12-2013

The Impact of Securitization, Bank Liquidity Shocks, and Government Intervention on Lending and Banks' Asset Composition: Evidence from The U.S. 2007-2009 Financial Crisis

Peter V. Egly
The University of Texas Rio Grande Valley, peter.egly@utrgv.edu

THE IMPACT OF SECURITIZATION, BANK LIQUIDITY SHOCKS, AND GOVERNMENT INTERVENTION ON LENDING AND BANKS' ASSET COMPOSITION: EVIDENCE FROM THE U.S. 2007-2009 FINANCIAL CRISIS

A Dissertation

by

PETER VICTOR EGLY

Submitted to the Graduate School of
The University of Texas- Pan American
In partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2013

Major Subject: Business Administration with emphasis in the area of Finance

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PETER VICTOR EGLY

COMMITTEE MEMBERS

Dr. André Varella Mollick
Chair of Committee

Dr. Diego A. Escobari
Committee Member

Dr. Dave O. Jackson
Committee Member

Dr. Jun Sun
Committee Member

December 2013

ABSTRACT

Egly, Peter Victor, The Impact of Securitization, Bank Liquidity Shocks, and Government Intervention on Lending and Banks' Asset Composition: Evidence from the U.S. 2007-2009 Financial Crisis. Doctor of Philosophy (PhD), December, 2013, 164 pp., 18 tables, 15 figures, 61 references.

The 2007- 2009 financial crisis creates a new wave of research opportunities in part due to the transformation of the banking system that led to the development of securitized banking that is supported by short term funding sources provided through the money and capital markets. The near collapse of the financial system ultimately led to the ensuing government intervention by the Federal Reserve and the U.S. Treasury department to revive the frail U.S. economy. This dissertation has two basic research objectives: 1) investigate the impact of securitization and the subprime mortgage collapse on bank lending during the crisis and 2) examine changes in banks' balance sheet composition associated with government intervention.

Results suggest that traditional bank funding costs play a diminished role in the supply of bank lending in the larger bank samples (large banks and money center banks) and yet there is a positive impact of the repurchase agreement (REPO) market rates on bank lending that is pervasive in the smaller bank samples (small and medium) suggesting that increases in Repo rates fosters lending during the crisis period. Real estate lending exposure negatively affects bank lending in the small and medium bank samples. The evidence suggests that the Federal Reserves initial round of quantitative easing served as an important channel through which banks

were able to attain liquidity objectives during the crisis. The results suggest that small and money center banks with greater loan portfolio exposures choose to build liquidity in response to a rise in Repo rates compared to banks with lower lending exposures. Finally, the balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period and residential real estate portfolios has reverted to pre-crisis levels for money center banks and has remained mostly consistent throughout the sample period for all other banks with a modest rise noted in the post crisis period for large banks.

DEDICATION

Thanks to the love, encouragement and support of my family, both present and those who have gone before me, my academic goal with regards to the completion of the doctoral studies has been achieved. I dedicate this dissertation to my wife Maria Eugenia, who has been a constant supporter and who has sacrificed greatly putting my aspirations before hers and to my son Peter Victor who is the center of my life and who always believed that through hard work and perseverance I would complete this academic goal. To my parents Oscar and Perla who instilled the values of work ethic, dedication and perseverance, which are the key traits that guided me throughout this journey. To my siblings: Oscar H., Bernadette T., and Michelle M., and sister-in-law Rebecca and nephew Bryan who provided encouragement in my pursuit of this degree. To my Uncle Joe, my second father, who inspired and motivated me to pursue the PhD. Above all, I dedicate this humble effort to the Lord my God for without his love and guidance I would not have been able to complete this journey.

ACKNOWLEDGEMENTS

I am grateful to my dissertation chair, Dr. André Mollick for his insightful mentoring, patience and advice. I thank Dr. Mollick for exposing me to the fundamentals of quality research. I learned that quality research is a non-linear process that entails, together with many other components, an exhaustive exploration of all possible alternatives to the research quest. I am hopeful that if I am able to emulate Dr. Mollick's research philosophy that he has generously shared with me, I will be able to have a productive research career in the years to come.

I wish to express my deep felt thanks to my committee members: Dr. Dave Jackson, Dr. Diego Escobari and Dr. Jun Sun. I am thankful to Dr. Jackson for sharing his vast knowledge in the field of banking and finance with me over the years. But most importantly, I truly appreciate that he has always being there for me: a professor, mentor, committee member and always a friend. I extend my heartfelt thanks to Dr. Diego Escobari who was instrumental in providing insightful guidance with respect to the econometric modeling challenges that I encountered during the dissertation stage. I also wish to thank Dr. Sun who provided valued advice and support in data collection and manuscript editing and formatting.

I also would like to thank my colleagues and dear friends: Dr. David Johnk, Dr. Daniel Huerta and Dr. Robert Killins for their ongoing support, involvement and encouragement since without them this dissertation would have not been accomplished. A special thank you goes to my extended banking family that includes too many members to individually mention for their support, and encouragement.

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CHAPTER I

INTRODUCTION

The 2007- 2009 financial crisis, while unfortunate, has spawned a new wave of research opportunities that are of interest to academicians, economic policy makers, regulators, bank managers, investors and other affected parties including households and businesses. Financial crisis episodes, albeit of lesser magnitude to the 2007-2009 crisis, are irrefutably a part of U.S. economic history that has been the subject of extensive research. In recent history memorable episodes include the collapse and subsequent bail out of the Savings and Loan industry during the 1980s, the U.S. stock market crash of 1987, the hedge fund crisis of 1998 and the Dot.Com bust reflected in the stock market crash of 2002. The 2007-2009 financial crisis like previous crisis is rooted in lax monetary policy with interest rates at historic lows and was accompanied by a housing market boom and bust. What is unique to this latest financial crisis is the transformation of the banking system leading to the development of securitized banking and the shift towards short-term funding sources provided through the money markets and capital markets and the ensuing government intervention by the Federal Reserve and the U.S. Treasury to revitalize the weak U.S. economy. This dissertation has two basic research objectives: 1) to investigate the impact of securitization on bank lending in the midst of the 2007-2009 financial crisis and employ methodologies from the bank lending channel (BLC) literature to assess the impact of the subprime mortgage collapse on bank lending, and 2) to examine whether there are changes in banks' balance sheet composition primarily in terms of liquid asset holdings and loan

portfolio exposures that are associated with the government intervention whose objective was to stabilize the financial system.

In Chapter 3, I examine the impact that traditional bank costs of funding and the Repo-OIS spread have on bank lending given the advent of securitization. I also investigate the relationships of bank real estate loan portfolio exposure and deposit holdings to overall bank lending as a result of the financial crisis and concurrent subprime mortgage collapse. In Chapter 4, I examine the relationship between quantitative easing and bank liquidity as well as the relationship between the Repo-OIS spread and bank liquidity given the Fed's significant expansion of its balance sheet that initiated during the crisis period and the sharp increases in the Repo-OIS spread that were witnessed during this time frame. From a research framework there is a natural bond between Chapter 3 (lending essay) and Chapter 4 (liquidity essay) given that banks exercise managerial discretion in jointly choosing liquidity and lending levels and thus research that ignores either banking component would provide an incomplete assessment. The progression from Chapter 3 to Chapter 4 is also consistent with the timeline of economic events. The events include a period of lending activity fueled by the securitization and repo-markets, a subsequent collapse of the subprime mortgage market and disruption in capital and money markets, and the ensuing U.S. government intervention that injected significant liquidity into the financial system. I run the loan and liquidity models on the sample of banks following a four-size classification scheme based on total asset size that yields: 4,982 small banks, 475 medium banks, 34 large banks and 14 money center banks over a sample period 2005Q1 to 2010Q4.

In Chapter 3 of this dissertation I find that traditional bank costs of funding play a diminished role in the supply of bank lending. The negative relationship is well captured in the medium bank sample case under the dynamic panel specifications. The fact that variability in deposit costs

does not explain bank lending growth in the large and money center samples implies that larger banks have greater access to the securitization markets which arguably has become an important alternative funding source as suggested by Loutskina (2011) and others. However, it is interesting that the impact of Repo-OIS spread on lending seems to be present only in the small and medium bank samples and that the relationship is a positive one. While a widening of the Repo-OIS spread would *a priori* have a negative impact on lending, the positive and significant coefficient on the interaction term with respect to the Repo-OIS spread with the crisis indicator variable suggests that during the crisis period as the Repo-OIS spread rises bank lending for the small and medium bank sample cases also increases. This finding provides support to the theoretical model of financial intermediation proposed by Shleifer and Vishny (2010) that incorporates the effects of investor sentiment in the markets that suggest that banks have an incentive to securitize loans as long as the fees generated from loans are higher than what the banks expect they may potentially loose on their holdings of securitized asset should prices fall.

In Chapter 3 of this dissertation I also find some evidence supporting an inverse relationship between a bank's residential real estate portfolio exposure and overall bank lending that is particularly strong in the small and medium bank samples. Another interesting finding associated with the small bank sample is that banks with high exposure in their residential real estate portfolios increase new lending activity by a greater amount compared to banks with lower exposure in their residential real estate portfolios during the crisis period. The finding in the small bank sample case is consistent with the institutional memory hypothesis problem proposed by Berger and Udell (2004). The evidence presented in Chapter 3 with respective to the hypothesized positive relationship between transaction deposits and bank lending is mixed. The positive relationship between transaction deposits (Deposits II variable) and bank lending is well

captured in the small bank sample. I also find that the positive relationship between transaction deposits and bank lending weakens as bank size increases which is expected since the composition of the banks' balance sheet structure including sources of funding typically changes with bank size. An interesting finding in this dissertation is that banks with higher levels of transaction deposits reduce new lending activity by a greater amount compared to their counterparts with lower levels of transactions deposits during the crisis period which is evidenced in the medium bank sample case.

In Chapter 4 of this dissertation I find evidence that suggests that the Fed's initial round of quantitative easing served as an important channel through which banks were able to attain their liquidity objectives which took center stage during the crisis period. In this essay I surmise that bank liquidity behavior is not necessarily constant between banks of different asset size classes. For example, contrary to the findings by Cornett et al (2011) yet consistent with the findings by Loutskina (2011), I find that transaction deposits are only important in explaining bank liquidity for small and large banks. Furthermore, non-performing loans have the expected negative impact on bank liquidity that only seems relevant in the medium bank sample and there are "reputation effects" from commercial letters of credit on bank liquidity exhibited by money center bank samples.

I also find evidence supporting a direct relationship between liquidity and the Repo-OIS spread that is well evidenced in the small and medium bank samples. In the case of the small and money center bank samples, the results suggest that as the Repo-OIS spread rises that banks with greater loan portfolio exposures scaled by bank total assets would tend to build liquidity compared to their counterparts that have lower lending exposures. Cornett et al. (2011) reach a

similar conclusion when they apply their liquidity model to their large bank sample (their result was not significant when applied to their small bank sample).

The changes in bank balance sheet composition over the pre and post financial crisis period that are largely associated with the government intervention reveal some interesting results. The balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period with the shift being more discernible for the larger bank samples over the entire sample period. The residential real estate portfolio exposure has reverted back to pre-crisis levels in the money center bank sample case and has remained fairly consistent throughout the sample period in all other bank samples with a modest rise noted in the post crisis period in the large bank sample case. Overall bank loan portfolios scaled by total average balance sheet holdings seem to have trended downward during the post crisis period with the exception of the large bank sample where post crisis exposures have held fairly steady.

Taken as a whole, it is interesting that the Repo-OIS spread has the same directional impact in my lending and liquidity models. This finding offers support to the view that an active securitization market, which is usually linked to the repo markets, provides banks with a source of loan funding and liquidity. It is equally interesting to examine how demand deposits can serve as a key funding source of lending activity in the case of small banks while representing a key liquidity source with respect to small and large banks. Similarly, it is important to see how deposit costs impact both bank lending and liquidity behavior in a comparable manner such that when deposit costs rise both bank lending and liquidity fall in the smaller bank samples. Given that bank lending and liquidity risk management are dynamic processes driven by business cycle conditions, bank financial attributes and constraints, access to (and conditions of) capital and money markets and other internal and external factors, I employ a dynamic modeling approach.

More specifically, I employ dynamic panel methods and system GMM (SGMM) to estimate my lending and liquidity models as proposed by Blundell and Bond (1998) while most of the reviewed research uses static models of lending and liquidity behavior. The SGMM estimator is able to exploit the time-series attributes of the data, allows for the inclusion of lagged dependent variables as regressors and is capable of addressing endogeneity.

Overall the findings in my dissertation have important implications primarily for bank regulators. First, in the lending essay developed in Chapter 3 I find that not all banks (i.e. small, medium, large, and money center) behave in the same manner and therefore strong consideration should be given to re-assessing the existing pre-established guidelines that are used in determining a bank's level of safety and soundness. Second, even though the evidence of asymmetric affects of the Repo-OIS spread on bank lending is not common across all bank samples, the results from the small and medium bank samples provide an important signal that deserves attention. The securitization process is a lucrative venture that fueled bank lending in the pre-crisis period that if left unmonitored by regulators can result in significant negative consequences. As explained by Loutskina (2011) the securitization process jeopardized banks' fundamental screening and monitoring roles by affectively allowing them to easily move assets off their balance sheets. Depending on the severity of the potential negative outcomes, the implication of this finding extends beyond bank regulators to policy makers and investors. Third, with liquidity creation being a central theme during the financial crisis period and given the generally perceived soft loan demand the balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period. Overall bank liquidity exceeds pre-crisis levels in all bank samples and interest rates remain relatively low. Furthermore, if we accept that bank losses have been adequately recognized and that banks have been appropriately

recapitalized then the stage has been set for business recovery. This leads us to contemplate the following questions: Will we witness a loosening of bank credit standards to promote bank lending to help revive the economy? Have lessons been learned from the 2007-2009 financial crisis and are the bank regulators prepared to handle the new challenges that face them? How will an eventual subsequent contraction of the Federal Reserve's balance sheet which should hypothetically have a negative impact on liquidity in the financial system impact bank lending? These questions and many others become the spring board for ongoing research in this interesting field of study.

CHAPTER II

A SURVEY OF THE FINANCIAL CRISIS LITERATURE

The literature surrounding the 2007-2009 financial crisis has taken various paths. For instance, there is a group of papers that focus on the causes of the crisis and the subsequent U.S. government intervention. Another group of articles examine the near collapse of the financial system and the ensuing balance sheet adjustments of the various financial intermediaries'.

The changing banking models together with the creation of complex securities and the banks' increased dependency on the financial markets as a source of funding led to new research that re-examines theories of financial intermediation. This branch of research includes both theoretical and empirical work and focuses on the measurement of systemic risk and stress testing. Still another stream of literature deals with the equity market's reaction to government regulation enacted in response to the financial crisis. The literature also contains a series of papers that examine the effects of the crisis on bank lending, credit availability and its impact on real corporate behavior in regards to investment, employment, and technology decisions.

Taylor (2008) attributes the 2007-2009 financial crisis to loose U.S. monetary policy which translated to cheap money that accelerated the housing boom and subsequent bust. The boom and bust of the housing markets impacted the financial markets since falling house prices resulted in rising delinquencies and foreclosures. These negative effects were amplified through various channels including complex securitization instruments tied to the pooling, packaging, and sale of high-risk subprime mortgages. The rising uncertainty regarding the value of bank assets was at the core of the financial crisis and was captured by sharp increases in money market rates since

August 2007. In a follow-up paper Taylor and Williams (2009) examine interest-rate expectations in the midst of the 2007-2009 financial crisis. Using daily data between January 2, 2007 and August 8, 2008, they regress interest rate spreads including the difference between the 3-month LIBOR and the Overnight Index Swap (OIS) on credit default swaps (CDS rates), LIBOR- TIBOR spreads, LIBOR-REPO spreads and a dummy variable for the Term Auction Facility (TAF), a government based lending program. They conclude that expectations of future interest rates and counterparty risk are the main factors explaining the spread between interest rates on term lending and overnight rates while there is no robust evidence of liquidity effects.

Articles by Cecchetti (2009) & Brunnermeier (2009) each provide a comprehensive chronology of the 2007-2009 financial crisis. The paper by Cecchetti (2009) discusses the role of the Federal Reserve (Fed) in the initial stages of the crisis. To create liquidity in the banking system, the Fed employed traditional monetary tools such as reductions in target fed funds rate and primary lending rate as well as innovated mechanisms including various lending programs such as the Term Auction Facility (TAF), the Term Securities Lending Facility (TSLF) and the Primary Dealer Credit Facility (PDCF). Cecchetti (2009) concludes that the Fed's intervention had only short-term benefits in curbing risk and that these efforts were unable to keep the problems in the financial system from spilling over into the real economy. Brunnermeier (2009) introduces the concept of "amplification effects" in connection with the housing bust through various channels. These amplification effects include: (i) liquidity spirals driven by balance sheet effects of levered investors, (ii) lending channel effects as banks hoard cash and become concerned about future access to capital markets, (iii) runs on financial institutions through the non-renewal of commercial paper and repo funding, and (iv) net-work effects including counterparty credit risk. The changing role of financial intermediation during the 2007-2009

crisis was described by Adrian and Shin (2010a). With the advent of securitization, banks would be able to sell mortgages to institutions that financed their purchases through the issuance of mortgage backed securities (MBS). Adrian and Shin (2010a) explain that the credit crunch related to the financial crisis is captured through the collapse of balance sheet capacity for financial intermediaries that operate in the capital markets. The authors point out that there is an inverse (positive) relationship between total assets and leverage for households (broker dealers) and that leverage is a pro-cyclical phenomenon.

There is a stream of literature, both descriptive and empirical, that focuses on balance sheet adjustments made by various classes of financial intermediaries in response to changing market forces in the midst of the financial crisis. Adrian and Shin (2010b) examine the relationship between balance sheet size and leverage of investment banks (aka security broker/dealers) and investigate the aggregate consequences of pro-cyclical leverage over the time frame 1997Q1 to 2008Q1. They find that changes in collateralized borrowing and lending on intermediaries' balance sheets are good forecasting variables for shocks to market-wide risk proxied by the VIX index. Given their empirical findings, the authors also imply that financial market liquidity can be understood as the rate of growth of aggregate balance sheets.

He et al. (2010) tracks financial institutions balance-sheet adjustments in securitized assets, namely mortgage backed (MBS) and asset backed securities (ABS), for the sample period 2007Q4 to 2009Q2. The authors evaluate two financial crisis theories: one based on leverage-constraints and the other based on equity risk-capital constraints. They find that securitized asset holdings for hedge funds and broker-dealers declined while commercial banks saw increases in securitized asset holdings and leverage. On the liability side of balance sheets, repurchase agreement (REPO) financing declined sharply while government guaranteed debt issued by

commercial banks rose significantly. The authors conclude that the leverage constraint theory best fits the hedge funds and broker-dealer financial intermediaries while the equity-risk capital constraint theory best applies to the commercial banking sector. Related research by Gorton and Metrick (2010) examine the run on the REPO market. They contend that securitization and REPO financing were at the nexus of the crisis. Using a large data set consisting of credit spreads for securitized bonds and credit default swap (CDS) series they find spillover effects from subprime housing-related assets to non-real estate related asset markets. Regressing various credit spreads and REPO spreads on a series of control variables including the LIBOR- OIS spread, a measure of counterparty risk, they find that their counterparty risk measure was significant; implying higher uncertainty about bank solvency and lower values of REPO collateral.

Researchers have regained interest in examining theories of financial intermediation in light of the transition in the banking industry. Traditional banking models whereby banks made and held their loans through maturity were replaced by more complex models that involved origination, packaging, and loan sales thus building new links to the money markets and capital markets that served as important funding sources. Brunnermeier and Pedersen (2009) provide a model that links an asset's market liquidity with traders' funding liquidity. Their multi-period model of the economy has *J* risky assets and includes three groups of market participants: customers and speculators who trade assets and financiers who fund speculators' positions. They show that under certain conditions margin requirements are destabilizing and that market liquidity and funding liquidity are mutually reinforcing which leads to liquidity spirals. Their model results suggest that market liquidity: (i) can suddenly dry up, (ii) has commonality across assets, (iii) is related to volatility, (iv) is subject to flight to quality and (v) co-moves with the

market. A model of financial intermediation that accounts for investor sentiment was presented by Shleifer and Vishny (2010). In their three-period model banks make, securitize, distribute, and trade loans or hold cash. In their model, banks are able to borrow money by pledging securities as collateral while real activity consists of investment projects that become available in the first two periods that payout in the final period. The theory predicts that: (i) bank credit and real investment will be volatile when market prices are volatile; (ii) profit maximizing behavior creates systemic risk; (iii) banks' balance sheets, profits, and real investment are highly cyclical; and (iv) investment is strictly higher with securitization than without it.

Brunnermeier and Sannikov (2011) propose a macroeconomic model with financial intermediation. Their model of the economy contains two types of experts- entrepreneurs who manage capital and intermediaries who monitor entrepreneurs-and households that are less productive with financial frictions limiting the flow of funds between these economic agents. The authors explain that when business cycles exhibit persistence, generated by a temporary adverse shock, and amplification effects through leverage and price feedback, experts' net worth declines. Per the model an aggregated shock, affecting many experts concurrently, leads to decreased demand for assets and a drop in prices that further lowers experts' net worth with further feedback to assets prices creating asset price volatility. The authors summarize that: (i) due to high non-linear amplification effects the economy is susceptible to instability and occasionally enters volatility periods, (ii) risk is endogenous and asset price correlations are high in economic downturns and (iii) while securitization and derivative contracts leads to better sharing of exogenous risk they foster higher systemic risk. A similar paper by Korinek (2011) develops a model of systemic risk based on financial amplification effects that occur in response to strong adverse shocks. In his model the economy is comprised of two types of agents: bankers

and households with bankers subject to business risk and financial constraints. Per the model there are two types of goods: homogeneous consumption goods and productive assets. The model further assumes that bankers have superior productivity over households. In this model risk neutral bankers raise funds from households and invest in risky projects. The author shows that when project aggregate returns decline, bankers' liquid net worth also declines and is insufficient to meet contractual repayments with binding financial constraints leading to fire sales by bankers. The author concludes that: (i) bankers underinsure in ex-ante risk averse markets and engage in excessive fire sales in ex-post asset markets once an adverse shock materializes since bankers take prices in the economy as given and do not internalize pecuniary externalities of fire sales and (ii) financial markets are pro-cyclical such that constraints endogenously loosen (tighten) in good (bad times).

There is a series of empirical papers that respond to a developing trend that focuses on the stability of the banking system as a whole, a concept referred to as macro-prudential regulation. Using CDS rates and financial institution equity prices over the time frame from 2001 to 2008, Huang et al. (2009) form two default risk parameters used to assess portfolio credit risk. They define systematic risk as multiple simultaneous defaults of large financial institutions. They measure systemic risk by the theoretical price of insurance against financial distress of a portfolio of 12 U.S. banks calculated as the risk-neutral expectation of portfolio losses that equal or exceed a minimum share of the financial sector's total liabilities. For stress-testing purposes, authors examine the dynamic linkages between default risk factors and a number of macro-economic variables under a VAR framework and measure the response of individual bank's probability of default to changes in market conditions. Huang et al. (2011) apply their systemic risk model to the 19 bank-holding companies (BHC) covered by the U.S. Supervisory Capital

Assessment Program (SCAP) commonly known as the stress test over the period from January 2004 to December 2009. They find that a bank's contribution to the systematic risk indicator appears linearly related to its default probability but highly nonlinear with respect the institution's asset size and asset correlation. They find that their measure of systemic importance of financial institutions strongly resembles the SCAP results, the latter based on confidential, supervisory, and proprietary information.

Acharya et al. (2010) propose a model of systemic risk and show that each financial institution's contribution to systemic risk can be measured by its systemic expected shortfall (SES) which equals the financial institution's expected capital shortfall when the financial system is undercapitalized as a whole. The authors relate the institution's SES to its marginal expected shortfall (MES), applying a Value at Risk (VaR) approach to equity returns, and to its leverage. Authors run various OLS and Probit cross-section regressions using dependent variables such as SCAP shortfall normalized by tier one capital, realized SES, and realized CDS returns. They find that their ex-ante SES measure has strong predictive ability to forecast emerging risks as borne out during the 2007-2009 financial crisis (more specifically: the outcome of SCAP stress test results, the decline in the equity valuation of large global financial firms and the widening of the CDS spreads). Using daily CDS spreads and bond prices over the sample period January 2004 to June 2010 for 15 large global financial institutions, Giglio (2011) develops a measure of systemic risk defined as the probability of default of at least "n" number of banks. The author computes marginal and pairwise default probabilities for all banks and pairs of banks using linear programming techniques and probability bounds theory. The author finds that systemic risk in large banks did not increase until the Bear Stearns collapse in March 2008

and that some spikes in CDS spread and bond yields relate to idiosyncratic risk and not systemic risk.

An alternative measure of systemic risk referred to as CoVaR is introduced by Adrian and Brunnermeier (2010) and applied to a sample consisting of 6 BHC, 5 investment banks, 3 insurance companies and government sponsored enterprises Fannie and Freddie Mac over the time frame 1986Q1 to 2010Q1. Authors define CoVaR*i* as the VaR of the whole financial system conditional on bank *i* being in distress and ΔCoVaR*i*, a measure of an institution's contribution to the overall systemic risk, as the difference between CoVaR*i* and CoVaR in the median state of the institution. The ΔCoVaR*i* estimates are based on weekly changes in the market value of total assets of all publicly traded financial institutions (i.e. commercial banks, broker-dealers, insurance companies, and real estate companies) using quantile regressions. The conditional VaR and CoVaR estimates explicitly model the time variation of the joint distribution of asset returns as a function of lagged systematic state variables. The state variables used include: VIX, short term liquidity spreads (based on REPO and Treasury bill rates), yield-curve slope (based on long- term and short-term Treasury rates), credit spreads (based on long term BAA bond rates and Treasury rates), equity market returns and cumulative real estate sector returns. The authors' main conclusions are that institutions may have a low VaR but a high CoVaR and that forward-looking ΔCoVaR are countercyclical by design and hence in sharp contrast to the pro-cyclical nature of current regulation. De Nicolo and Lucchetta (2010) present a modeling framework using VAR methodology and quantile regressions that delivers joint forecasts of indicators of systemic real risk and systemic financial risk. Their systemic real risk indictor is GDP at risk defined as the worst predicted realization of quarterly real GDP growth at a 5 probability over a predetermined forecasting horizon. Their systemic financial risk indictor is defined as the worst

predicted realization of market adjusted returns of a large portfolio of financial firms at a 5 probability over a predetermined forecasting horizon. To examine how their systemic risk indicators respond to structural shocks in the economy, they use impulse responses to identified structural shocks based on macroeconomic and banking theory. Using large sets of quarterly time series of indicators of financial and real activity for G-7 countries they find evidence of out of sample forecasting power for tail realizations of real activity for several countries and that aggregate demand shocks are the main drivers of the real cycle while credit demand shocks drive the bank lending channel.

The narrative that describes the consequences of the 2007-2009 financial crisis points to the unprecedented government intervention through various lending and or funding programs, debt and deposit guarantees, large scale assets purchases, direct assistance (through the capital purchase program among others), and bank holding company (BHC) stress tests such as SCAP. The research in this area focuses on the equity markets' reaction to government intervention. Employing event-study methodology to returns derived from standard market model specifications; Peristian et al. (2010) investigate whether the 2009 Supervisory Capital Assessment Program (SCAP) stress test produced information demanded by the market. The authors test four SCAP events including the announcement, clarification, stress methodology and results and compute cumulative abnormal returns (CAR's) from OLS regressions over the time frame 7/1/2006 to 6/30/2007. Forming various bank portfolios identified by capital adequacy (i.e. GAP vs. no GAP banks), SCAP banks, Top 50 banks excluding SCAP banks, they find the "announcement" and "stress test methodology" were non- events while the "clarification" and "result" events lead to significant (non- significant) positive abnormal returns for GAP (no GAP) banks. Regressing CAR's from results window on GAP/assets, clarification CAR (a proxy

for expected GAP) and dummy variable no-GAP, authors find that: (i) larger unexpected GAP's leads to more negative abnormal returns, (ii) clarification CAR is a good proxy for expected GAP, (iii) investors new which banks had GAP's and (iv) government's reporting of the size of the GAP shortage provided information to the market.

A study by Subrahmanyam et al. (2011) investigates the differential stock- market reaction to recent financial regulation including the Emergency Economic Stabilization Act (ESSA) of 2008 and American Recovery and Reinvestment Act (ARRA) of 2009 on 134 commercial banks, 69 S&L's, 105 insurance companies and 100 REITs. Using standard event-study methodology to returns derived from standard OLS market model, the authors find that eight of the nine events tied to legislation passed between February 2007 and July 2009 have a significant market reaction. Authors point out that the one regulatory event which results in a positive market reaction for all groups of firms was the October 3, 2008 legislation that passed the Troubled Asset Repurchase (TARP) program. On the individual firm level, the authors find that while market-model regression alphas decrease post-event for bank and insurance firms, the passing of the legislation results in a decrease in systematic risk faced by these two groups.

There is a strand of literature that investigates the behavior of bank lending in the midst of the 2007-2009 bank crisis and the impact of credit availability on real corporate behavior on investment, employment, and technology decisions. From the bank's perspective, Ivashina and Scharfstein (2010) who focus on syndicated loans, find that new loans to large borrowers fell by 47% during the fourth quarter of 2008 relative to the prior quarter and by 79% relative to the peak of the credit boom during the second quarter of 2007. Shortly after the failure of Lehman Brothers in 2008, the authors find that there was a simultaneous run by short-term bank creditors and borrowers who drew down on their credit lines leading to sharp increases in commercial and

industrial (C&I) loans reported by the banks. They conclude that these two sources of stress on bank liquidity led to a reduction in overall lending. From the corporate borrower viewpoint, Almeida et al. (2009) examine whether firms with large fractions of their long term debt (LTD) maturing during the financial crisis (identified as the treatment group) are forced to adjust their investment behavior in ways that are more pronounced than otherwise similar firms whose long term debt matures well after the crisis (identified as the control group). Their basic idea is that long term debt is difficult to renegotiate on short notice during the crisis. Firms are matched on the basis of asset size, SIC classification, credit ratings, Tobin's Q, long term leverage ratio, cash flows and cash holdings. Authors find that both groups, each containing 86 firms, have similar investment rates in the pre-crisis period from 2007Q1 to 2007Q3 while in the post crisis period from 2008Q1 to 2008Q3 the investment rate drops significantly only for the treatment group. Authors also find that the relationship between maturity structure and investment disappears (strengthens) for firms with insignificant (large) amounts of LTD. Similar work by Campello et al. (2010) that is based on survey data collected on 400 U.S. public and private firms explores the interaction between internal and external liquidity and its effects on investment and other corporate decisions such a R&D and employment growth in light of the financial crisis. The authors find that small, private, non-investment grade, unprofitable firms exhibit high line of credit (LOC) to asset ratios compared to large, public, investment-grade profitable firms. They also find that when cash balances are low, an increase in cash flows leads to an increase in the LOC/Asset ratio while when cash balances are high there is only a weak relationship between cash flows and LOC/Asset ratio. They also conclude that: (i) firms whose LOC's are cancelled due to LOC covenant violation (less than 10% of the total sample), two thirds of violators are able to renegotiate, (ii) at average cash balances an increase in the LOC does not alter investment

plans, (iii) for cash rich firms investments increase when LOC's increase, and (iv) there is a trade off between cash savings and investments for firms with limited access to LOC's however as LOC's increase both savings and investment increase.

Taken as a whole the literature presented in this dissertation is divided into three basic broad topics that cover financial systemic risk, lending behavior and government intervention during the crisis. The literature that deals with financial systemic risk is driven by changes in the banks intermediation process and the substantial growth in the securitization markets that also serves to motivate my research that focuses on bank lending and liquidity behavior at a micro-level. My research draws from literature on the behavior of bank lending during the crisis with some distinction primarily relating to the modeling techniques employed (i.e. dynamic panel models) and variable selection used in formulating the lending models (i.e. the inclusion of Repo-OIS spread and macro-variables). While most of the government intervention literature centers on equity market reaction to stress testing of the major banks and to recent financial regulation dealing with bail out programs to promote lending, my research examines changes in banks' balance sheet composition associated with government intervention.

CHAPTER III

THE IMPACT OF SECURITIZATION AND BANK LIQUIDITY SHOCKS ON BANK LENDING: EVIDENCE FROM THE U.S.

3.1 Introduction

There is a new and rapidly growing body of literature that examines bank lending during the 2007-2009 financial crisis. This essay investigates two interesting distinct yet related themes that deal with the rise in popularity of the securitization markets and collapse of the subprime mortgage market. While the origins of the securitization markets[1] dates to the 1970's, the U.S. economy has witnessed explosive growth in this market since its inception up until the advent of the 2007-2009 financial crisis. To illustrate this point using Flow of Funds account data for the U.S., the amount of securitized home mortgages grew from U.S. $27.7 billion as of 1976Q1, a starting period for the home mortgage securitization market, to U.S. $ 6.4 trillion as of 2007Q4. The securitization phenomenon has transformed the way in which financial intermediation takes place. Under the traditional banking model, the funding of illiquid loans with liquid deposits (i.e. liquidity transformation) was viewed as a fundamental role performed by the banks. Based on the traditional banking model, banks are in the business of making loans that are retained until maturity with government insured demand deposits representing the main source of bank funding. In recent years the banking model has changed in that bank originate loans that are pooled,

[1] Securitization is a process of creating and issuing new financial instruments such as debt securities or bonds whose payments of principal and interest derive from cash flows generated by a separate pool of assets. Typically, the pool of assets that are initially owned by commercial banks are transferred to a separate legal entity known as a special purpose vehicle (SPV).

tranched, and eventually resold through the securitization process. Under the new banking model, large investors (e.g. mutual funds, sovereign wealth funds, large cash rich companies) who are the supplier of bank funds receive collateral to protect their investments since insured banks cannot offer government backed deposit insurance to these investors[2]. An important implication of the securitization process as pointed out by Altunbas et al.(2009) is that while bank financed projects may be illiquid, the underlying loan, if eligible, may be sold which in turn provides the originating bank with a new source of financing. The recent literature that examines the securitization market is motivated by its explosive growth, the banks increased dependency on the financial markets as a source of funding, and by the impact that this market had on the U.S. financial banking system during the 2007-2009 financial crisis. Researchers including Brunnermeier and Pedersen (2009), Shleifer and Vishny (2010), Brunnermeier and Sannikov (2011) and Korinek (2011) provide the theoretical framework tied to the new banking model with emphasis on the measurement of systemic risk and stress testing. Collectively these studies propose a bidirectional relationship between asset market liquidity and traders funding liquidity, introduce the phenomena of amplification effects through various channels including the repo markets, posit a positive relationship between securitization and real investment by banks, and conclude that financial markets are pro-cyclical. The recent empirical work in this area of research as pointed out by Loutskina (2011) focuses on the shadow-banking system[3] off balance sheet implications of securitization.

[2] In practice this form of collateralized transaction between an investor and the bank is commonly referred to as a repurchase (repo) agreement. That is the investor purchases some asset from the bank (i.e. the collateral) at an agreed upon price with the understanding that the bank will repurchase the same asset some time in the future at a higher pre-established price.

[3] Commercial banks in essence transferred their maturity mismatch between long term assets and short term liabilities to a shadow banking system consisting of off- balance investment vehicles such as special purpose vehicles (SPV) and conduits. The SPVs raise funds by selling short term asset backed securities (ABS), which may include residential mortgages, primarily to money market funds.

The subsequent collapse of the subprime mortgage market along with the disruption in the capital markets evidenced by market liquidity constraints and perceived increases in counterparty risk placed strong downward pressure on bank's earnings and weakened bank balance sheets. Prior to the 2007-2009 financial crisis the stage had been set as evidenced by historically low interest rate and lax credit markets that served to create an ideal condition for the first national bubble in U.S. home prices that has been compared to bubble and bust experienced during the Great Depression of the 1930s . By mid-2007 the correction in the housing market led banks to report substantial losses and to take significant write downs of its real estate mortgage portfolios as a result of rising delinquencies and home value reductions. The rising loan delinquencies are arguably a consequence of an increase in non-traditional lending characterized by loose requirements on borrower's income verification to support mortgage repayment ability and minimal down payment requirements. There are those who claim that the real estate mortgage-backed securities market fueled the housing bubble by providing increased financing of these high risk non-traditional loans through the securitization process. Others would conclude that the housing, securitization, and repo markets were at the nexus of the financial crisis.

Surprisingly, there is sparse literature that investigates the impact of securitization on bank lending. Altunbas et al. (2009) draws from a large data set of euro- area banks from 12 countries over a sample 1999-2005 and examines the impact of securitization on the effectiveness of the bank lending channel (BLC) and the banks' ability to grant loans. Using a data set of U.S. banks and a sample period from 1976Q1 to 2007Q4, Loutskina (2011) introduces a new bank-level index that estimates bank loan portfolio liquidity to examine the impact of securitization on bank liquidity and lending management. Neither of these papers, however, captures the cost of securitization in modeling loan behavior. Moreover, while it is well known that the housing

bubble and subsequent burst was at the heart of the 2007-2009 financial crisis, the specification by Loutskina (2011) does not control for this important variable. Further, the study by Loutskina (2011) ends at the early stages of the 2007-2009 financial crisis and thus the results may not reflect the full impact of the financial crisis.

This dissertation examines new evidence on the effectiveness of the bank-lending channel (BLC) due to the collapse of the subprime mortgage market. The BLC posits that changes in monetary policy are able to shift bank loan supply usually available to bank-dependent borrowers through the presence of legal reserve bank deposit requirements. Over time, the BLC literature has identified alternative sources of bank liquidity shocks emanating from regime shifts, speculative bank runs , "hot money" flows or exchange rate volatility that have changed the BLC mechanism (refer to Khwaja and Mian (2008), among others). Understanding how a historic economic event such as the subprime mortgage market collapse affects bank lending is important for policy makers, bank regulators and investors. In times of financial crisis losses tend to spread across financial institutions thus jeopardizing the well being of the financial system as a whole with negative repercussions for the economy and the business community.

Cecchetti (2009) claims that the triggering event of the financial crisis took place in August 2007 when the large French bank BNP Paribas suspended redemptions from three of its investment funds since it could not reliably value the assets backed by U.S. subprime mortgage debt held in those funds. Gorton and Metrick (2010) define the subprime mortgage market as a financial innovation created to provide housing finance to disproportionately poor and minority individuals with some combination of spotty credit histories, a lack of income verification or no money for a down payment. The symptom of this crisis is also captured through the 3 month LIBOR-OIS spread, which is a common proxy in the literature for counterparty risk (refer to

Figure 3.1). I argue that this event introduced a liquidity shock to the banks that was unrelated to business fundamentals while highly related to problems arising from housing mortgages.

Figure 3.2 which depicts the TED spread provides a similar story to that of Figure 3.1 while also capturing the liquidity crunch that evolved during the crisis. Brunnermeier (2009) points out that prior to the 2007-2009 financial crisis, banks were heavily exposed to maturity mismatch through liquidity backstop credit facilities granted to their off- balance sheet vehicles and through their increased reliance on the repo markets. History shows us that by mid-2007 a reduction in funding liquidity, as evidenced by investors' reluctance to purchase mortgage/asset-backed paper, placed enormous pressure on the financial system. Ivashina and Scharfstein (2010) point out that the meltdown of the subprime mortgage market in turn raised concerns about the solvency and liquidity of the financial institutions that unfolded into a full-scale banking panic following the failures of Lehman Brothers' and Washington Mutual and the government takeovers of Fannie Mae, Freddie Mac, and its intervention in AIG during the latter part of 2008Q3.

This essay is further motivated by the absence of research regarding the impact that the subprime mortgage market collapse had on the financial system as whole. The near collapse of the U.S. financial system had global repercussions impacting capital markets, money markets, and credit markets while instilling wide spread anxiety, fear, and panic in the investing public and other economic agents as well. Loose monetary policy, cheap money, and aggressive lending contributed to the boom and subsequent bust of the housing market including the fall of the subprime mortgage market. As pointed out by Cecchetti (2009) in the summer of 2007 it was becoming obvious that banks and other financial institutions would be incurring substantial losses from their exposure to the subprime mortgage loans. The ensuing negative impact on bank

capitalization and its affect on bank lending lead to Federal Reserve intervention to attempt to avert a sharp contraction in bank lending that would spillover into a severe recession.

Drawing from a modeling framework previously used in the banking literature this essay investigates the impact of securitization on bank lending in the midst of the 2007-2009 financial crisis and employs methodologies from the BLC literature to assess the impact of the subprime mortgage collapse on bank lending. This area of research is of interest to academicians, economic policy makers, regulators, bank managers, investors, and other affected parties including households and businesses. Financial crisis episodes, albeit of lesser magnitude compared to the 2007-2009 crisis, are a part of U.S. economic history. What is unique to this latest financial crisis is the transformation of the banking system leading to the development of securitized banking and the shift towards short-term funding sources provided through the money markets and capital markets. It is the securitization phenomena that allow us to re-examine empirical models of lending behavior. The work of Gorton and Metrick (2010) implies that the traditional bank run on deposits that disrupted the banking system dating back to the days of the banking panic of the early 1930s has been replaced by a run in the repo markets.

The focus of the research bears resemblance with the studies by Khwaja and Mian (2008), Paravisini (2008), Cornett et al. (2011) and Egly and Mollick (2013). These authors exploit significant events such as unanticipated nuclear test in Pakistan, in the case of the former, and government sponsored lending programs in Argentina, in the case of the Paravisini (2008) and the U.S. Treasury's Capital Purchase Program (CCP) in the case of Egly and Mollick (2013), to determine whether liquidity shocks related to these events impact bank lending. To understand the impact of bank liquidity shocks on the economy, Khwaja and Mian (2008) apply a fixed-effects methodology to loan-level panel data from 1996-2000 on corporate lending in Pakistan.

They find a significant bank-lending channel for all borrowing firms and that larger firms are able to attenuate the impact of a supply-side liquidity shock by borrowing from other unaffected banks. Examining government allotments granted over the 1993-1999 time frame to banks in Argentina, Paravisini (2008) finds that banks expand lending in response to the added dollars of external financing. Based on a sample of 111 banks that received the government allotments and loan data for over 220,000 firms and individuals, he also concludes that financial constraints prevent banks from undertaking profitable lending opportunities and that these opportunities are not arbitraged by other competing lenders.

Drawing from the population of insured commercial banks in the U.S. between 2006Q1 and 2009Q2, Cornett et al. (2011) find that banks that relied heavily on core deposits and equity capital continued to lend money during the financial crisis relative to other banks while banks that held higher levels of illiquid assets chose to increase asset liquidity and reduce lending. They also find that off-balance sheet liquidity risk materialized onto the banks' balance sheets and curbed new lending since increased takedown demand displaced lending capacity. Egly and Mollick (2013) apply dynamic panel data methods to a subsample of 100 banks that were CPP recipients over a period from 2008Q3 to 2009Q4 and find a very modest impact on lending by only the largest banks. They conclude that CPP's business objectives to boost loan growth and stimulate business activity during the financial crisis were unmet.

The modeling of bank- lending behavior would be incomplete if this essay ignored the credit channel of monetary policy transmission in my empirical framework. The existence of balance sheet and bank lending channels that are encompassed within the credit channel are captured in the survey paper by Bernanke and Gertler (1995) and in the symposium paper by Mishkin (1995).

The aforementioned authors claim that the balance-sheet channel (BSC) stresses the potential impact of changes in monetary policy on borrower's balance sheets and income statements while the bank- lending channel (BLC) focuses more narrowly on the potential effect of monetary policy on the supply of bank loans. They assert that according to the credit-channel theory, the direct effects of monetary policy actions on interest rates are magnified by endogenous changes in the external finance premium, which is defined as the cost differential arising from funds raised externally (equity or debt issues) compared to internally generated funds (i.e. retained earnings). The nature and focus of this essay leans towards a detection of a BLC as opposed to a BSC, since the latter would typically require a data set comprised of non-financial firms that is not compiled for purposes of this research. However, as pointed out by Bernanke and Gertler (1995) an increase in bank holdings of volatile securities and derivative instruments may have also increased the sensitivity of bank lending to interest rates via the BSC. Finally, this essay acknowledges that this research indirectly measures the impact of a credit channel on the economy through our econometric methodology that allows for reverse causation effects from lending to economic output.

This essay expands the literature in the following distinct ways. First, there has been little attention placed on empirically testing this new form of bank run as proposed by Gorton and Metrick (2010) on bank lending behavior. Second, unlike previous studies on lending behavior that include interest rate proxies to control for bank funding costs and to measure the effectiveness of monetary policy through the bank lending channel, this essay incorporates a repo spread variable backed by securitized bonds where the collateral consists mainly of real estate mortgage backed securities. The model specifications employed examine whether these new channels of bank liquidity creation represent a sustainable alternative compared to more

traditional sources of bank funding. Third, in contrast to previous studies the sample period from 2005Q1 to 2010Q4 covers economic expansion (including the peak period of the housing bubble), the subsequent bust as well as a greater time span of the latest U.S. financial crisis and the following mild recovery. The sample period also covers an important transition experienced by the financial industry that deals with a changing banking model that eventually lead to new forms of bank runs. Fourth, the research framework and estimation methods provide an opportunity to corroborate and challenge the common findings presented in recent literature of the positive impact of securitization on bank lending. By employing dynamic panel estimation methods, this essay addresses the potential issue of endogeneity that is present in earlier work on bank lending models. For example, there are mixed findings on the causation between bank lending and output. The employed methodology exploits the time series and cross sectional attributes of the data and to control for the potential for reverse caution effects. Fifth, there has been limited attention focusing on how the subprime mortgage market collapse impacted bank lending. The impact of the financial crisis, viewed from a much broader window, on bank lending has been examined by Ivashina and Scharfstein (2010) whose sample is based on large syndicated loans. They identify bank runs linked to short-term creditors and to bank corporate borrowers who increased their credit-line utilization following the Lehman Brothers collapse during the peak of the financial crisis. Sixth, drawing from rich empirical work on the BLC and employing individual bank-level data and macro variables, this essay assesses the presence of a BLC incorporating a bank liquidity shock caused by the subprime mortgage market crisis. The subprime mortgage crisis arguably generated an exogenous liquidity supply shock that is uncorrelated with firm loan demand. Beforehand, this essay acknowledges that one of the major modeling challenges in the BLC literature is to properly identify whether monetary policy directly affects loan supply or loan

demand. All else equal, it is expected that the subprime mortgage market collapse represents a negative bank liquidity shock.

3.2 Data

The sample draws from the population of commercial banks that are insured through the Federal Deposit Insurance Corporation (FDIC) over the sample time frame 2005Q1 to 2010Q4. The bank information used is originally documented in Consolidated Reports of Condition and Income "call reports" that are submitted by insured banks on a quarterly basis. The call reports that commercial banks file are Federal Financial Institutions Examination Council (FFIEC) forms FFIEC-031 or FFIEC-041. The choice of the FFIEC form is dictated by the geographic scope of the bank's business (i.e. domestic offices only FFIEC-041 or domestic and foreign offices FFIEC-031). The bank data used for this research is available through Federal Deposit Insurance Corporation (FDICs) statistics on depository institutions (SDI) data base at the following website (http://www2.fdic.gov/sdi/index.asp) last accessed on 8/15/2012.

Since this essay works with bank-level data, in the case of multibank holding companies (BHC) data only from the lead bank is selected. In many instances the lead bank commonly represents over 80% of the total insured assets reported by the BHC[4]. Banks with missing balance sheet and/or income information required for this study were excluded from the sample. In keeping with Loutskina (2011) to minimize the impact of outliers we eliminate all bank-quarter data with asset growth over the preceding quarter in excess of 50%, those with total loan growth exceeding 100%, and those bank-quarters with total loans to asset ratio less than 10%. By

[4] To investigate the presence of multibank holding companies (MBH), I extracted a list of the largest 150 financial institutions as of the beginning of the sample. I matched each of these institutions against the FDIC website to determine if they were MBH. The number of banks excluded that formed part of a MBH represent less than 2% of the total sample (lead banks of MBH were retained for this study).

applying the above criteria to the population of FDIC insured commercial banks 63,629 bank quarters were removed from the initial data set[5].

To examine the impact of securitization on lending, this essay focuses on the sample of the large commercial banks that are typically engaged in the securitization process. To investigate the impact of the subprime mortgage market collapse on lending both large and small bank subsamples are used. This essay explores different classification schemes to identify bank size in term of total assets[6]. While government sponsored enterprises (GSEs) such as the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac) facilitated small bank access to the securitization market, the securitization markets have been dominated mostly by larger banks including investment banks. As pointed out by Loutskina (2011), large banks tend to have much stronger relationships with investment banks that provide the banks with a direct route to the derivatives markets. These relationships are likely to decrease the securitization costs and reduce the time it takes to securitize loans for large banks compared to their smaller counterparts.

As part of my preliminary analysis in building bank samples, the initial large bank sample consists of commercial banks with total assets ≥ U.S. $500 million while banks below this asset size threshold are identified as small banks. Table 3.1 summarizes the sample bank distribution by quarter over the entire time frame 2005Q1 to 2010Q4 using this classification scheme. From Table 3.1 I am able to conclude that the number of large banks in the sample ranged from a low of

[5] In the initial data set there were 7,895 banks reported per quarter on average vs. 5,259 in the final data set. The maximum (minimum) number of reported banks in the initial data set was 8,215 at 2007Q1and 7,223 at 2010Q4. Refer to Table 1 for the distribution of banks in the final sample.

[6] Kolari et al. (2006) examine the profitability and riskiness of small business lenders and apply a classification scheme to identify bank size in terms of total assets as follows: < $100 million (very small), $100 million- $300 million (small), $300 million-$500 million (medium), $500 million to $3 billion (large) and > $3 billion (very large). A similar approach was used by Kishan and Opiela (2000).

746 at 2005Q1 to a high of 962 as of 2008Q2, 2009Q1, and 2009Q2 with the average number of banks being 913 over the sample period. Since the initial focus is on the impact of repo spreads on bank lending the sample is limited to the large banks since they tend to be most active in the securitization and repo markets. It is plausible that some banks that meet this minimum size indicator at the beginning of the sample period could fall below the minimum threshold especially during the 2007 financial crisis period in which some banks experienced heavy losses and large write downs in their real estate portfolios. I choose to retain in the sample those banks that may fall below the size threshold in any given quarter since it is not anticipated that these banks, in the near term, would necessarily make major changes to their funding sources or their business model. The bank information extracted includes loan balances on various loan categories (e.g. total loans, commercial and industrial (C&I) and residential real estate loans), total assets, balance sheet liquidity measures (e.g. securities held to maturity, securities available for sale, cash and balances due, mortgage backed securities and asset bank securities, federal funds sold and reverse repos), Tier 1 risk based capital ratio, cost of deposits (e.g. interest expense on deposits to total deposits) and various bank deposit measures (e.g. total deposits that include demand deposits, money market accounts, savings accounts and time deposits and transaction deposits that include demand deposits and NOW accounts). Appendix A provides further description of the bank variables employed in this essay.

Since my initial bank classification scheme (i.e. large vs. small banks) based on total asset cutoff of U.S. $500 million does not seem to adequately capture the different behavior traits of the banks, I explore alternative sub sample classifications. From a practical viewpoint it would seem improbable that a large money center bank for example would exhibit similar behavior traits compared to say a large bank that is at the lower bound of the U.S. $500 million cut off.

Following the approach used by Verma and Jackson (2008), the bank sample is divided into four groups based on average total asset size as follows: small banks (average total assets < U.S. $1 billion), medium banks (average total assets > U.S. $1 billion and < U.S. $20 billion), large banks (average total assets > U.S. $20 billion and < U.S. $90 billion) and money center banks (average total assets > U.S. $90 billion).

Table 3.2 presents descriptive information on the banks classified in the four groups following the four-size classification scheme. Some interesting results emerge under this alternative bank classification scheme. When scaled by bank mean total assets, banks exposure to total loans (net loans) declines as overall bank size rises. For example, the ratio of total mean loans to mean assets is 0.678 for small banks (151055.2/222758.2) identified in Panel A while this ratio falls to 0.599 for large banks (2.75E+07/4.59E+07) shown in Panel C. This finding is consistent with the view that bank size has typically affected the type of activities that banks engage in. For example, small banks generally focus on the retail side of business making loans and issuing deposits to consumers and small businesses while large banks engage in retail and wholesale banking activities with a tendency to emphasize wholesale over retail banking. With the exception of the money center banks (as shown in Table 4 Panel D) it is equally interesting that the exposure on commercial loans, scaled by bank mean total assets, rises as overall bank size increases. The ratio of mean commercial loans to mean assets which is not reported in the Table 3.2 yet is computed from the values in Table 3.2 increases from 0.087 for small banks to 0.106 for medium banks and to 0.123 for large banks before dropping to 0.109 for money center banks. This result is also consistent with the tendency of large banks to focus on wholesale activities that include lending to larger corporations to support their capital expenditure and operating capital requirements. This lending behavior is in contrast to that of small banks that lend to smaller and

less sophisticated customers. The banks investments in real estate mortgage and asset backed securities (rmbs and abs) scaled by total assets increases with bank size. These ratios increase from 0.071 to 0.104 and from 0.000 to 0.008 for rmbs and abs of small banks compared to money center banks accordingly. A similar finding is seen in the fed funds sold and securities purchased under agreements to resell (frepo) scaled balances (the ratio increases from 0.020 to 0.066 when small banks are contrasted with money center banks). On the liability side of the balance sheet we see that domestic deposits (depdom), scaled by mean total assets, and that bank capitalization ratios (capt1r) decline as bank size increases. The ratio of mean domestic deposits to mean assets which is not reported in Table 3.2 yet is computed from the values in Table 3.2 decreases from 0.782 for small banks to 0.463 for money center banks. This finding supports the view that larger banks have greater access to capital and money markets, including repos, compared to their smaller counterparts. The findings suggest that large banks operate with lower amounts of equity capital compared to small banks and that large banks tend to rely more on purchased funds such as FED funds and lower levels of core deposits.

The main variable of interest includes repo spreads collateralized by real estate mortgage backed securities. The repo spread is the difference between the 90 day repo rate for a given bond class and the Overnight Index Swap (OIS). Figure 3.3 portrays a Repo-OIS series with the collateral consisting of real estate mortgage backed securities (rmbs). This series is based on daily frequency and covers the time frame 12/31/04 to 12/31/10. The repo markets allows banks and other market participants to obtain collateralized funding by selling owned securities while agreeing to repurchase them at loan maturity. Brunnermeier (2009) suggests that banks rely on repo markets in addition to other markets such as the commercial paper, fed funds, and interbank markets to finance their activities. Based on Figure 3.3 the Repo-OIS spread is at its widest point

during the peak period of the crisis between 2007Q3 and 2008Q4. This essay also includes a daily spread series consisting of the difference between the 90 day London Interbank Offered Rate (LIBOR) and the (OIS) which is depicted in Figure 3.1. The series in Figure 3.1 serves to depict the state of the interbank markets. From a practical standpoint, Libor-OIS spread is commonly viewed as a proxy for counter party risk. In Figure 3.1 the Libor-OIS spread first showed signs of trouble in the interbank markets in the summer of 2007. Gorton and Metrick (2010) suggest that by late summer and early fall of 2007 an initial shock had occurred that negatively impacted the securitization markets in particular high-grade tranches that commonly served as collateral in the repo markets. Figure 3.1 shows the full impact of the crisis during the second half of 2008. This was a time period that included events such as the Lehman Brothers and Washington Mutual bankruptcies and the U.S. government bailout of AGI in September, as well as the TARP U.S. government bailout which began funding in October 2008.

Figure 3.2 portrays the TED spread which represents the difference between the 90 day LIBOR rate and the 90 day U.S. Treasury Bill series over the time frame12/31/04 to 12/31/10. Figure 3.2 provides a similar story to that shown in Figure 3.1. The TED spread is an alternative measure of perceived risk in the economy since Treasury Bills are considered risk free investments while Libor rates reflect the credit risk of default of unsecured lending to commercial banks. An increase in the TED spread signals investors' perceptions of increased credit default risk on interbank loans. The TED spread also widens during times of financial crisis as banks experience a flight to quality wishing to hold high quality collateral. This flight to quality makes holding U.S. Treasury bills more attractive thus placing downward pressure on Treasury bill rates that further widen the TED spread.

The repo spread series and 90 day LIBOR-OIS spread are downloadable from Bloomberg's data base (http://www.bloomberg.com, last accessed on 8/15/2012). The TED spread series are downloadable from Federal Reserve Economic Data (FRED) data base available through the Federal Reserve Bank of Saint Louis (http://research.stlouisfed.org/fred2, last accessed on 8/15/2012). To control for loan demand in the model this essay includes a real GDP growth rate (RGDP) variable. The Real Gross Domestic Product (RGDP) growth rate variable is computed using quarterly data on RGDP expressed in Billions of Chained 2005 Dollars (Series GDPC1), available from the U.S. Department of Commerce: Bureau of Economic Analysis website (http://bea.gov/national/index.htm#gdp, last accessed on 8/15/2012). To proxy for the stance of monetary policy this essay incorporates the effective federal funds rate that is available through Federal Reserve Bank of Saint Louis (http://research.stlouisfed.org/fred2, last accessed on 8/15/2012). The series identified as FEDFUNDS is measured in monthly frequency and is compiled by the Federal Reserve Bank of Saint Louis. A quarterly FEDFUNS series is formed from the monthly series since the bank variables are measured in a quarterly frequency.

Table 3.3 Panels A through D presents contemporaneous bivariate correlations for the independent bank variables and macro variables that are employed in the lending models for the four subsamples of banks. The bank total assets are presented in log form (lta) while the liquidity (Liq I) and deposit variables (Dep I and Dep II) are scaled by bank total assets. The liquidity measure includes cash in banks and securities held to maturity and available for sale. Deposit I includes demand deposits, money market deposits, saving deposits and time deposits. Deposit II is a more narrow measure that captures demand deposits and NOW accounts that are collectively considered transaction deposits. Residential real estate loans (reloans) are scaled bank total loans. The Tier 1 risk-based capital ratio (capt1r) and deposit cost (depcost) variables are presented in

ratio form. The former represents the ratio of bank Tier 1 capital to total risk weighted assets while the latter is the ratio of bank interest expense on deposits to bank deposits.

An inspection of Table 3.3 suggests that bank behavior is not necessarily fully consistent across the bank subsamples. For example, there is a moderate correlation between bank total assets (lta) and residential real estate loan portfolios (reloans) of 0.313 for money center banks (refer to Panel D) yet the correlation turns to a negative of -0.101 for large banks (see Panel C) and to negligible correlation coefficients of 0.010 and 0.004 for small and medium banks as shown in Panel A and B, respectively. Another interesting correlation pattern emerges with between the liquidity variable and bank total assets in the four bank subsamples. The moderate and negative correlation of -0.156 for the small banks in Panel A suggests that increases in liquidity were not accompanied by a contemporaneous increase in bank balance sheet assets and thus increases in liquidity may simply have been part of an effort to recapitalize the banks whose balances sheets had been negatively impacted by losses. It is puzzling that the correlation matrix reflects a negative relationship between the deposit variables and bank total assets. Typically I would expect strong positive correlations between deposit variables and bank total assets, especially in the case of small to medium banks, given the high degree of leverage that banks typically operate with. It is commonly known that small to medium banks are able to control the size of their balance sheet through their deposit gathering efforts which to some extent are driven by the banks deposit pricing strategies.

With the exception of the money center bank sample reported in Panel D, the correlation between the bank tier1 capital ratio (capt1r) and bank total assets (lta) is negative ranging from -0.045 for the medium banks in Panel B to -0.175 for small bank in Panel A. This finding suggests that any increase in capitalization did not translate to a positive co-movement in bank lending or

some other expansion of the balance sheet as evidenced through a liquidity build up with a concurrent stabilization of the banks lending portfolio. This finding also supports the view that the banking system was experiencing an overall period of recapitalization in part spawned by the affects of the financial crisis. Inspection of Table 3.3 also suggests that deposit costs (depcost) and various rate measures such as the Repo-OIS spread (repo-ois) and fed funds rates (ffr) have the strongest correlations with bank total assets of large banks as reflected on Panel C. With the exception of the negative correlation between the Repo-OIS spread with the RGDP growth rate variable (rgdpg) of -0.793, all other correlations are either low or moderate as seen in Panels A through D of Table 3. The low to moderate correlations help mitigate any potential collinearity issues that could impact the lending models while in no model do I allow for the Repo-OIS spread and the RGDP variables to enter simultaneously.

3.3 Methodology

As an initial step this essay employs a panel data fixed-effects estimation to 1) model the effect of repo spreads on bank- lending behavior, and 2) model the effect of bank's exposure in residential real estate portfolios on bank- lending behavior. The advantage of the fixed-effects estimation is that it allows for the cross sectional units' (individual banks) time invariant unobserved effects to be correlated with the means of the regressors. The model incorporates various control variables including bank specific variables measuring asset size, balance sheet liquidity, bank capitalization, deposits, and deposit costs as described in the preceding Data Section. The bank- control variables capture supply-side lending constraints that are common to bank lending models (refer to Altunbas et al. (2009) and Cornett et al. (2011), among others). This essay also includes macro variables such as a real GDP growth rate, and an effective federal funds rate.

The real GDP growth rate controls for loan demand (see Berger and Udell (2004) and Li (2010), among others) while the interest rates series is commonly associated with the banking lending channel (BLC) literature. The BLC posits that monetary policy may be transmitted to the real economy through its effects on bank loans and that a tightening in monetary policy diminishes the supply of bank loans to firms. The model is expressed as follows:

$$\Delta L_{i.t} = \beta_{i,0} + \beta_1 bk_{i,t} + \beta_2 RREL_{i,t} + \beta_3 repo_t + \beta_4 macro_t + \varepsilon_{i,t} \quad (1)$$

where the Δ prefix indicates the change of the bank loan variable *L* which is expressed in log form*; bk* represents *a* vector of bank specific variables that include bank total assets (TA) expressed in log form, a balance sheet liquidity measure (Liq) that is scaled by total assets and defined as the sum of cash in banks and securities held to maturity and available for sale, bank capitalization (Cap) measured as the Tier 1 risk-based capital ratio, two deposit measures (Dep I and Dep II) that are scaled by total assets with Deposit I consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits and Deposit II capturing demand deposits and NOW accounts that are collectively considered transaction deposits, and the cost of deposits (Dc) defined as the ratio of interest expense on deposits to total deposits; *RREL* expresses the banks residential real estate portfolio scaled by total loans (net loans); *repo* measures the REPO-OIS spread, and *macro* represents a vector of macro-economic variables. The macro vector includes an effective federal funds rate and the real GDP growth rate (RGDP).

Equation 1 is related to the fixed effects loan specification used by Cornett et al. (2011) with some distinct differences that are introduced in this essay. A major distinction is that the proposed model handles potential issues of reverse causation of bank lending with various regressors that are explained in subsequent paragraphs of the methodology section while other differences relate to the choice of variables. For example, the above specification introduces the *repo* spread

variable which is the main variable of interest for this essay. Since traditional funding costs are suspected to have a reduced impact on lending as a result of expanded securitization, equation 1 tests for this transition towards alternative bank funding sources by retaining a deposit cost variable (Dc) that is included in the vector of bank variables *bk*. Third, unlike Cornett et al. (2011) who incorporate a TED spread as the only macro variable, equation 1 incorporates additional *macro* variables that are commonly used in the BLC literature.

The specification presented in equation 1 is used to address two distinct yet related themes that are covered in Essay I of this dissertation that deal with modeling bank lending behavior. The initial theme deals with the impact on bank lending from changes in funding sources tied to the evolution of the securitization process while the second theme focuses on examining the impact on overall bank lending from liquidity shocks emanating from the subprime mortgage crisis. In this research framework, these two central themes emphasize different subsamples of the population of FDIC insured commercial banks with the securitization theme focusing on the larger bank subsamples while the subprime mortgage crisis theme examines the full bank sample and various subsamples[7].

This essay also proposes dynamic panel estimation to model bank lending behavior that is similar to specifications employed by Altunbas et al. (2009) and Matousek and Sarantis (2009), among others. While these two cited studies deal with modeling bank lending behavior in European countries, the basis of their models bear resemblance to the model proposed in this essay. The proposed model also draws from bank lending models used by Kishan and Opiela (2000), Ashcraft (2006) and Jayaratne and Morgan (2000) who examine lending behavior by U.S. banks. The model is represented by the following equation:

[7] Maintaining a single specification for the bank lending model as opposed to introducing alternative specifications reduces the potential for omitted variable bias between competing model specifications.

$$\Delta L_{i.t} = \beta_{i,0} + \beta_1 \Delta L_{i,t-1} + \beta_2 bk_{i,t} + \beta_3 RREL_{i,t} + \beta_4 repo_t + \beta_5 macro_t + \varepsilon_{i,t} \quad (2)$$

The bank variables are normalized with respect to their average across all banks in a given sample similar to the specification used by Matousek and Sarantis (2009). The Tier 1 risk-based capital variable (capt1r) and the cost of deposit measure (Dc) are reported in ratio form. The normalization of the bank specific variables takes the following form:

$$TA_{i,t} = \ln TA_{i,t} - \frac{\sum_i \ln TA_{i,t}}{N_t} \quad (3)$$

$$Liq_{i,t} = \frac{LiqA_{i,t}}{TA_{i,t}} - \frac{\sum_i \frac{LiqA_{i,t}}{TA_{i,t}}}{N_t} \quad (4)$$

$$Cap_{i,t} = \frac{Tier1Cap_{i,t}}{RWA_{i,t}} - \frac{\sum_i \frac{Tier1Cap_{i,t}}{RWA_{i,t}}}{N_t} \quad (5)$$

$$Dep_{i,t} = \frac{Dep_{i,t}}{TA_{i,t}} - \frac{\sum_i \frac{Dep_{i,t}}{TA_{i,t}}}{N_t} \quad (6)$$

$$Dc_{i,t} = \frac{IntE_{i,t}}{TD_{i,t}} - \frac{\sum_i \frac{IntE_{i,t}}{TD_{i,t}}}{N_t} \quad (7)$$

where i=1,…..N; t=1,…..T; and N is the number of banks and T is the time period; $TA_{i,t}$ are the total assets of bank i in quarter t; $Liq_{i,t}$ is the ratio of bank i liquid assets as defined in the data section divided by bank i total assets in quarter t;$Cap_{i,t}$ is the ratio of bank i Tier 1 capital divided by bank i total risk weighted assets (RWA) in quarter t; $Dep_{i,t}$ is the ratio of bank deposits based on various measures as defined in the data section divided by bank i total assets in quarter t and $Dc_{i,t}$ is the ratio of bank i interest expense on deposits divided by bank i total deposits in quarter t.

While this essay initially focuses on the impact of repo spreads on bank lending, the inclusion of FFR in the model for both research themes covered in this essay aligns with empirical research that investigates the presence of a BLC and with the underlying research purpose. This essay also explores whether the subprime mortgage market crisis (i.e. a bank liquidity shock) impacts the supply of bank lending in a BLC framework. The intent is to capture the impact of the subprime mortgage market crisis through changes the banks' residential real estate portfolio exposure. The bank sample used to explore the impact of the subprime mortgage market crisis on bank lending is much broader covering small and large banks with the smaller banks excluded from the initial research theme that deals with securitization which is a phenomenon that is more conducive to larger banks. Under the securitization theme, Essay I works with larger banks since these tend to be more active in the securitization markets and use more complex funding sources including higher use of repo agreements. Moreover, the BLC literature suggests that the effectiveness of the BLC is impacted by banks' asset size, liquidity, and capital with smaller banks tending to be more responsive to monetary policy changes as measured by FFR.

This essay employs dynamic panel methods and system GMM (SGMM) to estimate the model as proposed by Blundell and Bond (1998)[8]. Using dynamic panel methods the first difference removes bank specific effects and time-invariant explanatory variables. The SGMM technique employed in this essay uses the two-step estimator. In broad terms, lagged levels of right hand side variables (RHS) serve as instruments for the differenced equation while lagged differences of right hand side variables serves as instruments for the equation in levels under SGMM specifications. The SGMM estimator is able to exploit the time-series attributes of the data, allows for the inclusion of lagged dependent variables as regressors and is capable of

[8] I also run the regressions using difference GMM (DGMM) as proposed by Arellano and Bond (1991) and the central findings of this essay remain qualitatively unchanged.

addressing endogeneity. The inclusion of the lagged dependent variable captures any persistence exhibited in bank lending over time. Bank lending is a dynamic process that is driven by multiple criteria that takes into account many factors such as business cycle conditions, bank loan portfolio performance, bank financial attributes and constraints, competition and loan demand. As pointed out by Altunbas et al. (2009), GMM estimators ensure efficiency and consistency contingent on the absence of second-order serial correlation and the validity of the instruments.

In this study the potential for endogeneity of bank lending with various regressors in the proposed model is present. For example, an increase in bank lending funded through increase in deposits or other external liabilities, *ceteris paribus*, would lead to an increase in bank total assets. Changes in lending activity may also have an effect on bank total assets for the simple reason that loans from an accounting perspective are included in banks' total assets. There are also mixed findings on the causation relationship between bank lending and output. The direction of the causation from bank lending to output is based on the idea that many small bank-dependent firms are unable to access alternative forms of financing which leads to economic fluctuations. We could also encounter endogeneity bias between lending and bank on balance sheet liquidity since banks have managerial discretion to choose liquidity levels and lending jointly. Based on this analysis, I choose to identify bank total assets, liquidity and real GDP growth rate as endogenous variables for modeling purposes.

To investigate the impact of the financial crisis on bank lending this essay proposes several specifications that expand the benchmark model. First, in following with Kishan and Opiela (2000) and Cornett et al. (2011) the bank sample is divided into four asset size classes to better isolate the impact of the various financial constraints on bank loan supply. Second, given the high correlation of -0.793 between the Repo-OIS spread and the RGDP growth rate variable as

reported in Table 3.3, I replace the Repo-OIS spread with the RGDP growth rate variable under alternative specifications that model bank lending behavior. Third, similar to Cornett et al. (2011), this essay allows for the interaction between an indicator variable identified as a *Crisis* variable to capture the impact of the financial crisis and certain bank variables such as residential real estate portfolio, bank deposits, and Tier 1 risk based capital ratio. The *Crisis* dummy variable is assigned a value of one during the crisis period from 2007Q3 to 2008Q4 and zero otherwise. The idea behind the interaction terms is to determine whether the effects of the crisis, measured through the crisis indicator variable operate through the bank variables. For example, banks with high risk exposure in their residential real estate portfolios would be expected to reduce new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. Fourth, this essay explores the asymmetric effects of the Repo-OIS spread on bank lending through its interaction with the Crisis variable. A priori, I would expect that during the crisis period, rising Repo-OIS spreads would have served to discourage banks from granting new bank credit to the extent that REPO financing represents an important source of bank financing.

Since the Sargan test on the validity of over-identifying restrictions is not robust to heteroskedasticity or autocorrelation in the error terms, for model diagnostic purposes I choose to apply and report the Hansen J statistic which is a well-accepted standard specification check used with two-step SGMM which I employ in this essay. Roodman (2009) explains that the J-test is usually and reasonably thought of as a test of instrument validity but that it can also be viewed as a test of structural specification. While the Hansen test is robust to the presence of heteroskedasticity and autocorrelation it is usually weakened in the presence of a high instrument count the latter which is not a matter of concern in my specifications. Using system GMM

(SGMM) estimation between 16 to 20 instruments are generated depending on the model specification after imposing restrictions on the instrument matrix[9].

3.4 Hypothesis

This essay identifies four testable hypotheses regarding the impact of securitization on bank lending during the 2007-2009 financial crisis. The literature proposes that development of the securitization market offers an important alternative funding source for banks, especially for the larger banks. Loutskina (2011) claims that the securitization process not only represents a substitute for on balance sheet liquidity, but also serves as a mechanism to finance loans when funds are constrained by the absence of available external financing. The idea is that if banks can liquidate their loans to support their liquidity needs, they can also do so to supply new credit making banks less dependent on the traditional sources of funds including insurable deposits and non-insurable deposits including certificates of deposits. It follows that the change in the intermediation process brought upon by securitization, whereby funds from ultimate suppliers (households/lenders) are channeled to the ultimate borrowers, should lead to changes in bank funding costs to the extent that banks can access this new source of funding. For those banks that cannot readily access securitization markets in a cost effective fashion, I expect an inverse relationship between rising bank deposit costs and bank lending. The empirical literature that explores the bank-lending channel (BLC) finds that securitization has impacted the effectiveness of monetary policy to influence the supply of bank loans. The implication is that securitization

[9] The SGMM estimation was performed on STATA software using xtabond2 program code written by Roodman (2006). Under this program code, "gmmstyle" variable list includes endogenous variables while "ivstyle" variable list includes exogenous variables. In my model gmmstyle variables include: bank total assets, liquidity, and real GDP growth. All other model variables are ivstyle variables. The collapse command restricts the number of instruments created in a manner that a single instrument is created for each variable and lag distance rather than an instrument being created for each time period, variable and lag distance.

enhances bank liquidity and reduces banks' funding needs in the event of monetary tightening. This leads to the first hypothesis:

H_1: Traditional bank costs of funding measured through established monetary rates play a diminished role in the supply of bank lending for the larger banks. Since traditional bank costs of funding are proxied by (Dc), a variable included in the vector of bank variables in equation 2, I hypothesize that $\beta_2 \leq 0$ with respect to (Dc) for the smaller bank samples.

Altunbas et al. (2009) suggests that the advent of securitization has likely altered bank characteristics such as size, on balance sheet liquidity ratios and capital requirements that are usually emphasized in the literature to identify shifts in loan supply. The literature suggests that the securitization process may also serve to reduce the regulatory capital requirements by offloading credit risk from the loan portfolio. The capital relieve resulting from securitization may lead to, *ceteris paribus,* an increase in the supply of bank loans. Therefore, an active securitization market provides banks with an additional source of both loan funding and liquidity. Loutskina (2011) suggests that as the bank's ability to securitize loans increases, their holding of liquid assets on the balance sheet decreases. She also claims that since liquid funds and loans are two core components of bank assets, a decrease in liquid funds leads to an offsetting increase in lending. The literature however also suggests that securitization activity is influenced by business cycle conditions such that securitization increases during periods of economic expansion when there is lower investor uncertainty regarding the valuation of securitized assets. At the same time, banks with heavy reliance on securitization for liquidity and loan funding needs are more vulnerable to economic shocks when the market for securitized assets is disrupted. This implies

that in the absence of a strong market for securitized assets, banks must hold enough liquid funds to provide liquidity to borrowers and depositors on demand. The second hypothesis is as follows:

H_2: Repo spreads narrow (widen) in times of economic expansion (contraction) and its effects on bank loan supply attenuate (intensify) during expansionary (contractionary) periods. Therefore based on equation 2, I hypothesize that there are asymmetric repo effects on bank lending captured in β_4 when interacted with a crisis dummy.

The banks' residential real estate loans were the key asset that allowed for the development of the securitization process. The idea is that prior to the financial crisis, the residential real estate portfolio represented a key source of potential liquidity since these loans could be package and resold in the securitized markets. In practice during the pre-financial crisis period, banks were able to liquidate (sell) loans to either finance their liquidity needs or fund new lending. During the financial crisis when funding liquidity dried up the residential real estate portfolio became an illiquid asset held by banks. It is plausible that the subprime mortgage market collapse generated a negative liquidity shock to the banks that recorded large losses and significant write downs in their real estate mortgage portfolios. It is also conceivable that the degree of the liquidity shock would be directly related to the level of concentration in the lending portfolio tied to real estate mortgage lending and related mortgage backed securities. It is reasonable to expect that an increase in liquidity risk exposure, captured by the level of the banks' residential real estate portfolio, would hinder the banks' capacity to generate new lending. This essay argues that banks that held higher levels of illiquid assets during the financial crisis period would need to build up their level of liquid assets which would in turn restrict bank lending. Banks choose liquidity levels

and lending jointly since these are two core components of the banks' assets. This leads to the third hypothesis:

H_3: During the financial crisis period there is an inverse relationship between a bank's exposure in its residential real estate lending portfolio, *RREL* scaled by total loans and overall bank lending. Therefore, based on equation 2, I hypothesize that $\beta_3<0$ when interacted with a crisis dummy.

Cornett et al. (2011), show that banks that are more exposed to liquidity risk stemming from exposure to unfunded loan commitments, the withdrawal of wholesale deposits, or the loss of other sources of short term financing tend to hoard cash and other liquid assets in times of crisis. It is expected that during recessionary periods, and certainly during the financial crisis, that non-financial firms' increased reliance on bank funding would be inversely related to its balance sheet strength measured in terms of internal liquidity. On this premise, the composition of the banks' lending portfolio would reflect the banks' degree of liquidity risk as noted above. On this basis it is expect that a bank's capacity to generate new loans diminishes as its exposure to liquidity risk rises. Banks may respond by rationing credit if anticipated liquidity needs are likely to be high. Cornett et al. (2011) also point out that based on explicit and implicit government backing, transaction deposits (aka core deposits) consisting of demand deposit transaction accounts, NOW accounts and certificates of deposit under the FDIC coverage threshold are unlikely to leave the banking system during a crisis. Cornett et al. (2011) find that banks with stable sources of funding (i.e. higher reliance on core deposits and equity capital) were less constrained by the financial crisis and therefore were able to continue to lend. These authors also suggest that during the 2007-2009 financial crisis funds were leaving the securities market and flowing into the

banking system with most of these funds going into transaction deposit accounts. If transaction deposits, along with bank capital, represent stable sources of financing during the 2007-2009 financial crisis, then banks with higher levels of transaction deposits and capital would be more willing to roll down their liquidity cushions to support bank lending. This argument leads to the fourth hypothesis:

H_4: During the financial crisis period there is a direct relationship between bank transaction deposits scaled by total asset and overall bank lending. Since bank transaction deposits proxied by (Dep II), a variable included in the vector of bank variables in equation 2, I hypothesize that $\beta_{2>}0$ with respect to (Dep II) scaled by total assets when interacted with a crisis dummy.

3.5 Results

3.5.1 Fixed Effects Static Panel Data Model Results

Table 3.4 shows results using fixed effect panel data estimation for the sample of small banks with total assets less than U.S. $1 billion as of the beginning of the sample period. The dependent variable in all models is the one period change in bank net loans and leases that enters the model in log form. Table 3.4 introduces various model specifications with Model 1 representing the benchmark model for this essay. The coefficients on the bank total assets variable are negative yet statistically insignificant while the coefficients on the liquidity variable are also negative ranging from -0.019 to -0.020 and statistically significant at the 1% level across all models. The negative, albeit insignificant, relationship between bank total assets and lending is consistent with results reported by Cornett et al. (2011) and Jayaratne and Morgan (2000). The results suggest that for small banks, the changes in their balance sheet are mainly driven by changes in liquidity holdings as opposed to lending opportunities. The bank Tier 1 capital ratio coefficients are zero across all

models. The positive, yet very modest coefficients on the bank deposit I and II variables respectively ranging between 0.001 and 0.003 which are mostly significant at the 5% level suggest that for small banks deposits continue to represent a key funding source that supports bank lending growth. It is interesting that the coefficients on the deposit variable are modestly larger on Models 2, 4, and 6 that use a narrower deposit measure (Deposits II) consisting of transaction deposits when compared to the coefficients on the loan models that use the broader Deposit I measure. This finding speaks to the importance of the transaction deposits for the small banks as a core funding source for bank lending as implied by Kashap and Stein (2000). These authors suggest that small, poorly capitalized banks may not be able to offset a drain in core deposits, due to contractionary monetary policy by offering large time deposits to support continued lending. The negative sign on the coefficients for the bank deposit costs variable are in line with expectations and are insignificant across all models ranging between -0.001 and -0.002. For small banks, the increased exposure of residential real estate loans in the bank's lending portfolio curbs overall lending growth evidenced by the negative coefficients ranging from -0.104 to -0.114 in Table 3.4, significant at the 1% level.

The positive and significant coefficients on the Repo-OIS spread ranging from 0.006 to 0.016 suggest that a widening of the spread promotes an increase in bank lending. While this finding seems counter intuitive and at odds with expectations, to the extent that banks are able to sustain a profit in the face of rising costs they will continue to maximize and explore funding alternatives including those provided by the repo markets. In Models 5, 6, and 7, I introduce interaction terms between the crisis indicator variable and certain bank variables including residential real estate loans, bank deposits, and Tier 1 risk based capital ratio. In Model 5 the negative yet insignificant coefficient of -0.002 on the real estate interaction term suggests that in the small bank sample

case, banks with high risk exposure in their residential real estate portfolios reduce new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. The negative and significant coefficient on the interaction term for Model 6 with respect to bank deposits with the crisis variable supports the view that small banks during the crisis period are focused more on liquidity building versus bank lending. Model 8 allows this essay to capture the asymmetric effects of the Repo-OIS spread on bank lending by introducing the interaction term between the Repo-OIS spread and the crisis indicator variable[10].The positive and significant coefficient of 0.011 on the interaction term in Model 8 suggests that during the crisis period a widening of the Repo-OIS spread fostered bank lending.

Table 3.5 reports results for the sample of medium banks with total assets ranging between U.S. $1billion and U.S. $20 billion as of the beginning of the sample period. In contrast to the small bank sample case discussed in the preceding paragraphs, the coefficients on the bank total assets variable are positive and highly significant ranging from 0.028 to 0.034 in Table 3.5. The coefficients on the liquidity variable remain negative, highly significant yet larger in magnitude ranging from -0.113 to -0.117 compared to the small bank sample case. Contrary to expectations, the coefficients on the Tier 1 capital ratio variable are negative and significant at the 5% level in 5 of the 8 models reported in Table 3.5. However across all models, the coefficient on the Tier I capital ratio variable is very small reported at -0.001. While the common view that lending is bounded by bank capitalization remains appealing, the negative relationship between bank Tier 1 capital and lending are in line with the view by Altunbas et al. (2009) and Loutskina (2011),

[10] To explore the asymmetric effect of Repo-OIS spread I also experimented with a recession indicator variable with data downloaded from the National Bureau of Economic Research website http://www.nber.org/cycles.html last accessed on 3/11/13. Due to the high correlation between the recession variable and my crisis dummy variable of 0.688, I chose to keep the crisis variable since there was no added value by incorporating a recession variable to the data set.

among others. These authors suggest that the advent of securitization has likely altered the importance of bank characteristics, including capital requirements that are usually emphasized in the literature to identify loan supply-side shifts. It is also interesting that the narrow based deposit measure (Deposits II) looses significance as we move from the small bank sample towards the medium bank sample. This finding is not necessarily surprising since the composition of the banks' balance sheet structure including sources of funding typically changes with bank size. What is interesting to see is that the coefficients on the broader based deposit measure (Deposits I) that range from -0.099 to -0.100 suggest that as deposits rise, there is a reduction in bank lending growth. This finding could be attributed to factors such as unique financial characteristics, risk preferences, overall economic conditions, or some combination thereof. The negative sign on the coefficients for the bank deposit costs variable are in line with expectations, much larger in magnitude compared to the small bank sample case, and yet remain insignificant across all models ranging between -1.098 and -1.169. For the medium banks, the increase exposure of residential real estate loans in the bank's lending portfolio curtails overall lending growth as seen by the negative coefficients that range from -0.003 to -0.019 in Table 3.5 that are however statistically insignificant.

A widening of the Repo-OIS spread continues to exert a positive effect on bank lending based on the positive and significant coefficients (i.e. 0.025 in Models 1 and 2 and 0.005 in Model 8) for the medium bank sample. The positive coefficients are at variance with what is expected since a widening of the Repo-OIS spread intuitively should lead to reduced lending. In Model 5 the coefficient on the real estate interaction term with the crisis indicator variable is zero and statistically insignificant. This finding suggests that in the case of medium banks their level of exposure in residential real estate portfolios has no impact on bank lending growth during the

crisis period. The negative yet insignificant coefficient on the interaction term in Model 6 with respect to bank deposits with the crisis variable is consistent with the view that the medium banks during the crisis period are also focused more on a liquidity building versus bank lending. As in the small bank sample case, the positive and significant coefficient on the interaction term between the Repo-OIS spread and the crisis indicator variable in Model 8 support the presence of asymmetric effects of the Repo-OIS spread on bank lending.

Table 3.6 shows results for the sample of large banks with total assets ranging between U.S. $20 billion and U.S. $90 billion as of the beginning of the sample period. The coefficients on the bank total assets variable are positive yet not significant while the coefficients on the liquidity variable are negative in all cases ranging from -0.068 to -0.077 and modestly significant in 5 of the 8 models reported in Table 3.6. As in the case of the medium bank sample, the coefficients on the Tier 1 capital ratio variable remain negative ranging between -0.003 and -0.004 however they are statistically insignificant in the large bank sample case as reported in Table 3.6. The importance of banks' deposits as a key loan funding source seems to diminish as bank size increases. It is interesting that the results reflect that none of the coefficients on the deposits variables in any of the models are statistically significant in explaining loan growth in the large bank sample case as reported in Table 3.6. This finding follows Kashap and Stein (2000) in that larger well capitalized banks rely on diverse sources of funding outside of transaction deposits including non-reservable deposits (large-denomination CD's) and other deposit claims to support lending even during periods of contractionary monetary policy. Although the coefficients on the deposit costs variable are not of the expected sign, it is further noted they are not statistically significant. As in the case of the medium bank sample, the increased exposure of residential real estate loans in the bank's lending portfolio curbs overall lending growth as seen by the negative

coefficients that range from -0.021 to -0.041 in Table 3.6 that are, however, statistically insignificant.

The Repo-OIS spread has no impact on bank lending based on the zero coefficient reported in Model 1 and the near zero and insignificant coefficient of 0.002 shown in Model 2 in the large bank sample case. However an increase in the Repo-OIS spread has a negative impact on bank lending based on the negative and significant coefficient of -0.024 in Model 8 that is consistent with expectations. In Model 5 the negative yet insignificant coefficient of -0.010 on the real estate interaction term suggests that in the large bank sample case that banks with high risk exposure in their residential real estate portfolios reduce new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. As in the small bank sample case, the negative coefficients on the interaction terms for Models 6 and 7 with respect to bank deposits and Tier 1 capital ratio respectively with the crisis variable are consistent with the view that the large banks during the crisis period are also focused more on a liquidity building versus bank lending while acknowledging however that these coefficients are insignificant. There is no evidence of asymmetric effects of the Repo-OIS spread on bank lending given the insignificant coefficient on the interaction term between the Repo-OIS spread and the crisis indicator variable.

Table 3.7 shows results for the sample of money center banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. As in the medium bank sample case, the coefficients on the bank total assets variable are positive and significant ranging from 0.040 to 0.050 in Table 3.7. Unlike the small, medium and large bank samples, the coefficients on the liquidity variable for the money center bank sample are positive ranging from 0.062 to 0.080 yet statistically insignificant. Contrary to expectations, the Tier 1 capital ratio variable is negative and

highly significant at the 1% level across models with coefficients ranging from -0.010 to -0.012 as reported in Table 3.7. As in the large bank sample case, none of the coefficients on the deposits variables in any of the models are statistically significant in explaining loan growth. The negative sign on the coefficients for the bank deposit costs variable are in line with expectations, much larger in magnitude compared to the small bank sample case, and yet remain insignificant across all models ranging between -0.044 and -0.305. Similar to medium and large bank cases, the increase exposure of residential real estate loans in the bank's lending portfolio reduces overall lending growth as seen by the negative coefficients that range from -0.035 to -0.067 in Table 3.7 that are however statistically insignificant.

The Repo-OIS spread has no impact on bank lending based on the negative and insignificant coefficients ranging from -0.015 to -0.017 reported in Models 1, 2, and 8 for the money center bank sample. As in the large bank sample case, the negative yet insignificant coefficient of -0.044 on the real estate interaction term in Model 5 suggests that in the money center bank sample case that banks with high risk exposure in their residential real estate portfolios reduce new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. The negative and marginally significant coefficient on the interaction term in Model 7 with respect to the Tier 1 capital ratio variable with the crisis variable supports the view that the money center banks during the crisis period paid attention towards rebuilding liquidity.

The overall results of the fixed effects static panel data models across all bank subsamples are summarized as follows. With the exception of the small bank sample there is a positive relationship that is highly significant in the medium and money bank center samples between bank total asset and bank lending. There is a negative and significant relationship between bank

liquidity and lending that is highly significant in the small and medium bank samples, moderately significant in the large bank sample while positive yet insignificant in the money center bank sample case. Contrary to expectations, the relationship between the Tier 1 capital ratio variable and bank lending is negative in all subsamples except in the small bank sample case which exhibited zero coefficients on the Tier 1 capital ratio variable. This relationship however is only significant in the medium and money center bank sample cases. Furthermore, the coefficients are quite small reported at -0.001 in the medium bank sample cases and range from -0.010 to -0.012 in the money center bank sample cases. This implies that the importance of bank deposits as a key funding source for bank lending diminishes as bank asset size increases. The findings also suggest that changes in bank deposit costs do not help explain increases in bank lending as the coefficients on bank deposit costs are statistically insignificant across all models in all bank samples. The results also support the view that increases in the banks' residential real estate portfolios curtail overall lending growth however this finding is only statistically significant in the small bank sample case. The presence of asymmetric effects of the Repo-OIS spread on bank lending is only detected in the small and medium bank sample cases.

I also conduct some residual based diagnostics that are applied after running the fixed effects panel data benchmark model in each bank classification subsample. In all cases, visual inspection of normal probability plots does not support the assumption that the residuals are normally distributed. Skewness and kurtosis tests on the residuals also lead me to reject the null that the residuals have skew and kurtosis values representative of a normal distribution. Although the mean of the residuals in all cases was close to zero, the test for constant variance in the residuals does not hold and suggests the presence of heteroskedasticity[11]. Collectively, these findings do

[11] To avoid unnecessary clutter I do not include graphs and separate tables that support the residual diagnostics. The narrative conveys the central message of the diagnostic exercise. The STATA output is available upon request.

not support a Gaussian white-noise process suggesting that there could be some specification issues with the fixed effects panel data estimations employed in this essay. In any event, the fixed effects panel data estimations represent a “first pass” and serve as a benchmark for the development of dynamic panel data models which allow me to address endogeneity issues and to conduct comparative analysis between these competing techniques. It is also noted that fixed effects panel data specifications seem to be the most common methodology used by researchers to model bank lending behavior. See, for example, Cornett et al. (2011) and Khwaja and Mian (2008).

3.5.2 Dynamic Panel Data Model Results

Table 3.8 reflects model specifications using a system GMM estimator applied to the sample of small banks with total assets less than U.S. $1 billion as of the beginning of the sample period. Under these specifications this essay allows for feedback effects from bank lending to bank total assets, liquidity and real GDP growth rate variables. Across all model specifications we see a significant positive effect of an increased balance sheet (i.e. bank total assets) on bank lending with coefficients ranging from 0.017 to 0.035. These results are somewhat intuitive given the relatively simple balance structure of the small banks whose earning assets are largely centered in investments securities and loans. The coefficients on the bank liquidity variable remain negative and statistically significant at the 1% level however the coefficients are much larger in magnitude ranging from -0.112 to -0.206 in Table 3.8 when compared to the coefficients reported in the static model cases. The Tier 1 capital ratio coefficients are zero across all models. The coefficients on the bank deposit variables are positive and highly significant in all models ranging from 0.008 to 0.022 which supports the common view of the importance of deposits, particularly transaction deposits (Deposits II) as core funding source for bank lending particularly in the case

of small banks. Contrary to expectations the coefficients on bank deposit costs variable are positive albeit small in magnitude ranging from 0.002 to 0.005 and significant in 5 of the 8 specifications. Following this line of reasoning, Loutskina and Strahan (2009) point out that strong loan demand may spur an increased appetite for deposits required to fund new loans that potentially may lead to higher deposit yields (i.e. a positive relationship between deposit costs and loan growth). For the small bank sample, the increased exposure of residential real estate loans in the bank's lending portfolio curtails overall lending growth evidenced by the negative and highly significant coefficients that range from -0.182 to -0.312 in Table 3.8.

A widening of the Repo-OIS spread leads to an increase in bank lending based on the positive and significant coefficient of 0.010 reported in Models 1 and 2 for the small bank sample. In Model 5 the positive and significant coefficient of 0.008 on the real estate interaction term implies that in the small bank sample case that during the crisis period banks with high risk exposure in their residential real estate portfolios expand new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios. It is plausible that the adjustments of the overall lending portfolios to pre-crisis periods would materialize over time as banks take corrective action steps that may include increased monitoring, problem loan recognition and related loan reserve adjustments, as well as adjustments to credit policy and a strategic reassessment of the banks appetite for loan risk. This line of reasoning is consistent with the institutional memory hypothesis problem proposed by Berger and Udell (2004). Under this hypothesis, credit risk rises during expansionary periods since bankers have a short memory failing to recognize prior periods of economic slowdown. The increased credit risk leads to eventual loan performance issues that further evolve into an economic downturn which leads banks to raise credit standards and lower credit risk accordingly. The negative and highly

significant coefficient on the interaction term with respect to the Tier 1 capital ratio variable with the crisis variable in Model 7 supports the view that the small banks during the crisis period are focused more on liquidity building rather than bank lending. The highly significant non-zero coefficient for the interaction term between the Repo-OIS spread and the crisis indicator variable in Model 8 suggests that the Repo-OIS spread has asymmetric effects on bank lending. The positive coefficient on the interaction term suggests that during the crisis period as the Repo-OIS spread rises bank lending also rises. As pointed out by Shleifer and Vishny (2010) in their theoretical model of financial intermediation that incorporates the effects of investor sentiment in the markets, banks have an incentive to securitize loans as long as the fees generated from loans are higher than what the banks expect they may potentially loose on their holdings of securitized asset should prices fall. The securitization process in and of itself is fueled by loan production and, primarily in the case of investment banks, is commonly funded through repo arrangements.

The significant Hansen statistics cast doubt on the analysis of the results in Table 3.8 since the instruments as a group used for estimation are not orthogonal to the disturbance terms, thus violating a key assumption of the system GMM estimator. While violations of assumptions would typically lead to the reassessment of the model or consideration of alternative estimators, it is noted that the proposed bank lending model meets the assumptions of the system GMM estimator when applied to the remaining bank sub-samples consisting of medium, large, and money center banks. It is further noted that the proposed model parallels other lending models presented in the literature (see Cornett et al. (2011), Altunbas et al. (2009) and Matousek and Sarantis (2009), among others). In the small bank sample case where the assumption does not hold, it is plausible that the behavior of this random sample is triggering this problem[12].

[12] A common practice to address specifications issues that are detected through Sargan diagnostic tests is to reconsider models with various lag lengths to eliminate serial correlation in first order residuals or to reduce the

Table 3.9 reports results for the sample of medium banks with total assets ranging between U.S. $1 billion and U.S. $20 billion as of the beginning of the sample period. The coefficients on the bank total assets variable are mostly positive ranging from 0.016 to 0.043 yet only marginally significant in 2 of the 8 models reported in Table 3.9. The liquidity coefficients remain negative ranging from -0.124 to -0.227 albeit at weaker significance levels compared to the small bank sample case. Contrary to expectations, the coefficients on the Tier 1 capital ratio variable are negative and highly significant ranging from -0.006 to -0.007 in Table 3.9. An interesting finding is the negative and highly significant coefficients ranging from -0.227 to -0.238 on the deposit I variable which suggests that a rise in deposits would lead to a reduction in bank lending growth. While this result goes against expectations, I conjecture that this finding could be attributed to factors such as unique bank financial characteristics, risk and or liquidity preferences, overall economic conditions or some combination thereof. The negative sign on the coefficients for the bank deposit costs variable are in line with expectations, much larger in magnitude compared to the small bank sample case, and are highly significant across all models ranging between -0.849 and -1.193. The increase exposure of residential real estate loans in the bank's lending portfolio reduces overall lending growth as seen by the negative coefficients that range from -0.099 to -0.149 that are statistically significant in 7 of the 8 models reported in Table 3.9.

The Repo-OIS spread continues to have a positive impact on bank lending based on the positive and significant coefficient of 0.015 reported in Models 1 and 2 for the medium bank sample. As in the small bank sample case, the positive yet insignificant coefficient of 0.015 on the

number of instruments. Through the use of the SGMM estimator technique and the restrictions imposed on the instrument matrix, I reduced the number of instruments to only 16 in my benchmark model in all 4 bank subsample cases. While acknowledging that the Hansen statistics are acceptable in all other bank subsamples, an obvious material difference between the small bank sample and all other bank samples is the small banks' "large" sample size (i.e. there are 4,982 small banks, 475 medium banks, 34 large banks and 14 money center banks). On this basis, the behavior (or the characteristics) of the small bank sample should not in and of itself motivate an attack on the model.

real estate interaction term implies that in the medium bank sample case that during the crisis period banks with high risk exposure in their residential real estate portfolios expand new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios. The negative and significant coefficient of -0.101 on the interaction term in Model 6 with respect to the bank deposits with the crisis variable supports the view that the medium banks during the crisis period are focused more on a liquidity building instead of bank lending. The statistically significant coefficient of 0.016 for the interaction term between the Repo-OIS spread and the crisis indicator variable in Model 8 suggests the presence of asymmetric effects of the Repo-OIS spread on bank lending.

Table 3.10 reports results for the sample of large banks with total assets ranging between U.S. $20 billion and U.S. $90 billion as of the beginning of the sample period. The coefficients on the bank total assets variable are negative yet insignificant across all models. Contrary to the medium bank sample case, the coefficients on the liquidity variable are positive ranging from 0.180 to 0.529 and statistically significant in 5 of the 8 models reported in Table 3.10. As in the medium bank sample case, the coefficients on the Tier 1 capital ratio variable are negative and significant in 7 of the 8 models ranging from -0.008 to -0.012 reported in Table 3.10. It is interesting that the results suggest that none of the coefficients on the deposit variables in any of the models are statistically significant in explaining loan growth in the large bank sample case as reported in Table 3.10. While the coefficients on the deposit costs variable are not of the expected sign, none of the coefficients that range from 1.328 to 1.960 are statistically significant. The insignificant coefficients on the residential real estate exposure variable suggest that an increase in the banks exposure to residential real estate has no impact on overall lending growth. It is possible that large banks are not subject to a reduction in lending due to benefits associated with geographical risk

dispersion in their residential real estate portfolios that would not be evident in small and medium banks.

The Repo-OIS spread has no impact on bank lending based on the positive yet insignificant coefficients reported in Models 1, 2, and 8 for the large bank sample. It is possible that bank lending by large banks is not impacted by an increase in the Repo-OIS spread due to offsetting income that is typically generated from securitization activities that the larger banks engage in as mentioned by Shleifer and Vishny (2010). Unlike the small and medium bank sample cases, the coefficient on the real estate interaction term with the crisis indicator variable in Model 5 is negative albeit insignificant in the large bank sample. A negative and significant coefficient on the interaction term suggests that banks with high risk exposure in their residential real estate portfolios reduce new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. Although the negative coefficient of -0.173 on the interaction term in Model 6 with respect to the bank deposits with the crisis variable implies that the medium banks during the crisis period are focused more on a liquidity building instead of bank lending, the coefficient is not statistically significant. The insignificant coefficient on the interaction term between the Repo-OIS spread and the crisis indicator variable in Model 8 does not support the presence of asymmetric effects of the Repo-OIS spread on bank lending.

Table 3.11 shows results for the sample of money center banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. As in the case of the large bank sample, bank total assets are statistically insignificant. Bank liquidity has become insignificant in explaining bank lending across all models in the money center bank sample case. The coefficients on the Tier 1 capital ratio variable are mostly negative yet insignificant across models with

coefficients ranging from -0.004 to -0.032 in Table 3.11. While the common view that lending is bounded by bank capitalization is intuitive, the negative relationship between bank capitalization and lending may be influenced by the advent of securitization as suggested by Altunbas et al. (2009) and Loutskina (2011) among others. These authors also suggest that securitization may have diminished the role of balance sheet liquidity and overall bank asset size as key bank lending determinants. As in the large bank sample case, neither deposit variables nor deposit costs help to explain loan growth. Similar to the large bank sample case, the insignificant coefficients on the residential real estate exposure variable suggest that an increase in the banks exposure to residential real estate has no impact on overall lending growth. Similar to the large bank sample case, it is possible that overall lending by the money center banks is not impacted by an increase in their residential real estate portfolios given the geographical risk dispersion that is commonly exhibited in money center banks residential real estate portfolios.

The Repo-OIS spread continues to have no impact on bank lending based on the negative and insignificant coefficient in Models 1, 2, and 8 for the money center bank sample. As in the large bank sample case, it is possible that bank lending is not affected by an increase in the Repo-OIS spread due to offsetting income generated by the securitization activities which includes the underwriting and sale of securities that are common to money center banks. In Model 5 the positive yet insignificant coefficient of 0.380 on the real estate interaction term suggests that in the money center bank sample case that banks with high risk exposure in their residential real estate portfolios increase new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. The negative coefficients on the interaction terms for Models 6 and 7 with respect to bank deposits and Tier 1 capital ratio variables respectively with the crisis variable are consistent with the view that the

money center banks during the crisis period are also largely focused on a liquidity building while acknowledging however that these coefficients are insignificant. As in the large bank sample case, the insignificant coefficient on the interaction term between the Repo-OIS spread and the crisis indicator variable in Model 8 does not support the presence of asymmetric effects of the Repo-OIS spread on bank lending.

An overall assessment of the dynamic panel data models across all bank subsamples reveals the following key highlights. Bank total assets help to explain lending growth only in the small bank sample with coefficients being positive and highly significant while turning negative yet insignificant only in the large bank sample case. There is an inverse relationship between liquidity and bank lending that is significant in the small and medium bank samples that turns positive in the large and money center bank samples and significant in the large bank sample case. Contrary to expectations, the relationship between the Tier 1 capital ratio variable and bank lending is negative in all subsamples except in the small bank sample case which exhibited zero coefficients on the Tier 1 capital ratio variable. The impact of deposits on bank lending varies based on bank size with no impact being captured by the large and money center bank samples. Increases in bank deposits seem to support bank lending in the small bank sample with an opposite effect being reported in the medium bank sample. Increases in deposit costs had the expected effect on lending in the medium bank sample, an opposite yet very small effect in the small bank sample and no effect in the large and money center bank samples. For the small and medium bank samples, the results support the view that increases in the banks residential real estate portfolios curtail overall lending growth. The presence of asymmetric effects of the Repo-OIS spread on bank lending captured through the interaction term between the Repo-OIS spread and the crisis indicator variable seems to be limited to the small and medium bank sample cases.

A comparative analysis between the fixed effects and dynamic panel model estimations across all bank subsamples renders some interesting findings. The positive and significant relationship between bank total assets and bank lending reported under fixed effects specifications in the medium and money center bank samples are positive yet no longer significant under the dynamic panel model estimations. In the small bank sample case, it is noted that the dynamic panel estimations find a positive and significant relationship between bank total asset and bank lending that is not captured under the fixed effects models. The statistical relationship between liquidity and lending follows a similar pattern as I move from the fixed effects to the dynamic panel models with the noted exception of the large bank sample case. Under fixed effects and dynamic panel estimations, the relationship is negative and significant in the small and medium bank sample cases while positive yet insignificant in the money center bank sample with the coefficients being much larger in small bank sample case under dynamic panel estimations. Interestingly, in the large bank sample case the relationship between liquidity and lending is negative and significant under fixed effects panel estimations that become positive and significant under dynamic panel models. Both estimators behave similarly with respect to the negative impact that the Tier 1 capital ratio variable imposes on bank lending noting that the dynamic panel estimations find a negative and significant relationship in the large bank sample that is not captured under the fixed effects models. While both estimators find a negative relationship between the Tier 1 capital ratio variable and lending in the money center bank sample, it is noted that the relationship is statistically significant only under fixed effects estimations. With respect to the relationship between bank deposits and bank lending both estimators also behave similarly. Under fixed effects and dynamic panel models the relationship is positive and significant in the small bank sample, negative and significant in the medium bank sample, negative and

insignificant in the large bank sample while turning positive and insignificant in the money center bank sample. Under fixed effects models deposit costs do not help explain lending growth since none of the coefficients on the deposit costs variable are significant. Under dynamic panel estimations increases in deposit costs had the expected negative significant effect on lending in the medium bank sample, an opposite significant yet very small effect in the small bank sample and no effect in the large and money center bank samples. For the small bank sample case both estimators provide support for the view that increases in the banks residential real estate portfolios curtail overall lending growth. This finding is also observed for the medium bank sample only under dynamic panel models. Both estimators also find that residential real portfolio exposures play no role in determining overall bank lending growth in the large and money center bank samples. Both estimators behave similarly in explaining the presence of asymmetric effects of the Repo-OIS spread on bank lending expressed through the interaction term between the Repo-OIS spread and the crisis indicator variable. Both estimators find a positive and significant relationship in the small and medium bank samples that remains positive however insignificant in the large bank sample case that turns negative and insignificant in the money center bank sample case.

Overall this essay finds support for hypothesis H1 which suggests that traditional bank costs of funding play a diminished role in the supply of bank lending (i.e. $\beta_2 \leq 0$ in equation 2). The negative relationship is well captured in the medium bank sample case under the dynamic panel specifications as reported in Table 3.9. The fact that variability in deposit costs does not explain bank lending growth in the large and money center samples is also consistent with H1 since the larger banks presumably should have greater access to the securitization markets which arguably has become an important alternative funding source.

There is some evidence to support hypothesis H2 which posits that there are asymmetric affects of the Repo-OIS spread on bank lending (i.e.β4 in equation 2 interacted with the crisis dummy variable). The results are consistent in that the fixed effects and dynamic panel models suggest the presence of asymmetric affects that are however limited to the small and medium bank samples. Since the Repo-OIS spread can be viewed essentially as a funding cost I would expect that its impact should permeate across all banks that use this type of funding source which typically consists of the larger bank samples. While asymmetry that is detected in the small and medium bank samples is an interesting finding, the absence of asymmetry in the remaining bank samples is somewhat surprising. The positive and significant coefficient on the interaction term reported in Model 8 in Table 3.8 and Table 3.9 suggests that during the crisis period as the Repo-OIS spread rises bank lending also rises which is an interesting result reported in this essay. My finding provides support to the theoretical model of financial intermediation proposed by Shleifer and Vishny (2010) that incorporates the effects of investor sentiment in the markets that suggest that banks have an incentive to securitize loans as long as the fees generated from loans are higher than what the banks expect they may potentially lose on their holdings of securitized asset should prices fall. The securitization process in and of itself is fueled by loan production and, primarily in the case of investment banks, is commonly funded through repo arrangements.

There is some evidence to support H3 that states that there is an inverse relationship between a bank's exposure in its residential real estate portfolio and overall bank lending (i.e. $\beta_3<0$ in equation 2). This is particularly evident in the small bank and medium bank sample cases as reported in Tables 3.8 and 3.9. In the small bank sample, banks with high risk exposure in their residential real estate portfolios increase new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period

which is contrary to expectations. The finding in the small bank sample case is in step with the institutional memory hypothesis problem proposed by Berger and Udell (2004). Under this hypothesis credit risk rises during expansionary periods since bankers have a short memory failing to recognize prior periods of economic slowdown. The increase credit risk leads to eventual loan performance issues that further evolve into an economic downturn which leads banks to raise credit standards and lower credit risk accordingly.

The evidence to support H4 that asserts a positive relationship between transaction deposits and bank lending is mixed (.i.e. $\beta_2>0$ in equation 2). The positive relationship between transaction deposits (Deposits II variable) and bank lending is well captured in the small bank sample case as seen in Table 3.8. The evidence that transaction deposits seems to loose importance as bank size increases is also expected since the composition of the banks' balance sheet structure including sources of funding typically changes with bank size. An interesting finding in this essay that goes against the hypothesis is that banks with higher levels of transaction deposits reduce new lending activity by a greater amount compared to their counterparts with lower levels of transactions deposits during the crisis period. This finding is statistically significant in the medium bank sample case as shown in Model 6 in Table 3.9. It is important to keep in mind that while banks with stable sources of financing may be better positioned from a liquidity standpoint to support lending activity compared to less liquid and weaker capitalized banks there are other factors that influence lending activity such as banks' unique credit cultures, changes in credit policy, evolving loan demand, banks' liquid risk preferences, and business sentiment among others. These other factors extend beyond the scope of this essay and are subjects for future research.

3.6 Conclusion

Although the evidence suggests that traditional bank costs of funding play a diminished role in the supply of bank lending particularly in the larger bank samples implying that securitization markets have arguably become an important alternative funding source, the impact of Repo-OIS spreads on lending is absent in the larger bank samples. Interestingly, the presence of asymmetric effects of the Repo-OIS spread on bank lending seems to be limited to the small and medium bank samples. Furthermore, the findings suggest that during the crisis period as the Repo-OIS spread rises bank lending also rises which is an interesting result reported in this essay that provides support to the theoretical model of financial intermediation proposed by Shleifer and Vishny (2010)[13].

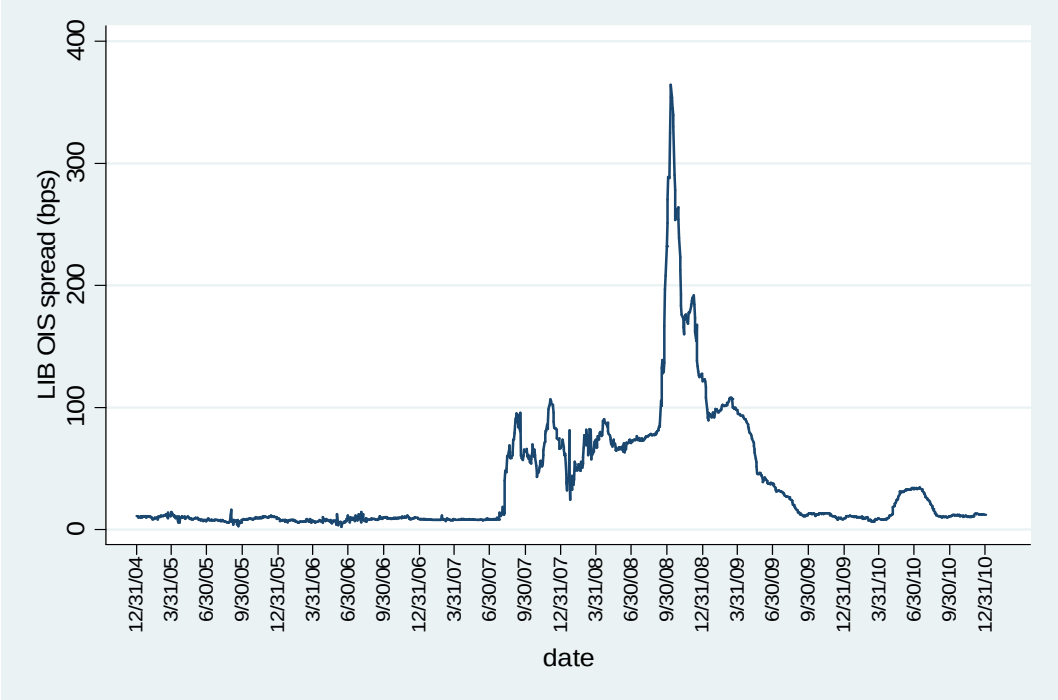
There is some evidence supporting an inverse relationship between a bank's residential real estate portfolio exposure and overall bank lending that is particularly strong in the small and medium bank sample cases. An interesting finding reported in the small bank sample case is that banks with high risk exposure in their residential real estate portfolios increase new lending activity by a greater amount compared to banks with lower risk exposure in their residential real estate portfolios during the crisis period. The finding in the small bank sample case is consistent with the institutional memory hypothesis problem proposed by Berger and Udell (2004).

The evidence also suggests that the positive relationship between transaction deposits and bank lending diminishes as bank size increases. Furthermore, in the medium bank sample case the findings suggests that banks with higher levels of transaction deposits reduce new lending

[13] The shadow banking system which is funded in part through the repo markets has experienced significant pressure and severe collateral shortages due to the Federal Reserve's purchases of U.S. Treasuries as part of its quantitative easing strategies. See, The Wall Street Journal of May 23, Kessler 2013 on "The Fed Squeezes the Shadow-Banking System".

activity by a greater amount compared to their counterparts with lower levels of transaction deposits during the crisis period. Although banks with stable sources of financing may be better positioned from a liquidity standpoint to support lending activity compared to less liquid and weaker capitalized banks there are other factors that influence lending activity such as banks' unique credit cultures, changes in credit policy, evolving loan demand, banks' liquid risk preferences, and business sentiment among others. These other factors extend beyond the scope of this essay and may be explored in future research.

Figure 3.1 Libor-Overnight Index Swap (OIS) Spread



Source: The 90 day London Interbank Offered Rate (Libor) series US0003M and the Overnight Index Swap(OIS) series USSOC Curncy are expressed in daily frequency and were downloaded from the Bloomberg data base http://www.bloomberg.com The spread was computed by subtracting the OIS series from the Libor series. The author computes a quarterly average Libor- OIS spread series from the daily data. The quarterly series is used for model purposes. The OIS rate is a commonly used measure of investor expectations of the effective federal funds rate. The Libor rate is expected to reflect credit risk and the expectations on future overnight fed funds rates.

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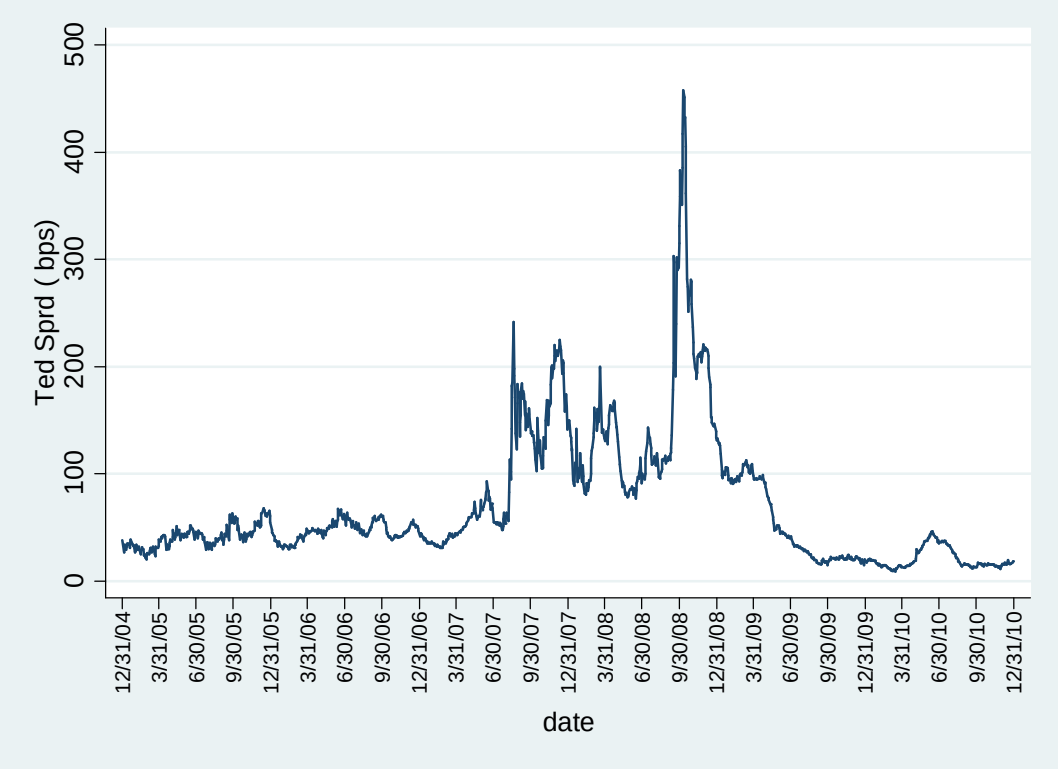
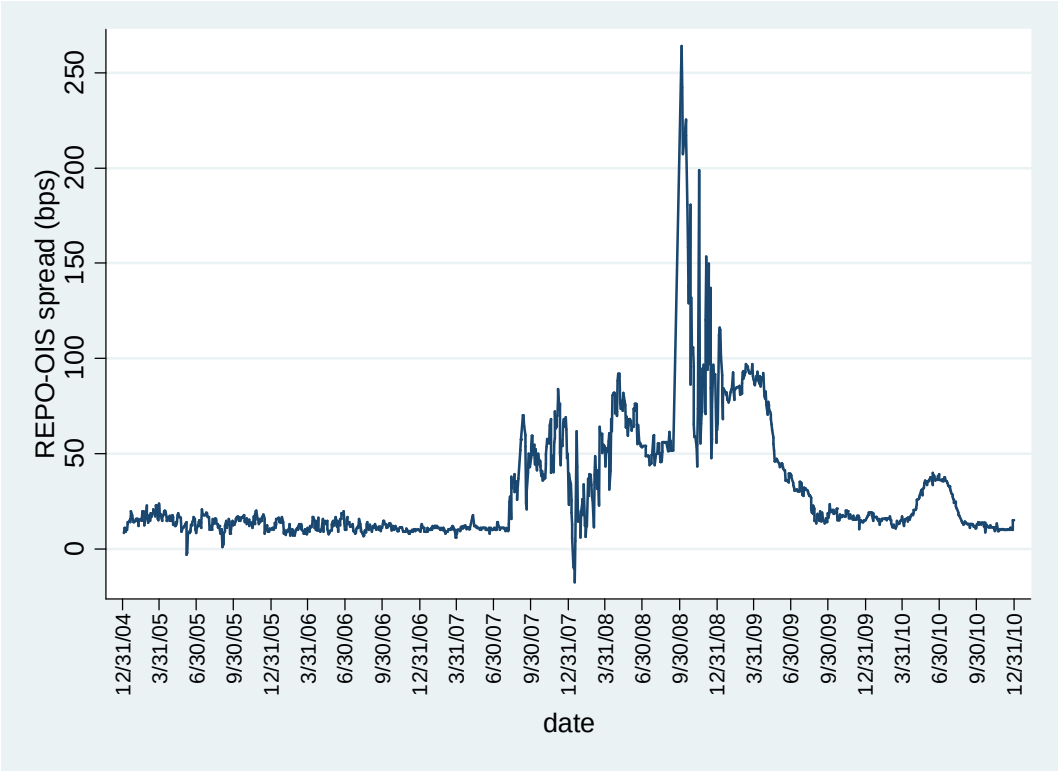
Figure 3.2 TED Spread



Source: The 90 day London Interbank Offered Rate (Libor) series USD3MTD156 N and the 90 day U.S. Treasury Bill series DTB3 are expressed in daily frequency and were downloaded from the Federal Reserve Economic Data (FRED) data base available through the Federal Reserve Bank of Saint Louis http://research.stlouisfed.org/fred2/ The TED spread was computed by subtracting the U.S. Treasury Bill series from the Libor series. The author computes a quarterly average TED spread series from the daily data. The quarterly series is used for model purposes. The TED spread is viewed as an indicator of perceived credit risk in the economy.

Figure 3.3 Repo-(OIS) Spreads R/E Backed Collateral



Source: The 90 day Repurchase Agreement (REPO) series RPMB03M with collateral consisting of real estate mortgage backed (RMBS) and the Overnight Index Swap (OIS) series USSOC Curncy are expressed in daily frequency and were downloaded from the Bloomberg data base http://www.bloomberg.com.. The spread was computed by subtracting the OIS series from the REPO series. The author computes a quarterly average REPO-OIS spread series from the daily data. The quarterly series is used for model purposes. The REPO markets allow banks and other market participants to obtain collateralized funding by selling owned securities while agreeing to repurchase them at loan maturity.

Table 3.1 Bank Distribution

Year	Quarter	Large Bank	Small Bank	Total
2005	1	746	4060	4806
	2	772	4009	4781
	3	796	4068	4864
	4	828	4099	4927
2006	1	918	4276	5194
	2	946	4306	5252
	3	954	4328	5282
	4	951	4339	5290
2007	1	956	4500	5456
	2	953	4523	5476
	3	954	4521	5475
	4	955	4523	5478
2008	1	957	4503	5460
	2	962	4520	5482
	3	957	4515	5472
	4	958	4513	5471
2009	1	962	4488	5450
	2	962	4508	5470
	3	943	4472	5415
	4	928	4444	5372
2010	1	915	4256	5171
	2	893	4229	5122
	3	882	4181	5063
	4	867	4138	5005

Notes: Represents the number of banks examined between 2005Q1 and 2010Q4. The banks are separated into two groups. Large (small) bank are those whose total assets exceed (fall below) U.S. $500 million in total assets as of the beginning of the sample period. The data is available through Federal Deposit Insurance Corporation (FDIC) website. http://www2.fdic.gov/sdi/index.asp.

Table 3.2 Bank Descriptive Statistics

Panel A (TA < U.S. $1 billion)

Variable	Obs	Mean	Std Dev.	Min	Max
asset	114203	222758.2	194982.5	50003	2837389
net loans	114203	151055.2	141077.6	7790	1414196
reloans	114203	48802.37	63016.87	0	756515
comloansdom	114203	19406.27	28146.41	0	1428146
rmbs	114203	15771.88	31819.75	0	1050181
abs	103615	106.4727	2047.975	0	188895
sechmat	114203	6606.147	21999.03	-250952	550297
secfsale	114203	37180.44	47433.48	0	1082084
depdom	114203	174128.9	158104.9	500	2405441
Cash	114203	10098.05	14622.51	-178	380620
ffsrepo	114203	4537.981	9470.274	0	438438
capt1r	114203	15.28516	6.563361	0.021337	50.03195

Panel B (TA> U.S. $1 billion and < U.S. $20 billion)

Variable	Obs	Mean	Std. Dev.	Min	Max
asset	10930	3398152	3587482	502046	3.27E+07
net loans	10930	2293808	2489323	127300	2.23E+07
reloans	10930	733581.1	1330553	0	1.99E+07
comloansdom	10930	360635.2	562567.8	0	4850149
rmbs	10930	400612.9	716409.5	0	1.71E+07
abs	9152	8169.441	74016.39	0	2354260
sechmat	10930	122859	450698.4	-183326	1.18E+07
secfsale	10930	546362.4	801322.4	0	8178007
depdom	10930	2442229	2509636	0	3.01E+07
Cash	10930	141477.6	276097.6	10	4592160
ffsrepo	10930	45342.98	154658.6	0	2850000
capt1r	10930	12.30282	5.02087	0.024048	49.72369

Table 3.2 Bank Descriptive Statistics-continued
Panel C (TA> U.S. $20 billion and < U.S. $90 billion)

Variable	Obs	Mean	Std. Dev.	Min	Max
asset	779	4.59E+07	2.48E+07	1582921	1.69E+08
net loans	779	2.75E+07	1.60E+07	1141757	1.25E+08
reloans	779	8770274	7697717	0	3.98E+07
comloansdom	779	5627078	5647719	0	2.59E+07
rmbs	779	5439802	7402032	0	5.01E+07
abs	598	770379	2017680	0	1.85E+07
sechmat	779	1092533	2958350	-1532625	2.51E+07
secfsale	779	7711980	8968807	0	6.83E+07
depdom	779	2.87E+07	1.88E+07	901085	1.36E+08
Cash	779	2914472	5149576	361	3.88E+07
ffsrepo	779	1011476	2286952	0	1.80E+07
capt1r	779	12.74958	6.779036	6.245451	47.71689

Panel D (TA> U.S. $90 billion)

Variable	Obs	Mean	Std. Dev.	Min	Max
asset	322	4.43E+08	4.71E+08	5.09E+07	1.77E+09
net loans	322	2.25E+08	2.06E+08	2.24E+07	7.32E+08
reloans	322	8.49E+07	9.23E+07	3052000	3.77E+08
comloansdom	322	4.84E+07	4.58E+07	1985000	1.82E+08
rmbs	322	4.60E+07	5.45E+07	1903217	2.53E+08
abs	322	3743973	6136682	0	2.92E+07
sechmat	322	1701747	6204059	0	4.74E+07
secfsale	322	6.71E+07	7.91E+07	3430433	3.54E+08
depdom	322	2.05E+08	2.01E+08	2.68E+07	8.38E+08
Cash	322	2.73E+07	4.01E+07	1112825	2.28E+08
ffsrepo	322	2.93E+07	6.41E+07	0	3.02E+08
capt1r	322	8.757402	1.724193	6.127613	15.16773

Notes: All bank variables are expressed in levels and in thousands of dollars with the exception of our Tier1 risk-based capital variable (capt1r) which is in ratio form. The descriptive detail is on four sub samples of banks (panels A through D) measured by average total assets over the sample period. The sample covers from 2005Q1 to 2010Q4. Bank variable definitions are detailed in Appendix A: Bank Variables. The bank data was downloaded from Federal Deposit Insurance Corporation (FDICs) statistics on depository institutions (SDI) data base: http://www2.fdic.gov/sdi/index.asp. The SDI information is extracted from quarterly call reports (FFIEC form FFIEC-031 for banks with domestic and foreign offices or form FFIEC-041 for banks with domestic offices only).

Table 3.3 Correlation Matrix Independent Variables

Panel A Small Bank Subsample (TA < U.S. $1 billion)

	lta	liq I	dep I	dep II	reloans	capt1r	depcost	repo-ois	ffr	rgdpg
lta	1.000									
liq I	-0.156	1.000								
dep I	-0.252	0.248	1.000							
dep II	-0.417	0.286	0.636	1.000						
reloans	0.010	0.098	-0.008	-0.029	1.000					
capt1r	-0.175	0.324	-0.129	0.015	0.176	1.000				
depcost	0.044	-0.057	-0.146	-0.118	0.007	-0.074	1.000			
repo-ois	0.034	-0.047	-0.041	-0.047	-0.038	-0.050	0.005	1.000		
ffr	-0.113	-0.035	0.029	0.066	-0.017	0.055	0.073	-0.279	1.000	
rgdpg	-0.039	0.047	0.042	0.047	0.036	0.053	0.014	-0.793	0.350	1.000

Panel B Medium Bank Subsample (TA> U.S. $1 billion and < U.S. $20 billion)

	lta	liq I	dep I	dep II	reloans	capt1r	depcost	repo-ois	ffr	rgdpg
lta	1.000									
liq I	0.119	1.000								
dep I	-0.231	-0.187	1.000							
dep II	-0.125	0.069	0.202	1.000						
reloans	0.004	0.234	-0.073	-0.038	1.000					
capt1r	-0.045	0.408	-0.245	-0.060	0.168	1.000				
depcost	-0.070	-0.153	-0.081	-0.138	-0.052	-0.056	1.000			
repo-ois	0.053	-0.082	-0.072	-0.108	-0.021	-0.063	0.286	1.000		
ffr	-0.148	-0.065	-0.034	0.108	-0.008	-0.018	0.243	-0.279	1.000	
rgdpg	-0.058	0.082	0.065	0.111	0.020	0.070	-0.096	-0.793	0.350	1.000

Table 3.3 Correlation Matrix Independent Variables- continued

Panel C Large Bank Subsample (TA>U.S. $20 billion and < U.S. $90 billion)

	lta	liq I	dep I	dep II	reloans	capt1r	depcost	repo-ois	ffr	rgdpg
lta	1.000									
liq I	0.082	1.000								
dep I	-0.151	-0.137	1.000							
dep II	-0.037	0.159	0.067	1.000						
reloans	-0.101	0.362	0.121	0.208	1.000					
capt1r	-0.128	0.080	-0.296	-0.011	-0.110	1.000				
depcost	-0.162	-0.272	0.050	-0.201	-0.120	-0.117	1.000			
repo-ois	0.141	-0.029	-0.030	0.000	-0.032	-0.085	0.265	1.000		
ffr	-0.360	-0.136	-0.034	-0.046	0.011	-0.083	0.349	-0.279	1.000	
rgdpg	-0.145	0.028	0.017	0.013	0.037	0.078	-0.082	-0.793	0.350	1.000

Panel D Money Center Bank Subsample (TA> U.S. $90 billion)

	lta	liq I	dep I	dep II	reloans	capt1r	depcost	repo-ois	ffr	rgdpg
lta	1.000									
liq I	-0.011	1.000								
dep I	-0.471	-0.385	1.000							
dep II	-0.187	0.526	0.167	1.000						
reloans	0.313	-0.443	0.324	-0.036	1.000					
capt1r	0.116	0.426	-0.113	0.079	-0.028	1.000				
depcost	-0.079	-0.339	-0.005	-0.279	0.033	-0.320	1.000			
repo-ois	0.061	-0.035	-0.035	-0.050	-0.058	-0.144	0.201	1.000		
ffr	-0.137	-0.226	-0.084	-0.059	0.041	-0.487	0.425	-0.279	1.000	
rgdpg	-0.061	0.022	0.006	0.049	0.057	0.086	-0.012	-0.793	0.350	1.000

Note: The bank total assets (lta) variable enters in log form. The liquidity (liq I) and deposit (dep I & II) variables are scaled by bank total assets while residential real estate loan (reloans) variable is scaled by bank total loans. Tier1 risk-based capital (capt1r) and deposit cost (depcost) variables are in ratio form. Refer to Appendix A for listing of the bank variable names and codes. Bank data was obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12. The bivariate correlations cover the entire sample period from 2005Q1 to 2010Q4. The correlation matrix includes the macro-variables used in this study along with the REPO-OIS spread which is a key variable employed in this research. Author's calculations.

Table 3.4 Fixed effects panel models. Dependent variable: Bank lending growth, small bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	.030***(.003)	.030***(.003)	.038*** (.003)	.038***(.003)	.034***(.003)	.034***(.003)	.033***(.003)	.031***(.003)
BankTotal Assets normalized	-.003(.003)	-.003(.003)	-.004(.003)	-.004(.003)	-.004(.003)	-.003(.003)	-.004(.003)	-.003(.003)
Bank Liquidity-I normalized	-.020***(.003)	-.020***(.003)	-.020***(.003)	-.019***(.003)	-.020***(.003)	-.020***(.003)	-.020***(.003)	-.020***(.003)
Bank Tier 1 Capital normalized	.000(.000)	-.000(.000)	.000(.000)	-.000(.000)	.000(.000)	-.000(.000)	.000(.000)	.000(.000)
Bank Deposits- I normalized	.001**(.000)		.001**(.000)		.001**(.000)		.001**(.000)	.001**(.000)
Bank Deposits- II normalized		.003**(.001)		.003*(.001)		.003**(.001)		
Bank Deposit Costs normalized	-.001(.005)	-.002(.005)	-.001(.005)	-.002(.005)	-.001(.005)	-.001(.005)	-.001(.005)	-.001(.005)
Real Estate Loans normalized	-.109***(.009)	-.109***(.009)	-.114***(.009)	-.113***(.009)	-.105***(.009)	-.105***(.009)	-.104***(.009)	-.106***(.009)
REPO-OIS Spread	.016***(.001)	.016***(.001)						.006***(.001)
Fed Funds Rate	.005***(.000)	.005***(.000)	.005***(.000)	.005***(.000)	.005***(.000)	.005***(.000)	.005***(.000)	.005***(.000)
Real GDP Growth Rate			-.001***(.000)	-.001***(.000)	-.000***(.000)	-.000***(.000)	-.000***(.000)	
Crisis dummy					.007***(.001)	.007***(.000)	.007***(.000)	.000(.001)
Real Estate Loans normalized*crisis					-.002(.002)			
Bank Deposits- II normalized*crisis						-.009**(.004)		
Bank Tier 1 Capital normalized*crisis							-.000***(.000)	
REPO-OIS Spread * crisis								.011***(.001)
Within R^2	.062	.062	.059	.059	.063	.063	.063	.064

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. Hausman tests were used to determine whether fixed or random effects models are the appropriate specification. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 4,982 banks in the sample of small banks defined as those banks with total assets less than U.S. $1 billion as of the beginning of the sample period. There are 107,587observations in each model run.

Table 3.5 Fixed effects panel models. Dependent variable: Bank lending growth, medium bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	-.012(.011)	-.011(.011)	.001(.011)	.001(.011)	-.007(.011)	-.006(.011)	-.007(.011)	-.010(.011)
BankTotal Assets normalized	.028***(.008)	.034***(.008)	.028***(.008)	.034***(.008)	.028***(.007)	.034***(.008)	.028***(.008)	
Bank Liquidity-I normalized	-.114***(.021)	-.116***(.020)	-.113***(.021)	-.116***(.020)	-.114***(.021)	-.117***(.020)	-.114***(.021)	-.114***(.021)
Bank Tier 1 Capital normalized	-.001**(.001)	-.001(.001)	-.001**(.001)	-.001(.001)	-.001**(.001)	-.001(.001)	-.001**(.001)	-.001**(.001)
Bank Deposits- I normalized	-.100***(.020)		-.099***(.020)		-.100***(.020)		-.100***(.020)	-.100***(.020)
Bank Deposits- II normalized		.038(.024)		-.038(.024)		.039(.025)		
Bank Deposit Costs normalized	-1.166(.752)	-1.098(.759)	-1.169(.753)	-1.102(.761)	-1.166(.762)	-1.108(.778)	-1.166(.761)	-1.168(.759)
Real Estate Loans normalized	-.012(.037)	-.015(.037)	-.016(.037)	-.019(.037)	-.003(.037)	-.005(.037)	-.003(.037)	-.005(.037)
REPO-OIS Spread	.025***(.002)	.025***(.002)						.005*(.003)
Fed Funds Rate	.009***(.000)	.009***(.000)	.008***(.000)	.008***(.000)	.008***(.000)	.008***(.000)	.008***(.000)	.008***(.000)
Real GDP Growth Rate			-.002***(.000)	-.002***(.000)	-.001***(.000)	-.001***(.000)	-.001***(.000)	
Crisis dummy					.013***(.003)	.013***(.001)	.013***(.001)	.005**(.002)
Real Estate Loans normalized*crisis					.000(.008)			
Bank Deposits- II normalized*crisis						-.029(.032)		
Bank Tier 1 Capital normalized*crisis							.000(.000)	
REPO-OIS Spread * crisis								.016***(.004)
Within R^2	.134	.129	.132	.127	.141	.136	.141	.141

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. Hausman tests were used to determine whether fixed or random effects models are the appropriate specification. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 475 banks in the sample of medium banks defined as those banks with total assets ranging between U.S. $1 billion and $20 billion as of the beginning of the sample period. There are 10,391observations in each model run.

Table 3.6 Fixed effects panel models. Dependent variable: Bank lending growth, large bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	.016(.026)	.009(.026)	.017(.023)	.010(.024)	.011(.026)	.006(.027)	.011(.026)	.020(.026)
BankTotal Assets normalized	.016(.016)	.017(.018)	.016(.016)	.017(.018)	.016(.016)	.017(.018)	.016(.016)	.016(.016)
Bank Liquidity-I normalized	-.075*(.044)	-.068(.044)	-.075*(.044)	-.068(.043)	-.077*(.045)	-.068(.044)	-.076*(.044)	-.076*(.044)
Bank Tier 1 Capital normalized	-.004(.003)	-.003(.002)	-.004(.003)	-.003(.002)	-.004(.003)	-.003(.002)	-.004(.003)	-.004(.003)
Bank Deposits- I normalized	-.094(.068)		-.096(.068)		-.096(.068)		-.095(.068)	-.095(.068)
Bank Deposits- II normalized		-.016(.102)		-.015(.100)		-.017(.113)		
Bank Deposit Costs normalized	.175(1.483)	.236(1.572)	.167(1.487)	.231(1.575)	.171(1.495)	.237(1.557)	.233(1.494)	.184(1.459)
Real Estate Loans normalized	-.040(.071)	-.023(.071)	-.041(.069)	-.024(.069)	-.034(.074)	-.021(.075)	-.035(.074)	-.036(.075)
REPO-OIS Spread	.000(.010)	.002(.010)						-.024**(.009)
Fed Funds Rate	.007***(.001)	.007***(.001)	.006***(.001)	.007***(.001)	.006***(.001)	.006***(.001)	.006***(.001)	.006***(.001)
Real GDP Growth Rate			.001(.001)	.000(.001)	.001**(.001)	.001*(.001)	.001**(.001)	
Crisis dummy					.016*(.009)	.012*(.007)	.012*(.007)	.003(.014)
Real Estate Loans normalized*crisis					-.010(.030)			
Bank Deposits- II normalized*crisis						-.004(.115)		
Bank Tier 1 Capital normalized*crisis							-.001(.001)	
REPO-OIS Spread * crisis								.023(.025)
Within R^2	.085	.076	.086	.078	.092	.082	.092	.091

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. Hausman tests were used to determine whether fixed or random effects models are the appropriate specification. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 34 banks in the sample of large banks defined as those banks with total assets ranging between U.S. $20 billion and $90 billion as of the beginning of the sample period. There are 736 observations in each model run.

Table 3.7 Fixed effects panel models. Dependent variable: Bank lending growth, money center bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Constant	.019(.024)	.020(.024)	.010(.021)	.010(.020)	-.004(.013)	-.003(.018)	-.003(.016)	.006(.016)
BankTotal Assets normalized	.045**(.016)	.050**(.021)	.044***(.014)	.048**(.020)	.040***(.013)	.044**(.019)	.048**(.017)	.040**(.013)
Bank Liquidity-I normalized	.062(.067)	.067(.071)	.063(.066)	.066(.071)	.066(.066)	.067(.072)	.080(.069)	.067(.069)
Bank Tier 1 Capital normalized	-.012***(.004)	-.010***(.003)	-.012***(.004)	-.010***(.003)	-.012***(.004)	-.011***(.003)	-.011***(.003)	-.012***(.004)
Bank Deposits- I normalized	.091(.123)		.095(.126)		.107(.133)		.135(.157)	.103(.140)
Bank Deposits- II normalized		-.177(.115)		-.175(.117)		-.193(.183)		
Bank Deposit Costs normalized	-.238(1.349)	-.305(1.342)	-.233(1.392)	-.298(1.387)	-.044(1.790)	-.231(1.621)	-.291(1.552)	-.205(1.333)
Real Estate Loans normalized	-.067(.065)	-.067(.063)	-.061(.061)	-.060(.057)	-.035(.040)	-.038(.053)	-.041(.047)	-.040(.042)
REPO-OIS Spread	-.015(.012)	-.017(.013)						-.015(.012)
Fed Funds Rate	.007***(.001)	.007***(.001)	.008***(.001)	.007***(.001)	.007***(.001)	.007***(.001)	.008***(.001)	.006***(.001)
Real GDP Growth Rate			.001(.001)	.001(.001)	.002*(.001)	.002*(.001)	.002(.001)	
Crisis dummy					.032(.028)	.018*(.010)	.018*(.010)	.052*(.026)
Real Estate Loans normalized*crisis					-.044(.096)			
Bank Deposits- II normalized*crisis						.046(.368)		
Bank Tier 1 Capital normalized*crisis							-.021*(.012)	
REPO-OIS Spread * crisis								-.062(.044)
Within R^2	.123	.122	.121	.120	.138	.135	.163	.162

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. Hausman tests were used to determine whether fixed or random effects models are the appropriate specification. Robust standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 14 banks in the sample of money center banks defined as those banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. There are 303 observations in each model run.

Table 3.8 Dynamic panel models. Dependent variable: Bank lending growth, small bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Loan growth (1-lag)	.035(.073)	.012(.067)	.321***(.046)	.329***(.046)	.311***(.047)	.321***(.047)	.311***(.047)	.018(.073)
BankTotal Assets normalized	.033***(.009)	.035***(.010)	.018**(.008)	.021***(.008)	.019**(.008)	.021***(.008)	.017**(.008)	.033***(.009)
Bank Liquidity-I normalized	-.204***(.034)	-.169***(.034)	-.143***(.031)	-.112***(.028)	-.145***(.031)	-.114***(.028)	-.147***(.031)	-.206***(.034)
Bank Tier 1 Capital normalized	.000(.000)	-.000(.000)	-.000(.000)	-.000***(.000)	-.000(.000)	-.000(.000)	-.000(.000)	.000(.000)
Bank Deposits- I normalized	.012***(.002)		.008***v(.002)		.008***(.002)		.009***(.002)	.012***(.002)
Bank Deposits- II normalized		.015***(.003)		.021***(.006)		.022***(.006)		
Bank Deposit Costs normalized	.004*(.002)	.002(.004)	.005*(.003)	.002(.003)	.005*(.003)	.002(.003)	.005*(.003)	.004*(.002)
Real Estate Loans normalized	-.254***(.035)	-.312***(.035)	-.182***(.032)	-.188***(.032)	-.187***(.032)	-.190***(.032)	-.182***(.032)	-.258***(.035)
REPO-OIS Spread	.010***(.001)	.010***(.001)						.000(.001)
Fed Funds Rate	.003***(.000)	.003***(.000)	.006***(.000)	.006***(.000)	.006***(.000)	.006***(.000)	.006***(.000)	.003***(.000)
Real GDP Growth Rate			-.001***(.000)	-.001***(.000)	-.001***(.000)	-.001***(.000)	-.001***(.000)	
Crisis dummy					-.002*(.001)	.000(.001)	.000(.001)	-.004***(.001)
Real Estate Loans normalized*crisis					.008***(.003)			
Bank Deposits- II normalized*crisis						-.011(.007)		
Bank Tier 1 Capital normalized*crisis							-.001***(.000)	
REPO-OIS Spread * crisis								.012***(.001)
Hansen Test-Chi square	89.09	87.48	307.30	315.96	308.03	317.26	308.22	87.49
Prob> Chi-square	.000	.000	.000	.000	.000	.000	.000	.000
AB(1) z	.000	.000	.000	.000	.000	.000	.000	.000
AB(2) z	.028	.005	.350	.303	.415	.353	.422	.017

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. Bank total assets, liquidity and real GDP growth are treated as endogenous in all models. There are 4,982 banks in the sample of small banks defined as those banks with total assets less than U.S. $1 billion as of the beginning of the sample period. There are 95,421 observations in each model run. Models 1 and 2 employ 16 instruments, Models 3, 4, and 8 use 18 instruments while Models 5, 6, and 7 use 20 instruments.

Table 3.9 Dynamic panel models. Dependent variable: Bank lending growth, medium bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Loan growth (1-lag)	.200(.177)	.351*(.190)	.391***(.126)	.371***(.122)	.371***(.126)	.351***(.122)	.369***(.126)	.174(.171)
BankTotal Assets normalized	.016(.020)	.035(.022)	.025(.022)	.043*(.022)	.025(.022)	.041*(.022)	-.024(.022)	.019(.020)
Bank Liquidity-I normalized	-.213**(.094)	-.190*(.106)	-.124(.082)	-.142*(.082)	-.139*(.082)	-.153*(.083)	-.138*(.082)	-.227**(.092)
Bank Tier 1 Capital normalized	-.007***(.001)	-.007***(.001)	-.007***(.001)	-.006***(.001)	-.007***(.001)	-.006***(.001)	-.007***(.001)	-.007***(.001)
Bank Deposits- I normalized	-.230***(.050)		-.238***(.050)		-.237***(.050)		-.237***(.050)	-.227***(.050)
Bank Deposits- II normalized		.021(.053)		.058(.050)		.074(.047)		
Bank Deposit Costs normalized	-1.193***(.458)	-.849***(.296)	-1.096**(.492)	-.886**(.378)	-1.093**(.482)	-.953**(.398)	-1.088**(.480)	-1.170***(.449)
Real Estate Loans normalized	-.148**(.062)	-.099(.066)	-.122*(.065)	-.136**(.062)	-.133**(.064)	-.141**(.060)	-.131**(.064)	-.149**(.063)
REPO-OIS Spread	.015***(.003)	.015***(.004)						.000(.004)
Fed Funds Rate	.004***(.001)	.005***(.001)	.004***(.001)	.004***(.001)	.005***(.001)	.005***(.001)	.005***(.001)	.004***(.001)
Real GDP Growth Rate			-.000(.001)	-.000(.001)	.000(.001)	-.000(.001)	.000(.001)	
Crisis dummy					.004(.005)	.008***(.002)	.008***(.002)	-.002(.005)
Real Estate Loans normalized*crisis					.015(.011)			
Bank Deposits- II normalized*crisis						-.101**(.045)		
Bank Tier 1 Capital normalized*crisis							.000(.000)	
REPO-OIS Spread * crisis								.016***(.006)
Hansen Test-Chi square	12.60	8.38	14.71	1.67	14.02	9.96	14.06	12.90
Prob> Chi-square	.050	.211	.065	.221	.081	.268	.080	.045
AB(1) z	.002	.000	.000	.000	.000	.000	.000	.002
AB(2) z	.884	.115	.248	.286	.285	.329	.287	.958

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. Bank total assets, liquidity and real GDP growth are treated as endogenous in all models. There are 475 banks in the sample of medium banks defined as those banks with total assets ranging between U.S. $1 billion and $20 billion as of the beginning of the sample period. There are 9,353 observations in each model run. Models 1 and 2 employ 16 instruments, Models 3, 4, and 8 use 18 instruments while Models 5, 6, and 7 use 20 instruments.

Table 3.10 Dynamic panel models. Dependent variable: Bank lending growth, large bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Loan growth (1-lag)	.099(.399)	-.149(.762)	-.285(.321)	-.247(.379)	-.178(.286)	-.176(.337)	-.246(.299)	.105(.372)
BankTotal Assets normalized	-.019(.077)	-.062(.140)	-.069(.097)	-.065(.142)	-.056(.098)	-.047(.146)	-.057(.106)	-.018(.074)
Bank Liquidity-I normalized	.529**(.210)	.180(.197)	.450***(.170)	.305(.235)	.455**(.183)	.351(.235)	.443**(.180)	.513**(.209)
Bank Tier 1 Capital normalized	-.012**(.005)	-.008(.005)	-.010***(.004)	-.008**(.003)	-.009**(.004)	-.008**(.003)	-.009**(.004)	-.011**(.005)
Bank Deposits- I normalized	-.171(.216)		-.267(.234)		-.190(.250)		-.198(.246)	-.160(.198)
Bank Deposits- II normalized		-.092(.320)		-.252(.206)		-.139(.208)		
Bank Deposit Costs normalized	1.943(2.062)	1.328(2.750)	1.809(1.778)	1.649(1.864)	1.774(1.837)	1.546(1.996)	1.960(1.847)	1.901(2.044)
Real Estate Loans normalized	.105(.132)	.258(.574)	.147(.101)	.128(.114)	.183(.139)	.146(.126)	.169(.124)	.108(.136)
REPO-OIS Spread	.020(.021)	.021(.029)						.001(.026)
Fed Funds Rate	.007(.005)	.004(.008)	.001(.005)	.001(.006)	.003(.006)	.003(.007)	.003(.005)	.008(.006)
Real GDP Growth Rate			.001(.002)	.001(.002)	.001(.002)	.001(.002)	.001(.002)	
Crisis dummy					.047(.031)	.024(.021)	.025(.020)	.006(.027)
Real Estate Loans normalized*crisis					-.071(.054)			
Bank Deposits- II normalized*crisis						-.173(.146)		
Bank Tier 1 Capital normalized*crisis							-.002(.002)	
REPO-OIS Spread * crisis								.015(.031)
Hansen Test-Chi square	2.12	2.22	3.41	4.84	4.32	5.27	3.98	2.07
AB(1) z	.156	.581	.317	.367	.168	.243	.237	.131
AB(2) z	.805	.897	.411	.584	.636	.694	.472	.750

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. Bank total assets, liquidity and real GDP growth are treated as endogenous in all models. There are 34 banks in the sample of large banks defined as those banks with total assets ranging between U.S. $20 billion and $90 billion as of the beginning of the sample period. There are 650 observations in each model run. Models 1 and 2 employ 16 instruments, Models 3, 4, and 8 use 18 instruments while Models 5, 6,and 7 use 20 instruments.

Table 3.11 Dynamic panel models. Dependent variable: Bank lending growth, money center bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Loan growth (1-lag)	-.474(.612)	-.523**(.252)	-.643(.502)	-.532(.359)	-.727(.807)	-.751(.601)	-.608(.470)	-.628(.873)
BankTotal Assets normalized	.044(.051)	.075*(.041)	.015(.058)	.153(.280)	-.023(.104)	.020(.123)	.038(.471)	.001(.068)
Bank Liquidity-I normalized	1.058(1.553)	-.167(.565)	1.992(2.276)	-.746(1.974)	2.008(2.781)	-.355(1.090)	.092(1.762)	1.366(2.152)
Bank Tier 1 Capital normalized	-.023(.026)	-.004(.014)	-.019(.027)	.001(.018)	-.024(.042)	-.010(.045)	-.011(.035)	-.032(.044)
Bank Deposits- I normalized	.849(.757)		2.242(1.567)		2.289(1.908)		.798(.628)	1.161(1.377)
Bank Deposits- II normalized		.253(.926)		1.200(.817)		3.459(13.039)		
Bank Deposit Costs normalized	8.473(25.970)	-7.296(18.048)	-5.615(2.321)	-8.702(26.791)	-2.496(43.049)	-4.012(32.656)	.531(23.269)	16.462(36.878)
Real Estate Loans normalized	.510(.323)	.295(.214)	.383(.248)	.150(.586)	.429(.415)	.334(.580)	.422(.531)	.647(.452)
REPO-OIS Spread	-.023(.040)	-.031(.029)						-.003(.032)
Fed Funds Rate	-.009**(.004)	-.009*(.005)	-.002(.010)	.002(.007)	.002(.011)	.006(.008)	-.003(.008)	-.005(.006)
Real GDP Growth Rate			-.002(.003)	-.002(.002)	-.003(.003)	-.003(.002)	-.001(.002)	
Crisis dummy					-.091(.230)	.036(.032)	.039(.037)	.057***(.022)
Real Estate Loans normalized*crisis					.380(.708)			
Bank Deposits- II normalized*crisis						-1.780(7.495)		
Bank Tier 1 Capital normalized*crisis							-.003(.045)	
REPO-OIS Spread * crisis								-.019(.058)
Hansen Test-Chi square	1.12	1.94	2.35	6.22	2.60	6.33	2.66	1.43
AB(1) z	.742	.433	.866	.462	.972	.914	.790	.691
AB(2) z	.490	.387	.020	.389	.153	.553	.389	.471

Sample period 2005Q1-2010Q4. The dependent variable net loans and leases, and bank total assets enter the models in log form. The liquidity and bank deposit measures are scaled by bank total assets while the residential real estate loan variable is scaled by bank total loans. Liquidity I includes cash in banks and securities held to maturity and available for sale. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. Bank total assets, liquidity and real GDP growth are treated as endogenous in all models. There are 14 banks in the sample of money center banks defined as those banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. There are 267 observations in each model run. Models 1 and 2 employ 16 instruments, Models 3, 4, and 8 use 18 instruments while Models 5, 6, and 7 use 20 instruments.

CHAPTER IV

THE IMPACT OF GOVERNMENT INTERVENTION ON THE STABILIZATION OF DOMESTIC FINANCIAL MARKETS AND ON U.S. BANKS' ASSET COMPOSITION

4.1 Introduction

The 2007-2009 financial crisis that spawned from various factors such as the housing boom, aggressive mortgage lending activity, financial innovation through the creation of new funding products, and an increased access to money and capital markets culminated with an unprecedented U.S. government intervention in the financial sector. Cecchetii (2009) and others claim that by the summer of 2007 it was clear that banks and other financial institutions stood to lose billions of dollars from their exposure to subprime mortgage loans. In the advent of the housing boom, Watson (2008) mentions that riskier loans to less creditworthy borrowers became common and thus the market of potential borrowers had expanded beyond traditional bounds using a variety of non-traditional mortgage contracts. The aforementioned author claims that the development that had a strong impact on the credit problems during the financial crisis was the funding of uninsured mortgage credit to borrowers whose credit history prevented them from obtaining conventional loans. Many researchers argue that the housing finance model was predicated on rising real estate prices. After several years of double-digit increases, fueled in large part by real estate investor purchases rather than homeowner purchases, the market appreciably softened. Factors that contributed to the weakening of the housing market included rising interest rates between 2003 and 2006 and a reduced pool of

qualified homeowners. The impact of rising house prices had two effects. It reduced the pool of qualified homeowners and created a buyers market comprised of less-creditworthy households and investors that could only justify their purchases with profit forecasts based on high mortgage leverage, financing terms with escalating repayment schedules and the expectation of quick resale at a higher price.

The ensuing bust in the housing market impacted the financial markets since falling house prices contributed to rising mortgage loan delinquencies and an increase in home foreclosures. The growing uncertainty with respect to the value of banks' balance sheets was at the core of the financial crisis and was captured by sharp increases in money market rates. The rising uncertainty as to the value of banks' balance sheets prompted banks to hoard cash as they became concerned about their continued ability to tap into the capital markets to cover funding requirements. Rising liquidity constraints that initially arose in the interbank markets and perceived increases in counterparty risk eventually led to an overall disruption in the capital markets. With the financial system on the verge of collapse as a result of the spillover effects from the housing bust, and given the threat of a sharp contraction in credit and bank lending, it was clear that government intervention would soon emerge. Given the weak response to the Fed's monetary policy actions that involved reductions in target and primary lending rates, the Fed experimented with innovative short term bank lending programs designed to inject liquidity into the financial system. Other important government-led efforts include debt and deposit guarantees, large scale asset purchases, and direct assistance through the U.S. Treasury's Troubled Asset Relief (TARP) and Capital Purchase (CPP) programs. The purpose of these programs was to stabilize the ailing financial system and to restore investor confidence.

An interesting area of research that has received some attention is the U.S. government's intervention in response to the 2007-2009 financial crisis. Some researchers focus on the effectiveness (or lack thereof) of the Fed's short term lending programs (e.g. Taylor and Williams (2009), and Cecchetti (2009) among others), while others examine the impact of the government bailout programs on bank lending (e.g. Li (2010), Ivashina and Scharfstein (2010) and Egly and Mollick (2013)). Other researchers explore the impact of the government intervention on the stock market and overall investor confidence (e.g. Subrahmanyam et al. (2011) and Huerta et al. (2011), among others). To gain an overall economic perspective of the government intervention, Veronesi and Zingales (2010) calculate the costs (i.e. cost to tax-payers) and benefits (i.e. increased value of banks' financial claims) of the government bailout and determine that it was an overall success. These authors contend that from an economic viewpoint the government intervention created value by preventing a run on banks and by providing capital that reduces banks inefficiencies related to excessive leverage which in turn impacts the banks' ability to exploit future investment opportunities. With the exception of the work of Ivashina and Scharfstein (2010), none of the referenced papers focus on the impact of the government intervention on federally insured commercial banks balance sheet composition. Moreover, Ivashina and Scharfstein (2010) examine bank lending during the crisis with a focus on loan level data on syndicated transactions. These authors conclude that the stress placed on liquidity from draw downs under existing credit commitments and the run by short-term bank creditors led to an overall reduction in bank lending.

This essay expands the literature by investigating whether there are changes in commercial banks' balance sheet composition that are associated with the government intervention whose objective was to stabilize the financial system. This essay investigates the following research

questions: 1) What was the impact of the government intervention on bank liquidity? 2) Has the proportion of residential real estate loans with respect to the total bank loan portfolios reverted to pre-crisis levels? 3) Have new differences emerged in balance sheet composition between large banks and small banks as a result of the government intervention? Examining the liquidity behavior of banks is interesting given the recent environment of expansionary U.S. monetary policy. The Fed's unprecedented expansion of its balance sheet as a result of multiple rounds of quantitative easing (QE) beginning in late 2008 have led to massive increases in liquidity in the financial system that to a large extent is held by banks. The U.S. Government intervention offers a unique opportunity to explore changes in bank behavior that are manifested through their balance sheets. Researchers including Cornett et al. (2011) suggest that in times of crisis, banks tend to build up liquidity reserves as part of an overall strategy to manage liquidity risk which in turn may stem from multiple channels including exposure to unfunded loan commitments, withdrawal of wholesale deposits, or the loss of other sources of short term financing (i.e. debt rollover risk). This research is of interest to economic policy makers, regulators, bank managers and the investor public. As noted by He et al. (2010), there has been a massive restructuring of the financial sector balance sheets since late 2007. These authors claim that between 2007Q4 and 2009Q1 commercial bank holdings of securitized assets increased by approximately U.S. $550 billion while holdings of these asset types by hedge funds and broker/dealers decreased by roughly U.S. $800 billion. On the liability side of the balance sheet, the repo finance market declines by roughly U.S. $ 1.5 trillion whereas government backed debt issued by the banking sector, including FDIC insured deposits and FDIC guaranteed bonds, increases by approximately U.S. $1.3 trillion. These authors claim that the balance sheet restructuring is driven by

weakening financing conditions in debt and equity markets during the crisis as well as the loss of liquidity in the secondary markets for many asset classes.

This essay contributes to the literature in several distinct ways. First, this essay examines bank behavior capturing periods of economic expansion, the financial crisis, and post crisis periods. The work by He et al. (2010) that uses quarterly data spanning from 2007Q4 to 2009Q1 serves to motivate this essay. Yet this essay differs from their work in several ways. This essay focuses on the behavior of commercial banks while their work covers a broader base of the financial sector that includes hedge funds and broker/dealers, insurance companies, commercial banks, and the government. A deeper understanding of commercial bank behavior is driven by their role in stimulating business and economic activity. He et al. (2010) investigate balance sheet adjustments with respect to asset and mortgage backed securities attempting to track how these assets have shifted across the institutions. This essay examines changes in balance sheet composition of commercial banks from a wider view examining various asset categories that exhibit varying degrees of liquidity. Second, this essay examines how crisis theories on financial intermediation that are based on leverage and equity risk-capital constraints apply to the commercial banking sector acknowledging beforehand that many of these theories are focused on the investment banking sector. Third, the liquidity models presented in this essay that control for the Fed's expansion of its balance sheet through quantitative easing (QE) incorporate a macro perspective view on bank liquidity building. It is important to account for the impact of QE that began in late 2008 since it led to massive increases in liquidity in the financial system that ended up on bank balance sheets. Fourth, matching CPP banks with non-CPP banks on balance sheet characteristics provides an opportunity to examine whether distinct behavior patterns have emerge between the banks on various dimensions. It is noted that most of the research on the

effectiveness of the CPP has been directed towards bank lending. Revisiting the impact of the CPP long after its implementation in 2008 remains an interesting topic given the extensive debate that this program was subjected to. This essay explores whether banks have stabilized to pre-crisis levels and if there has been any permanent changes in banks asset composition in the post crisis period resulting from the impact of government intervention.

4.2 Data

The sample for this essay is taken from the population of commercial banks that are insured through the Federal Deposit Insurance Corporation (FDIC) over the sample time frame 2005Q1 to 2010Q4. The bank information is originally compiled in Consolidated Reports of Condition "call reports" that are submitted by insured banks on a quarterly frequency. Banks prepare and submit their call reports on Federal Financial Institutions Examination Council (FFIEC) forms FFIEC-031 or FFIEC-041. Banks choose the appropriate FFIEC form that is based on the bank's geographic scope of business (i.e. domestic offices only FFIEC-041 or domestic and foreign offices FFIEC-031). The bank data used for this essay are available through Federal Deposit Insurance Corporation (FDICs) statistics on depository institutions (SDI) data base at the following website (http://www2.fdic.gov/sdi/index.asp, last accessed on 8/15/2012).

This essay works with bank-level data and in the case of multibank holding companies (BHC) data only from the lead bank is retained. In many instances the lead bank commonly represents over 80% of the total insured assets reported by the BHC[14]. Banks with missing balance sheet and/or income information required for this study will be excluded from the sample. This essay applies several qualifiers to the population of commercial banks to minimize

[14] To investigate the presence of multibank holding companies (MBH), I extracted a list of the largest 150 financial institutions as of the beginning of the sample. I matched each of these institutions against the FDIC website to determine if they were MBH. The number of banks excluded that formed part of a MBH represent less the 2% of the total sample (lead banks of MBH were retained for this study).

the impact of outliers[15]. By applying the various qualifiers to the population of FDIC insured commercial banks, the full sample contains 126,234 bank quarters that covers a sample period from 2005Q1 to 2010Q4. This filtering process removed 63,629 bank quarter observations from the initial data set. To explore behavior patterns of the commercial banks, the resulting sample is decomposed into various subsample classifications following Verma and Jackson (2008). More specifically, the bank sample is divided into divided into four groups based on average total asset size as follows: small banks (average total assets < U.S. $1 billion), medium banks (average total assets > U.S. $1 billion and < U.S. $20 billion), large banks (average total assets > U.S. $20 billion and < U.S. $90 billion) and money center banks (average total assets > U.S. $90 billion). The bank information used in this essay includes loan balances on various loan categories (e.g. total loans and residential real-estate loans), total assets, balance sheet liquidity measures (e.g. securities held to maturity, securities available for sale, and cash and balances due), Tier 1 risk-based capital ratio, commercial letters of credit, non-performing loans (e.g. includes loans and leases 90 days or more past due plus non-accrual loans), two bank deposit measures (e.g. total deposits that include demand deposits, money market accounts, savings accounts and time deposits and transaction deposits that include demand deposits and NOW accounts), costs of deposits (e.g. interest expense on deposits to total deposits) and net operating income. Appendix B provides further description of the bank variables employed in this essay.

The macro variable I employ in the liquidity models presented in this essay consists of a repo spread measured as the difference between the 90 day repo rate for a given bond class and the Overnight Index Swap (OIS) series over the sample period. The collateral for the repo-OIS series consists of real estate mortgage backed securities. Gorton and Metrick (2010) find that

[15] Refer to data section of essay I where the qualifiers have been explained in detail.

increases in repo spreads during the crisis signaled concern with respect to counterparty risk. These authors further explain that the location and size of subprime risks held by the counterparties in the repo market were unknown which led to fear that liquidity would dry up for collateral in all asset classes. On this basis it is reasonable that such concerns would lead banks to reassess their liquidity strategies. The repo spread series are downloadable from Bloomberg's data base (http://www.bloomberg.com, last accessed on 8/15/12).

Table 4.1 Panels A through D depict contemporaneous bivariate correlations for the independent bank variables, the macro variable that is used in the liquidity models for the four subsamples of banks and a quantitative easing (QE) indicator variable that is assigned a value of one during the Fed's initial round of quantitative easing from 2008Q4 to 2010Q1 and zero otherwise. An examination of Table 4.1 shows that bank behavior varies across the samples. To illustrate this point, there is a positive yet modest correlation between bank total assets (lta) and bank loans (loans) of 0.080 for small banks (see Panel A) that turns to a negative -0.091 and -0.076 in the medium and large bank sample cases (refer to Panels B and C) that further decreases to -0.430 in the money center bank case (see Panel D). The fairly strong negative co-movement between bank loans and total assets in the money center bank sample suggests that increases in the loan portfolio are not accompanied by a contemporaneous increase in bank balance sheet assets. The negative correlation may capture the money center banks ability (and use of) off balance activities associated with the securitization process that effectively allowed the banks to remove loans (and the risk associated with these loans) from their balance sheets. Another interesting relationship exists between net operating income (nop) and bank tier 1 capital ratio (capt1r) which is positive ranging from 0.045 for the large banks in Panel C to 0.183 for the medium banks in Panel B turning negative at -0.220 only in the money center bank sample case

in Panel D. The negative correlation suggests that increases in net operating profits are met with a concurrent decrease in bank's capital ratio possibly associated with the effects weaken balance sheets and or dividend distributions that are common among money center banks.

The relationship between commercial letters of credit (lc) and bank loans (loans) seems stronger as we move from the small bank sample towards the larger bank samples while turning negative in the money center bank sample case. The correlations are 0.039, 0.080, 0.245, and -0.596 in Panels A, B, C, and D accordingly. It is equally interesting that bank loans and letters of credit seem to serve as complementary products in the large bank sample case (i.e. positive co-movement) yet appear to behave as substitutes in the money center bank sample (i.e. negative co-movement). There is a moderate negative relationship between non-performing loans (npl) and net operating income (nop) ranging from ranging from -0.379 for the large banks in Panel C to -0.499 for the small banks in Panel A. This finding is somewhat intuitive since it is plausible that an increase in non-performing loans may be potentially offset with a contemporaneous decrease in bank operating net income. With the exception of the high positive correlation of 0.636 between deposits I and II in the small bank sample, the high positive correlation of 0.676 between deposits I and loans in money center bank sample, the negative correlations of -0.596 and -0.764 that associate commercial letters of credit with loans and deposits I accordingly in the money center bank sample, and the positive correlation of 0.578 between QE and non-performing loans in the money center bank sample, all other correlations are either low or moderate as seen in Panels A through D in Table 4.1. The low to moderate correlations help mitigate any potential collinearity issues that could impact the liquidity models noting that in no model do I allow for the aforementioned highly correlated variables to jointly enter a single model simultaneously.

To gain some insight into the research questions posed in the introduction section that are designed to explore changes in bank balance sheet composition resulting from the government intervention, this essay presents a comparative analysis of bank behavior based on sample size over the sample period. In order to accentuate differences in bank behavior the analysis begins by contrasting the small bank sample with the money center bank sample and follows with further analysis that focuses on the medium and large bank samples. The analysis renders some interesting results. Figure 4.1 shows the trend in average total bank loan balances and the ratio of total bank loan balances to total average assets for the small bank sample (average total assets < U.S. $1 billion) over the period from 2005Q1 to 2010Q4 while Figure 4.2 depicts the same trend information for the money center banks (average total assets > U.S. $90 billion). The trends in average total bank loan balances reveal somewhat similar patterns for both samples up through the end of the crisis period albeit with greater volatility exhibited in the money center bank sample case. For the remainder of the sample period average total bank loan balances seem to flatten out in the small bank sample case yet remain volatile with a general continued upward trend in the case of the money center bank sample. In the case of the small banks, the pattern in the loan balances may be a reflection of the continued, yet modestly improved, state of the economy and the cautionary stance of small businesses given the continued uncertainty regarding the economic outlook. The slight downward trend in the ratio of total bank loan balances to total average assets particularly in the post crisis period are very similar for both the small and money center bank samples. The trends in these two series would suggest continued liquidity hoarding by the small banks that arguably have lesser access to capital markets and other external funding sources and as well as continued liquidity building being pursued by the money center banks.

Figures 4.3 and 4.4 show the trends in average total bank loan balances and the ratio of total bank loan balances to total average assets for the medium bank and large bank samples respectively. The trends for the medium bank sample reflected in Figure 4.3 closely resemble those of the small bank sample while those of large bank sample shown in Figure 4.4 seem to follow the trends of the money center bank sample albeit with less volatility. It is also noted that in the post crisis period the ratio of total bank loan balances to total average assets has held fairly steady in the case of the large banks while the money center banks have experience a continuous decline in their loan portfolios scaled by total average balance sheet holdings. In the medium and large bank samples cases it is noted that loan portfolios scaled by total average balance sheet holdings during the post crisis period are below the loan portfolio exposures that were carried in the pre-crisis period. This finding is also reflected in the small and money center bank samples as seen in Figures 4.1 and 4.2 accordingly.

Figures 4.5 and 4.6 depict the trend in the proportion of the residential real estate portfolio with respect to average total bank loan balances outstanding for small bank and money center banks respectively for the sample period from 2005Q1 to 2010Q4. In both bank samples, the residential real estate portfolio seems to hold fairly steady hovering at approximately 35% of the average total bank loan balances. Visual inspection of Figure 4.6 suggests that the money center banks residential real estate (R/E) loan portfolio exposure has reverted to pre-crisis levels while the small bank sample residential R/E loan portfolio exposure has remained stable throughout the entire sample period. Figure 4.7 that depicts the trend line for the residential real estate portfolio for the medium bank sample mirrors the trend line for the small bank sample shown in Figure 4.5. Figure 4.8 shows the trend for the residential R/E loan portfolio exposure for the large bank

sample and reveals a slight upward trend in the post crisis period suggesting that the large banks in fact have increased their exposure beyond pre-crisis levels.

Given the stability exhibited in the residential real estate portfolio, the decline in the proportion of the total loan portfolios with respect to total average assets in the post crisis period for the small banks as shown in Figure 4.1 would seem to be traced to other loan portfolio segments such as commercial and industrial (C&I) loans. While the money center banks experience a comparable decline in the post crisis period as seen in Figure 4.2, the decline in the small bank sample case may be attributed to differences in the scope of business activities performed by small versus money center banks. Small banks tend to focus on retail activities and typically support depository and borrowing needs of smaller businesses while large banks tend to lend to larger corporations. In contrast, large banks engage in both retail and wholesale banking and often concentrate on the wholesale side of the business. In their study on the cyclical behavior of large versus small manufacturing firms in response to monetary policy shocks, Gertler and Gilchrist (1994) conclude that small firms tend to shed inventories at a rapid pace during an economic slowdown while large firms initially borrow to build up inventories. These authors also point out that short term borrowing closely follows a similar pattern to that shown in the inventory trends. Under the premise that small banks focus on retail customers and accommodate mainly the small business sector, the results reflected in Figure 4.1 provide support to the findings by Gertler and Gilchrist (1994).

Figure 4.9 shows the trend in average liquid assets and the ratio of liquid assets to total average assets for the small bank sample over the period from 2005Q1 to 2010Q4. Figure 4.10 reflects the same liquidity measures for the money center banks. The liquidity measure includes cash and balances due from depository institutions, securities available for sale and securities

held to maturity. The liquidity trends seem compatible with the loan trends in that these two core components of bank assets are usually strongly linked. Loutskina (2011) claims that a decrease in liquid funds normally leads to an offsetting increase in lending. The higher proportion of liquidity holdings by the small banks compared to the money center banks is consistent with view that small banks have lesser access to capital markets and other external funding sources. In the case of the small bank sample as shown in Figure 4.9 liquidity holdings in terms of dollars and as a proportion of the overall bank balance sheet continue on the rise well into the post crisis period. At 2010Q4 average bank liquidity holdings are recorded at their highest levels in terms of dollars and balance sheet proportions over the sample period from 2005Q1 to 2010Q4 for the small bank sample. The liquidity trends under both measures during and after the crisis period for the most part have been rising at a faster pace in the money center bank sample case as depicted in Figure 4.10. Similar trends are noted for both the medium and large bank samples as shown in Figures 4.11 and 4.12 respectively.

In sum, the balance sheet composition for banks in general has shifted towards greater liquidity in the post crisis period with the shift being more discernible for the larger bank samples over the entire sample period. The residential real estate portfolio exposure has reverted to pre-crisis levels in the case of the money center bank sample and has remained fairly consistent throughout the sample period in all other bank samples with a modest rise noted in the post crisis period in the large bank sample case. Overall bank loan portfolios scaled by total average balance sheet holdings seem to have trended downward during the post crisis period with the exception of the large bank sample where post crisis exposures have held fairly steady.

4.3 Methodology

This essay focuses on examining changes in banks balance composition resulting from the U.S. Government intervention aimed to stabilize the financial domestic markets that were disrupted during the 2007-2009 financial crisis. More specifically, this essay focuses on the behavior of banks' primary earning assets, namely liquid assets and loans. Based on the co-existing relationship between deposit taking and lending behavior as documented by Kashyap et al. (2002), Gatev et al. (2009) and Cornett et al. (2011), among others, this essay presents a liquidity model that accounts for the important synergies that arise from these two basic traditional banking activities (i.e. lending and deposit-taking). In addition to bank deposits and loans, the model incorporates various control variables including bank-specific variables measuring asset size, bank capitalization, deposit costs, non-performing loans, net operating income, and commercial letters of credit as described in the preceding Data Section. The bank-control variables such as assets, capitalization, and deposit costs are commonly viewed as supply-side constraints in liquidity models (see Cornett et al. (2011) and Loutskina (2011), among others). Since it is well known that bank liquidity is further impacted by loan portfolio performance, I control for this behavior through the non-performing loans variable in my liquidity model. The net operating income variable is intended to capture the banks access to additional internal sources of funds while the commercial letters of credit variable proxies as a measure of banks' ability to raise funds externally (i.e. bank reputation). This essay also includes the repo spread as a macro variable to capture the liquidity crunch that prevailed during the crisis[16]. Gorton and Metrick (2010) point out that during the crisis both repo spreads and repo

[16] Cornett et al (2011) employ a TED spread in their lending and liquidity models. The correlation between the TED spread and the repo-OIS spread is 0.909 that is computed over the sample period of this study which covers from 2005Q1to2010Q4.

haircuts rose with such increases correlated with concerns about counterparty risk or uncertainty about collateral values. This essay proposes dynamic panel estimation to model bank liquidity behavior that is similar to the static specification presented by Loutskina (2011). The model is expressed as follows:

$$\Delta Liq_{i.t} = \beta_{i,0} + \beta_1 \Delta Liq_{i,t-1} + \beta_2 bk_{i,t} + \beta_3 macro_t + \beta_4 QE_t + \varepsilon_{i,t} \quad (1)$$

where the Δ prefix represents the change of the bank liquidity variable *Liq* which is expressed in log form and includes cash in banks and securities held to maturity and available for sale; *bk* represents a vector of bank-specific variables that include total assets (TA) expressed in log from, loans (loans) scaled by total assets, capitalization (capt1r) measured as the Tier 1 risk-based capital ratio, two deposit measures (Dep I and Dep II) that are scaled by total assets with Deposit I consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits and Deposit II capturing demand deposits and NOW accounts that are collectively considered transaction deposits, cost of deposits (depcost) defined as the ratio of interest expense on deposits to total deposits, non-performing loans (npl) scaled by bank loans, net operating income (nop) scaled by total assets, and commercial letters of credit (lc) scaled by total assets; *macro* represents the economic variable proxied by the repo-OIS spread; and *QE* is an indicator variable to capture the impact of the Fed's initial round of quantitative easing. As in the case of the model specifications presented in Essay I, the bank variables are normalized with respect to their average across all banks in a given sample similar to the specification used by Matousek and Sarantis (2009).

Equation 1 is related to the static model introduced by Loutskina (2011) with some distinct differences in this essay. First, the above specification introduces a macro variable (i.e. the repo-OIS spread) into the model that allows this essay to account for the liquidity crunch and the

perceived increased credit and counterparty risk that prevailed during the crisis. Commercial banks were exposed to funding liquidity risk concurrent with the development of the shadow banking system. The banks ran the risk that investors might (and did) cut back from buying asset-backed commercial paper which would place significant pressure on the operations of bank related special purpose vehicles (SPVs) that relied on this form of short-tem financing. The argument is that tight liquidity conditions captured through increases in the repo-OIS spread impact bank liquidity risk management strategies. For example, banks with high liquidity risk exposure would be expected to raise cash and other liquid investments (and possibly curb new lending) more than banks with low liquidity risk exposure when the repo-OIS spread spikes. Second, given that liquidity risk management is a dynamic process impacted by lending commitments, bank loan portfolio conditions, demand deposit claims, access to (and conditions of) capital and money markets and other internal and external factors this essay employs a dynamic approach to model liquidity behavior as will be detailed below. Third, unlike Loutskina (2011) this essay incorporates a quantitative easing (QE) dummy variable under alternative specifications to specifically control for the effects of the initial round of quantitative easing on bank liquidity behavior[17].

This essay employs dynamic panel methods and system GMM (SGMM) to estimate the model as proposed by Blundell and Bond (1998)[18]. Using dynamic panel methods the first difference removes bank specific effects and time-invariant explanatory variables. The SGMM technique employed in this essay uses the two-step estimator. In broad terms, lagged levels of

[17] Since the Fed's initial round of quantitative easing ran from November 2008 to April 2010, I create a dummy variable QE that takes the value of "1" from 2008Q4 to 2010Q1 and "0" otherwise. I do not control for the second round of quantitative easing that covers the period from November 2010 to June 2011 (or subsequent rounds of QE) since my sample period ends in December 2010.

[18] I also run the regressions using difference GMM (DGMM) as proposed by Arellano and Bond (1991) and the central findings of this essay remain qualitatively unchanged.

right hand side variables (RHS) serve as instruments for the differenced equation while lagged differences of right hand side variables serve as instruments for the equation in levels under SGMM specifications. The SGMM estimator is able to exploit the time-series attributes of the data, allows for the inclusion of lagged dependent variables as regressors and is capable of addressing endogeneity. As pointed out by Altunbas et al. (2009), GMM estimators ensure efficiency and consistency contingent on the absence of second order serial correlation and the validity of the instruments.

In this study the potential for endogeneity of bank liquidity with model regressors including bank loans is present. For example, we encounter endogeneity bias between balance sheet liquidity and bank lending since banks have managerial discretion to choose liquidity levels and lending jointly. Banks need to choose on optimal level of liquid assets to meet demands from depositors and borrowers. A bank management perceived increase in liquidity risk exposure could curtail new bank lending activity. Another example of endogeneity bias may arise between balance sheet liquidity and bank total assets. An increase in liquidity funded through an increase in deposits or other external liabilities, *ceteris paribus*, would lead to an increase in bank total assets. Changes in management driven liquidity strategies may also have an effect on bank total assets for the simple reason that liquid holdings from an accounting perspective are included in banks' total assets. Based on this line of thinking in this essay I take bank total assets and loans as endogenous variables for modeling purposes.

This essay employs several specifications based on the benchmark model. First, as previously mentioned, following Verma and Jackson (2008) the bank sample is divided into four asset size classes to discern whether bank behavior patterns that are manifested through the banks' balance sheet impact liquidity differently. Second, given the high correlation of 0.636 between deposits I

and II in the small bank sample case; and in the money bank sample case, the correlation of 0.676 between deposits I and loans, the correlations of -0.596 and -0.764 that associate commercial letters of credit with loans and deposits I respectively, I alternate between highly correlated variables under separate specifications that model bank liquidity behavior. In no model do I allow for the aforementioned highly correlated variables reported in Table 4.1 to jointly enter a single model simultaneously. Third, this essay allows for the interaction between an indicator variable identified as *Quantitative Easing* to capture the indirect impact of the Fed's initial round of quantitative easing on liquidity through bank lending. This essay also explores the interaction between bank loans and the repo-OIS spread. The *Quantitative Easing* (QE) dummy variable is assigned a value of one during the initial round of QE period from 2008Q4 to 2010Q1 and zero otherwise. The purpose behind the interaction terms is to determine whether the substantial influx of liquidity into the financial system, captured through the QE indicator variable, and the effects of the crisis, measured through the repo-OIS spread operate through bank loans. For example, banks with high credit risk exposure in their loan portfolios would be expected to hoard more cash (i.e. high liquidity risk exposure) compared to banks with lower credit risk exposure in their loan portfolios during the crisis period when the repo-OIS spread rises.

Since the Sargan test on the validity of over-identifying restrictions is not robust to heteroskedasticity or autocorrelation in the error terms, for model diagnostic purposes I choose to apply and report the Hansen J statistic which is a well-accepted standard specification check used with two-step SGMM which I employ in this essay. Roodman (2009) explains that the J-test is usually and reasonably thought of as a test of instrument validity but that it can also be viewed as a test of structural specification. While the Hansen test is robust to the presence of

heteroskedasticity and autocorrelation it is usually weakened in the presence of a high instrument count the latter which is not a matter of concern in my specifications. Using system GMM (SGMM) estimation between 12 to 20 instruments are generated depending on the model specification after imposing restrictions on the instrument matrix[19].

To further assess the short and medium term impact of the government intervention on bank balance sheet composition, this essay applies a parsimonious match sample process that is similar to the approach used by Harris et al.(2013) who examine the impact of the U.S. government's Troubled Asset Relief Program (TARP) capital injections on bank efficiency. First I match the CPP bank recipients listed on the July 27, 2012 TARP transaction report that is available from the U.S. Treasury Department's Office of Financial Stability website (http://financialstability.gov, last accessed on 8/15/2012) to my previously described bank sample. Under the Capital Purchase Program the U.S. Treasury provided U.S. $205 billion in capital to 707 institutions with the final investment under the program made in December 2009. Through this initial step I identify 501 banks in my sample that are CPP bank recipients. Unlike Harris et al. (2013) who match TARP with non-TARP banks on the basis market capitalization and book-to-market ratio this essay matches TARP with non-TARP banks on the basis of total assets, capitalization (measured through the Tier 1 risk-based capital ratio) and liquidity (defined as the sum of cash in banks and securities held to maturity and available for sale scaled by total assets). The matching criteria used in this essay are common in the banking literature (see Kashyap and Stein (2000) and Kishan and Opiela (2000), among others). To illustrate, Kishan

[19] The SGMM estimation was performed on STATA software using xtabond2 program code written by Roodman (2006). Under this program code, "gmmstyle" variable list includes endogenous variables while "ivstyle" variable list includes exogeneous variables. In my model gmmstyle variables include: bank total assets and loans. All other model variables are ivstyle variables. The collapse command restricts the number of instruments created in a manner that a single instrument is created for each variable and lag distance rather than an instrument being created for each time period, variable and lag distance.

and Opiela (2000) find that small, poorly capitalized banks may not be able to offset a drain in core deposits, due to a contractionary monetary policy, by offering large time deposits to support continued lending. The difference in matching criteria between this essay and Harris et al. (2013) is explained by the nature of the samples employed in that this essay includes both privately owned and publicly traded banks (i.e. 489 TARP recipients) while Harris et al. (2013) includes only publicly traded banks (i.e. 227 TARP recipient banks). It is noted that both Harris et al. (2013) and this essay exclude investment banks since these banks are usually not considered traditional lending and depository institutions. Investment banks are commonly identified as institutions that service a narrower yet sophisticated and high dollar client base and therefore their exclusion allows us to remain within the general scope of this essay.

Expanding the TARP recipient sample (and by extension the corresponding match sample) to include privately held banks in this essay is appealing on several counts. First, it allows for a better representation of the U.S. financial system that is predominately comprised of small privately owned banks[20]. Second, expanding the sample to include both publicly traded and privately owned bank allows us to capture large and small banks which provides for increased sample heterogeneity. This is important since this essay (and essay one) suggests that the behavior of large and small banks differs on many dimensions including lending and liquidity activities. Third, it remains challenging from a practical viewpoint (although adequately explained in Harris et al. (2013) from a methodological perspective) how a viable match is obtained for the largest banks that were TARP recipients since there are no obvious non-TARP

[20] See Table 1 in essay one that provides a distribution of banks by quarter based on total assets between 2005Q1through 2010Q4. Large (small) banks are those whose total assets exceed (fall) below U.S. $500 million as of the end of the quarter. A similar table that describes quarterly bank distribution over a similar time frame with a different asset cut off (total assets of U.S. $1 billion) is available in Cornett et al. (2011) which leads to the same conclusion.

banks in terms of size, scope and structure to compare to (see Li (2010) and Egly and Mollick (2013)).

In the next step of the matching process I identify 10 non-TARP banks whose total assets are the closest to the TARP bank's total assets as of the quarter in which the TARP bank received the funds. Using this process five of the non-TARP banks have assets above the TARP bank total assets while the other five have assets below the TARP bank total assets. Once the 10 non-TARP banks have been identified I compute the absolute difference between the Tier 1 risk based capital ratio for each non-TARP bank and the TARP bank's Tier 1 risk based capital ratio. These absolute differences are ranked from smallest to largest in which case I choose to retain the six smallest differences that I use in the final matching phase. In the final step, I compute the absolute differences on the liquidity variable for the remaining six banks selecting the non-TARP bank with the smallest absolute difference on this measure as the match[21]. The matched banks are observed for a consecutive four quarter period[22] (i.e. 4 quarter pre-TARP distribution period followed by a 4 quarter post-TARP distribution period) and paired T tests are performed on the differences in balance sheet composition (i.e. namely bank loans, loan quality, liquidity, and Tier 1 risk based capital ratio) and on bank performance to determine whether the mean differences are statistically different from zero.

[21] The matching process did not locate a suitable match for the 12 largest banks. Therefore, in following with Li (2010) I exclude from the matching process these 12 large banks that were TARP recipients. It was widely acknowledged that the U.S. Treasury would be unlikely to allow the largest U.S. banks to fail due to the potential impact of systemic risk. To avoid signaling that specific major large banks were weaker than others, the U.S Treasury made capital injections into all top 20 of the largest U.S. banks under TARP. The 12 banks include: J.P Morgan Chase, Key Corp, PNC Group, Bank of America, BB&T Corp, US Bancorp, Wells Fargo, Sun Trust Banks, Citigroup, Capital One, Regions Bank and Bank of New York. The final sample size for the matching exercise resulted in 489 TARP/CPP recipient banks.

[22] The pre-and post-TARP distribution time horizon seems adequate since it should account for any seasonally that the banks may be exposed to while still remaining within range from the TARP distribution event. Harris et al (2013) use a 6 quarter consecutive period in their study and run robustness tests with a 4 quarter period attaining similar results.

4.4 Hypothesis

This essay puts forth two testable hypotheses dealing with the impact of the government intervention on the stabilization of the domestic financial markets, particularly on U.S. banks' asset composition and performance. From an economic perspective the success of the government intervention has been established by Veronesi and Zingales (2010). These authors contend that the intervention created value by averting a run on the banks and by furnishing capital that reduced bank inefficiencies with regards to excessive leverage that impeded the banks' ability to exploit future viable investment opportunities. The Fed's intervention through quantitative easing also had a substantial impact on banks' balance sheets as demand deposits, small time and saving deposits increased by some estimated U.S. $800 billion between 2007Q4 and 2009Q1 according to He et al. (2010). During this time frame, these authors suggest that commercial banks and the government were net purchasers of securitized assets while hedge funds, broker dealers and insurance companies were net sellers of these asset types. Since conditions of improved bank capitalization (prevalent among the larger banks due to the TARP/CPP government initiatives) and increased deposits coupled with soft loan demand would translate to increased bank liquidity, *ceteris paribus* banks would have a cushion that would be available to support an ensuing increase in loan demand. Any increase in lending activity would most likely need to be supported by a concurrent improvement in overall economic conditions and yet this issue is blurred by the mixed empirical findings on the causation between bank lending and output. It is reasonable to believe that during the crisis period banks with high loan exposures would most likely refrain from further expanding their loan portfolios and opt for a strategy of liquidity building. This rationalization leads to first hypothesis:

H_1: During the financial crisis period there is a direct relationship between quantitative easing and liquidity. I hypothesize that $\beta_{4>}0$ in equation 1.

An active securitization market provided banks with an additional source of loan funding and liquidity while the repo markets were an important funding source for securitized banking activities. Loutskina (2011) suggests that as the bank's ability to securitize loans increases, its holdings of balance sheet liquid assets declines. The banking literature also suggests that securitization activity is impacted by business cycle conditions such that securitization activity rises during periods of economic expansion when there is lower investor uncertainty regarding the valuation of securitized assets. On the other hand during the crisis we witnessed a loss of "funding liquidity" in terms of the relative ease (or lack thereof) in which an investor is able to borrow against assets (e.g. repo markets). During the crisis we also experienced a loss of "market liquidity" driven by forced sales that further depressed the market value of assets. A rise in the repo rates would signal concern with regards to counterparty risk or increased uncertainty about valuation of the securitized assets which, *a-priori*, would lead the banks to take precautionary measures to preserve liquidity. Gorton and Metrick (2010) point out that the location and size of subprime risks held by counterparties in the repo market were unknown which led to fear that liquidity would dry up for collateral in all asset classes. The crisis is viewed as a disruptive event that would have a negative impact on bank liquidity due to its effects (i.e. bank losses, loan portfolio write offs, loss of bank stock market capitalization). While it may be argued that the crisis may have not been accurately forecasted by most banks, it is plausible that a rise in the repo rates could trigger banks to build liquidity to support borrower and depositor demand. The second hypothesis is as follows:

H_2: During the financial crisis period there is direct relationship between repo-OIS spread and liquidity. Since repo-OIS spread is a variable contained in *macro* in equation 1, I hypothesize that $\beta_3>0$ in equation 1.

4.5 Results

4.5.1 Dynamic Panel Data Model Results

Table 4.2 reflects model specifications using a system GMM estimator applied to the sample of small banks with total assets less than U.S. $1 billion as of the beginning of the sample period. Under these specifications this essay allows for feedback effects from bank liquidity to bank total assets and loan variables. Across all model specifications we see a significant positive effect of an increased balance sheet (i.e. bank total assets) on bank liquidity with coefficients ranging from 0.136 to 0.179. This result is consistent with expectations given that I am dealing with a small bank sample as opposed to a large bank sample. Following Loutskina (2011) I can rationalize a negative relationship between asset size and liquidity for large banks since large banks have fewer frictions in accessing capital markets and therefore can afford to hold less liquid funds on their balance sheet at any given point in time. Interestingly, the coefficients on the bank loan variable are also positive and statistically significant at the 5% level, with the exception of Model 7, ranging from 0.091 to 0.155 as reported in Models 1, 4, 5, 6, and 7 in Table 4.2. This finding is consistent with the small bank results reported by Cornett et al. (2011) and suggests that banks with higher illiquid asset portfolios (i.e. holding more loans), are pressured to increase liquidity holdings. The coefficients on the bank net operating income variable are negative and statistically significant ranging from -0.009 to -0.013 in the small bank sample case. This finding would suggest that although net operating income is commonly viewed as an internal source of liquidity creation, this income may be channeled to other uses in the case

of small banks. The coefficient on the Tier 1 capital ratio variable is positive yet very small at 0.003 and significant only in Model 3 suggesting that a rebuilding of capital leads to restored liquidity in the small bank sample case. For the most part however, the Tier 1 capital ratio variable has no impact on bank liquidity based on the zero coefficients reported across all other models except for Model 3 as previously noted. The coefficients on the bank deposit variables are positive and highly significant in all models ranging from 0.273 to 0.942. This finding is at odds with Cornett et al. (2011) who find a negative relationship between core deposits and liquidity. While banks are able to (and did) rely on core deposits to sustain bank lending, it is also true that banks received a significant influx of liquidity through Fed expansion activity (multiple rounds of quantitative easing) and as a result of a massive restructure of the financial sector balance sheets as explained by He et al. (2010). The reliance on core deposits to support lending would explain a negative relationship between deposits and liquidity while the liquidity influx offers support for a positive relationship between deposits and liquidity. It is noted that Loutskina (2011) also finds a positive relationship between transaction deposits (dep II in my model) and balance sheet liquidity in her model. Consistent with expectations, rising deposit costs have a negative and significant impact on bank liquidity creation with coefficients ranging from -0.121 to -0.216. Rising costs of funds place downward pressure on banks operating margins which commonly lead to balance sheet adjustments that are mostly observed in liquidity realignments for small banks. There are two interpretations to the negative and statistically significant coefficient of -2.563 on the letters of credit variable. First, to the extent that commercial letters of credit are viewed as bank commitments that facilitate businesses' ability to conduct trade, they represent a form of bank financing to businesses. In this regard, increases in the banks' commercial letter of credit portfolios bring about added liquidity risk. Second,

Loutskina (2011) suggests that there is a "reputation effect" associated with banks that issue commercial letters of credit since under this type of bank product the creditworthiness of the bank is being substituted for that of the buyer of goods. The implication is that large strong reputable banks that would normally engage in commercial letters of credit activity could afford to maintain lower levels of on-balance sheet liquidity at any given point in time. It is noted that this second interpretation however seems more appropriate for large bank samples as opposed to the small bank sample. The negative coefficients on the non-performing loans variable reported in Models 1, 4, 5, and 7 while statistically insignificant and small in magnitude ranging from -0.001 to -0.002 are of the anticipated sign implying that a deterioration in the quality of the banks' loan portfolio is expected to negatively impact bank liquidity. At worst, a deterioration in the quality of the loan portfolio that remains uncorrected could result in bank losses and at best monitoring costs increases as the quality of the loan portfolio decreases.

The positive and significant coefficients on the repo-OIS spread ranging from 0.042 to 0.058 suggest that banks build liquidity in response to rising repo-OIS spreads that would signal concern with regards to counterparty risk or increased uncertainty about valuation of securitized assets. The coefficients on the QE variable in Models 4 through 7 are positive and highly significant ranging from 0.030 to 0.042 suggesting that the Fed's initial round of quantitative easing had a positive impact on bank liquidity. The positive and significant coefficient of 0.240 on the interaction term in Model 6 with respect to bank loans with the repo-OIS spread suggest that as the repo-OIS spread rises that banks with greater loan portfolio exposures scaled by bank total assets would tend to build liquidity compared to their counterparts that have lower lending exposures. In their liquidity model, Cornett et al. (2011) use a similar interaction term (that uses a TED spread) to the one presented in Model 6 that was not significant in their small bank

sample. These authors do find a positive significant relationship between the interaction term and liquidity in their large bank sample defined as banks with total assets greater than U.S. $1 billion. The positive and significant coefficient of 0.241 on the interaction term on Model 7 with respect to bank loans with the QE indicator variable would suggest that banks with higher loan exposures may place greater reliance on funds received through the Fed's QE process to help alleviate liquidity pressures compared to those banks that have lower loan exposures.

The significant Hansen and Arellano Bond (AB) statistics cast doubt on the analysis of the results in Table 4.2. The instruments as a group used for estimation are not orthogonal to the disturbance terms and there is auto correlation in the first differenced error terms, thus violating a key assumption of the system GMM estimator. While violations of assumptions would typically lead to the reassessment of the model or consideration of alternative estimators, it is noted that the proposed bank liquidity model meets the assumptions of the system GMM estimator when applied to the medium, large, and money center banks samples. It is further noted that the proposed model parallels other liquidity models presented in the literature (see Loutskina (2011) and Cornett et al. (2011), among others). In the small bank sample case where the assumptions do not hold, it is plausible that the behavior of this random sample is triggering this problem[23].

Table 4.3 reports results for the sample of medium banks with total assets ranging between U.S. $1 billion and U.S. $20 billion as of the beginning of the sample period. The coefficients on bank total assets are positive yet insignificant ranging from 0.149 to 0.212. The coefficients on

[23] A common practice to address specifications issues that are detected through Sargan and AB diagnostic tests is to reconsider models with various lag lengths to eliminate serial correlation in first order residuals or to reduce the number of instruments. Through the use of the SGMM estimator technique and the restrictions imposed on the instrument matrix, I have reduced the number of instruments to only 16 in my benchmark model in all 4 subsample cases. While acknowledging that the Hansen and AB statistics are acceptable in all other bank subsamples, an obvious material difference between the small bank sample and all other bank samples is the small banks' "large" sample size (i.e. there are 4,982 small banks, 475 medium banks, 34 large banks and 14 money center banks). On this basis, the behavior (or the characteristics) of the small bank sample should not in and of itself motivate an attack on the model.

the bank loan variable remain positive in the medium bank sample ranging from 0.128 to 0.281 as reported in Models 1, 4, 5, 6, and 7 yet they are statistically insignificant. As in the small bank sample case, the coefficients on the net operating income variable remain negative small in magnitude ranging from -0.002 to -0.003 however statistically insignificant in the medium bank sample. The coefficients on the Tier 1 capital ratio variable are zero across all models suggesting that the Tier 1 capital ratio variable has no impact on bank liquidity. Unlike the small bank sample case, the deposit variables are no longer significant in explaining liquidity behavior in the medium bank sample case. Even though the deposit variables are no longer significant, it is interesting to find that the deposit costs variable remains important in explaining liquidity behavior as seen by the deposit costs coefficients that are negative and significant ranging from -3.311 to -3.722 as seen in Table 4.3. Contrary to expectations and in contrast to the small bank sample case, the coefficient on the letters of credit variable in Model 2 is positive and is statistically significant suggesting that the issuance of letters of credit fosters liquidity creation for the medium banks. However, the significant Hansen and Arellano Bond (AB) statistic in Model 2 diminishes the importance of this finding. Consistent with the small bank sample, the coefficients on the non-performing loans remain negative ranging from -0.005 to -0.006 however they become statistically significant in the 5 specifications reported in Table 4.3.

As in the small bank sample case, the coefficients on the repo-OIS spread remain positive ranging from 0.021 to 0.053 and statistically significant in 5 of the 6 models implying that banks build liquidity in response to rising repo-OIS spreads. The coefficients on the QE variable remain positive and significant ranging from 0.062 in Model 6 to 0.068 in Model 4. Contrary to the small bank sample case, the negative yet insignificant coefficient of -0.070 on the interaction term in Model 6 with respect to the bank loans with the repo-OIS spread suggests that as the

repo-OIS rises that banks with greater loan portfolio exposure scaled by bank total assets would tend to deplete liquidity compared to their counterparts that have lower lending exposures. Unlike the small bank sample case, the interaction of bank loans with the QE indicator variable has no impact on liquidity based on the insignificant coefficient of 0.169 reported in Model 7.

Table 4.4 reports results for the sample of large banks with total assets ranging between U.S. $20 billion and U.S. $90 billion as of the beginning of the sample period. Similar to the medium bank sample case, the coefficients on the bank total assets variable are insignificant ranging from -0.307 to 0.111. Contrary to the small bank sample case, the coefficients on the bank loan variable are negative and insignificant ranging from -0.503 to -0.962 in Models 1, 4, 5, 6, and 7 of Table 4.4. Cornett et al. (2011) find a positive and significant relationship between illiquid asset portfolios (i.e. holding more loans) and liquidity in their large bank sample defined as banks with total assets greater than U.S. $ 1billion. The coefficients on the bank net operating income variable remain negative across all models and significant only in Models 7 with the coefficient reported at -0.025. This finding is counter-intuitive in that an increase in net operating income which is considered an internally generated source of funding does not necessarily translate to liquidity creation in the large bank sample case. It is plausible that the net operating income potentially represents a supplemental funding source for loan generation for the large banks. The coefficients on the Tier 1 capital ratio variable are positive ranging from 0.006 to 0.028 and statistically insignificant across all models. It is interesting that transaction deposits (dep II) regain importance as a source of liquidity creation in the large bank sample case. The coefficients on dep II are positive ranging from 1.034 to 3.230 and statistically significant in 4 of the 6 models. Cornett et al. (2011) do not find a statistically significant relationship between core deposits (holding more deposits) and liquidity in the large bank sample case. The negative yet

insignificant coefficient of -0.895 reflected on the dep I variable in Model 3 implies that increases in the banks' broader based deposit holdings do not necessarily translate to increases in bank liquidity. In other words, while increases in transaction deposits (dep II) seem to be associated with liquidity creation, it remains unclear whether or not other broader deposit claims primarily represent loan funding sources in the large bank sample case. The coefficients on the deposit costs variable remain negative ranging from -3.420 to -9.943 however insignificant across all models in the large bank sample case. Consistent with expectations, the coefficient on the letters of credit variable is negative yet statistically insignificant. Contrary to the small and medium bank sample cases, the coefficients on the non-performing loans are positive ranging from 0.028 to 0.040 yet statistically insignificant.

Unlike the small and medium bank samples, the repo-OIS spread has no impact on liquidity based on the insignificant coefficients ranging from 0.001 to 0.122 reported across all models with the exception of Model 7 that reflects a marginally significant coefficient of 0.122. It is possible that bank liquidity is not impacted by an increase in the Repo-OIS spread given the influx of liquidity that the larger banks experienced via the government intervention. As in the small and medium bank samples, the QE variable continues to have a positive impact on liquidity based on the significant coefficients ranging from 0.089 to 0.119 in Models 4 through 7. In Model 6 the positive yet insignificant coefficient of 0.734 on the interaction term with respect to the bank loans with the repo-OIS spread suggests that as the repo-OIS rises that banks with greater loan portfolio exposure scaled by bank total assets would tend to increase liquidity compared to their counterparts that have lower lending exposures. As in the medium bank sample case, the interaction of bank loans with the QE indicator variable has no impact on liquidity based on the insignificant coefficient of -0.266 reported in Model 7.

Table 4.5 reports results for the sample of money center banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. As in the medium and large bank sample cases, the bank total assets variable has no impact on bank liquidity based on the insignificant coefficients that range from -0.482 to 0.173. The coefficients on the bank loan variable are positive and insignificant in Models 1, 4, 5, and 7 ranging from 0.036 to 1.815 while negative and significant reported at -2.183 in Model 6. As in the medium bank sample case, net operating income has no impact on liquidity since none of the coefficients are statistically significant. The Tier 1 capital ratio variable displays negative coefficients reported at -0.005 and -0.018 in Models 1 and 5 respectively and positive coefficients ranging from 0.001 to 0.003 in the remaining models that are however statistically insignificant across all models. Similar to the medium bank sample case, the deposit variables do not help explain liquidity behavior of money center banks with the exception of transaction deposits (dep II) in Model 6. Similar to the large bank sample case, the deposit cost variable does not seem to impact liquidity behavior since none of the coefficients are statistically significant. The coefficient on the letters of credit variable reported at -61.035 is of the expected sign and is statistically significant suggesting that money center banks may enjoy "reputational effects" that allow them to maintain lower levels of balance sheet liquidity.

The coefficients on the repo-OIS spread are positive ranging from 0.044 to 0.163 yet only marginally significant in 1 of the 6 models reported in Table 4.5. Similar to the large bank sample case, it is possible that bank liquidity is not impacted in all models by an increase in the Repo-OIS spread as a result of the influx of liquidity that the money center banks received primarily through the U.S. Treasury's CPP and from a redistribution of liability claims as repo-markets shrunk as suggested by He et al. (2010). The coefficients on the QE variable are positive

ranging from 0.070 to 0.127 and significant in 2 of the 4 models. Similar to the small bank sample case, the positive and significant coefficient of 0.979 on the interaction term in Model 6 between bank loans with repo-OIS spread suggests that as the repo-OIS spread increases that banks with greater loan portfolio exposures scaled by bank total assets would tend to build liquidity compared to their counterparts that have lower lending exposures. Similar to the medium and large bank sample cases, the interaction of bank loans with the QE indicator variable has no impact on liquidity given the insignificant coefficient of -0.231 reported in Model 7.

An overall assessment of the dynamic panel data models across all bank subsamples reveals the following key highlights. Beforehand, the summarized findings pertaining to the small bank sample are taken with caution given the misspecification problems that are encountered with this subsample that have been previously discussed in the results section of this essay. Bank total assets help to explain bank liquidity growth only in the small bank sample with coefficients being positive and highly significant while turning negative yet not significant in several specifications in the large and money center bank sample cases. There is a direct relationship between liquidity and bank lending that is significant in the small bank sample while remaining positive yet insignificant in the medium bank sample that turns negative and insignificant in the large bank sample. The relationship between liquidity and bank lending is mostly positive and insignificant in the money center bank sample with the noted exception of a single specification that reported a significant negative coefficient. There is an inverse relationship between bank net operating income and liquidity that is statistically significant in small bank sample, negative and insignificant in the medium bank sample, and negative and significant in one specification reported in the large bank sample. The relationship between net operating income and bank

liquidity is positive in six of the seven specifications reported however statistically insignificant across all specifications in the money center bank sample case. For the most part the Tier 1 capital ratio variable does not help to explain liquidity growth with the noted exception of a single specification reported in the small bank sample. Furthermore the coefficients on the Tier I capital variable are either zero or near zero in all the specifications across all the samples. The broad based deposit measure (dep I) that closely mirrors transaction deposits (dep II) only in the small bank sample case, has a favorable impact on liquidity growth based on the positive and significant coefficient in the small bank sample case. The coefficient on this broad based deposit measure is also positive yet not significant for the money center sample while turning negative and statistically insignificant in both the large and medium bank samples. There is a direct relationship between transaction deposits (dep II) and liquidity growth in the small, medium and large bank samples that is statistically significant in the small and large bank samples. The relationship between transaction deposits and liquidity is mixed, and mostly insignificant, in the money center bank sample with some specifications reflecting positive coefficients and others reporting negative coefficients with only one model reporting a positive and significant coefficient. Increases in deposit costs have a negative impact on liquidity growth that are statistically significant in the small and medium bank samples that are not statistically present in the large and money center bank samples. With the noted exception of the medium bank sample case, the "reputation effect" on bank liquidity proxied by the letters of credit variable is captured by the negative coefficients that are statistically significant in the small and money center bank sample cases. Non-performing loans help to explain liquidity behavior only in the medium bank sample based on the negative and significant coefficients that turn positive yet insignificant in the large bank sample. Non-performing loans have the anticipated sign in the small bank sample

however the coefficients are statistically insignificant. The relationship between non-performing loans and bank liquidity in the money center bank sample is mixed, and mostly insignificant, with only one of the five model specifications reporting a positive significant coefficient.

Overall this essay finds support for H1 that suggests that during the financial crisis period there is a direct relationship between quantitative easing and bank liquidity (i.e. $\beta_{4>}0$ in equation 1). This relationship is well captured across all bank samples based on the positive and statistically significant coefficients reported on the QE indicator variable. The positive relationship is consistent with the view that during the crisis period the Fed's initial round of quantitative easing had a positive impact on bank liquidity. During this time frame it is documented that commercial banks were net purchasers of significant amounts of securitized assets which are treated as liquid assets (i.e. securities) on the banks balance sheets (see, He et al.2010). It is also possible that the results are capturing the absence of strong loan demand during the crisis period and a general tendency for businesses to postpone borrowing activity given the heighten uncertainty that existed during the crisis period. From a banking viewpoint, any increase in lending activity would require some indication of a concurrent improvement in overall economic conditions. *A priori* during the crisis period it is reasonable to expect that banks with high loan exposures would curb lending and choose to build liquidity with quantitative easing serving as an important channel through which bank liquidity objectives could be potentially attained. However, the evidence only supports the presence of direct effects of quantitative easing on bank liquidity since for example the interaction of quantitative easing with bank lending does not help to explain bank liquidity.

There is some evidence to support H2 that states that during the financial crisis period there is a direct relationship between the repo-OIS spread and bank liquidity (i.e. $\beta_{3>}0$ in equation 1).

The positive relationship is well captured in the small and medium bank samples as seen in Tables 4.2 and 4.3. The positive relationship diminishes as we move towards the larger bank samples since only one specification reflects a significant coefficient on the repo-OIS variable in the large and money center bank sample cases. Nonetheless, the positive relationship is consistent with the view that increases in the repo rates signal concern with regards to counterparty risk or increased uncertainty about valuation of the securitized assets that would lead banks to take precautionary measures to preserve liquidity. The direct relationship is also in line with the view that during the crisis period there was a loss of funding liquidity in term of the relative ease (or lack thereof) in which banks are able to borrow against assets in the repo markets. *A priori* during the crisis period it is plausible that banks with greater loan exposures would tend to build liquidity compared to their counterparts that have lower lending exposures concurrent with a rise in the repo-OIS spread. The evidence supports the presence of an indirect impact of the repo-OIS spread on liquidity through bank lending in the small and money center bank sample cases as seen in Model 6 in Tables 4.2 and 4.5.

4.5.2 Matched sample analysis

Table 4.6 Panel A reports descriptive statistics on key balance sheet characteristics and performance measures and compares these financial attributes as they apply to a match sample of TARP and non-TARP banks[24]. More specifically, the balance sheet characteristics deal with Tier 1 risk based capital ratio, bank loan exposure, loan quality (i.e. non-performing loans), and liquidity while the bank performance attribute relates to bank net operating income. Examining the changes in these financial attributes allows this essay to assess the short to medium term impact of the government intervention on the banking the system. Due to the capital infusions

[24] For a detailed description of the matching procedure refer to the methodology section of this essay.

made by the government, TARP banks exhibit a statistically significant increase in their capital base. The Tier 1 risk based capital ratio is higher in the 4 quarters after TARP fund receipt based on the reported mean of 12.507% compared to the previous 4 quarters as reflected by the mean of 10.744% with a mean difference of 1.763%which is statistically significant at the 1% level. While non-TARP banks also experienced a statistically significant increase in their Tier 1 risk based capital ratios the magnitude of the change is roughly half of that experienced by the TARP banks. The increase in Tier 1 risk based capital ratios for the non-TARP banks is most likely attributed to the clean up the loan portfolios and the buildup of liquidity that many banks experienced during the crisis period due to a massive restructuring of the financial sector balance sheets as noted by He et al.(2010). It is interesting to find that for both TARP and non-TARP banks loan exposures scaled by total assets have declined by comparable amounts when compared to their pre-crisis levels as seen by the mean differences of -0.036 and -0.034 that are statistically significant at the 1% level and that there is no statistical difference in the loan exposures between TARP and non-TARP banks. The overall decline in the loan exposure may be a reflection of the overall fragile yet improving economy and business owner uncertainty that has lingered beyond the crisis period that has resulted in the postponement of capital asset purchases that are typically financed by bank borrowing in the case of small and medium size businesses. The TARP banks recorded lesser deterioration in their loan portfolios compared to non-TARP banks when transitioning from the pre to the post crisis period as seen in the mean differences of 1.789 and 2.003, respectively that are statistically significant at the 1% level. It also noted that the non-TARP banks pre and post levels of non-performing loans are significantly higher compared to the TARP banks as seen by the negative mean differences of -0.459 and -0.672 respectively that are statistically significant at the 1% level. Therefore from a loan quality

viewpoint these findings suggest that there is no perceived added weakness in TARP bank portfolios when compared to the non-TARP banks.

Another interesting finding is the comparable increase in liquidity scaled by bank total assets for both TARP and non-TARP banks when compared to their pre-crisis levels as seen by the mean differences of 0.033 and 0.030 that are statistically significant at the 1% level and that there is no statistical difference in the liquidity exposures between TARP and non-TARP banks in the post- crisis period. This finding suggests that both TARP and non-TARP banks appear to be more focused on liquidity creation as opposed to promoting lending growth which is one of the key objectives of the TARP program. Both TARP and non-TARP banks record losses in the post crisis period suggesting that the capital infusions did little to improve the performance of the recipient banks. The performance measure (net operating income scaled by bank assets) is negative in the 4 quarters after TARP fund receipt based on the reported mean of -0.213 compared to a positive mean value in the previous 4 quarters of 0.499 yielding a mean difference of -0.713 which is statistically significant at the 1% level. In the case of the non-TARP banks the pre-crisis mean value is 0.579 while the post-crisis mean value is negative at -0.238 that leads to a mean difference of -0.817 that is also statistically significant at the 1% level. The findings also suggest that from a performance perspective there is no statistical difference between TARP and non-TARP in the post- crisis period. The decline in performance for the TARP and non-TARP banks in this essay is more pronounced and consistent between the two groups of banks when compared to the results reported by Harris et al. (2013). These authors employ two performance measures, a broad based measure consisting of operating revenue scaled by total assets and a narrower measure which is the net interest margin. Based on the broad based measure Harris et al. (2013) find that both the TARP and non-TARP banks experience a decline in performance

from the pre to the post TARP period with the decline (i.e. mean differences) being much greater for the TARP bank (i.e. 2.83% vs. 0.23%). Interestingly, these authors also find that while net interest margins declined (i.e. mean differences) by 0.28% for TARP banks the margins actually rose (i.e. mean differences) slightly by 0.09% for the non-TARP banks. The performance results in this essay bear some resemblance to Harris et al. (2013) based on their broad operating revenue performance measure. It is also important to distinguish that in this essay we are dealing with banks that are much smaller is size compared to the sample used in Harris et al. (2013) that include only publicly traded banks[25]. The decline in operating performance is also a reflection of the weak interest rate environment that has placed significant pressure on bank lending profits especially for the smaller banks. In a Wall Street Journal article of October 22th, by Fitzpatrick (2012) "Low Rates Pummel Banks" low interest rates are squeezing bank profits and over time passive profitability is likely to accelerate further shakeout of insured institutions while noting that net interest margins at 2012Q are at their lowest since 2009Q2 and have been dropping since 2011Q3.

The descriptives in Panel B of Table 4.6 show that the distributional properties of the variables that are used for matching criteria (i.e. banks assets, Tier 1 risk based capital ratio and bank liquidity) are very similar for the match sample of TARP and non-TARP banks. For example the mean of bank assets for the TARP banks is U.S. $2.709 billion compared to U.S. $2.751 billion for non-TARP banks while the standard deviations are U.S. $8.005 billion and U.S. $8.306 billion respectively. With respect to the Tier 1 risk based capital ratio matching variable the mean ratio is 11.967 and 10.825 for the TARP and non-TARP banks accordingly

[25] To illustrate the size comparison issue the average market value of equity of the TARP and non-TARP banks reported in Harris et al. (2013) is U.S. $3,201.9million and $2,885.4million while the average total asset size for the TARP and non-TARP banks in this essay is U.S. $2,709.2million and $2,751.9million respectively. The difference is also observed in the TARP injection amounts (i.e. in Harris et al. (2013) the mean TARP injection is U.S. $470.6 million and in this essay the mean TARP injection is U.S. $78.0 million).

while the sample variances are reported at 5.509 and 7.510. Finally, the mean values for the liquidity ratio matching variable are 0.191 and 0.187 for the TARP and non-TARP banks while the respective sample variances are 0.009 and 0.007.

4.5.3 Liquidity behavior TARP vs. non-TARP banks

It is appealing to investigate the liquidity behavior of TARP and non-TARP banks to determine whether any important differences exist. For example Li (2010) finds that lending increased after the distribution of TARP funds in his bank sample that exclude the largest banks. Given the dynamics between liquidity and lending, I would expect that the impact of bank lending on liquidity may vary between non-TARP banks and TARP banks especially if there are differences between the bank groups in terms of client base, lending risk profile, and/or loan demand. Bayazitova and Shivdasani (2012) find that TARP infusions were provided to banks that presented significant systemic risk, faced high expected financial distress costs while exhibiting strong asset quality and important political connections. If in fact TARP distributions were granted to "healthy banks" that otherwise were only lacking additional capital support to fund viable lending projects, I would expect that the effect of added capital may have balanced the playing field between TARP and non-TARP banks (i.e. loan growth rates at TARP banks would be even lower without TARP investments). The descriptive analysis reported in Table 4.6 Panel A suggests that the loan quality, although on the decline, for the TARP banks in the pre and post TARP periods is better compared to the loan quality reported by the non-TARP banks. The reductions in non-performing loan portfolios would provide banks with the flexibility to promote increased lending (if supported by demand and viable lending projects) or restore liquidity. On this basis, the impact of non-performing loans on liquidity may vary between TARP and non-TARP banks.

Table 4.7 reports regression results using a system GMM estimator applied to the benchmark liquidity model 1 and an alternative specification (model 2) to a sample of TARP and non-TARP banks obtained through the matching process described in the methodology section. In both

samples bank lending has no impact on liquidity based on the non-significant coefficients reported in Model 1 of -0.395 and 0.336 for the TARP and non-TARP bank samples respectively. The coefficients on the net operating income variable are negative in both models for the TARP and non-TARP banks samples ranging from -0.007 to -0.018 and only marginally significant in the non-TARP bank case with Model 1 and 2 reporting a coefficient of -0.018. This finding while counter-intuitive would suggest that for the non-TARP banks net operating income potentially represents a supplemental funding source for loan generation or that there are other uses of net operating income that prevent liquidity buildup such as dividend distributions or management lead objectives to address loan portfolio quality concerns.

The Tier 1 risk based capital ratio variable does not help explain changes in the level of liquidity for TARP or non-TARP banks in the benchmark model while noting that the Tier 1 risk based capital ratio variable has a positive and marginally significant impact on liquidity in Model 2 for the non-TARP banks. The central theme of liquidity creation is prevalent in the regressions for TARP and non-TARP banks based on the coefficients on the bank deposit variable that range from 1.311 to 1.831 that are statistically significant at the 1% level across the models. Interestingly, while the coefficients on the deposit costs variable are of the expected sign in all cases ranging from -2.490 to -4.417, deposit costs are only statistically significant in the TARP bank sample (i.e. Model 1 coefficient of -4.417 and Model 2 coefficient of -4.146). This finding would suggest that liquidity build up is more price sensitive for TARP banks compared to non-TARP banks.

The findings do not support the view that loan portfolio quality has an impact on bank liquidity given the zero coefficient reported in Model 1 for the TARP banks and the near zero and insignificant coefficient of -0.007 reported in Model 1 for the non-TARP banks. While the

impact of the crisis on liquidity is not captured by the crisis indicator variable for neither the TARP nor the non-TARP banks based on the statistically insignificant coefficients reported in Table 4.7, it is noted that the coefficients on repo-OIS spread are significant and of the anticipated sign across all models. A rise in the repo-OIS spread (which occurred during the crisis) would signal concern with regards to counterparty risk or increased uncertainty about valuation of the securitized assets that would lead banks to take precautionary measures to preserve liquidity.

4.6 Conclusion

The need to build liquidity became a common theme among banks during the crisis period and the evidence in this essay suggests that the Fed's initial round of quantitative easing served as an important channel through which bank liquidity objectives were obtained. The surge in bank liquidity may also be explained by the absence of strong loan demand during the crisis period and a general tendency for businesses to defer borrowing activity given the heighten uncertainty that existed during the crisis period. Furthermore, from a banking perspective any increase in lending activity would require some indication of a concurrent improvement in economic conditions. I also conclude that bank liquidity behavior is not necessarily constant between banks of different asset size classes. For example, transaction deposits are an important source of liquidity creation only for the small and large bank samples while deposit costs are no longer important in explaining liquidity behavior in the larger bank samples. The direct relationship between transaction deposits and bank liquidity in this essay is at variance with the results by Cornett et al (2011) but in line with the results by Loutskina (2011). Similarly, non-performing loans have the expected negative impact on bank liquidity that only seems relevant in

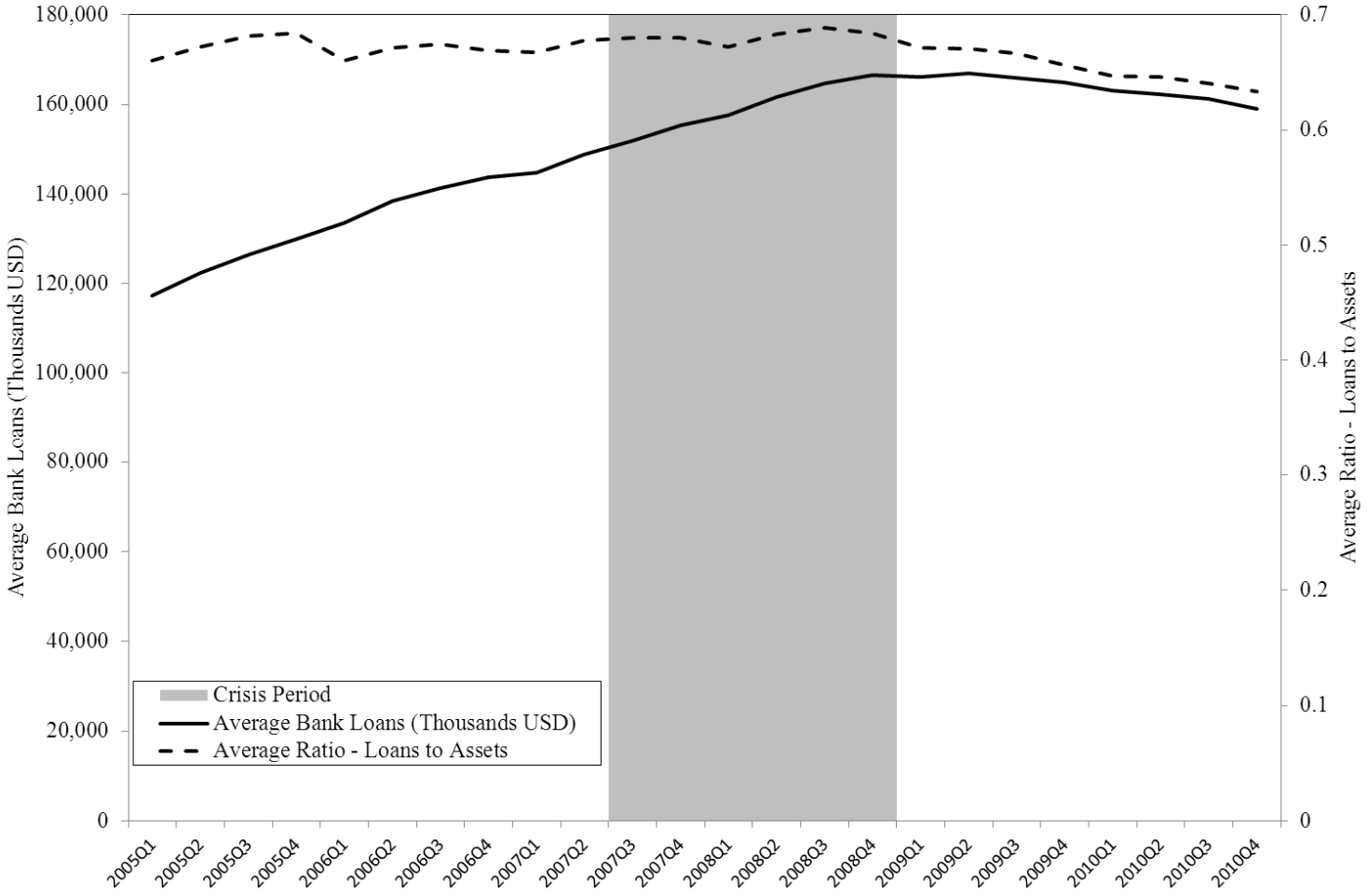
the medium bank sample while “reputation effects” from commercial letters of credit on bank liquidity is only exhibited by the money center bank sample.

There is some evidence supporting a direct relationship between liquidity and the repo-OIS spread. The direct impact of the repo-OIS spread on bank liquidity is well evidenced in the small and medium bank sample cases and weakens as we move towards the larger bank samples. The positive relationship is consistent with the view that increases in the repo rates signal concern with regards to counterparty risk or increased uncertainty about valuation of the securitized assets that would lead banks to take precautionary measures to preserve liquidity. The positive and significant coefficient on the interaction term with respect to bank loans with the repo-OIS spread in the small and money center bank samples provides support of the posited relationship between the repo-OIS and liquidity during the crisis. In the case of the small and money center bank samples, the results suggest that as the repo-OIS spread rises that banks with greater loan portfolio exposures scaled by bank total assets would tend to build liquidity compared to their counterparts that have lower lending exposures. In their liquidity model, Cornett et al. (2011) find a similar result in their large bank sample defined as banks with total assets greater than U.S. $1 billion and no significance in the small bank sample that includes banks with total assets under U.S. $ 1 billion.

The balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period with the shift being more discernible for the larger bank samples over the entire sample period. The residential real estate portfolio exposure has reverted to pre-crisis levels in the money center bank sample case and has remained fairly consistent throughout the sample period in all other bank samples with a modest rise noted in the post crisis period in the large bank sample case. Overall bank loan portfolios scaled by total average balance sheet

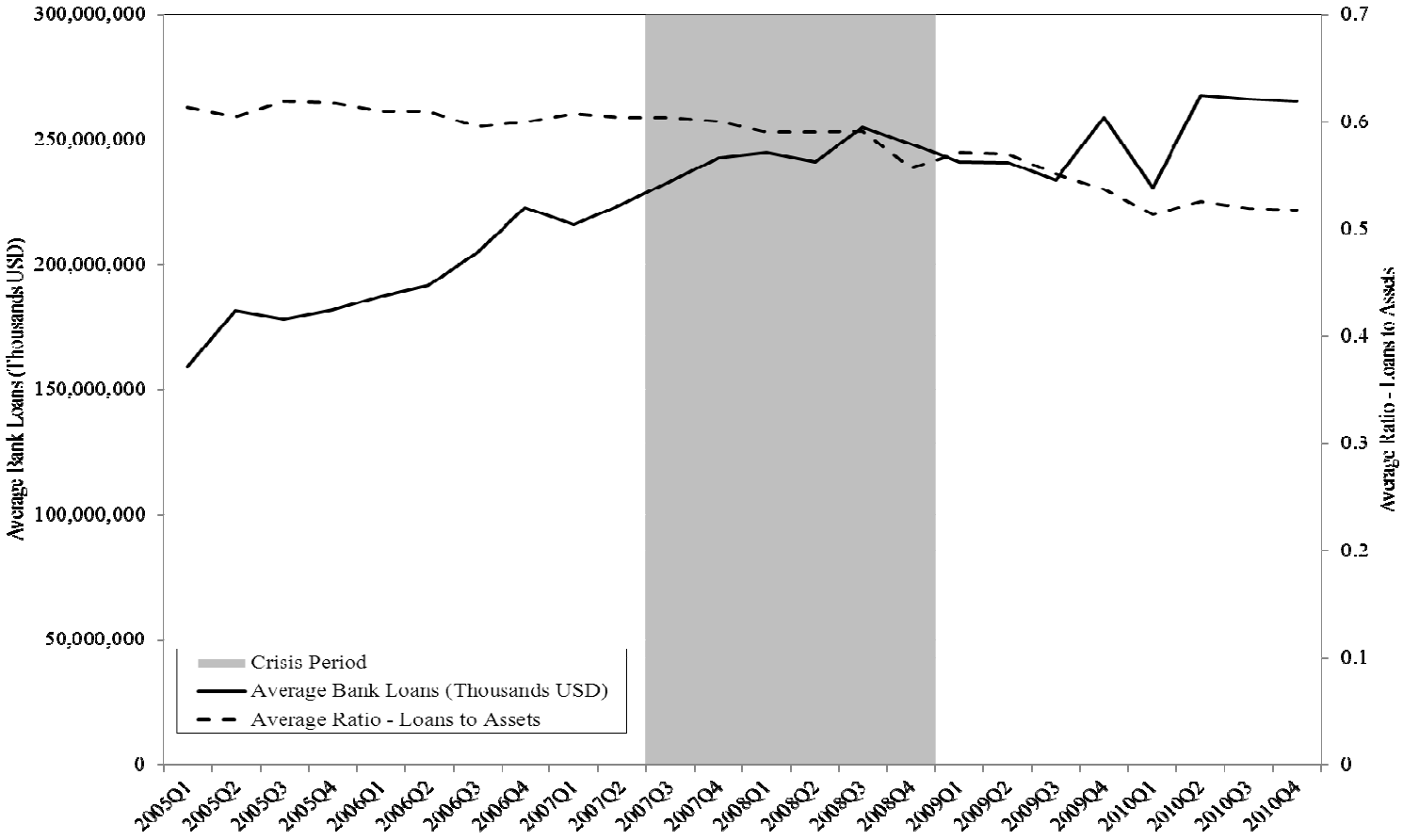
holdings seem to have trended downward during the post crisis period with the exception of the large bank sample where post crisis exposures have held fairly steady.

Figure 4.1 Loan Trend Analysis-Small Banks (Average Total Assets < U.S. $1 billion)



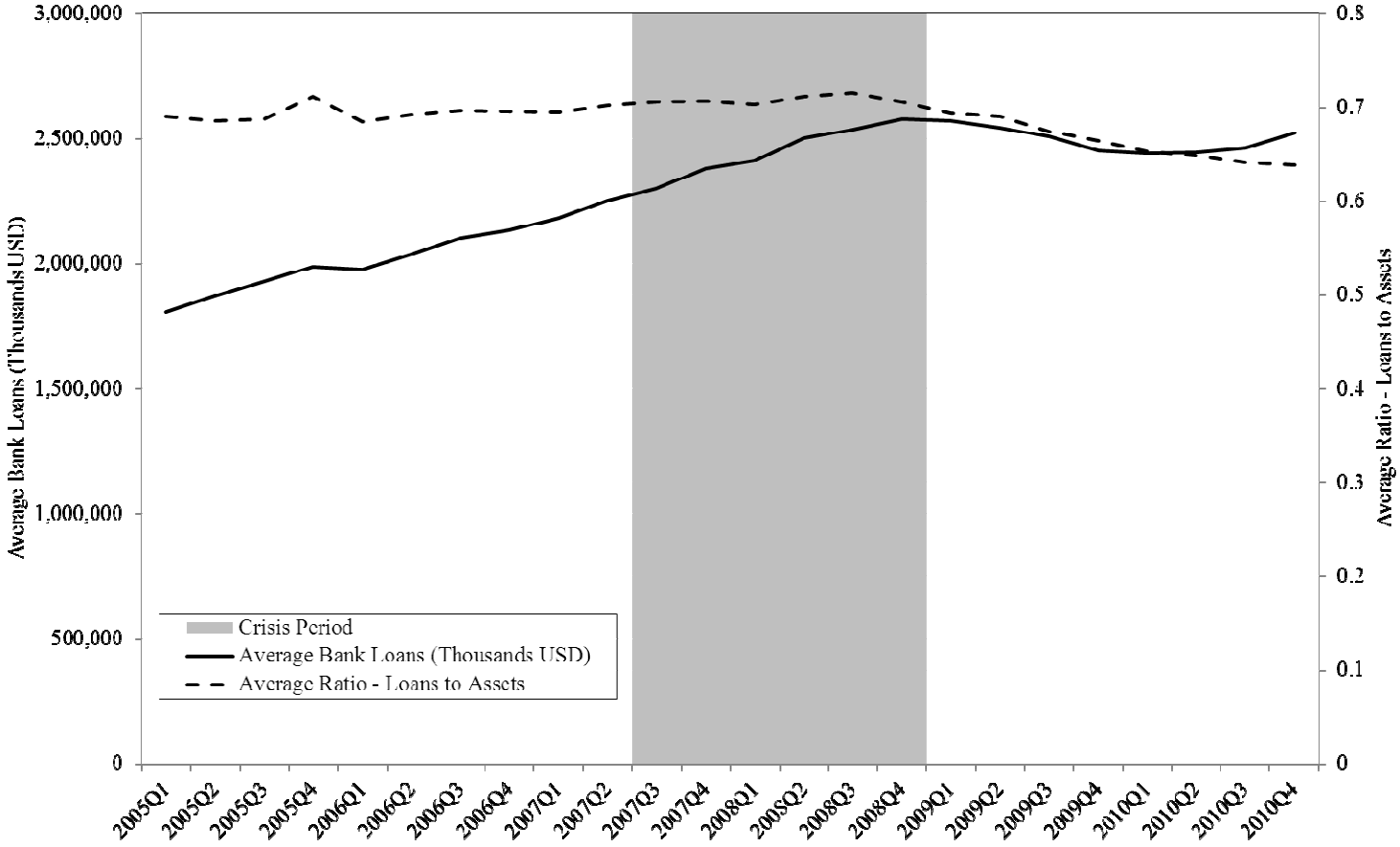
Note: The solid line represents the average of bank total loans computed quarterly for banks that hold average total assets < U.S. $1billion. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank total loans to average total bank assets. The left axis reflects the average total bank loans while the right axis shows the proportion of loans to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.2 Loan Trend Analysis-Money Center Banks (Average Total Assets > U.S. $90 billion)



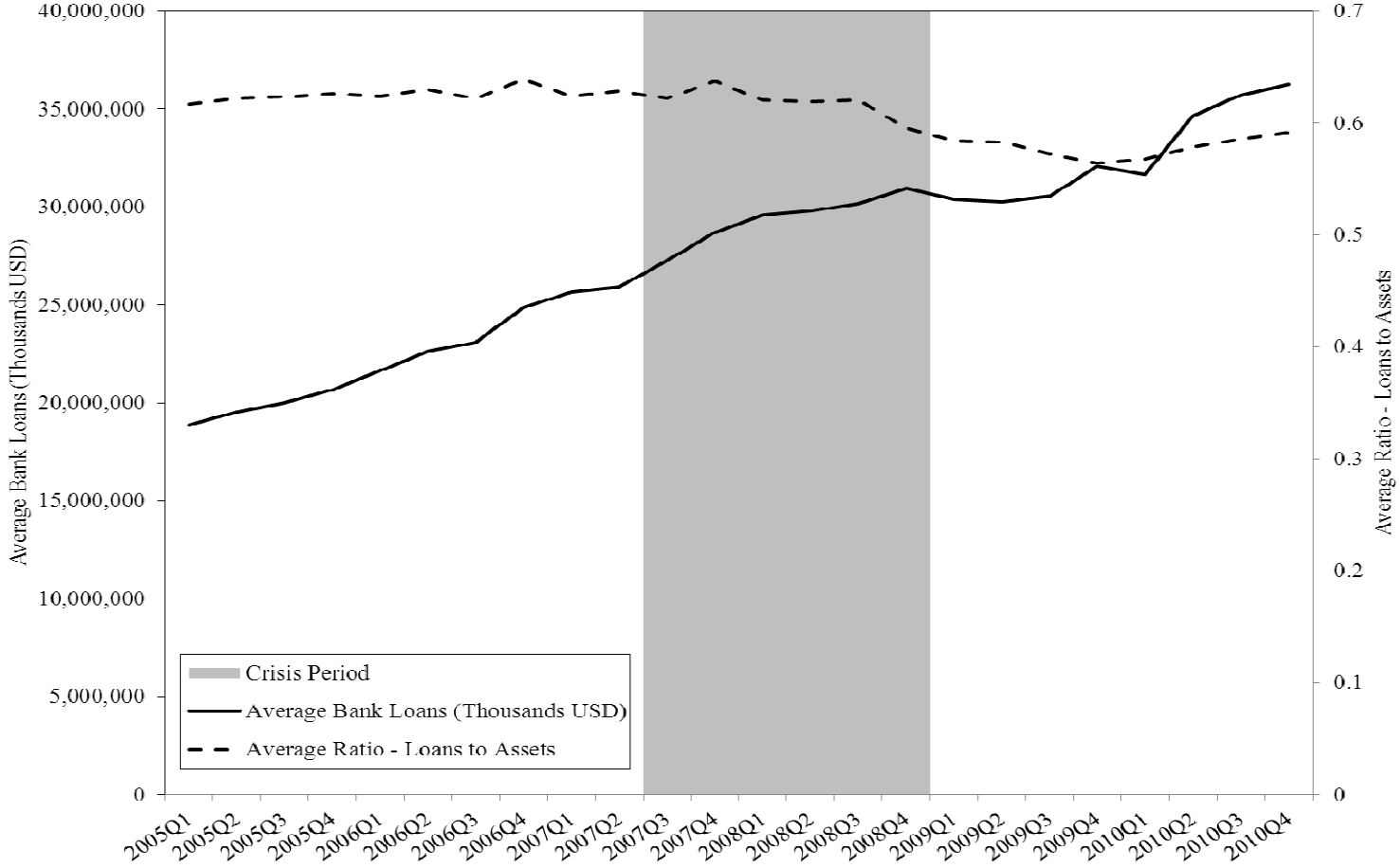
Note: The solid line represents the average of bank total loans computed quarterly for banks that hold average total assets > U.S. $90 billion. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank total loans to average total bank assets. The left axis reflects the average total bank loans while the right axis shows the proportion of loans to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.3 Loan Trend Analysis-Medium Banks (Average Total Assets > U.S. $1 billion and <U.S. $20 billion)



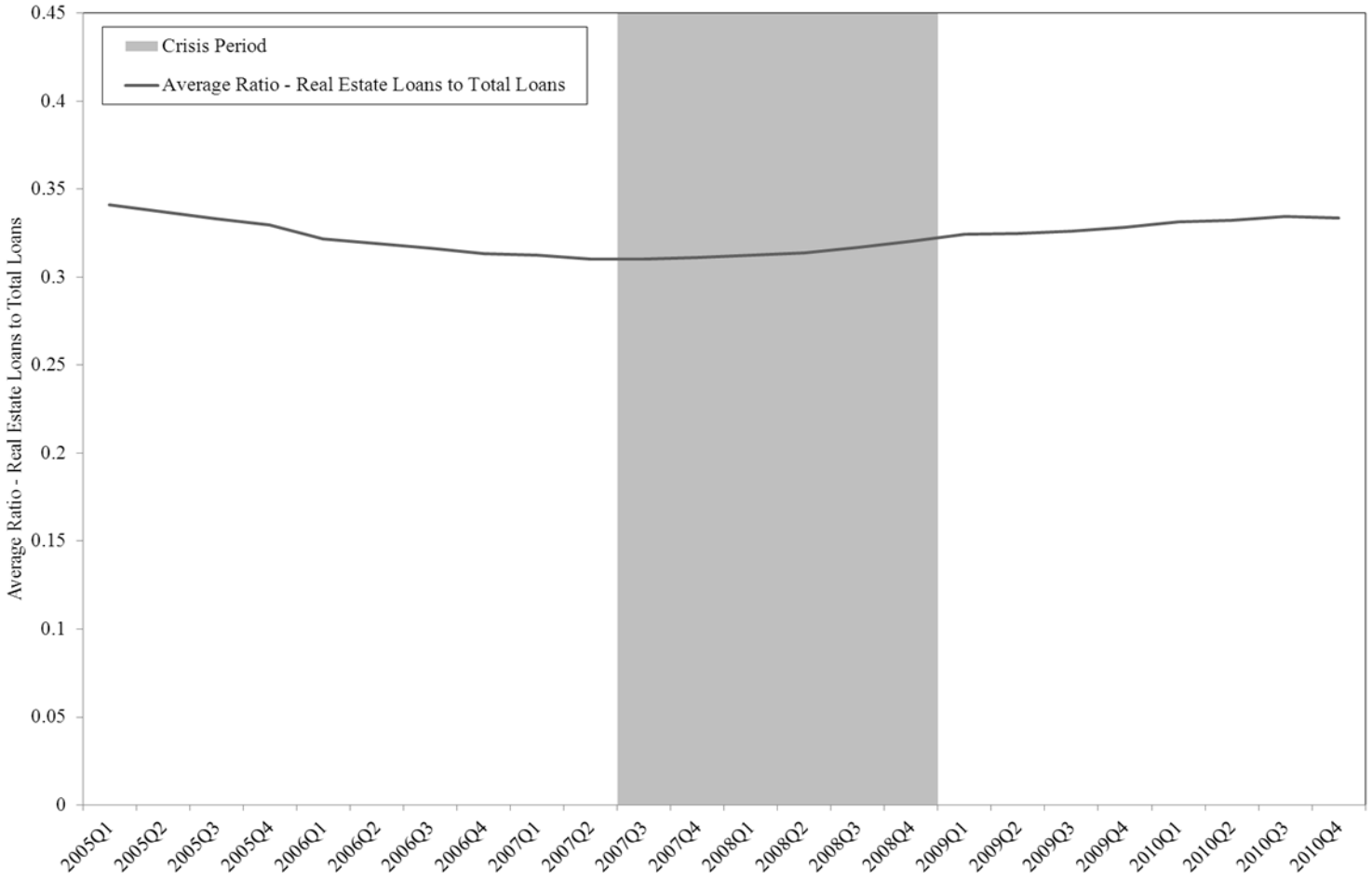
Note: The solid line represents the average of bank total loans computed quarterly for banks that hold average total assets > U.S. $1billion and < U.S $20 billion. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank total loans to average total bank assets. The left axis reflects the average total bank loans while the right axis shows the proportion of loans to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.4 Loan Trend Analysis-Large Banks (Average Total Assets > U.S. $20 billion and <U.S. $90 billion)



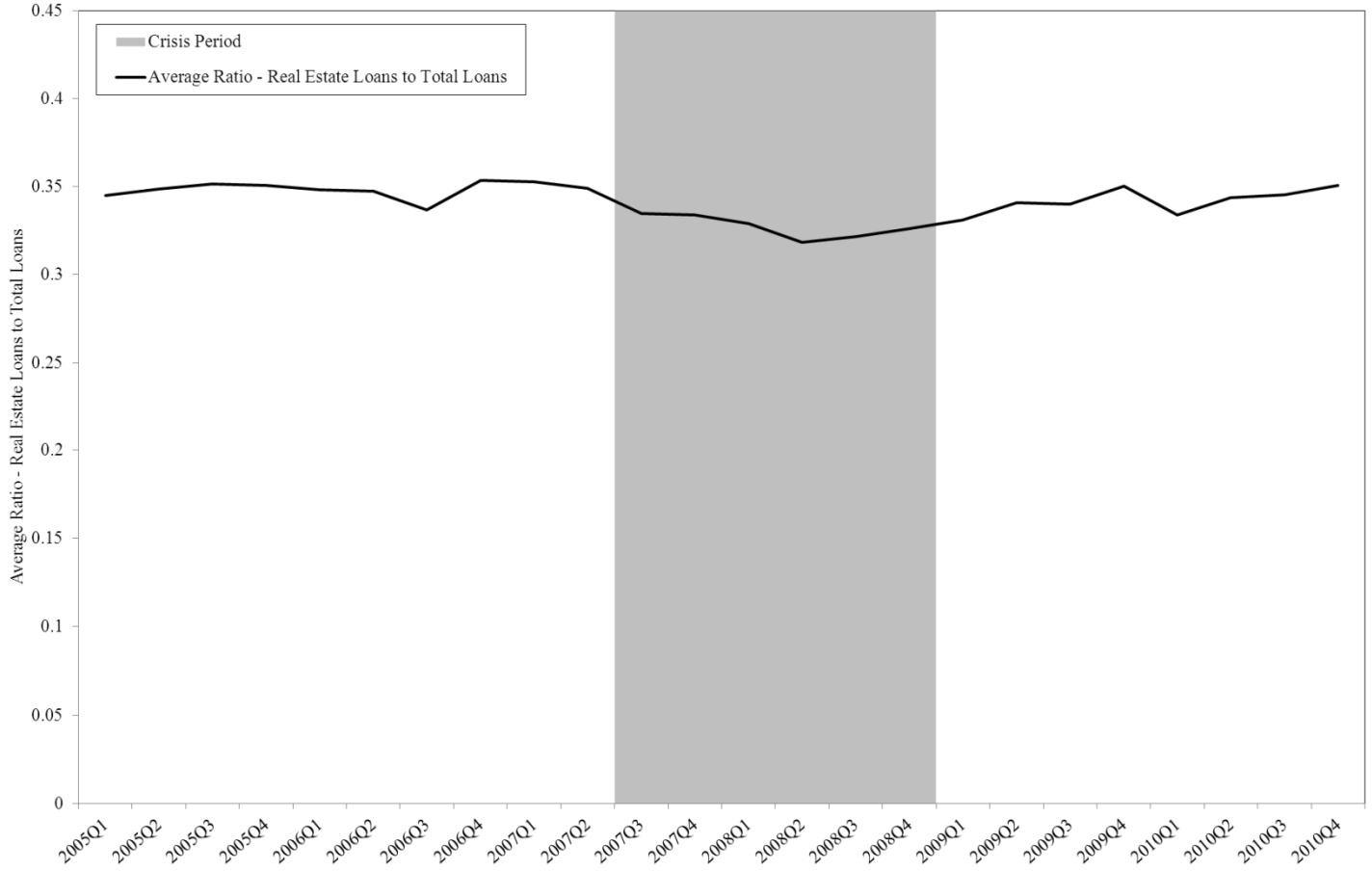
Note: The solid line represents the average of bank total loans computed quarterly for banks that hold average total assets > U.S. $20 billion and < U.S $90 billion. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank total loans to average total bank assets. The left axis reflects the average total bank loans while the right axis shows the proportion of loans to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.5 Residential Real Estate Loan Ratio Trend Analysis-Small Banks (Average Total Assets < U.S. $1 billion)



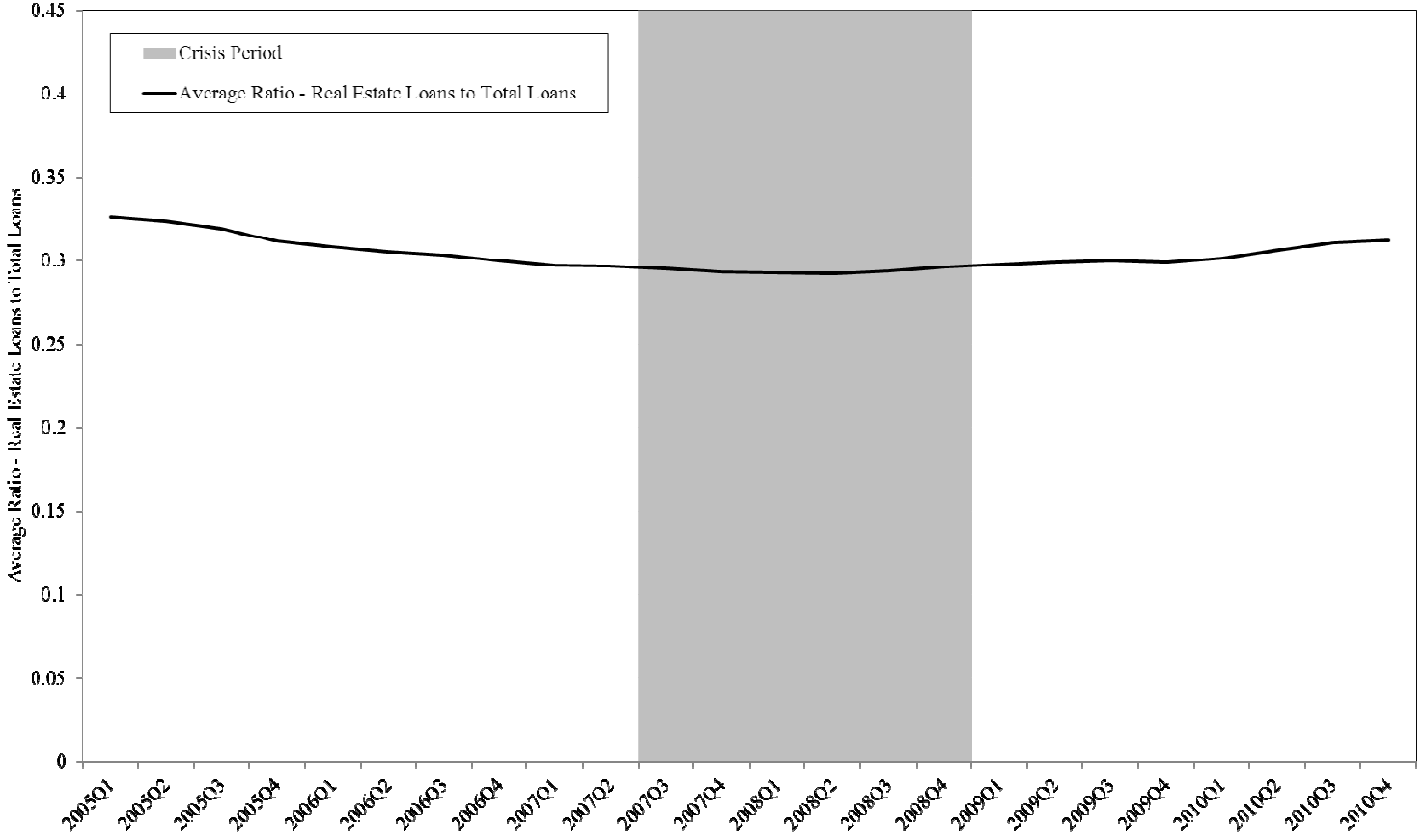
Note: The solid line represents the proportion of average total residential real estate loans to average total bank loans computed quarterly for banks that hold average total assets < U.S. $1 billion. The dollar amounts used to compute this series are expressed in thousands of U.S. dollars. The left axis reflects the proportion of residential loans to total loans. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.6 Residential Real Estate Loan Ratio Trend Analysis-Money Center Banks (Average Total Assets > U.S. $90 billion)



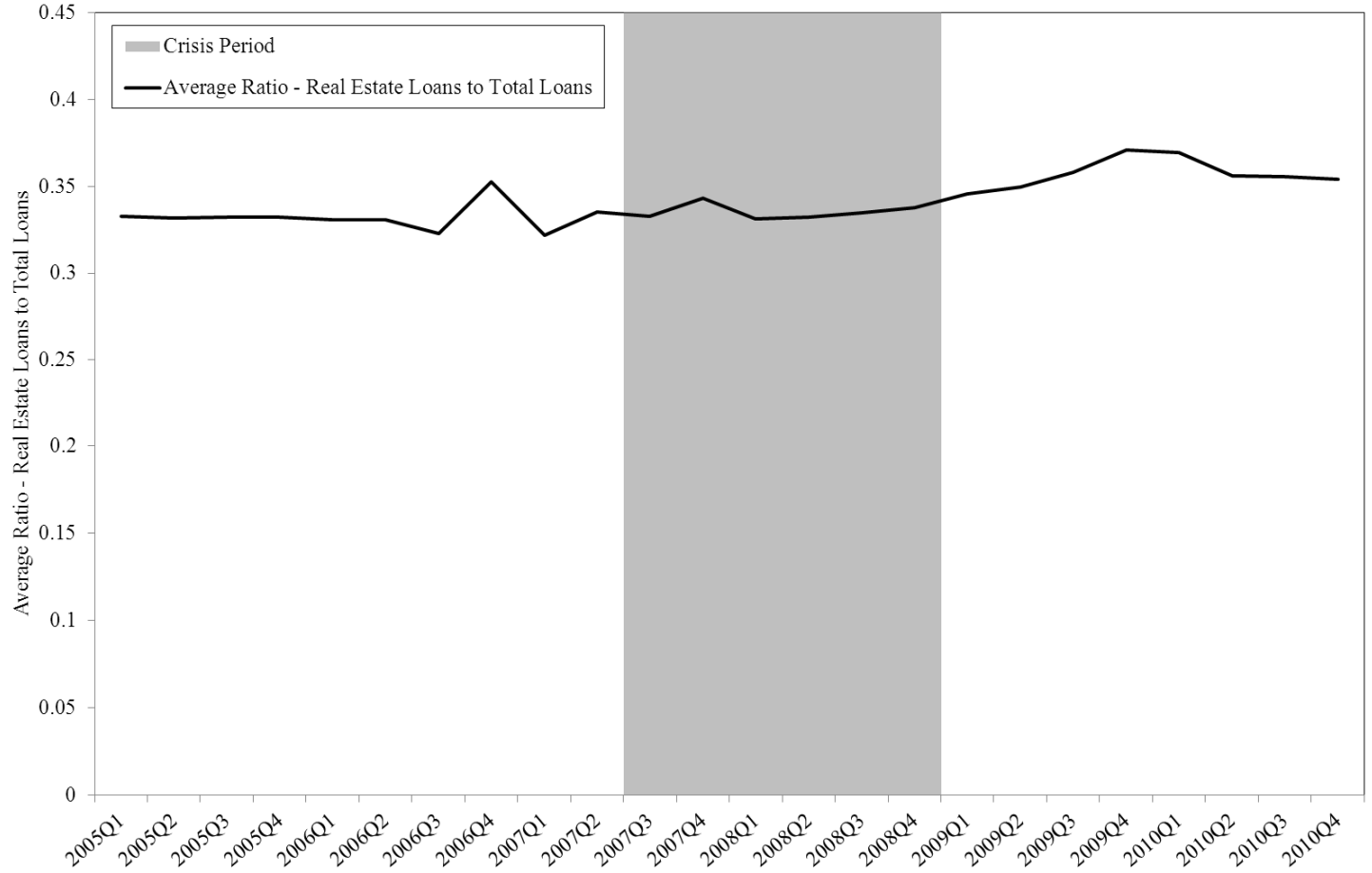
Note: The solid line represents the proportion of average total residential real estate loans to average total bank loans computed quarterly for banks that hold average total assets > U.S. $90 billion. The dollar amounts used to compute this series are expressed in thousands of U.S. dollars. The left axis reflects the proportion of residential loans to total loans. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12

Figure 4.7 Residential Real Estate Loan Ratio Trend Analysis-Medium Banks (Average Total Assets > U.S. $1 billion and < U.S. $20 billion)



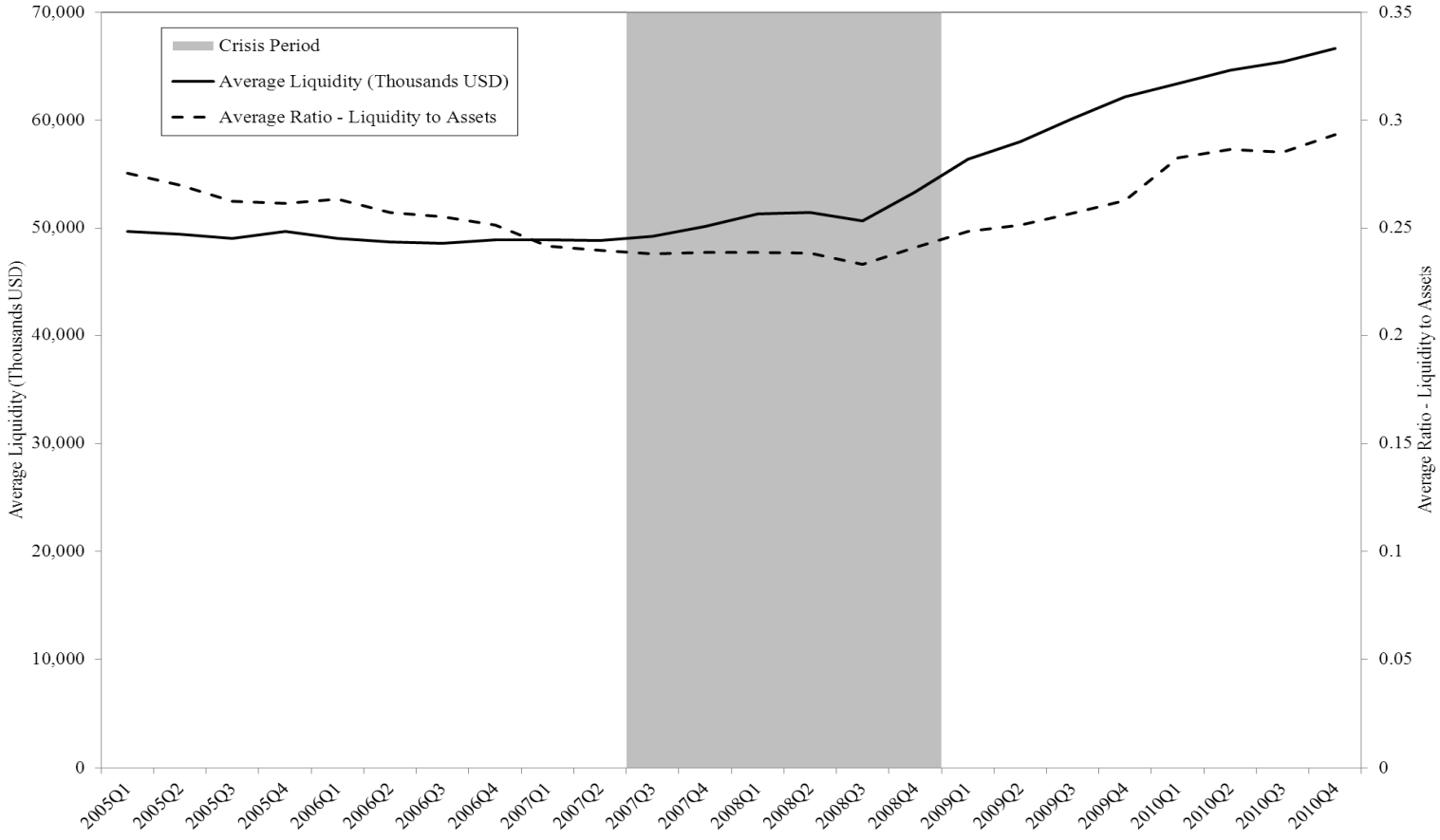
Note: The solid line represents the proportion of average total residential real estate loans to average total bank loans computed quarterly for banks that hold average total assets > U.S. $1 billion and U.S.$20 billion. The dollar amounts used to compute this series are expressed in thousands of U.S. dollars. The left axis reflects the proportion of residential loans to total loans. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12

Figure 4.8 Residential Real Estate Loan Ratio Trend Analysis-Large Banks (Average Total Assets > U.S. $20 billion and < U.S. $90 billion)



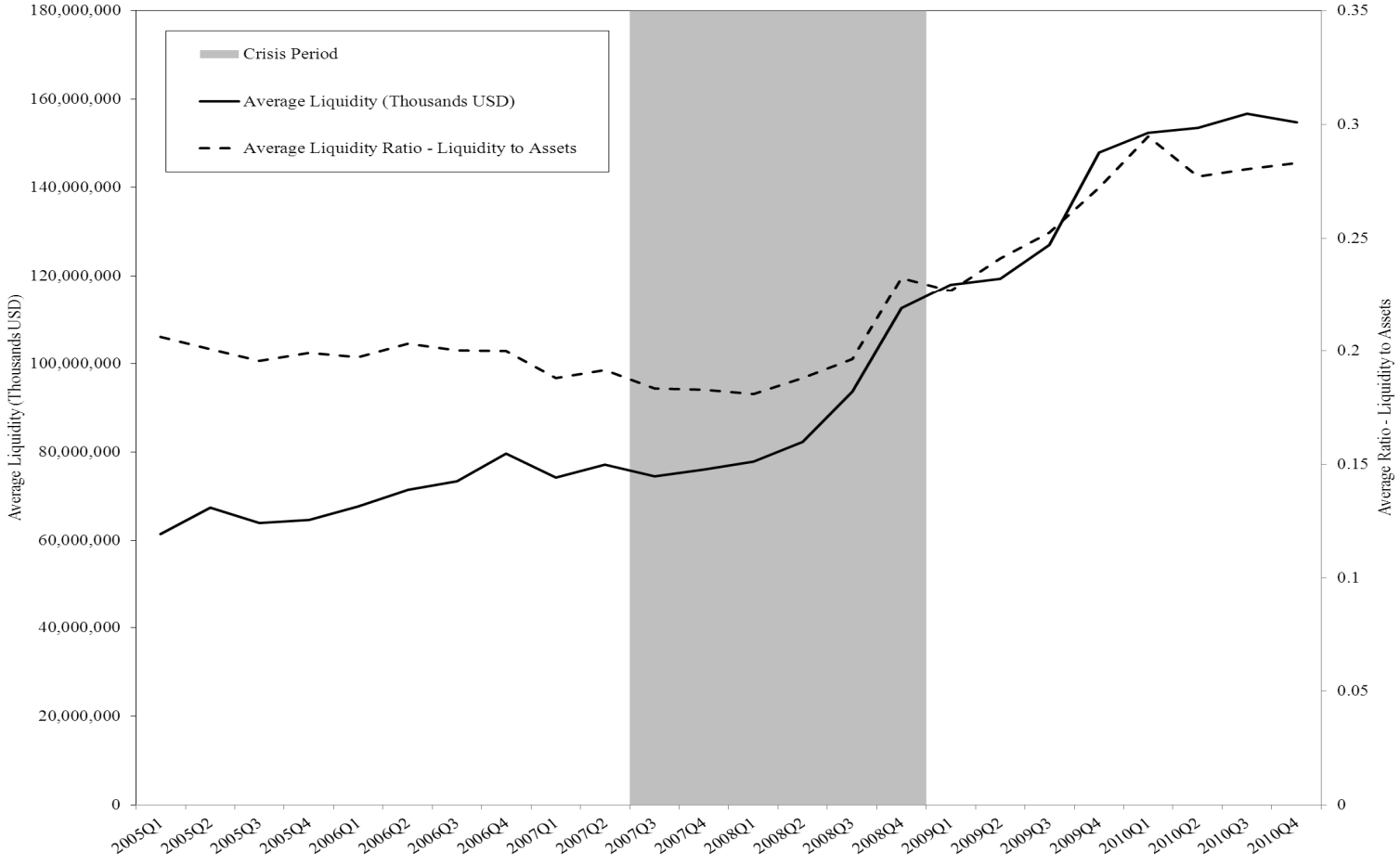
Note: The solid line represents the proportion of average total residential real estate loans to average total bank loans computed quarterly for banks that hold average total assets > U.S. $20 billion and U.S. $90 billion. The dollar amounts used to compute this series are expressed in thousands of U.S. dollars. The left axis reflects the proportion of residential loans to total loans. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4. These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.9 Liquidity Trend Analysis-Small Banks (Average Total Assets < U.S. $1 billion)



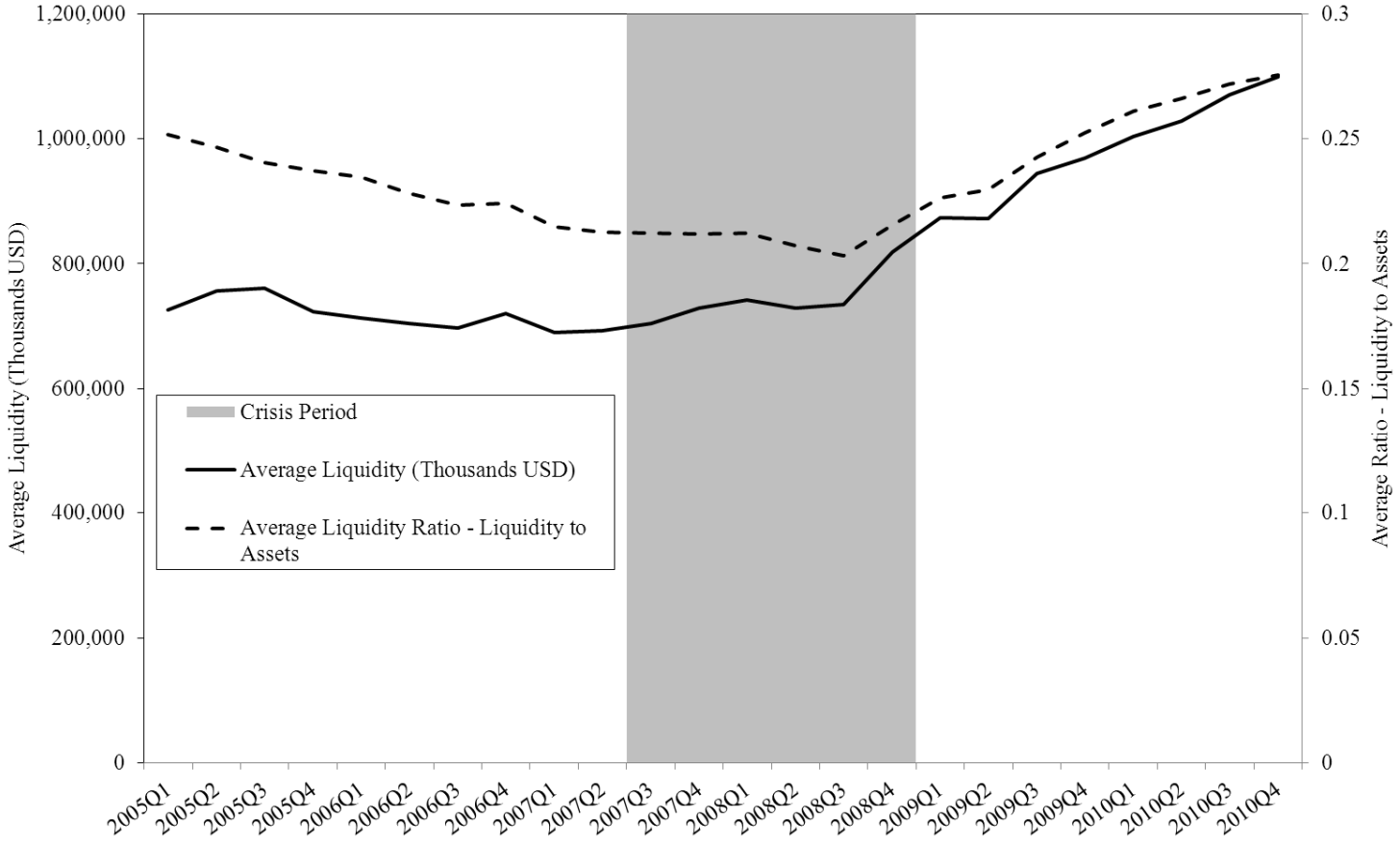
Note: The solid line represents the average of bank total liquidity computed quarterly for banks that hold average total assets < U.S. $1 billion. The liquidity amount includes cash and balances due from depository institutions, securities available for sale and held to maturity. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank liquidity to average total bank assets. The left axis reflects the average total bank liquidity while the right axis shows the proportion of liquidity to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.10 Liquidity Trend Analysis-Money Center Banks (Average Total Assets > U.S. $90 billion)



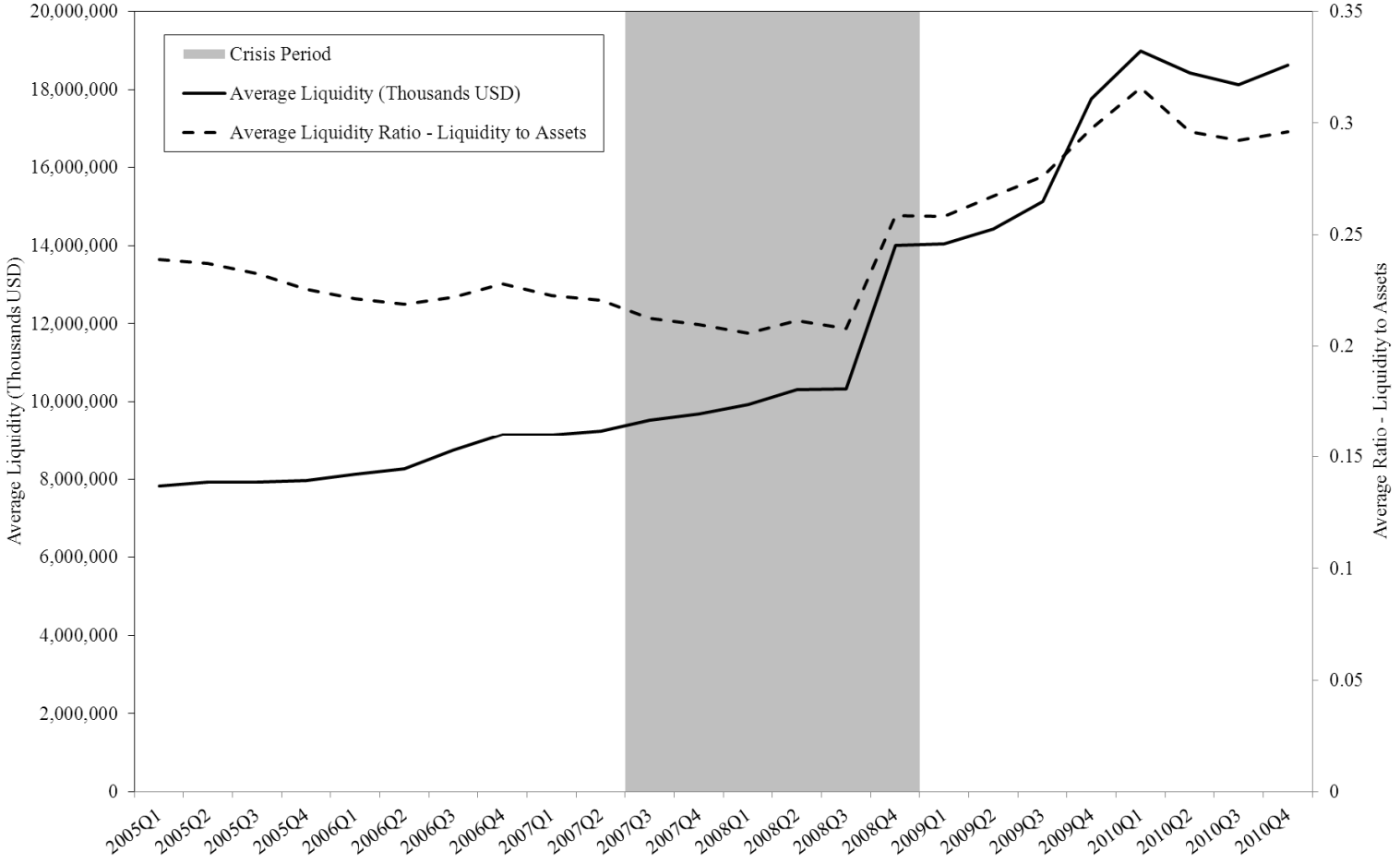
Note: The solid line represents the average of bank total liquidity computed quarterly for banks that hold average total assets > U.S. $90 billion. The liquidity amount includes cash and balances due from depository institutions, securities available for sale and held to maturity. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank liquidity to average total bank assets. The left axis reflects the average total bank liquidity while the right axis shows the proportion of liquidity to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Figure 4.11 Liquidity Trend Analysis-Medium Banks (Average Total Assets > U.S. $1 billion and < U.S. $ 20 billion)



Note: The solid line represents the average of bank total liquidity computed quarterly for banks that hold average total assets > U.S. $1 billion and < U.S. $20 billion. The liquidity amount includes cash and balances due from depository institutions, securities available for sale and held to maturity. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank liquidity to average total bank assets. The left axis reflects the average total bank liquidity while the right axis shows the proportion of liquidity to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12

Figure 4.12 Liquidity Trend Analysis-Large Banks (Average Total Assets > U.S. $20 billion and < U.S. $ 90 billion)



Note: The solid line represents the average of bank total liquidity computed quarterly for banks that hold average total assets > U.S. $20 billion and < U.S. $90 billion. The liquidity amount includes cash and balances due from depository institutions, securities available for sale and held to maturity. The dollar amounts are expressed in thousands of U.S. dollars. The dotted line shows the proportion of average total bank liquidity to average total bank assets. The left axis reflects the average total bank liquidity while the right axis shows the proportion of liquidity to total assets. The shaded area represents the crisis period that covers from 2007Q3 to 2008Q4.These series represent author's calculations. Bank data obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12.

Table 4.1 Correlation Matrix Independent Variables

Panel A Small Bank Subsample (TA < U.S. $1 billion)

	lta	loans	nop	capt1r	dep I	dep II	depcost	lc	npl	repo	QE
lta	1.000										
loans	0.080	1.000									
nop	-0.045	-0.034	1.000								
capt1r	-0.175	-0.267	0.084	1.000							
dep I	-0.252	-0.045	0.008	-0.129	1.000						
dep II	-0.417	-0.050	0.083	-0.028	0.636	1.000					
depcost	0.044	0.043	-0.001	0.074	-0.146	-0.118	1.000				
lc	0.018	0.039	0.015	-0.014	-0.008	-0.003	-0.001	1.000			
npl	0.080	0.013	-0.499	-0.069	-0.004	-0.065	-0.004	-0.017	1.000		
repo	0.058	0.032	-0.090	-0.067	-0.054	-0.061	-0.033	-0.005	0.093	1.000	
QE	0.076	-0.008	-0.201	-0.056	-0.026	-0.044	-0.056	-0.013	0.227	0.482	1.000

Panel B Medium Bank Subsample (TA> U.S. $1 billion and < U.S. $20 billion)

	lta	loans	nop	capt1r	dep I	dep II	depcost	lc	npl	repo	QE
lta	1.000										
loans	-0.091	1.000									
nop	-0.078	-0.029	1.000								
capt1r	-0.045	-0.317	0.183	1.000							
dep I	-0.231	0.093	-0.112	-0.245	1.000						
dep II	-0.125	0.090	0.087	-0.060	0.202	1.000					
depcost	-0.070	0.196	-0.008	-0.056	-0.081	-0.138	1.000				
lc	0.012	0.080	0.035	-0.047	-0.261	-0.035	0.017	1.000			
npl	0.122	-0.028	-0.469	-0.105	0.064	-0.138	-0.020	-0.014	1.000		
repo	0.079	0.047	-0.148	-0.061	-0.053	-0.126	0.135	-0.008	0.134	1.000	
QE	0.092	-0.026	-0.262	-0.032	0.040	-0.087	-0.126	-0.016	0.332	0.482	1.000

Table 4.1 Correlation Matrix Independent Variables-continued

Panel C Large Bank Subsample (TA> U.S. $20 billion and < U.S. $90 billion)

	lta	loans	nop	capt1r	dep I	dep II	depcost	lc	npl	repo	QE
lta	1.000										
loans	-0.076	1.000									
nop	-0.175	0.077	1.000								
capt1r	-0.128	-0.540	0.045	1.000							
dep I	-0.151	0.029	-0.155	-0.296	1.000						
dep II	-0.037	-0.127	-0.093	-0.011	0.155	1.000					
depcost	-0.162	0.227	0.185	-0.117	-0.034	-0.201	1.000				
lc	0.167	0.245	-0.040	-0.298	0.098	0.145	-0.103	1.000			
npl	0.161	0.007	-0.379	0.034	0.021	0.210	-0.208	0.031	1.000		
repo	0.183	-0.031	-0.296	-0.074	-0.001	0.000	0.092	-0.061	0.175	1.000	
QE	0.216	-0.103	-0.398	0.014	0.066	0.054	-0.203	-0.076	0.433	0.482	1.000

Panel D Money Center Bank Subsample (TA> U.S. $90 billion)

	lta	Loans	nop	capt1r	dep I	dep II	depcost	lc	npl	Repo	QE
lta	1.000										
loans	-0.430	1.000									
nop	-0.008	-0.033	1.000								
capt1r	0.116	-0.351	-0.220	1.000							
dep I	-0.471	0.676	-0.067	-0.113	1.000						
dep II	-0.187	-0.279	0.213	0.079	0.167	1.000					
depcost	-0.079	0.259	-0.021	-0.320	-0.005	-0.279	1.000				
lc	0.198	-0.596	0.069	0.046	-0.764	-0.083	-0.024	1.000			
npl	0.314	-0.112	-0.424	0.547	0.091	-0.046	-0.372	-0.217	1.000		
repo	0.079	-0.038	-0.404	-0.024	-0.007	-0.072	0.035	-0.151	0.197	1.000	
QE	0.081	-0.113	-0.388	0.284	0.076	0.009	-0.270	-0.191	0.578	0.482	1.000

Note: Bank total assets (lta) expressed in log form. The loans (loans), net operating income (nop), deposit (dep I & II), and commercial letters of credit (lc) variables are scaled by bank total assets. The non-performing loans (npl) variable is scaled by bank total loans. Tier1 risk-based capital (capt1r) and deposit cost (depcost) variables are in ratio form. Bank data was obtained from FDICs statistics on depository institutions (SDI) website http://www2.fdic.gov/sdi/index.asp last accessed pm 8/15/12. The repo spread (repo) variable was computed by subtracting the Overnight Index Swap (OIS) series from the 90 day repo rate for a given bond class collateralized by mortgage backed securities. Quantitative easing (QE) is a dummy variable assigned a value of one during the Fed's initial round of quantitative easing from 2008Q4 to 2010Q1 and zero otherwise. Sample period 2005Q1 to2010Q4.

Table 4.2 Dynamic panel models. Dependent variable: Bank liquidity growth, small bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Liquidity growth (1-lag)	.017(.039)	.034(.039)	.039(.042)	.018(.039)	.018(.039)	.018(.039)	.017(.039)
Bank Total Assets normalized	.177***(.030)	.170***(.031)	.136***(.031)	.176***(.030)	.179***(.030)	.177***(.029)	.175***(.029)
Bank Loans normalized	.153**(.077)			.151**(.076)	.155**(.077)	.116**(.053)	.091(.057)
Bank Net Operating Income normalized	-.010**(.005)	-.011**(.005)	-.013***(.005)	-.011**(.005)	-.011**(.005)	-.011**(.005)	-.009**(.005)
Bank Tier 1 Capital normalized	.000(.001)	.000(.001)	.003***(.001)	.000(.001)	.000(.001)	.000(.001)	.000(.001)
Bank Deposits- I normalized			.273***(.007)				
Bank Deposits- II normalized	.941***(.027)	.942***(.027)		.941***(.027)	.941***(.027)	.936***(.027)	.942***(.027)
Bank Deposit Costs normalized	-.215***(.075)	-.212***(.070)	-.121***(.046)	-.216***(.075)	-.216***(.075)	-.215***(.075)	-.215***(.075)
Letters of Credit normalized		-2.563**(1.232)					
Non–Performing Loans normalized	-.001(.002)			-.001(.002)	-.001(.002)	-.000(.002)	-.002(.002)
Repo-OIS spread	.058***(.006)	.057***(.006)	.058***(.006)		.042***(.008)	.047***(.007)	.042***(.008)
QE dummy				.042***(.007)	.031***(.008)	.030***(.008)	.031***(.008)
Bank Loans normalized*Repo-OIS spread						.240***(.061)	
Bank Loans normalized*QE							.241***(.057)
Hansen Test-Chi square	52.90	46.03	127.49	52.17	52.23	56.84	55.51
Prob> Chi-square	.000	.000	.000	.000	.000	.000	.000
AB(1) z	.000	.000	.000	.000	.000	.000	.000
AB(2) z	.000	.000	.000	.000	.000	.000	.000

The dependent variable liquidity includes cash in banks and securities held to maturity and available for sale. Bank total assets and loans are treated as endogenous in all models. Liquidity and bank total assets enter the models in log form. The bank loans, net operating income, deposit measures (I&II) and letters of credit are scaled by bank total assets while the non-performing loans variable is scaled by bank total loans. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 4,982 banks in the sample of small banks defined as those banks with total assets less than U.S. $1 billion as of the beginning of the sample period. There are 95,417observations in each model run. Models 1, 2, 3, 4, 5, and 6 employ 16, 13, 12, 16, 17, and 20 instruments respectively. Sample period 2005Q1-2010Q4.

Table 4.3 Dynamic panel models. Dependent variable: Bank liquidity growth, medium bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Liquidity growth (1-lag)	-.640**(.251)	-.723***(.116)	-.756***(.183)	-.637**(.264)	-.637**(.262)	-.647***(.216)	-.664***(.169)
Liquidity growth (2-lags)	-.057*(.033)	-.062*(.034)	-.072*(.037)	-.059*(.034)	-.058*(.034)	-.058*(.036)	-.059*(.032)
Bank Total Assets normalized	.188(.200)	.150(.224)	.149(.255)	.212(.202)	.209(.203)	.191(.179)	.206(.174)
Bank Loans normalized	.172(.332)			.189(.336)	.191(.335)	.281(.306)	.128(.203)
Bank Net Operating Income normalized	-.002(.004)	-.002(.004)	-.003(.004)	-.003(.004)	-.003(.004)	-.003(.004)	-.002(.004)
Bank Tier 1 Capital normalized	.000(.003)	.000(.004)	.000(.004)	.000(.003)	.000(.003)	.000(.004)	-.000(.004)
Bank Deposits- I normalized			-.229(.300)				
Bank Deposits- II normalized	.138(.274)	.062(.252)		.137(.277)	.136(.276)	.114(.230)	.117(.224)
Bank Deposit Costs normalized	-3.601**(1.459)	-3.311**(1.407)	-3.381**(1.531)	-3.621**(1.476)	-3.638**(1.479)	-3.722**(1.570)	-3.451***(1.158)
Letters of Credit normalized		18.038***(2.775)					
Non–Performing Loans normalized	-.006**(.003)			-.005*(.003)	-.005*(.003)	-.005*(.003)	-.006**(.003)
Repo-OIS spread	.053***(.017)	.045**(.018)	.047**(.020)		.023(.015)	.022*(.012)	.021*(.013)
QE dummy				.068***(.011)	.063***(.010)	.062***(.009)	.063***(.010)
Bank Loans normalized*Repo-OIS spread						-.070(.448)	
Bank Loans normalized*QE							.169(.148)
Hansen Test-Chi square	6.32	3.57	4.21	6.66	6.66	7.50	7.68
Prob> Chi-square	.276	.311	.240	.247	.247	.379	.362
AB(1) z	.365	.374	.432	.374	.372	.322	.297
AB(2) z	.323	.000	.028	.361	.360	.220	.097

The dependent variable liquidity includes cash in banks and securities held to maturity and available for sale. Bank total assets and loans are treated as endogenous in all models. Liquidity and bank total assets enter the models in log form. The bank loans, net operating income, deposit measures (I&II) and letters of credit are scaled by bank total assets while the non-performing loans variable is scaled by bank total loans. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 475 banks in the sample of medium banks defined as those banks with total assets ranging between U.S. $1 billion and $20 billion as of the beginning of the sample period. There are 9,353 observations in each model run. Models 1, 2, 3, 4, 5, and 6 employ 16, 13, 12, 16, 17, and 20 instruments respectively. Sample period 2005Q1-2010Q4.

Table 4.4 Dynamic panel models. Dependent variable: Bank liquidity growth, large bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Liquidity growth (1-lag)	-.310(.270)	-.641*(.353)	-.583(.395)	-.275(.278)	-.266(.288)	-.329(.285)	-.211(.274)
Bank Total Assets normalized	-.037(.194)	-.307(.263)	-.258(.307)	.015(.195)	.008(.198)	-.084(.243)	.111(.220)
Bank Loans normalized	-.684(1.121)			-.503(1.130)	-.519(1.175)	-.627(.755)	-.962(1.105)
Bank Net Operating Income normalized	-.022(.014)	-.015(.014)	-.013(.015)	-.019(.015)	-.020(.016)	-.013(.014)	-.025*(.015)
Bank Tier 1 Capital normalized	.011(.020)	.006(.022)	.008(.025)	.012(.020)	.012(.022)	.008(.024)	.028(.018)
Bank Deposits- I normalized			-.895(.650)				
Bank Deposits- II normalized	2.505*(1.382)	3.230**(1.575)		2.417*(1.317)	2.405*(1.300)	2.922(2.065)	1.034(1.309)
Bank Deposit Costs normalized	-3.754(9.222)	-3.420(6.947)	-8.543(6.081)	-6.721(9.855)	-6.737(9.942)	-3.876(8.658)	-9.943(8.815)
Letters of Credit normalized		-11.741(22.273)					
Non–Performing Loans normalized	.029(.028)			.029(.033)	.030(.033)	.028(.049)	.040(.028)
Repo-OIS spread	.107(.092)	.070(.093)	.067(.103)		.053(.076)	.001(.098)	.122*(.066)
QE dummy				.117**(.059)	.104**(.051)	.089*(.049)	.119**(.051)
Bank Loans normalized*Repo-OIS spread						.734(1.339)	
Bank Loans normalized*QE							-.266(.475)
Prob> Chi-square	.665	.566	.524	.653	.644	.706	.493
AB(1) z	.354	.762	.745	.331	.341	.409	.220
AB(2) z	.523	.318	.348	.626	.648	.484	.797

The dependent variable liquidity includes cash in banks and securities held to maturity and available for sale. Bank total assets and loans are treated as endogenous in all models. Liquidity and bank total assets enter the models in log form. The bank loans, net operating income, deposit measures (I&II) and letters of credit are scaled by bank total assets while the non-performing loans variable is scaled by bank total loans. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 34 banks in the sample of large banks defined as those banks with total assets ranging between U.S. $20 billion and $90 billion as of the beginning of the sample period. There are 650 observations in each model run. Models 1, 2, 3, 4, 5, and 6 employ 16, 13, 12, 16, 17, and 20 instruments respectively. Sample period 2005Q1-2010Q4.

Table 4.5 Dynamic panel models. Dependent variable: Bank liquidity growth, money center bank sample

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Liquidity growth (1-lag)	-.040(.876)	-.441(.442)	-.318(.731)	-.232(.928)	-.016(1.078)	-.599**(.263)	-.003(1.311)
Bank Total Assets normalized	-.034(.159)	-.121(.293)	-.077(.293)	.088(.210)	-.047(.183)	-.482(.376)	.173(.785)
Bank Loans normalized	.250(.804)			.036(.987)	.057(.882)	-2.183**(.895)	1.815(2.882)
Bank Net Operating Income normalized	.017(.072)	.004(.052)	.009(.049)	.020(.057)	.017(.060)	-.033(.039)	.007(.096)
Bank Tier 1 Capital normalized	-.005(.035)	.003(.037)	.002(.048)	.003(.043)	-.018(.040)	.001(.023)	.001(.059)
Bank Deposits- I normalized			.504(1.513)				
Bank Deposits- II normalized	-3.246(3.307)	1.125(2.099)		1.188(2.160)	-3.228(4.776)	7.606***(2.719)	-1.554(11.561)
Bank Deposit Costs normalized	-4.695(25.921)	-8.354	-6.519(11.326)	13.093(24.356)	2.620(34.198)	-14.053(15.373)	-16.383(49.522)
Letters of Credit normalized		-61.035***(23.648)					
Non–Performing Loans normalized	-.003(.054)			-.001(.050)	.001(.050)	.042***(.006)	-.073(.057)
Repo-OIS spread	.085(.100)	.149(.113)	.163*(.098)		.044(.094)	.065(.058)	.154(.132)
QE dummy				.113**(.053)	.052(.069)	.127**(.051)	.070(.099)
Bank Loans normalized*Repo-OIS spread						.979***(.167)	
Bank Loans normalized*QE							-.231(.766)
Hansen Test-Chi square	6.07	5.28	4.36	6.04	5.35	2.02	7.43
Prob> Chi-square	.415	.260	.359	.419	.500	.980	.491
AB(1) z	.543	.605	.639	.669	.582	.631	.645
AB(2) z	.976	.346	.725	.920	.966	.074	.953

The dependent variable liquidity includes cash in banks and securities held to maturity and available for sale. Bank total assets and loans are treated as endogenous in all models. Liquidity and bank total assets enter the models in log form. The bank loans, net operating income, deposit measures (I&II) and letters of credit are scaled by bank total assets while the non-performing loans variable is scaled by bank total loans. Deposit I measures domestic deposits consisting of the sum of demand deposits, money market deposits, saving deposits and time deposits. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 14 banks in the sample of money center banks defined as those banks with total assets greater than U.S. $90 billion as of the beginning of the sample period. There are 285 observations in each model run. Models 1, 2, 3, 4, 5, and 6 employ 16, 13, 12, 16, 17, and 20 instruments respectively. Sample period 2005Q1-2010Q4.

Table 4.6 Panel A TARP vs. Non-TARP Banks. Balance Sheet and Performance Descriptive Statistics Measures

Tier 1 Capital	TARP	NON-TARP	Difference (TARP - NON-TARP)
Pre-TARP Q(-4 to -1)	10.744%	11.100%	-0.356%***
Post-TARP Q (+1 to +4)	12.507%	11.910%	0.597%***
Difference (POST - PRE)	1.763%***	0.810%***	
Loans-to-Assets Ratio	**TARP**	**NON-TARP**	**Difference (TARP - NON-TARP)**
Pre-TARP Q(-4 to -1)	0.745	0.743	0.002
Post-TARP Q (+1 to +4)	0.709	0.710	-0.001
Difference (POST - PRE)	-0.036***	-0.034***	
Loan Quality	**TARP**	**NON-TARP**	**Difference (TARP - NON-TARP)**
Pre-TARP Q(-4 to -1)	1.604	2.063	-0.459***
Post-TARP Q (+1 to +4)	3.393	4.066	-0.672***
Difference (POST - PRE)	1.789***	2.003***	
Liquidity-to-Assets Ratio	**TARP**	**NON-TARP**	**Difference (TARP - NON-TARP)**
Pre-TARP Q(-4 to -1)	0.175	0.178	-0.004***
Post-TARP Q (+1 to +4)	0.208	0.208	0.000
Difference (POST - PRE)	0.033***	0.030***	
Performance	**TARP**	**NON-TARP**	**Difference (TARP - NON-TARP)**
Pre-TARP Q(-4 to -1)	0.499	0.579	-0.080**
Post-TARP Q (+1 to +4)	-0.213	-0.238	0.025
Difference (POST - PRE)	-0.713***	-0.817***	

Table 4. 6 Panel B TARP vs. Non-TARP Banks. Balance Sheet Descriptive Statistics Matching Criteria

Assets - TARP		Assets - NON-TARP	
Mean	2709223.988	Mean	2751961.027
Standard Error	362035.359	Standard Error	375644.176
Median	480691	Median	478765
Standard Deviation	8005812.582	Standard Deviation	8306749.031
Sample Variance	64093035094782.700	Sample Variance	69002079467118.900
Kurtosis	43.235	Kurtosis	45.395
Skewness	6.168	Skewness	6.326
Range	70378132	Range	76974081
Minimum	55457	Minimum	55622
Maximum	70433589	Maximum	77029703
Sum	1324810530	Sum	1345708942
Count	489	Count	489
Tier 1 Capital - TARP		Tier 1 Capital - NON-TARP	
Mean	11.967	Mean	10.825
Standard Error	0.106	Standard Error	0.124
Median	11.583	Median	10.402
Standard Deviation	2.347	Standard Deviation	2.740
Sample Variance	5.509	Sample Variance	7.510
Kurtosis	3.391	Kurtosis	22.478
Skewness	1.425	Skewness	2.744
Range	15.951	Range	37.127
Minimum	6.444	Minimum	0.422
Maximum	22.395	Maximum	37.549
Sum	5851.901	Sum	5293.575
Count	489.000	Count	489.000
Liquidity - TARP		Liquidity NON-TARP	
Mean	0.191	Mean	0.187
Standard Error	0.004	Standard Error	0.004
Median	0.180	Median	0.181
Standard Deviation	0.095	Standard Deviation	0.081
Sample Variance	0.009	Sample Variance	0.007
Kurtosis	1.161	Kurtosis	1.494
Skewness	0.849	Skewness	0.822
Range	0.598	Range	0.543
Minimum	0.016	Minimum	0.016
Maximum	0.614	Maximum	0.559
Sum	93.308	Sum	91.436
Count	489	Count	489

Bank assets expressed in levels and in thousands of dollars. The Tier 1 capital variable is defined as the ratio of bank Tier 1capital to total risk weighted assets. The Liquidity variable is measured as the sum of cash in banks and securities held to maturity and available for sale scaled by bank total assets. The descriptive detail is for the sample of TARP and the matched non-TARP banks as of the quarter in which the match is made. There are 489 TARP banks and 425 non-TARP banks in the full sample therefore some non-TARP banks were selected more than once as the best match.

Table 4.7 Dynamic panel models. Dependent variable: Bank liquidity growth, TARP vs. Non-TARP banks

	TARP		Non-TARP	
	Model 1	Model 2	Model 1	Model 2
Liquidity growth (1-lag)	0.147(0.245)	0.679(0.517)	0.256(0.335)	0.048(0.363)
Bank Total Assets normalized	-0.009(0.038)	-0.033(0.048)	0.089*(0.047)	0.061(0.048)
Bank Loans normalized	-0.395(0.874)		0.336(1.310)	
Bank Net Operating Income normalized	-0.007(0.011)	-0.009(0.013)	-0.018*(0.010)	-0.018*(0.010)
Bank Tier 1 Capital normalized	-0.008(0.007)	-0.011(0.008)	0.008(0.006)	0.010*(0.006)
Bank Deposits- II normalized	1.311***(0.266)	1.709***(0.411)	1.613***(0.418)	1.831***(0.399)
Bank Deposit Costs normalized	-4.417***(1.669)	-4.146**(2.045)	-2.490(2.073)	-2.691(1.788)
Letters of Credit normalized		-3.028(5.914)		4.785(4.327)
Non–Performing Loans normalized	0.000(0.010)		-0.007(0.008)	
Repo-OIS spread	0.122***(0.023)	0.108***(0.030)	0.074***(0.022)	0.078***(0.023)
Crisis dummy	-0.001(0.034)	0.064(0.064)	-0.022(0.035)	-0.027(0.036)
Hansen Test-Chi square	8.69	4.05	16.77	2.58
Prob> Chi-square	0.192	0.400	0.010	0.631
AB(1) z	0.004	0.025	0.020	0.095
AB(2) z	0.835	0.341	0.522	0.982

The dependent variable liquidity includes cash in banks and securities held to maturity and available for sale. Bank total assets and loans are treated as endogenous in all models. Liquidity and bank total assets enter the models in log form. The bank loans, net operating income, deposit measure and letters of credit are scaled by bank total assets while the non-performing loans variable is scaled by bank total loans. Deposit II captures demand deposits and NOW accounts aka transaction deposits. The bank Tier 1 capital and the bank deposit cost variables are expressed in ratio form. All right hand side bank variables are normalized with respect to their averages across all banks in a given sample. The models employ the Blundell-Bond (1998) two-step estimator. The Hansen tests report the orthogonal conditions of over-identifying restrictions of the instruments as a group under the null that over-identifying restrictions are valid, i.e. exogeneity of instruments. AB (1) and AB (2) refer to Arellano-Bond serial correlation tests under the null of no autocorrelation in the first differenced error terms. Corrected standard errors are reported in parenthesis. The symbols *, **, and *** refer to levels of significance of 10, 5, and 1% respectively. There are 489 banks in the TARP bank sample and 425 banks in the non- TARP bank sample therefore some non-TARP banks are matched on more than one TARP bank. There are 3,351 (2,916) observations in each TARP (non-TARP bank) bank model run. Model 1 and 2 employ 17 and 14 instruments respectively. Sample period 2007Q4-2010Q4.

CHAPTER V

CONCLUSION

The 2007- 2009 financial crisis, while unfortunate, has spawned a new wave of research opportunities that are of interest to academicians, economic policy makers, regulators, bank managers, investors, and other affected parties including households and businesses. The 2007-2009 financial crisis like previous crisis is rooted in lax monetary policy with interest rates at historic lows and was accompanied by a housing market boom and bust. What is unique to this latest financial crisis is the transformation of the banking system leading to the development of securitized banking and the shift towards short-term funding sources provided through the money and capital markets and the ensuing government intervention by the Federal Reserve and the U.S. Treasury to revive the frail U.S. economy. This dissertation has two basic research objectives:1) to investigate the impact of securitization on bank lending in the midst of the 2007-2009 financial crisis and employ methodologies from the bank lending channel (BLC) literature to assess the impact of the subprime mortgage collapse on bank lending, and 2) to examine whether there are changes in banks' balance sheet composition primarily in terms of liquid asset holdings and loan portfolio exposures that are associated with the government intervention whose objective was to stabilize the financial system.

In Chapter 3 of this dissertation I find that traditional bank costs of funding play a diminished role in the supply of bank lending. The negative relationship is well captured in the medium bank sample case under the dynamic panel specifications. The fact that variability in deposit costs does not explain bank lending growth in the large and money center samples

implies that larger banks have greater access to the securitization markets which arguably has become an important alternative funding source as suggested by Loutskina (2011) and others. However, it is interesting that the impact of Repo-OIS spread on lending seems to be present only in the small and medium bank samples and that the relationship is a positive one. While a widening of the Repo-OIS spread would *a priori* have a negative impact on lending, the positive and significant coefficient on the interaction term with respect to the Repo-OIS spread with the crisis indicator variable suggests that during the crisis period as the Repo-OIS spread rises bank lending for the small and medium bank sample cases also increases. This finding provides support to the theoretical model of financial intermediation proposed by Shleifer and Vishny (2010) that incorporates the effects of investor sentiment in the markets that suggest that banks have an incentive to securitize loans as long as the fees generated from loans are higher than what the banks expect they may potentially loose on their holdings of securitized asset should prices fall.

In Chapter 3 of this dissertation I also find some evidence supporting an inverse relationship between a bank's residential real estate portfolio exposure and overall bank lending that is particularly strong in the small and medium bank samples. Another interesting finding associated with the small bank sample is that banks with high exposure in their residential real estate portfolios increase new lending activity by a greater amount compared to banks with lower exposure in their residential real estate portfolios during the crisis period. The finding in the small bank sample case is consistent with the institutional memory hypothesis problem proposed by Berger and Udell (2004). The evidence presented in Chapter 3 with respective to the hypothesized positive relationship between transaction deposits and bank lending is mixed. The positive relationship between transaction deposits (Deposits II variable) and bank lending is well

captured in the small bank sample. I also find that the positive relationship between transaction deposits and bank lending weakens as bank size increases which is expected since the composition of the banks' balance sheet structure including sources of funding typically changes with bank size. An interesting finding in this dissertation is that banks with higher levels of transaction deposits reduce new lending activity by a greater amount compared to their counterparts with lower levels of transactions deposits during the crisis period which is evidenced in the medium bank sample case.

In Chapter 4 of this dissertation I find evidence that suggests that the Fed's initial round of quantitative easing served as an important channel through which banks were able to achieve their liquidity objectives which took center stage during the crisis period. In this essay I surmise that bank liquidity behavior is not necessarily constant between banks of different asset size classes. For example, contrary to the findings by Cornett et al (2011) yet consistent with the findings by Loutskina (2011), I find that transaction deposits are only important in explaining bank liquidity for small and large banks. Furthermore, non-performing loans have the expected negative impact on bank liquidity that only seems relevant in the medium bank sample and that "reputation effects" from commercial letters of credit on bank liquidity are only exhibited by the money center bank sample.

I also find evidence supporting a direct relationship between liquidity and the Repo-OIS spread that is well evidenced in the small and medium bank samples. In the case of the small and money center bank samples, the results suggest that as the Repo-OIS spread rises that banks with greater loan portfolio exposures scaled by bank total assets would tend to build liquidity compared to their counterparts that have lower lending exposures. Cornett et al. (2011) reach a

similar conclusion when they apply their liquidity model to their large bank sample (their result was not significant when applied to their small bank sample).

The changes in bank balance sheet composition over the pre and post financial crisis period that are largely associated with the government intervention reveal some interesting results. The balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period with the shift being more discernible for the larger bank samples over the entire sample period. The residential real estate portfolio exposure has reverted to pre-crisis levels in the money center bank sample case and has remained fairly consistent throughout the sample period in all other bank samples with a modest rise noted in the post crisis period in the large bank sample case. Overall bank loan portfolios scaled by total average balance sheet holdings seem to have trended downward during the post crisis period with the exception of the large bank sample where post crisis exposures have held fairly steady.

Taken as a whole, it is interesting that the Repo-OIS spread has the same directional impact in my lending and liquidity models. This finding offers supports to the view that an active securitization market, which is usually linked to the repo markets, provides banks with a source of loan funding and liquidity. It is equally interesting to examine how demand deposits can serve as a key funding source of lending activity in the case of small banks while representing a key liquidity source with respect to small and large banks. Similarly, it is important to see how deposit costs impact both bank lending and liquidity behavior in a comparable manner such that when deposit costs rise both bank lending and liquidity fall in the smaller bank samples. Given that bank lending and liquidity risk management are dynamic processes driven by business cycle conditions, bank financial attributes and constraints, access to (and conditions of) capital and money markets and other internal and external factors, I employ a dynamic modeling approach.

More specifically, I employ dynamic panel methods and system GMM (SGMM) to estimate my lending and liquidity models as proposed by Blundell and Bond (1998) while most of the reviewed research uses static models of lending and liquidity behavior. The SGMM estimator is able to exploit the time-series attributes of the data, allows for the inclusion of lagged dependent variables as regressors and is capable of addressing endogeneity.

Overall the findings in my dissertation have important implications primarily for bank regulators. First, in the lending essay developed in Chapter 3 I find that not all banks (i.e. small, medium, large, and money center) behave in the same manner and therefore strong consideration should be given to re-assessing the existing pre-established guidelines that are used in determining a bank's level of safety and soundness. Second, even though the evidence of asymmetric affects of the Repo-OIS spread on bank lending is not common across all bank samples, the results from the small and medium bank samples provide an important signal that deserves attention. The securitization process is a lucrative venture that fueled bank lending in the pre-crisis period that if left unmonitored by regulators can result in significant negative consequences. As explained by Loutskina (2011) the securitization process jeopardized banks' fundamental screening and monitoring roles by affectively allowing them to easily move assets off their balance sheets. Depending on the severity of the potential negative outcomes the implication of this finding extends beyond bank regulators to policy makers and investors. Third, with liquidity creation being a central theme during the financial crisis period and given the generally perceived soft loan demand the balance sheet composition for banks in general has shifted towards more liquid based banks in the post crisis period. Overall bank liquidity exceeds pre-crisis levels in all bank samples and interest rates remain relatively low. Furthermore, if we accept that bank losses have been adequately recognized and that banks have been appropriately

recapitalized then the stage has been set for business recovery. This leads us to contemplate on the following questions: Will we witness a loosening of bank credit standards to promote bank lending to help revive the economy? Have lessons been learned from the 2007-2009 financial crisis and are the bank regulators prepared to handle the new challenges that face them? How will an eventual subsequent contraction of the Federal Reserve's balance sheet which should hypothetically have a negative impact on liquidity in the financial system impact bank lending? These questions and many others become the spring board for ongoing research in this interesting field of study.

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APPENDIX A

APPENDIX A

BANK VARIABLES

Variable name	Code
Interest on deposits in domestic offices	intdepdom
Held to maturity securities	sechtmat
Available for sale securities	secfsale
Loans & leases net of unearned income and allowance	netloans
Total Assets	asset
Deposits in domestic offices	depdom
Secured by 1-4 family residential properties revolving and closed-end loans	reloans
Commercial and Industrial loans- to U.S. addressees(domicile)	comloansdom
Tier 1 risk-based capital ratio	capt1r
Cash and balances due from depository institutions	cash
Federal funds sold and reverse repurchase	ffsrepo
Transaction accounts-demand deposits and NOW accounts	trnaccts
Mortgage backed securities	rmbs
Asset backed securities- excludes mortgage backed securities	abs

Notes: The report files are zip files available in excel format that contain data compiled from Federal Reserve Consolidated Reports of Condition and Income ("call reports") submitted by insured banks on a quarterly basis. The call reports that commercial banks file are Federal Financial Institutions Examination Council (FFIEC) forms FFIEC-031 or FFIEC-041. The choice of the FFIEC form is dictated by the geographic scope of the bank business (i.e. domestic offices only FFIEC-041 or domestic and foreign offices FFIEC-031). The data is available through Federal Deposit Insurance Corporation (FDIC) website. http://www2.fdic.gov/sdi/index.asp. Under the FDIC website we choose the Industry Analysis tab which allows us to select the Bank Data and Statistics link. From the Bank Data and Statistics page we choose the statistics on depository institutions (SDI) link that allows access to the SDI data base.

APPENDIX B

APPENDIX B

BANK VARIABLES

Variable name	Code
Interest on deposits in domestic offices	intdepdom
Held to maturity securities	sechtmat
Available for sale securities	secfsale
Loans & leases net of unearned income and allowance	netloans
Total Assets	asset
Deposits in domestic offices	depdom
Secured by 1-4 family residential properties revolving and closed-end loans	reloans
Commercial and similar letters of credit	lc
Tier 1 risk-based capital ratio	capt1r
Cash and balances due from depository institutions	cash
Noncurrent loans to loans	npl
Transaction accounts-demand deposits and NOW accounts	trnaccts
Net operating income to assets	nop

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BIOGRAPHICAL SKETCH

Peter Victor Egly earned the degree of Doctor of Philosophy in Business Administration with concentration in Finance at the University of Texas- Pan American in 2013. He graduated from Texas A&M University in 1982 with a Bachelor's Degree in Business Administration with an emphasis in Management. Shortly after graduation, Peter started his thirty year banking career with the First National Bank of Brownsville aka Wells Fargo Bank, NA. While fulfilling his banking role in the mid 1980s, Peter was also a part time instructor imparting banking courses at Texas Southmost College in Brownsville, Texas. During his banking career Peter has worked in various lending and credit administration capacities currently supporting Wells Fargo Bank's business banking units in the Rio Grande Valley, Laredo and El Paso markets. His research focus is in banking issues. Peter has peer-reviewed journal publications in the *North American Journal of Finance and Banking Research* and the *Review of Quantitative Finance and Accounting*. Peter Victor Egly can be reached at 1544 Whitewing Drive in Brownsville, Texas 78521 or by phone at (956) 542-0127