costs. Particularly, the data period is 1998:1-2009:4. They are logged and then detrended using the HP filter. Both the data and the model has been calculated with the same method. Because one period in the model corresponds to one year, the data are also matched to the annual frequency and reported separately.

slightly decrease when the housing adjustment cost increases, but studies such as Iacoviello (2005) estimate it to be closer to zero.

The variance decomposition of the two shocks shows that financial intermediation cost accounts for 87 percent of the variation in the relative consumption and creates around 32 percent of variation in consumption alone. Intermediation costs are also the major source of variation for the housing market, causing 90 percent of variations in housing prices and housing stock due to their direct effect on the borrowing ability of impatient households.

Simulation

Figure 4-1 shows the effects of one standard deviation increase in neutral technology on the economy simulated for the US. Responses are reported with three values of adjustment cost, $\phi \in \{0, 0.2, 0.4\}$ to highlight its role. However, as it is estimated by Iacoviello (2005) the analysis below take $\phi = 0$ as the benchmark. As expected an increase in TFP leads to higher output and consumption for both household types. However, the increase in the latter is smaller due to consumption smoothing. Therefore, borrowers accumulate more real estate which drives up house prices. As the value of asset holdings

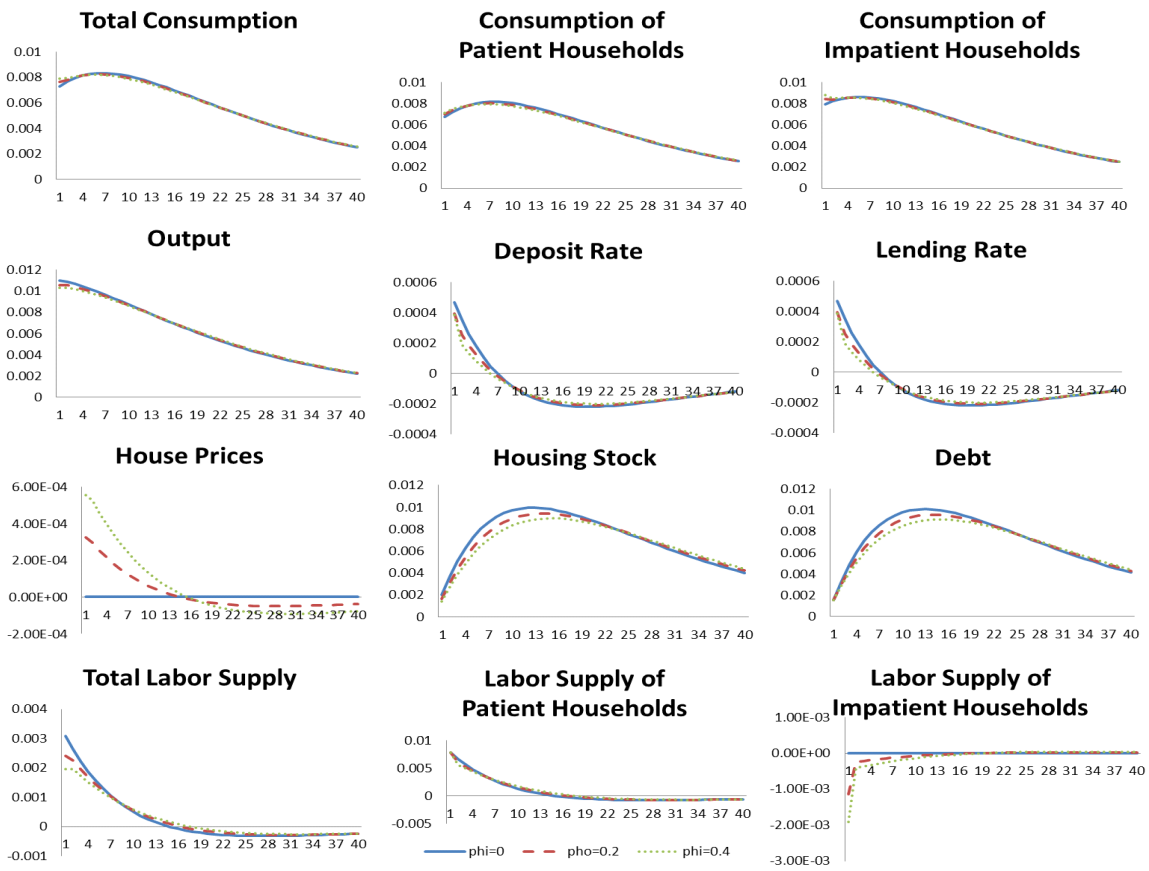

Figure 4-1: Responses to the TFP shock

Notes: The figures show the responses of key macroeconomic variables to a one standard deviation shock to the TFP for the US under different parametrization of the housing adjustment cost.

increases, the borrowing constraint becomes less tight, and households can borrow more and buy even more real estate. This creates an amplification effect in the economy. The income increase also causes a substitution and income effect for patient and impatient households, respectively. Because the substitution effect dominates the income effect, the total labor supply increases in the economy.

As the housing adjustment become more costly, responses of house prices turn out to be larger in magnitude. Because of the large change in housing prices, impatient households have to take more aggressive measures for their labor supply decisions. Apart from this, the housing adjustment cost does not seem to have a significant impact on the

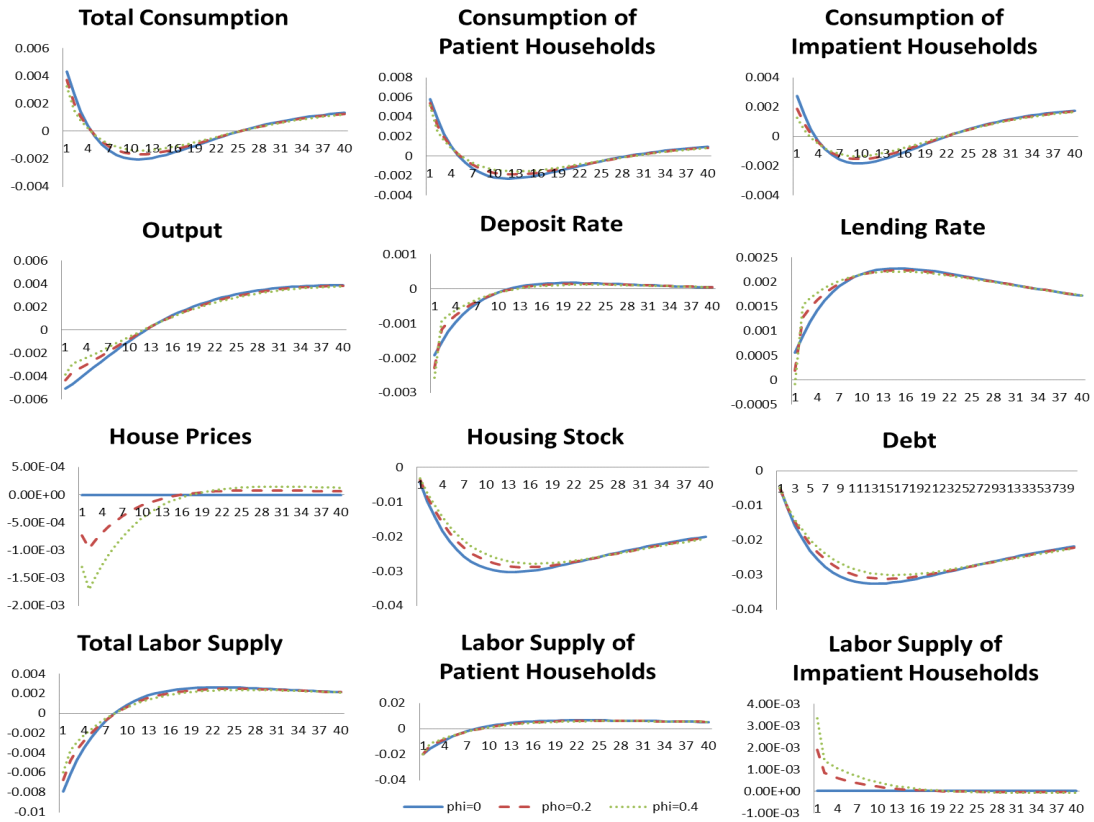

Figure 4-2: Responses to Intermediation Cost Shock

Notes: The figures show the responses of key macroeconomic variables to a one standard deviation shock to the intermediation cost for the US under different parametrization of the housing adjustment cost.

economy.

Figure 4-3 shows the responses to a one standard deviation increase in intermediation costs, c_t, under housing adjustment cost parametrization of $\phi \in \{0, 0.2, 0.4\}$. The mechanism in the model works as follows. When intermediation costs increase, lending becomes more costly for banks and their incentives to provide loans decrease which leads to a credit crunch in the loan market. The unavailability of credits then causes lending rates to rise which decreases the incentives to borrow as well. As impatient households find it more difficult to obtain funding, they stop accumulating real estate and house prices begin to fall. The price decline tightens credit constraints and causes an amplification mechanism in the economy by deepening the credit crunch. This amplification mechanism motivates

impatient households to work more as they need to raise more income. Because they accumulate less housing stock, they begin using a larger portion of their income for consumption. Additionally, lower deposit rates discourage patient households from saving. Both of these factors cause an initial rise in total consumption however as the credit crunch becomes more severe consumption declines as well. On the other hand, the increase in labor supply decreases real wages and causes patient households to work less. The substitution effect dominates the income effect, and total labor supply decreases which reduces the output as well.

Increasing the housing adjustment cost magnifies the response of housing prices. As adjustment becomes more costly impatient households work harder. Otherwise there is no difference in the responses of macroeconomic variables under various housing adjustment cost parametrization.

Figure 4-3 and 4-4 compare the responses for the US and Turkey under a TFP and financial intermediation cost shock, respectively. Figure 4 shows that the responses from both countries are very similar when there is a neutral technology shock. This is expected because countries are assumed to be identical except their intermediation costs. In other words, I used the same values for TFP shock, taste and preference parameters in simulations for both countries. The difference in their intermediation costs is the only source that separates the US from Turkey. However, if the TFP was also calibrated to the Turkish economy, the responses would be stronger than those in the US. Furthermore, the simplifying assumption of having frictions only on households but not on firms also contributes to this result.

A shock to the intermediation cost creates significant differences in Turkey by amplifying the effects dramatically relative to the US. Consumption and output responses

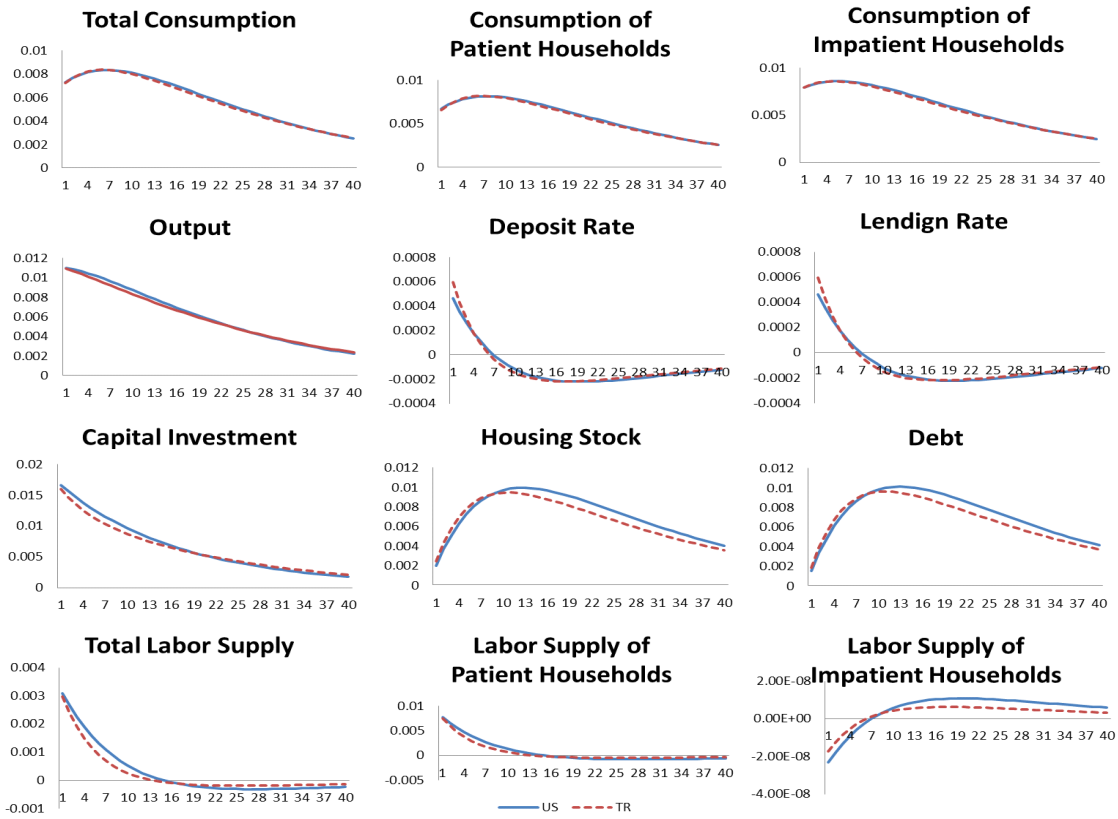

Figure 4-3: Responses to TFP shock for the US and Turkey

Notes: The figures show the responses of key macroeconomic variables to a one standard deviation shock to the TFP for the US and Turkey. Because the housing adjustment cost is estimated to be zero in data, I only use $\phi = 0$ to compare the two countries.

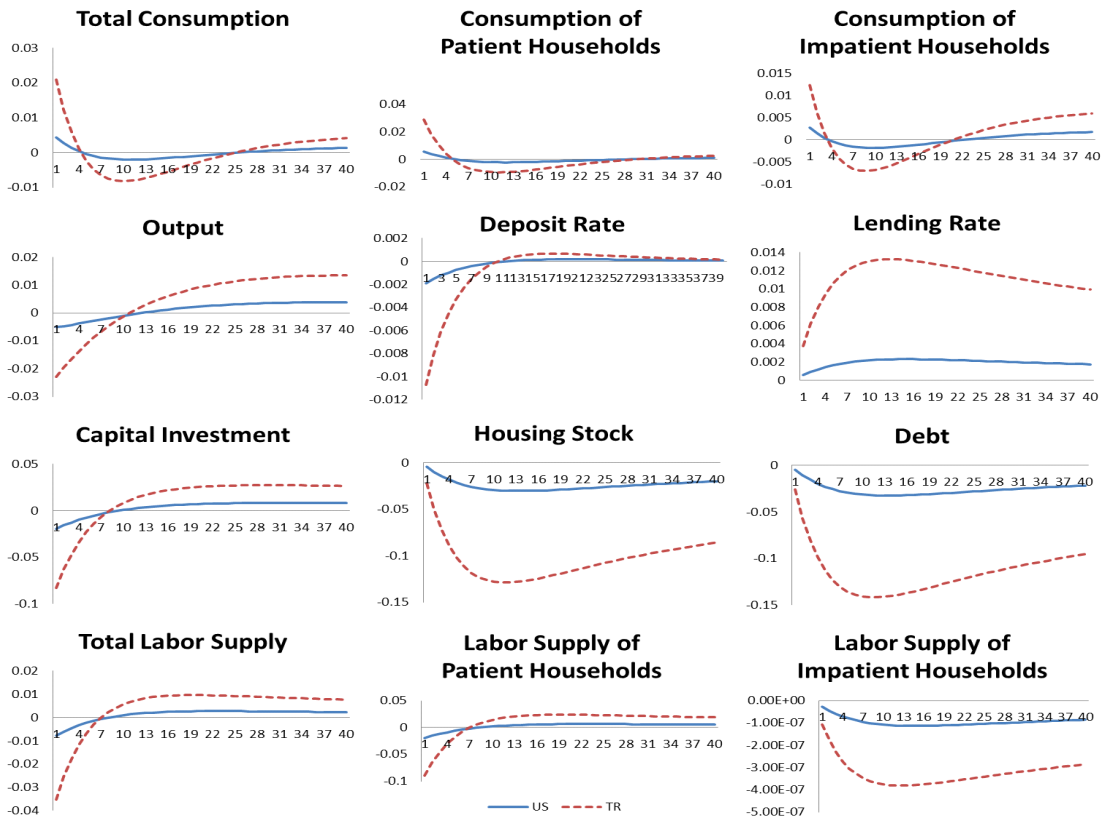

Figure 4-4: Responses to Intermediation Cost Shock for the US and Turkey

Notes: The figures show the responses of key macroeconomic variables to a one standard deviation shock to the intermediation cost for the US and Turkey. The housing adjustment cost is assumed to be zero.

in Turkey are double of those in the US, and responses of Turkey's housing and financial market variables are almost ten times larger than the US counterparts. In other words, the negative effects of a financial crisis on key macroeconomic variables would have been two times worse in the US, if the US had the same financial sector with Turkey. When the financial sector of a country grows more efficient the economy seems to cope with crises more effectively and create better consumption smoothing possibilities.

Conclusion

This chapter explains the relative consumption volatility differences between

developed and emerging countries using their financial development levels. The relative consumption volatility is on average 3 times larger in less developed countries which shows a significantly excessive volatility of consumption for these countries. To understand why consumption fluctuates more relative to output in less developed countries, I construct a DSGE model with housing market and collateral constraints. The financial intermediation cost is introduced to the model as a proxy for financial development levels. While the cost per asset is around 3 percent for developed countries, it is closer to 5 percent for emerging markets. This shows that a bank in an emerging market, such as Turkey, pays two times more than a bank in the US to raise the same amount of assets. This provides a stark difference between financial development levels of countries.

The model successfully replicates the volatility differences observed in the data. The results shows that the median country of emerging countries, Turkey, is four times more volatile than the US in terms of relative consumption to output. The mechanism of the model works as follows. A negative financial shock (high intermediation cost) makes the lending-borrowing process more costly for the agents in the economy and causes bank lending rates to increase. The credit crunch creates an amplification mechanism for all the macroeconomic variables. The model suggests that if the US had the same financial sector with Turkey, a shock to the financial intermediation cost would cause double sized negative effects for consumption and output. Moreover, the negative effects on housing and financial sectors would be almost ten times larger by the time the trough occurs in the recession. In this way, financial intermediation costs have a very significant role in creating frictions and amplifying the negative effects of financial crisis in an economy and should not be ignored in future studies.

CHAPTER V

CONCLUSION

The banking sector, although has a very important role in the US economy, did only recently gain its deserved attention from macroeconomists. However, banks still have been thought of as intermediaries that operate at no cost. However, in reality banks incur many costs ranging from wages to data processing expenses like any other firm and they extend great attention in controlling these costs in order to maximize their profits.

This dissertation fills the gap in the literature by presenting the first high frequency, micro level data of cost breakdowns for large and mid-sized banks in the US. Covering the period of 1992:1-2011:4, this dataset enlightens four empirical facts. First, intermediation costs increase dramatically in recessions. Second, they tend to have large increases rather than same magnitude decreases. Third, developed countries generally have lower intermediation cost per asset than their less developed counterparts which can suggest an efficiency measure for financial intermediaries. Finally, intermediation costs co-move with bank lending rates very closely across countries.

Building upon these empirical facts, the dissertation's first lesson is that these financial intermediation costs are highly countercyclical which creates a mechanism that amplifies the adverse effects of recessions. In particular, when intermediation costs increase, banks reflect them in their lending rates. Less favorable terms creates difficulties for borrowers (firms or households) and therefore the amount borrowed in the economy decreases. Due to shortages in external financing, borrowers demand less assets causing capital prices to go down which subsequently reduces their net worth. Knowing that borrowers have lower

net worth, banks charge even higher lending rates which creates a negative feedback loop in the economy. This mechanism creates new recessions and amplifies existing ones. In the data, a small increase in these costs can generate a 50 percentage point decrease in output. A theoretical model that incorporates costly intermediation using the mechanism above can generate realistic estimates of the data in capturing the relationship between financial intermediation costs and business cycles.

This dissertation also suggests that by triggering a negative feedback loop in the economy, intermediation costs can also cause delays in recoveries from recessions. The data shows that costs stay high even after recoveries take place. This does not only delay recoveries of an economy, but also causes banks to keep their lending rates high even after recoveries take place. Moreover, the difference in intermediation costs between developed and less developed countries leads to more pronounced effects in the latter group.

The final lesson of this dissertation is that intermediation costs affect households' consumption decisions as well. Specifically, when households purchase mortgage agreements from banks to buy real estate, they become prone to changes in intermediation costs. An increase in financial intermediation costs would alter their decisions about consumption and saving which causes uncertainty to take place in an economy. This would cause a lack in consumption smoothing which would lead to higher relative consumption volatility in the country. A model incorporating both financial intermediation costs and housing market interactions captures this result very closely to the data. Furthermore, in line with the data, this model finds that the volatility is higher for less developed countries.

BIBLIOGRAPHY

[1] Acemoglu, D., and A. Scott. 1997. Asymmetric business cycles: Theory and time-series evidence. Journal of Monetary Economics 97 (40): 501–533.

[2] Agenor, P. 2003. Benefits and costs of international financial integration: theory and facts. World Economy 26: 1089-118.

[3] Aghion, P., A. Banerjee, and T. Piketty. 1999. Dualism and macroeconomic volatility. Quarterly Journal of Economics 114: 1359–97.

[4] Aghion,P., P. Bacchetta, and A. Banerjee. 2004. Financial development and the instability of open economies. Journal of Monetary Economics 51: 1077–1106.

[5] Antunes, A., T. Cavalcanti, and A. Villamil. 2008. The effect of financial repression and enforcement on entrepreneurship and economic development. Journal of Monetary Economics 55 (2): 278-297.

[6] _____ 2013. Costly intermediation and consumption smoothing. Economic Inquiry 51 (Jan): 459–472.

[7] Baxter, M., and M. Crucini. 1995. Business cycles and the asset structure of foreign trade. International Economic Review 36: 821–54.

[8] Beck, T., A. Demirgüc-Kunt, and R. Levine. 2010. A new database on financial development and structure. World Bank dataset October 2010 update.

[9] Behrman, J. 1988. Intrahousehold allocation of nutrients in rural India: are boys favored? Do parents exhibit inequality aversion?. Oxford Economic Papers 40: 32-54.

[10] Bernanke, B., M. Gertler, and S. Gilchrist. 1999. The financial accelerator in a quantitative business cycle framework," in J. Taylor and M. Woodford, eds., Handbook of macroeconomics. Amsterdam: North- Holland, pp. 1341-93.

[11] Bordo, M. D., J.G. Haubrich. 2010. Creditcrises, money and contractions: An historical view", Journal of Monetary Economics 57, 1.18.

[12] Bureau of Labor Statistics. 2012. Unemployment rate and discouraged workers data. Retrieved from http://www.bls.gov/data/#unemployment

[13] Campbell, J R., and Z. Hercowitz. 2005. The role of collateralized household debt in macroeconomic stabilization. NBER Working Papers 11330, National Bureau of Economic Research, Inc, May.

[14] Cecchetti, S. D., M. Kohler, C. Upper. 2009. Financial crises and economic activity", NBER Working Paper No. 15379.

[15] Central Bank of the Republic of Turkey. 2013. Final consumption expenditure of resident and non-resident households in current and fixed prices, Ankara.

[16] Christiano, L. J., M. Trabandt, and K. Walentin. Introducing financial frictions and unemployment into a small open economy model. Journal of Economic Dynamics and Control 35.12: 1999-2041.

[17] Christensen, I., and A. Dib. 2008. The financial accelerator in an estimated New Keynesian model", Review of Economic Dynamics, 11 (1), pp. 155–178.

[18] Claessens, Stijn, M. A. Kose, and M. E. Terrones. 2012. How do business and financial cycles interact?. Journal of International economics 87.1: 178-190.

[19] Cook, D. 1999. The liquidity effect and money demand. Journal of Monetary Economics 43.2: 377-390.

[20] Cover, J. 1992. Asymmetric effects of positive and negative money-supply shocks. Quarterly Journal of Economics 107, 1261–82.

[21] Crucini, M. 1997. Country size and economic fluctuations. Review of International Economics 5, No. 2: 204–20.

[22] Davis, S. J., and J. A. Kahn. 2008. Interpreting the great moderation: changes in the volatility of economic activity at the macro and micro levels. Journal of Economic Perspectives 22(4): 155–80.

[23] DeLong, B.J., and L. H. Summers. 1998. How does macroeconomic policy affect output?" Brookings Papers on Economic Activity, (2), pp. 433-94.

[24] Denizer, C.A., M.F. Iyigun, and A. Owen. 2002. Finance and macroeconomic volatility. Contributions to Macroeconomics 2: 1–30.

[25] Easterly,W., R. Islam, and J. E. Stiglitz. 2001. Shaken and stirred: explaining growth volatility. Annual World Bank Conference on Development Economics, ed. by B. Pleskovic and N. Stern.

[26] Fanelli, J. M. 2008. Macro volatility and financial institutions. Macroeconomic Volatility, Institutions and Financial Architectures: The Developing World Experience,1-24.

[27] Ferreira da Silva, G. 2002. The impact of financial system development on business cycles volatility: cross-country evidence. Journal of Macroeconomics 24: 233-53, ed. by J.M. Fanelli.

[28] Foster, A. 1995. Prices, credit markets and child growth in low-income rural areas. Economic Journal 105: 551-70.

[29] Gambacorta L., and S. Iannotti. 2008. Are there asymmetries in the response of bank interest rates to monetary shocks. Applied Economics, 39 (19).

[30] Gertler, M., and Peter Karadi. "A model of unconventional monetary policy." Journal of Monetary Economics 58.1 (2011): 17-34.

[31] Gertler, M„ S. Gilchrist, and F. M. Natalucci. 2007. External constraints on monetary policy and the financial accelerator. Journal of Money, Credit and Banking 39.2-3: 295-330.

[32] Gertler, Mark, and Nobuhiro Kiyotaki. "Financial intermediation and credit policy in business cycle analysis." Handbook of Monetary Economics 3 (2010): 547.

[33] Greenwood, J., Z. Hercowitz, and G. W. Huffman. 1988. Investment, capacity utilization, and the real business cycle. The American Economic Review: 402-417.

[34] Hansen, G.D., and E. C. Prescott. 2005. Capacity constraints, asymmetries, and the business cycle. Review of Economic Dynamics, 8 (4) (2005), pp. 850–865

[35] Iacoviello, M. 2005. House prices, borrowing constraints and monetary policy in the business cycle. American Economic Review (June): 739-64.

[36] _____ 2011. Financial business cycles. Working Paper, Federal Reserve Board.

[37] Iacoviello, M., and M. Pavan. 2011. Housing and debt over the life cycle and over the business cycle. Boston College Working Papers in Economics 723, Boston College Department of Economics.

[38] Ireland, P.N., 2003. Endogenous money or sticky prices? Journal of Monetary Economics 50, 1623–1648

[39] Keynes, J.M. 1936. The general theory of employment, interest and money. Macmillan, London.

[40] Kose, M. A., E. S. Prasad, and M. E. Terrones. 2003. Financial integration and macroeconomic volatility. IMF Staff Papers , Vol. 50. No. 1.

[41] Laursen, T., and S. Mahajan. 2005. Volatility, income distribution, and poverty. in J. Aizenman and B. Pinto, Managing Volatility and Crisis: A Practitioner's Guide, Cambridge University Press: 101-36.

[42] Lawrence, E. 1991. Poverty and the rate of time preference: evidence from panel data. Journal of Political Economy, 119, 54–77.

[43] Lo, M., and J. Piger. 2005. Is the response of output to monetary policy asymmetric?Evidence from a regime-switching coefficients mode. Journal of Money, Credit and Banking, 37, 868–86.

[44] Macklem, T., A. Paquet, L. Phaneuf. Asymmetric effects of monetary policy: Evidence from the yield curve. CREFE Working Paper 42.

[45] Magud, N. E. 2008. On asymmetric business cycles and the effectiveness of countercyclical fiscal policies. Journal of Macroeconomics", Vol. 30, Issue 3, pp. 885- 905.

[46] Meier, A., Müller, G.J., 2006. Fleshing out the monetary transmission mechanism: output composition and the role of financial frictions. Journal of Money, Credit, Banking 38, 1999–2133.

[47] Mergent, Inc. Fifth Thrid Bank Income Statements. Retrieved May 2012, from Mergent Online database.

[48] OECD, 2010. Main economic indicators - complete database. Main Economic Indicators (database), http://dx.doi.org/10.1787/data-00052-en (Accessed on January 2013)

[49] Ordonez, G. L. 2009. Larger crises, slower recoveries: The asymmetric effects of financial frictions. Federal Reserve Bank of Minneapolis Research Department Staff Report 429.

[50] Pallage, S.,and M. Robe. 2003. On the welfare cost of economic fluctuations in developing countries. International Economic Review 44: 668–77.

[51] Ramey, G, and V.A. Ramey. 1995. Cross-country evidence on the link between volatility and growth. American Economic Review 85: 1138-51.

[52] Ravn, M.O., and M. Sola. 2004. Asymmetric effects of monetary policy in the United States. Federal Reserve Bank of St. Louis Review, 86(5), 41-60.

[53] Reinhart, C. M., and V. R. Reinhart. 2010. After the fall. NBER Working Paper No. 16334.

[54] Reinhart, C. M., and K. S. Rogoff. 2008. Banking crises: An equal opportunity menace. NBER Working Paper No. 14587.

[55] _____2009. The aftermath of financial crises. NBER Working Paper No. 14656.

[56] Rose, E. 1994. Consumption smoothing and excess female mortality in rural India. draft, University of Washington.

[57] Samwick, A. A. 1998. Discount rate heterogeneity and social security reform. Journal of Development Economics 57: 117–46.

[58] Sims, C. A., J. H. Stock, and M. W. Watson. 1990. Inference in linear time series models with some unit roots. Econometrica: Journal of the Econometric Society, 113-144.

[59] Sutherland, A. 1996. Financial market integration and macroeconomic volatility. Scandinavian Journal of Economics 98: 521–39.

[60] Thompson M.A. 2006. Asymmetric adjustment in the prime lending–deposit rate spread. Review of Financial Economics 15, 323–329.

[61] U.S. Bureau of Economic Analysis. Table 2.4.5U, personal consumption expenditures by type of product. (Accessed on January 2013).

[62] Veldkamp, L. 2005. Slow boom, sudden crash. Journal of Economic Theory. 124 (2), 230–257.