Essays in Macroeconomics and Finance

by

Amir Reza Mohsenzadeh Kermani

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ABSTRACT

The first chapter proposes a model of booms and busts in housing and non-housing consumption driven by the interplay between relatively low interest rates and an expansion of credit, triggered by further decline in interest rates and relaxing collateral requirements. When credit becomes available, households would like to borrow in order to frontload consumption, and this increases demand for housing and non-housing consumption. If the increase in the demand for housing translates into an increase in prices, then credit is fueled further, this time endogenously, because of the role of housing as collateral. Because a lifetime budget constraint still applies, even in the absence of a financial crisis, the initial expansion in housing and non-housing consumption will be followed by a period of contraction, with declining consumption and house prices. My mechanism clarifies that boom-bust dynamics will be accentuated in regions with inelastic supply of housing and muted in elastic regions. In line with qualitative predictions of my model, I provide evidence that differences in regions' elasticity of housing and initial relaxation of collateral constraints can explain most of the 2000-2006 boom and the subsequent bust in house prices and consumption across US counties.
The second chapter (co-authored with Daron Acemoglu, Simon Johnson, James Kwak and Todd Mitton) studies the value of political connections during turbulent times and shows the announcement of Tim Geithner as President-elect Obamas nominee for Treasury Secretary in November 2008 produced a cumulative abnormal return for financial firms with which he had a personal connection. This return was around 15 percent from day 0 through day 10, relative to other comparable financial firms. This result holds across a range of robustness checks and regardless of whether we measure connections in terms of meetings he had in 2007-08, non-profit board memberships he shared with financial services executives, or firms with headquarters in New York City. There were subsequently abnormal negative returns for connected firms when news broke that Geithners conrmation might be derailed by tax issues. We argue that this value of connections reflects the perceived impact of relying on the advice of a small network of financial sector executives during a time of acute crisis and heightened policy discretion.
The third chapter (co-authored with Adam Ashcraft and Kunal Gooriah) studies the impact of skin-in-the-game on the performance of securitized assets using evidence from conduit commercial mortgage backed securities (CMBS) market. A unique feature of this market is that an informed investor purchases the bottom 5 percent of the capital structure, known as the B-piece, conducting independent screening of loans from which all other investors benefit. However, during the recent credit boom, a secondary market for B-pieces developed, permitting these investors to significantly reduce their skin in the game. In this paper, we document, that after controlling for all information available at issue, the percentage of the B-piece that is sold by these investors has a significant adverse impact on the probability that more senior tranches ultimately default. The result is robust to the use of an instrumental variables strategy which relies on the greater ability of larger B-piece buyers to to sell these positions given the need for large pools of collateral. Moreover we show the risk associated with this agency problem was not priced.

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Contents

Chapter 1

Cheap Credit, Collateral and the Boom-Bust Cycle

1.1 Introduction[1]

During the period of 2000 to 2006, there was a decline in real interest rates followed by a rise of securitization and an easing of collateral requirements (Figure 1.1a). The US flow of funds during this period shows that in just seven years the stock of household mortgage liabilities more than doubled, increasing by 5.7 trillion dollars.[2] Despite a boom in housing construction, net investment of households in residential housing during this period comprised merely 2.4 trillion dollars, the other 3.3 trillion dollars of this amount is money cashed out from home equity.[3] Interestingly, as Figure 1.1b shows, during this period the total valule of cash-outs and the US current account deficit followed each other very closely. Turning to regional variations within the US, regions that accumulated more debt during this period experienced a larger boom in house prices and consumption which was followed by a larger bust in subsequent years (Figure 1.2).

This paper proposes an analysis of the economic boom and bust, where the bust is an inevitable consequence of the boom and provides empirical evidence from US counties to support this explanation. At the heart of the theory is the unsustainable increase in consumption driven by expanded credit and housing price increases that relax credit constraints. Crucially, it is the nature of this sort of increase in consumption that it must be reversed even in the absence of a financial crisis. My theory accounts not only for

[1]I am especially grateful to my advisors Daron Acemoglu, Simon Johnson and Rob Townsend for their invaluable guidance, encouragement and support. I also thank Marios Angelotos, David Autor, Abhijit Banerjee, Bengt Holmstrom, Nobu Kiyotaki, Guido Lorenzoni,Michael Peters, Ali Shourideh and especially Adam Ashcraft, Veronica Guerrieri, Jim Poterba and Iván Werning as well as seminar participants at Berkeley, LSE, LBS, MIT,U of Michigan and U of Texas at Austin . All errors are my own.

[2]From 4.7 trillion dollars in 1999 to 10.5 trillion dollars in 2006.

[3]Greenspan and Kennedy (2008) shows that the process of home equity cash-out began in the early 80s and accelerated by 1998. They estimate that since 1990, home equity extraction accounts for four-fifths of the increase in mortgage liabilities and for almost all the decline in the US households savings rate. The fact that home equity cash outs are even more important in their calculations partly springs from their definition of a cash-out which includes loans used for home improvement as well.

the boom-bust dynamics of housing wealth and consumption, but also for a central fact that has received insufficient attention: a significant fraction of the increase in consumption in many areas of the United States was financed by borrowing on housing collateral.[4] The theory thus links the decline in consumption and housing wealth in many economic sub regions to the very increase in consumption and housing wealth in the area and emphasizes that this cycle need not be driven by irrationality or exploitation by financial intermediaries. Rather the cycle results naturally from the interplay between expanding credit, consumers keen on frontloading their consumption, and the endogenous relaxation of credit constraints in a market dominated by housing collateral.

To be more precise, I consider an open economy with two main ingredients: the interest rate is lower than the discount rate of consumers, and households are subject to borrowing constraints with housing acting as collateral (as well as providing housing services). These two ingredients together lead to a pattern in which if it is possible to borrow, households borrow and increase their housing and non-housing consumption, and the rise in demand for housing becomes partially self-reinforcing because it increases housing prices- creating both a wealth effect and further relaxing credit constraints. However, because a lifetime budget constraint still applies, these households must reduce their housing and non-housing consumption in the future (which is anticipated), and when they do so, the dynamics play out in reverse. Given the low interest rate, they are willing to endure this period of declining consumption in return for the early consumption.

My theoretical mechanism highlights the importance of three factors in shaping how pronounced these dynamics will be. First is the expansion of credit, either because of further declines in interest rates or declines in collateral requirements that precipitate the entire boom-bust cycle in the first place. Second, is the difference between household time preference and the interest rate that determines the extent of frontloading behavior. Therefore, the lower the interest rate, the larger the boom-bust pattern induced by the same shocks. And third is the responsiveness of housing prices to the increase in demand for housing. Empirically, this is related to the elasticity of the housing supply, already emphasized and empirically exploited by Glaeser, Gyourko, and Saiz (2008), Saiz (2010) and Mian and Sufi (2011).

I show that the theoretical mechanism is quantitatively and qualitatively very different when housing supply is inelastic; an increase in housing demand leads to a rise in house prices, creating a wealth effect and relaxed credit constraints in a way that either does not happen or does not happen to the same extent with an elastic housing supply. In particular, a decline in interest rates reduces the user cost of housing, which leads to an increase in housing demand in all regions. In regions with an inelastic supply of housing, this raises the price of existing homes, which generates a wealth effect and relaxes the borrowing constraint. Relaxed borrowing constraints enable households in these regions to frontload their consumption, which results in a boom-bust cycle. On the other hand, in elastic regions, a decline in interest rates does not change house prices and therefore the borrowing constraint of households in elastic regions remains binding.

[4]The empirical work of Mian and Sufi (2011) is an exception which shows home-equity extraction due to rising home prices is responsible for both a large fraction of increase in household debt during the boom years as well as a rise in default rates in the years years following. However, they do not provide direct evidence on the relation between the rise in household debt and the rise in consumption during the boom years.

However, over time, households in these regions will use the resources freed from lower interest payments to buy a larger house and increase their non-housing consumption. A decline in collateral requirements relaxes the borrowing constraint in all regions, which increases the demand for housing and non-housing in the short run. In regions with inelastic supply of housing, then, credit is further expanded, this time endogenously, because of higher house prices. This will result in a boom-bust pattern that is amplified in inelastic regions.

In order to test the qualitative implications of my model at the reduced-form quantitative level, I build on a series of studies by Mian and Sufi (2009, 2011, 2012) and Mian, Rao and Sufi (2012) and show that the basic predictions of my model are borne out by the data. In particular, I find that during the period 2000-2006, regions with more inelastic supply of housing (as measured by Saiz (2010)), and regions that experienced greater change in the fraction of loans sold to non-GSEs experienced a more rapid increase in consumption and house prices and at least 70 percent of changes in house price growth and consumption growth is attributed to these variables. These very same factors that explain the boom in house prices and consumption during 2000 to 2006 also explain a significant fraction of decline in house prices and consumption between 2006 and mid-2008. Moreover, I show regions with less elastic supply of housing and higher change in the fraction of loans sold to non-GSEs experienced higher growth in their mortgage liabilities, not only during the boom years of 2000 to 2006 but also during the downturn of mid-2006 to mid-2008. The fact that mortgage liabilities in these regions continued to grow even after the downturn in house prices and consumption suggest that a significant fraction of decline in house prices and consumption is not driven by households reducing their debt, but instead, is driven by the reduction in the amount that households can increase their debt holding. In terms of policy this is an important distinction because policies that allow households to rollover their debt can only reduce the part of the downturn that is due to the deleveraging of households.

My model also enables the analysis of the quantitative role different factors played in the boom-bust cycle of 2000-2010 in the US economy. To this purpose, I calibrate key parameters of my model for regions with different elasticities of housing and different changes in the fraction of loans sold to non-GSEs, based on static characteristics of these regions and the time series of household mortgage liabilities of these regions from 2000 to 2006. First, the parameters that results from this calibration shows a gradual decline in collateral requirements during the boom years with the most rapid decline happening between 2003 and 2004. This relaxation of collateral requirements is more extreme the more inelastic the region, and the higher the change in securitization rate in that region. These estimates resemble the findings of Lee, Mayer and Tracy (2012) on the rise of the use of second lien loans.[5] Second, I show that my model does a good job of replicating the rise in house prices and consumption for the boom years and for the beginning of the bust. Third, this exercise helps to estimate the contribution of different components to the boom and bust dynamics. In particular, the model shows that whereas most of increase in house prices during the period of 2000 to 2003 came from declining real interest rates, the boom in 2004 and 2005 was driven by declining

[5]This is also similar to the time series and cross section of changes in securitization rate that happened during the boom years.

collateral requirements. However, the model implies that the same decline in collateral requirements would have resulted in a significantly milder boom-bust in house prices and consumption if interest rates had been at the level they were in 2000. This result is mainly because with higher interest rates households would have less incentive to frontload their consumption.

In order to asses the contribution of the financial crisis to the downturn dynamics, I extend the calibration of changes in collateral requirements for the period after 2007 based on changes in the actual time series of household mortgage liabilities from 2007 to 2011 and compare the implied dynamics of housing prices and non-housing consumption with the model without a reversal in initial relaxation of borrowing constraints. First, estimated parameters show a steady decline in collateral requirements such that by 2011, most of the initial decline in collateral requirements is reversed. Second, absent a financial crisis, the model does a fairly good job at predicting the level of the decline in house prices and consumption during the bust, however, the decline happens over a longer period of time. Adding the reversal in initial decline in collateral requirements significantly helps the model predict the sharp decline in consumption and house prices. Moreover the model predicts that the initial decline in house prices and consumption will be followed by a slight recovery, but to a level that is close to the steady state of the economy without a reversal in initial relaxation of lending standards which is well below the level of house prices and consumption in 2006 (the very top of the boom years).

Finally, results of the quantitative exercise allow for the study of the impact of different policies on house prices and household consumption in different regions. In particular I compare the impact of two different policies: (i) further reductions in the real interest rate and (ii) loan modification. The policy experiment shows that lowering interest rates is not effective in increasing consumption of households living in elastic regions, whereas it does increase consumption a little in regions with an inelastic supply of housing. This result is driven by the asymmetric impact of real interest rates on house prices. On the other hand, loan modification increases consumption in all regions temporarily. However loan modification is just delaying the recovery procedure and the initial increase in consumption is followed by a decline in consumption and house prices in the years following. The effectiveness of policy in general is limited because the decline in consumption is not only driven by some households deleveraging their debt holding - as is the case in Eggertsson and Krugman (2012) and Guerrieri and Lorenzoni (2012) - but more importantly because the level of consumption during the boom years itself was financed by the rapid growth in household liability.

The rest of this paper proceeds as follows. The next session briefly discusses the related literature. Section 2 presents the theoretical model, which highlights the differential impact of decline in interest rates and collateral requirements in regions with different elasticities of housing supply. I discuss the data in Section 3. Section 4 outlines the reduced-form empirical evidence and relates the boom-bust cycle to variations in elasticity of housing supply as well as the rise of securitization. Section 5 extends the theoretical model to a more general supply of housing, presents the result of the calibration of the model and perform policy experiments. Section 6 concludes.

1.1.1 Literature Review

On the theoretical dimension, this paper is most closely related to a number of recent studies on the housing boom and bust in an incomplete-market framework in which houses, in addition to providing housing services, provide a means of collateral for households. The importance of relaxation of borrowing constraints in explaining the simultaneity in capital inflows and the rise of house prices during the boom years has been raised in Ferrero (2012). Favilukis, Ludvigson and Nieuwerburgh (2012) also emphasizes the importance of financial market liberalization and its reversal to explain the housing boom and bust, however, it argues that most of the boom and bust would have happened even in the absence of capital inflows. The independent work of Garriga, Manuelli and Peralta-Alva (2012) constructs a semi-open economy and shows a decline in interest rates in addition to the relaxation of collateral requirements that is followed by a reversal in the initial relaxation can account for the housing boom and bust.[6] Midrigan and Philippon (2011) consider the impact of a credit crunch in a cash-in-advance economy in which the main role of home equity borrowing is to provide liquidity services and therefore monetary policy is very effective in reducing the recession driven by decline in house prices. Guerrieri and Lorenzoni (2011) studies a heterogeneous-agent model with durable goods and argue an increase in credit spreads, and not a shock to credit limits, can lead to a decline in demand for durable goods.[7] The frontloading behavior of households and its interaction with the elasticity of housing is what distinguishes the mechanism of this paper from other work. Also, in terms of the results, in all of the above studies the downturn in consumption and asset prices is generated by the reversal in initial credit expansion whereas in this paper the bust begins whenever there is not enough of a further decline in interest rates or in collateral requirements. At least in terms of data, it seems that both the decline in house prices and the decline in consumption predate any sign of shrinkage in the financial markets.[8] Also being written in continuous time makes this model tractable such that not only is the steady-state completely characterized, but also the transition path.

This paper naturally builds on the seminal work of Kiyotaki and Moore (1997). The literature on sudden stops also highlights the importance of collateral constraints in understanding output, asset prices and capital flows during episodes of crisis (for example see Aoki, Benigno and Kiyotaki (2007), Caballero and Krishnamurty (2001) Calvo, Coricelli and Ottonello (2012) and Mendoza (2010)). This paper complements this strand of literature by assuming financial frictions on the household side of the economy instead of on

[6]Their semi-open economy or segmented-financial-markets assumption assumes that a representative agent is able to use her housing stock as collateral to borrow from abroad at a rate that is lower than the marginal product of capital. Therefore a decline in mortgage rates that is not followed by a decline in marginal product of capital or a decline in collateral requirements increases the collateral value of houses.

[7]There is a larger literature incorporating housing sector (usually with heterogeneous agents) in the general equilibrium models. For example see Campbell and Hercowitz (2009), Iacoviello (2008), Jeske, Krueger and Mitman (2012) and Kiyotaki, Michaelides and Nikolov (2011).

[8]For example US securitization issuance and the S&P 500 kept increasing until mid-2007. Therefore in terms of timing it seems more likely that the downturn in consumption and in house prices precipitated the financial crisis and not the other way around.

the firms side.[9, 10]

Among empirical studies of the recent financial crisis, Mian and Sufi (2009) provides evidence of the relation between an increase in securitization and the rise of household mortgage liabilities and the subsequent surge in default rates. Dagher and Fu (2011) is another related study that shows the rise in the share of independent lenders is associated with a similar pattern of mortgage liabilities and default rates.[11] Mian and Sufi (2011) estimate that increasing house prices resulted in a $1.25 trillion dollars increase in existing homeowners liabilities from 2002 to 2006. Finally Mian and Sufi (2012) and Mian, Rao and Sufi (2012) show a disproportionately larger decline in consumption and in employment in counties that had higher debt-to-income ratios by 2006. This paper complements findings of these studies in a number of dimensions. First, it shows that not only during the downturn but also during the boom years house prices and consumption are closely associated with the factors that contributed to the expansion of credit, namely variations in the elasticity of housing and changes in the securitization rate. Second, I show that regions with a less elastic supply of housing and a higher change in securitization rate, despite having a larger decline in house prices and consumption during 2006 to mid-2008, continued to have *higher* growth in their mortgage liabilities during the period of 2006 to mid-2008. These two facts together show that it is true that in comparison to 2006 the decline in demand and in employment is driven by indebted households reducing their consumption, however, the level of consumption in 2006 itself was not sustainable and was financed by home-equity extraction by existing households.[12] In addition, this paper argues theoretically and empirically that changes in interest rates and collateral requirements (proxied by changes in the securitization rate) move all the three variables of house prices, consumption and household debt together and, depending on the elasticity of housing supply, the dynamics implied by these shocks can be very different. Therefore using the elasticity of housing as an instrument does not help one estimate the causal impact of house prices on household borrowing behavior or consumption.

There is a larger literature on the relationship between housing wealth and consumption which usually finds significant, but heterogeneous, effects on housing wealth (for example see Hurst and Stafford (2004),

[9] In the case of the recent crisis in the US, Adrian, Colla and Shin (2012) shows much of the decline in banks' lending to firms was compensated by bond financing such that by mid-2009 US non-financial corporate sector's liabilities started to increase. On the other hand, the *NY Fed Quarterly Report on Household Debt and Credit* (available at HTTP://www.newyorkfed.org/research/national_economy/householdcredit/DistrictReport_Q22012.pdf) shows a steady decline in total household debt since the third quarter of 2008. The above evidences is suggestive that during the current crisis financial frictions on the households are more important in explaining the economic downturn. Also as is argued by Midrigan and Philippon (2011) models with financial frictions on firms have a hard time explaining the cross-section of regional variation in the data on output.

[10] Another recent strand of literature studies the impact of financial frictions when financial institutions, in addition to firms, are facing the frictions. Among the others, see Brunnermeier and Sannikov (2012), Gertler and Kiyotaki (2010) and Rampini and Viswanathan (2012). Compared to models like Bernanke, Gertler and Gilchrist (1999) which put the financial frictions only on the firms, these papers show a more persistent and non-linear impact of financial frictions on the real side of economy.

[11] In general independent lenders,as compared to banks and thrifts, have always sold a much higher fraction of their loans to non-GSEs. This is mainly driven by higher cost of capital for these lenders and their specialization in originating loans to the lower tail of the market. In data there is a very high correlation between the change in fraction of securitized loans and the share of independent lenders and it seems that the increase in the share of independent lenders was an effect of the rise of securitization which lowered financing cost significantly for these independent investors.

[12] In terms of employment this means that by 2006 there was too much employment in the non-tradable and construction sectors and, at some point this needed to be corrected, which can result in the long periods of adjustment associated with a high unemployment rate.

Case, Quigley and Shiller (2005), Campbell and Cocco (2007) and Attanasio, Blow, Hamilton and Leicester (2009)). What this paper adds to that literature is that this relationship depends not only on individual characteristics, but also on the level of interest rates, on elasticity of housing in the region[13] and on the nature of the shock that is driving the both variables; meaning whether the shock is an income shock, an interest rate shock or a change in collateral requirements.

1.2 Theory

In this section I develop a model of a small, open economy with a representative household whose borrowing is constrained by the collateralizable fraction of its housing wealth. I begin by characterizing the environment and solving for the household's optimization problem, taking house prices dynamics as given. Next, I solve for the equilibrium of elastic regions and inelastic regions by endogenizing house prices. Finally, I shock the economy with surprise changes in interest rate and collateral requirements and characterize the transition path of the economy.

1.2.1 Setup

Consider a continuous-time, small, open economy[14] consisting of regions differing only in the total supply of land. Each region's population is normalized to one, and the representative household in region i lives there forever, has a discount rate ρ and enjoys housing consumption (h_{it}) as well as non-housing consumption (c_{it}). Region i's household preference is given by:[15]

$$\int_0^\infty e^{-\rho t}\left[logc_{it}+\eta logh_{it}\right]dt \tag{1.1}$$

The non-housing consumption good is the numeraire. Each unit of housing in region i is traded at price q_{it} and, in order to keep the model simple, I assume that there is no rental market for housing.

Similar to Kiyotaki and Moore (1997), I assume the only financial asset is the short term paper which has return r,[16] and the minimum holding of financial assets by the representative household (a_{it}) is constrained by fraction θ_i (<1) of household housing wealth:

$$a_{it}\geq-\theta_i q_{it}h_{it} \tag{1.2}$$

The representative household in region i receives a stream of endowment equal to w_i and assumes there

[13]Elasticity of housing determines whether the change in housing wealth is coming from the change in quantity or from the change in prices.

[14]This assumption is justified with the fact that during the period of 2000 to 2007, changes in the US current account deficit and changes in household mortgage liabilities follow each other closely. Interestingly, Ferrero (2012) shows this pattern has been common among all countries that experienced a housing boom in this period.

[15]The Cobb-Douglas aggregator is rationalized by the fact that in a cross section of data the share of housing cost in household expenditure has only small variations.

[16]As long as households assume the interest rate r is constant, this assumption is not restrictive, and any long-term contract can be replicated with a short-term contract.

is no change in r, θ_i or w_i.

Houses are produced by a combination of land and capital according to a Leontief production function:[17]

$$h_{it} = min(l_{it}, \frac{k_{it}}{B}) \quad (1.3)$$

Capital is produced using the numeraire good and its price is equal to one. The price of one unit of land in region i at time t is q^L_{it}. Moreover I assume there is no adjustment cost for the capital used in a house.[18] Then as long as $\dot{q}^L_{it}/q^L_{it} \leq r$,[19] the Leontief production function implies that:

$$h_{it} = l_{it} = k_{it}/B \quad (1.4)$$

$$q_{it} = q^L_{it} + B \quad (1.5)$$

When a household is buying a house, it receives the title for the land that is used in that house as well as the title for the house itself. Only the capital used in the house, and not the land, is subject to depreciation rate δ_k, which can be compensated for with household investment i_{it} in the house. Therefore the capital used in the house evolves according to:

$$\dot{k}_{it} = -\delta_k k_{it} + i_{it} \quad (1.6)$$

Given the Leontief production function for housing the amount of investment is:

$$i_{it} = \delta_k k_{it} \quad (1.7)$$

Therefore the representative household budget constraint is:

$$\dot{a}_{it} + q_{it}\dot{h}_{it} = w_i + ra_{it} - c_{it} - \delta_k B h_{it} \quad (1.8)$$

Finally, and most importantly, it is assumed that the interest rate is lower than the household's time preference rate ($r < \rho$). This assumption can be rationalized by a global saving glut hypothesis (Bernanke (2005)) or by the presence of a small fraction of the population who are more patient than others as in Guvenen (2009). But more importantly, an extension of the present model that includes agents with an income profile that is temporarily high (super stars) shows that $r < \rho$ is the only equilibrium steady state interest rate that arise in this economy with incomplete markets. In that framework higher income inequality results in a further decline in the interest rate.[20]

[17]For the quantitative exercise, I extend the housing production function to CES and show analytically that the qualitative results do not change.

[18]This is a relatively strong assumption that makes the model tractable. However, this helps to clarify the boom-bust cycle purely driven by the frontloading motivation from the boom-bust cycle induced by a temporary increase in demand for housing a la Mankiw and Weil (1989). Adding adjustment costs to this model results in larger boom-bust cycles.

[19]$\dot{q}^L_{it}/q^L_{it} > r$ is not possible because then even an investor who is not living in region i can invest in the land in region i and make more profit than buying financial assets and, therefore, there will be no lending.

[20]In fact $r < \rho$ is the general feature of most of the models with incomplete markets with shocks to the income profile of the households. For example see (Ayigari (1994) , Mendoza, Quadrini and Rios-Rull (2009)).

1.2.2 Household Problem

Region i's household problem can be written as:

$$\begin{aligned}
&\underset{[c_{it},a_{it},h_{it}]_0^\infty}{Max} && \int_0^\infty e^{-\rho t}\left[logc_{it}+\eta logh_{it}\right]dt \\
&s.t. && \dot{a}_{it}+q_{it}\dot{h}_{it}=w-c_{it}+ra_{it}-\delta_k Bh_{it} \\
& && -a_{it}\leq\theta_i q_{it}h_{it}
\end{aligned}$$

Defining the total wealth of the representative household as $W_{it}\equiv q_t h_{it}+a_t$, and $\delta\equiv\delta_k B$, we can rewrite the representative household problem as:

$$\begin{aligned}
&\underset{[c_{it},W_{it},h_{it}]_0^\infty}{Max} && \int_0^\infty e^{-\rho t}\left[logc_{it}+\eta logh_{it}\right]dt \\
&s.t. && \dot{W}_{it}=w-c_{it}+r\left(W_{it}-q_{it}h_{it}\right)-\delta h_{it}+\dot{q}_{it}h_{it} \qquad (1.9)\\
& && W_{it}\geq(1-\theta_i)q_{it}h_{it}
\end{aligned}$$

Using an extension of the maximum principle for an optimal control problem with mixed constraints (see Seierstad and Sydsæter (1987)), one can form the discounted Hamiltonian as:

$$\hat{\mathcal{H}}\equiv\left[logc_{it}+\eta logh_{it}\right]+\mu_{it}\left[w-c_{it}+r\left(W_{it}-q_{it}h_{it}\right)-\delta h_{it}+\dot{q}_{it}h_{it}\right] \tag{1.10}$$

And associated Lagrangian is:

$$\hat{\mathcal{L}}\equiv\hat{\mathcal{H}}+\lambda_{it}\left[W_{it}-\left(1-\theta_i\right)q_{it}h_{it}\right] \tag{1.11}$$

First order conditions can be simplified to:

$$\begin{aligned}
\frac{\dot{c}_{it}}{c_{it}} &= (r-\rho)+\frac{\lambda_{it}}{\mu_{it}} && (1.12)\\
\frac{\eta c_{it}}{h_{it}} &= (rq_{it}+\delta-\dot{q}_{it})+\left[\left(1-\theta_i\right)q_{it}\frac{\lambda_{it}}{\mu_{it}}\right] && (1.13)\\
\lambda_{it} &\geq 0\ \left(=\ iff\, W_{it}>\left(1-\theta_i\right)q_{it}h_{it}\right) && (1.14)
\end{aligned}$$

Without the borrowing constraint, equation (1.12) is the usual Euler equation. μ_{it} is the marginal benefit of one more unit of consumption and, therefore, λ_{it}/μ_{it} is the relative marginal value of one more unit of borrowing. This equation shows that the higher the relative marginal value of borrowing, the higher the growth rate of consumption, which means the lower the ability of household to transfer resources from the future to now. In equation (1.13), $(rq_t + \delta - \dot{q}_t)$ is the user cost of housing in a frictionless economy and, therefore, without the borrowing constraint, consumption smoothing between non-housing goods and housing implies $(rq_t + \delta - \dot{q}_t)\, h_{it}/\eta = c_t$. However, when the borrowing constraint is binding, the representative household cannot afford the down payment for buying a house and the household's demand for housing declines in comparison with the frictionless case. The higher the required down payment for each unit of housing $((1-\theta)\, q_t)$, the higher the decline in the demand for housing.

1.2.3 Equilibrium Characterization

So far we have characterized the differential equations governing the optimal behavior of the representative household for a given path of prices. The final step is to add the supply side of the housing market and to find the equilibrium house prices for the given behavior of the representative household. Let us define L_i as the aggregate supply of land in region i, h_{i0} initial housing stock of the representative agent and a_{i0} as the initial holding of financial assets by the representative household in region i . In order to reduce the number of variables for the definition of the equilibrium I use the equilibrium relations (1.4) and (1.5) $(k_{it}/B = l_{it} = h_{it}, q^L_{it} = q_{it})$. Then one can define the equilibrium as follows:

Definition 1: *Equilibrium in region i is a set of choices $[c_{it}, a_{it}, h_{it}]_{t=0}^{\infty}$ by the representative household and a set of house prices $[q_{it}]_{t=0}^{\infty}$ such that*

- *The representative household takes $[q_{it}]_{t=0}^{\infty}$ as given and maximizes its lifetime utility, i.e., solves problem* (1.9) *with the initial condition $W_{i0} = a_{i0} + q_{i0}h_{i0}$.*
- *Total demand for land in region i does not exceed the total supply $(h_{it} \leq L_i)$ with equality if and only if $q_{it} > B$.*[21]

Now in order to show main insights of the model, I consider two extreme cases for the supply of housing:

- Inelastic Supply: The supply of land in this case is very limited, such that all the land in the region has been used and the aggregate supply of housing is constant and equal to the total supply of land in the region $(\, h_{it} = L_i,\, i \in \{Inelastic\, Regions\}\,)$.[22]
- Elastic Supply: In this case there is plenty of unused land and therefore the price of land, q_L is zero. This results in a constant price for houses equal to the cost of capital used for building the house $(\, q_{it} = B,\, i \in \{Elastic\, Regions\}\,)$.

[21]This is equivalent to the price of land being zero $(q^L_{it} = 0)$

[22]The necessary condition for this is:

$$L_i < \frac{\eta w}{(1+\eta)\,\delta + B\,[(1+\eta)\,\theta r + (1-\theta)\,\rho]}$$

This means the demand for housing when house prices are equal to B, or in other words the price of land is zero, should be greater than the total supply of land in region i.

In characterizing the equilibrium for both regions, I use the following two lemmas that hold for both elastic regions and inelastic regions.

Lemma 1: *Suppose q_{it} is finite for all t. Then, for any value of a_{i0}, there exists t_1 such that $\lambda_{t_1} > 0$.*

Proof: see Appendix A.

Lemma 1 argues that independent of initial financial holdings of the representative household in region i (a_{i0}), there exists a time t_1 at which the household borrowing constraint binds ($\lambda_{t_1} > 0$). Intuition for this lemma is that since $r - \rho < 0$, when the household borrowing constraint does not bind, household consumption has a negative growth rate. This means the household wants to transfer as many of the resources as it can to today which results in the borrowing constraint becoming bindings.

Lemma 2: *Suppose r and θ_i are fixed. If there exists t_1 such that $\lambda_{t_1} > 0$, then $\lambda_t > 0$ for all $t \geq t_1$.*

Proof: see Appendix B.

Lemma 2 claims that in an economy without changes in r and θ_i, whenever the borrowing constraint binds, it remains binding forever. The intuition for this result is that in order for a constrained borrowing constraint to become unconstrained, the representative household should either reduce its consumption or its housing stock or the growth in house prices should increase. Because of the frontloading motivation, a decline in consumption or in housing stock are not desirable for a household. The proof shows an increase in growth of house prices that leads to a transition from a constrained borrowing constraint to a relaxed borrowing constraint cannot be an equilibrium because it results in the demand for housing exceeding the supply.

Lemmas 1 and 2 together show that in the steady-state the borrowing constraint is binding. Moreover it shows that there is, at most, one point in time in which the borrowing constraint of the representative household becomes binding. Therefore in order to solve for the entire equilibrium path, we must solve the problem backwards. First, we solve for the steady-state equilibrium. Second, we characterize the transition path while the household borrowing constraint is binding. Then we characterize the transition path when the borrowing constraint does not bind. Finally, using the household's initial financial assets and the fact that house prices are a continuous function of time, we find the point in time at which the borrowing constraint becomes binding.

I now characterize the equilibrium of inelastic regions and then proceed to the equilibrium of elastic regions.

1.2.3.1 Equilibrium Characterization for Inelastic Regions

In regions with an inelastic supply of housing, the total supply of housing is fixed and therefore the budget constraint of the representative household reduces to:

$$\dot{a}_{it} = w_i + r a_{it} - c_{it} - \delta L_i \tag{1.15}$$

When the borrowing constraint is binding, equations (1.12) to (1.14) in addition to (1.15) reduce to:

$$\frac{\dot{c}_{it}}{c_{it}} = (r-\rho) + \frac{(1+\theta_i\eta)\,c_{it} - (w-(1-\theta_i)\delta L_i)}{\theta_i\,(1-\theta_i)\,L_i q_{it}} \quad (1.16)$$

$$\dot{q}_{it} = r q_{it} + \frac{\delta}{\theta_i} - \frac{w - c_{it}}{\theta_i L_i} \quad (1.17)$$

$$a_{it} = -\theta_i q_{it} L_i \quad (1.18)$$

Steady state can be derived by imposing $\dot{c}_{it} = \dot{q}_{it} = 0$ in equations (1.16) and (1.17).

Proposition 1: *In the steady state of inelastic region i, the household housing wealth and non-housing consumption are given by:*

$$c_{ss}^{Inelastic} = \frac{[\theta_i r + (1-\theta_i)\,\rho]\,w_i - \delta L_i\,(1-\theta_i)\,\rho}{(1+\eta)\,\theta_i r + (1-\theta_i)\,\rho} \quad (1.19)$$

$$(q_{ss}h_{ss})^{Inelastic} = q_{ss}^{Inelastic} L_i = \frac{\eta w_i - (1+\eta)\,\delta L_i}{(1+\eta)\,\theta_i r + (1-\theta_i)\,\rho} \quad (1.20)$$

Corollary 1: *Comparative statics with respect to the interest rate r*

$$\frac{\partial c_{ss}^{Inelastic}}{\partial r} < 0, \qquad \frac{\partial\,(q_{ss}h_{ss})^{Inelastic}}{\partial r} < 0 \quad (1.21)$$

and with respect to the maximum loan to value ratio (θ_i) *are:*

$$\frac{\partial c_{ss}^{Inelastic}}{\partial \theta_i} < 0 \quad , \quad \frac{\partial\left(\theta_i\,(q_{ss}h_{ss})^{Inelastic}\right)}{\partial \theta_i} > 0 \quad (1.22)$$

$$\frac{\partial\,(q_{ss}h_{ss})^{Inelastic}}{\partial \theta_i} \gtreqless 0 \quad if\, and\, only\, if \quad \rho - (1+\eta)\,r \gtreqless 0 \quad (1.23)$$

Equations (1.21) show that the lower the interest rate, the higher the housing wealth and non-housing consumption of the household. Lower interest rates reduce the user cost of housing. Since the supply of housing is fixed, house prices should increase enough to reduce demand and make it equal to supply. Taking household debt as given, lower interest rates means lower interest payments for the household, which leaves more resources for consumption. However, this effect is partly muted because in the steady-state household debt is also increasing.

Equation (1.22) says that as a result of an increase in θ (i.e. lower collateral requirement), the steady-state consumption of the household *declines*. The intuition for this result is that a higher θ enables the representative household to borrow more. But after the household uses up this new borrowing capacity, it cannot borrow any more, and the household ends up with a higher amount of debt which translates into higher interest payments. But higher interest payments mean fewer resources remain for non-housing consumption. The impact of an increase in θ on housing wealth (equation (1.23)) is more interesting: on one hand the increase in θ means a lower down-payment is required for each unit of housing, which increases demand for housing. On the other hand, because of the consumption smoothing between non-housing and housing consumption, lower non-housing consumption in the steady state lowers the demand for housing. Therefore the change in housing wealth depends on the relative importance of these two forces. The higher η is the stronger the consumption-smoothing force and, therefore, the more negative the change in housing wealth. The higher is $\rho - r$ the more important is the lower down payment in boosting the demand for housing and therefore the more positive is the change in the housing wealth. However no matter whether the steady state housing wealth increases or decreases, as a result of an increase in θ, the total borrowing capacity (and therefore the total debt in the steady state)$\theta_i\,(q_{ss}h_{ss})^{Inelastic}$ increases.

After characterizing the steady-state equilibrium, now we can characterize the transition path for the representative household that begins with an initial condition (initial debt holding) that is different from the steady-state.

The next lemma shows that in inelastic regions, whenever the borrowing constraint is binding, the economy is in steady-state.

Lemma 3: *For any region i with an inelastic supply of housing, if $\lambda_{it} > 0$ then $q_{it} = q_{ss}^{Inelastic}$ and $c_{it} = c_{ss}^{Inelastic}$.*

Proof: From lemma 2 we see that once the borrowing constraint becomes binding it remains binding forever and therefore the behavior of house prices and of consumption is fully characterized by equations (1.16)-(1.18). Then from the (q_{it}, c_{it}) phase diagram in Figure 1.3 we see that this system of equations does not have any stable path. And the steady-state point given by $\dot{q}^{Constrained} = 0$, $\dot{c}^{Constrained} = 0$ is the only stable point in this system of equations.

When the borrowing constraint is not binding ($a_{it} > -\theta_{it}q_{it}L_i$), the household maximization problem (equations (1.12) to (1.14)) and the household budget constraint (equation (1.8)) reduce to:

$$\frac{\dot{c}_{it}}{c_{it}} = r - \rho \qquad (1.24)$$

$$\dot{q}_{it} = rq_{it} + \delta - \frac{\eta c_{it}}{L_i} \qquad (1.25)$$

$$\dot{a}_{it} = w_i - c_{it} + ra_{it} - \delta L_i \qquad (1.26)$$

As Figure 1.4 illustrates, among the paths described by equations (1.24) and (1.25), there is only one path that crosses the steady state. In equilibrium the household consumption and home prices move along this path until the borrowing constraint becomes binding. Moreover, initial point (q_{i0}, c_{i0}) should be such that exactly at the time the agent is reaching the steady state point (q_{ss}, c_{ss}), the borrowing constraint should become binding. Let us define T_i as the time it takes the economy in region i to reach its steady state. Proposition 2 characterizes the equilibrium path for inelastic region i, with initial level of debt holding a_{i0}.

Preposition 2: *In the inelastic region i, starting from an initial level of debt holding* $a_{i0} > -\theta_i \left(q_{ss}h_{ss}\right)^{Inelastic}$*:*

- *The representative household borrowing constraint does not bind throughout the transition until the economy reaches its steady state characterized by* (1.19), (1.20) *and* $a_{ss}^{Inelastic} = -\theta_i \left(q_{ss}h_{ss}\right)^{Inelastic}$
- *The economy in inelastic region i reaches its steady state in a finite time* ($T_i < \infty$).
- *The representative household non-housing consumption, house prices and representative household debt-holding during the transition (i.e.* $t \in [0, T_i]$ *) are given by:*

$$
\begin{aligned}
c_{it} &= c_{ss}^{Inelastic} e^{(r-\rho)(t-T_i)} && (1.27)\\
q_{it} &= -\frac{\delta}{r} + \frac{\eta}{\rho L_i} c_{ss}^{Inelastic} e^{(r-\rho)(t-T_i)} + \left(q_{ss}^{Inelastic} + \frac{\delta}{r} - \frac{\eta}{\rho L_i} c_{ss}^{Inelastic}\right) e^{r(t-T_i)} && (1.28)\\
a_{it} &= a_{i0}e^{rt} + \left(\frac{w - \delta L_i}{r}\right)\left(e^{rt} - 1\right) + \frac{c_{ss}^{Inelastic}}{\rho} e^{(r-\rho)(t-T_i)}\left(1 - e^{\rho t}\right) && (1.29)
\end{aligned}
$$

where T_i *is the solution to:*

$$
-\theta_i \left(q_{ss}H_{ss}\right)^{Inelastic} = a_{i0}e^{rT_i} + \left(\frac{w - \delta L_i}{r}\right)\left(e^{rT_i} - 1\right) + \frac{c_{ss}^{Inelastic}}{\rho}\left(1 - e^{\rho T_i}\right) \qquad (1.30)
$$

Proof: The fact that representative consumer borrowing constraint does not bind throughout the transition is because the only stable point of the constrained regime is the steady state (lemma 3). Equations (1.27) to (1.29) are solutions to the first-order differential equations that result from the household maximization problem, assuming the borrowing constraint is relaxed ((1.24)-(1.26)) plus imposing the following boundary conditions:

$$
\begin{aligned}
c_{iT} &= c_{ss}^{Inelastic},\ q_{iT} = q_{ss}^{Inelastic},\\
a_{i0} &: \ given
\end{aligned}
$$

Finally equation (1.30) arises from the fact that once the household reaches the steady state the borrowing constraint should become binding: $a_{iT} = -\theta_i \left(q_{ss}H_{ss}\right)^{Inelastic}$.

Defining $BC_{i0} \equiv a_{io} + \theta_i \left(q_{ss}h_{ss}\right)^{Inelastic}$ as the initial unused borrowing capacity, we have the following comparative statics:

Corollary 2: *Comparative statics with respect to unused borrowing capacity are:*

$$\frac{\partial T_i}{\partial BC_{i0}} > 0 \ , \ \frac{\partial c_{i0}}{\partial BC_{i0}} > 0 \ , \ \frac{\partial q_{i0}}{\partial BC_{i0}} > 0$$

Proof: The right hand side of (1.30) is a decreasing function of T_i. Therefore an increase in a_{i0} results in an increase in T_i. Then from (1.27) and (1.28) one can see that c_{i0} and q_{i0} are increasing in T_i.

Corollary 3 shows that the larger the unused borrowing capacity, the longer it takes the economy to reach the steady state, and therefore, the economy starts from a point that is further away from the steady state. This means household consumption and house prices are initially higher. This corollary is very useful when we introduce unexpected changes to the interest rate and the maximum loan-to-value ratio into the economy.

1.2.3.2 Equilibrium Characterization for Elastic Regions

The main difference between elastic regions and inelastic regions is that house prices are constant in elastic regions. Since lemmas 1 and 2 hold for elastic regions as well, we follow the same steps as before and characterize the equilibrium backward : solving for the steady-state, characterizing transition while the borrowing constraint is binding, and finally solving for the whole equilibrium by characterizing the transition path when the borrowing constraint is relaxed.

The representative household utility maximization (given by equations (1.12) to (1.14)) when its borrowing constraint is binding ($\lambda_{it} > 0$) in addition to house prices being constant ($q_{it} = B$) result in:

$$(1-\theta_i) B \frac{\dot{c}_{it}}{c_{it}} = -\left[\theta_i r B + (1-\theta_i)\rho B + \delta\right] + \frac{\eta c_{it}}{h_{it}} \tag{1.31}$$

$$(1-\theta_i) B \dot{h}_{it} = w_i - c_{it} - (\theta_i r B + \delta) h_{it} \tag{1.32}$$

Imposing steady state conditions $\dot{c} = 0$ and $\dot{h} = 0$ leads to the solution for the steady state:

Proposition 3: *In the steady state of elastic region i, the household housing wealth and non-housing consumption are given by:*

$$c_{ss}^{Elastic} = \frac{\left[\theta_i r + (1-\theta_i)\rho + \delta/B\right] w_i}{(1+\eta)(\theta_i r + \delta/B) + (1-\theta_i)\rho} \tag{1.33}$$

$$(q_{ss} h_{ss})^{Elastic} = B h_{ss}^{Elastic} = \frac{\eta w_i}{(1+\eta)(\theta_i r + \delta/B) + (1-\theta_i)\rho} \tag{1.34}$$

Corollary 3: *Comparative statics with respect to the interest rate r*

$$\frac{\partial c_{ss}^{Elastic}}{\partial r} < 0, \qquad \frac{\partial (q_{ss} h_{ss})^{Elastic}}{\partial r} < 0 \tag{1.35}$$

and with respect to the maximum loan to value ratio (θ_i) *are:*

$$\frac{\partial c_{ss}^{Elastic}}{\partial \theta_i} < 0, \qquad \frac{\partial \left(\theta_i \left(q_{ss}h_{ss}\right)^{Elastic}\right)}{\partial \theta_i} > 0 \tag{1.36}$$

$$\frac{\partial \left(q_{ss}h_{ss}\right)^{Elastic}}{\partial \theta_i} \gtreqless 0 \quad if\, and\, only\, if \quad \rho - (1+\eta)\, r \gtreqless 0 \tag{1.37}$$

Equation 1.35 shows that the lower the interest rate, the higher the housing wealth. However, the impact of lower interest rates on housing wealth in the steady-state is smaller for elastic regions (in compare to its impact in inelastic regions). This is because lower interest rates reduce the user cost of housing, and households in elastic regions build larger houses. However having a larger house results in higher depreciation costs which dampens the effect of lower interest rates on housing wealth. As before, lower interest rates increase the steady-state consumption. Higher θ_i (i.e. lower collateral requirement) reduces the steady state consumption and its impact on housing wealth depends on the balance between front-loading motivation (or the importance of lower down-payments) and consumption smoothing between housing and non-housing consumption.[23]

The following lemma characterizes the transition path of an elastic region i when the representative household borrowing constraint is binding.

Lemma 4: *In elastic region i, if* $\lambda_{it} > 0$ *then the solution to household maximization problem (equations* (1.31) *and* (1.32)*) is a saddle path for* (h_{it}, c_{it}) *described by*

$$c_{it} = f\left(h_{it}\right) \tag{1.38}$$

where $f(.)$ *is a strictly increasing function and* $c_{ss}^{Elastic} = f(h_{ss}^{Elastic})$.

Proof: Again from lemma 2 we use the fact that once the borrowing constraint becomes binding it remains binding forever and therefore the behavior of house prices and of consumption is fully characterized by equations (1.31) *and* (1.32). Then from the (q_{it}, c_{it}) phase diagram in Figure 1.5 we see that this system

[23] One observation is that if the depreciation cost is δqh instead of δh, the relation between the steady state housing wealth and consumption in both regions is the same and equal to:

$$q_{ss}h_{ss} = \frac{\eta}{(1+\eta)(r\theta+\delta)+(1-\theta)\rho} w$$

$$c_{ss} = \frac{\delta + r\theta + (1-\theta)\rho}{(1+\eta)(\delta + r\theta)+(1-\theta)\rho} w$$

One example in which the depreciation cost can be written as δqh is when housing is produced according to a Cobb-Douglas production function using capital and land. It seems that the real world is not a Leontief case since with better-quality facilities on the land the consumer can enjoy his or her housing more. On the other hand the study of Davis and Heathcote (2007) shows the share of land in the value of house is an an increasing function of house prices which is inconsistent with the Cobb-Douglas case but is consistent with a CES production function for housing in which there is complementarity between land and capital. Assuming $h = \left[\omega_k^{1/\sigma} k^{\frac{\sigma-1}{\sigma}} + (1-\omega_k)^{1/\sigma} l^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$ with $0 < \sigma < 1$, depreciation cost can be written as $\delta q^{\sigma} h$ which is in between Leontief case ($\sigma = 0$) and Cobb-Douglas case ($\sigma = 1$). In the calibration exercise, I use a CES characterization. It is shown that much of the intuition from the Leontief case holds for the CES case as well.

of equations has one saddle path that passes through the steady-state.

In elastic region i, when the borrowing constraint is not binding, the household maximization problem reduces to:

$$\frac{\dot{c}_{it}}{c_{it}} = r - \rho \tag{1.39}$$

$$c_{it} = \frac{rB+\delta}{\eta} h_{it} \tag{1.40}$$

$$\dot{a}_{it} = w - \frac{(1+\eta)\left(r+\frac{\delta}{B}\right)-\rho}{r+\frac{\delta}{B}} c_{it} + r a_{it} \tag{1.41}$$

Using equation (1.40), we can see that the point (h_{th}, c_{th}) is defined as a solution to this system of equations:

$$c_{th} = f(h_{th})$$
$$c_{th} = \frac{rB+\delta}{\eta} h_{th}$$

is the only point at which the borrowing constraint can go from being relaxed to being binding.[24] Finally let us also define $a_{th} \equiv -\theta_i B h_{th}$ and $W_{i0} \equiv a_{i0} + B h_{i0}$ as the initial wealth of the representative household in region i. Now we can characterize the full equilibrium path as follows:

Proposition 4:

- *If $W_{i0} \leq (1-\theta_i) B h_{th}$, the household borrowing constraint is binding throughout the transition, and (h_{it}, c_{it}) is the solution to equations (1.31) and (1.32) with the initial conditions:*

$$h_{i0} = \frac{W_{i0}}{(1-\theta_i) B}, \quad c_{i0} = f(h_{i0})$$

  and throughout the transition $c_{it} = f(h_{it})$.

- *If $W_{i0} > (1-\theta_i) B h_{th}$, the household borrowing constraint does not bind initially and in finite time (T_i) the borrowing constraint becomes binding and remains binding. The equilibrium (h_{it}, c_{it}) is characterized by:*

  - *for $t \in [0, T_i]$ the borrowing constraint does not bind, and the equilibrium is the solution to equa-*

[24]In other word at this point the shadow value of the borrowing constraint λ is equal to zero.

tions (1.39) to (1.41) with boundary-condition equations $h_{iT} = h_{th}$, $c_{iT} = c_{th}$ and $a_{iT} = a_{th}$:

$$
\begin{aligned}
c_{it} &= c_{th} e^{(r-\rho)(t-T_i)} \\
h_{it} &= h_{th} e^{(r-\rho)(t-T_i)} \\
a_{it} &= a_{th} e^{r(t-T_i)} + \frac{w}{r}\left(e^{r(t-T_i)} - 1\right) + \left(\frac{(1+\eta)\left(r+\frac{\delta}{B}\right)-\rho}{r+\frac{\delta}{B}}\right)\frac{c_{th}}{\rho} e^{(r-\rho)(t-T_i)}\left(1-e^{\rho t}\right)
\end{aligned}
$$

And T_i is computed with the additional boundary condition that $W_{i0} (= a_{i0} + Bh_{i0})$ is given.

- *for $t > T_i$, the borrowing constraint is binding and the equilibrium (h_{it}, c_{it}) is characterized by the solution to equations (1.31) and (1.32) with the boundary conditions $h_{iT} = h_{th}$, $c_{iT} = c_{th}$ and $a_{iT} = a_{th}$. and $c_{it} = f(H_{it})$*

Figure 1.6 shows the equilibrium transition path in the elastic region. If the household initial wealth is high enough, the household borrowing constraint is relaxed for awhile, and along the transition $c_{it} = (rB + \delta) H_{it}/\eta$. As the representative household exhausts its borrowing capacity, its demand for housing and for consumption declines until it reaches the point (h_{th}, c_{th}). From that point forward the borrowing constraint remains binding, and it is moving on the saddle path characterized by $c_{it} = f(H_{it})$ until the household reaches the steady state.

1.2.4 Impacts of Unexpected Permanent Changes in the Interest Rate and Collateral Requirements

So far I have assumed that the interest rate (r) and the maximum loan-to-value ratio in each region (θ) do not change. In this section I study the impact of *unexpected permanent* changes in r and θ for elastic and inelastic regions. I maintain the assumption that households in different regions assume r and θ are fixed and, therefore, any change in r and θ is a surprise for them.[25] First, I consider the impact of a permanent decline in the interest rate and a permanent increase in the maximum loan-to-value ratio and show endogenous boom-busts arise from these shocks by themselves. Then, I consider the impact of a permanent increase in the interest rate or a permanent decline in the maximum loan-to-value ratio and show this may result in fast decline in consumption and house prices that is partly recovered after the initial decline. Finally in order to keep the text short, I assume the economy is in the steady-state before the shocks happen. The extension of results to an arbitrary initial condition is straight-forward.

[25]This is a strong assumption and perhaps a more realistic assumption would be that households assume a stochastic process for r and θ. However this assumption not only makes the model tractable, but also helps to differentiate between the main mechanism of this paper (interaction between frontloading behavior and endogenous asset prices) and the precautionary saving motivation that exists in incomplete market settings such as those described in Guerrieri and Lorenzoni (2012).

1.2.4.1 Permanent Decline in the Interest Rate or Increase in the Maximum Loan-to-Value Ratio

Proposition 5: *Following an unexpected permanent decline in the interest rate r or increase in the maximum loan-to-value ratio θ_i in an inelastic region i, house prices q_{it} and non-housing consumption of the representative household in the region i ,c_{it}, increase discretely and the representative household borrowing constraint becomes relaxed. The initial increase in house prices and consumption is followed by a steady decline in both of them (q_{it}, c_{it}) until the economy reaches the new steady state. Throughout the transition and before reaching the steady state the borrowing constraint remains relaxed.*

The intuition for this result can be derived from equations (1.21) and (1.22). As a result of an unexpected permanent decline in the interest rate or of an increase in θ, in the new steady-state the household can rollover more debt. However, a household's level of debt holding before the shock and just after the shock are the same. This means that the household has some unused borrowing capacity and can therefore finance a higher level of consumption during the transition. But higher consumption also means more demand for housing which, in equilibrium, translates to higher home prices. As the representative household uses up its borrowing capacity, its consumption falls and therefore its demand for housing also declines, which results in a decline in home prices.

Figure 1.7 depicts the impact of a decline in interest rates. As a result of a decline in the interest rate, curves characterized by $\dot{q}^{Constrained} = 0$ and $\dot{c}^{Constrained} = 0$ shift to the right, and the new steady-state consumption and home prices are both higher than before.[26] In Figure 1.7 point a represents the steady-state equilibrium consumption as well as home prices for an inelastic region before a decline in the interest rate. After the interest rate decline, as a result of the wealth effect of the interest rate on home prices, the household borrowing constraint relaxes and the household can now finance a higher level of consumption by borrowing more. Therefore household consumption and home prices jump to a point on the new transition path (a') such that when the household reaches the new steady state it has used up all of its borrowing capacity.

Proposition 6: *In elastic region i, an unexpected, permanent decline in the interest rate results in a gradual increase in housing (h_{it}) and non-housing consumption (c_{it}) until the economy reaches the new steady-state. Throughout the transition the borrowing constraint remains binding.*

Figure 1.9 shows the impact of an unexpected decline in the interest rate in the (h_{it}, c_{it}) phase diagram. In contrast to inelastic regions, an interest rate shock does not generate a boom-bust pattern in the elastic regions. This is due to the fact that since home prices are constant, a decline in the interest rate does not lead to an immediate change in the wealth of households (in contrast to inelastic regions), and the household's borrowing constraint remains binding even after the shock. However as a result of the decline, interest payments of households decline and the freed-up resources are used to purchase a larger house as

[26]This results from equation (1.21).

well as to increase non-housing consumption. In terms of the figure, following the decline in interest rate a constrained household housing (h_{it}) remains constant and its non-housing consumption changes discretely, which is shown as a jump from a to a' and moves along the saddle path until it reaches the new steady state.

Proposition 7: *In elastic region i, an unexpected permanent increase in the maximum loan-to-value results in a discrete increase in housing (h_{it}) and in non-housing consumption (c_{it}). The initial increase in housing and in non-housing consumption is followed by a steady decline in both of them (h_{it}, c_{it}) until the economy reaches the new steady state.*

An increase in the maximum loan-to-value ratio enables households in elastic regions to extract more equity from the current houses that they have and to use the extra resources towards the purchase of a larger house and an increase in consumption. However as they use up their borrowing capacity their housing and non-housing consumption both decline until the economy reaches the steady state. Therefore a permanent increase in the maximum loan-to-value ratio in an elastic region generates a boom-bust cycle in housing and non-housing consumption (Figure 1.10).

1.2.4.2 Permanent Increase in the Interest Rate or Decline in the Maximum Loan-to-Value Ratio

So far I have characterized the responses of different regions to a permanent decline in interest rates or collateral requirements that are not reversed, and I show that these shocks by themselves generate a boom-bust cycle. This subsection considers the response of different regions to a permanent surprise increase in the interest rate or the collateral requirements assuming the economy is in steady-state before the shocks hit.

Proposition 5': *In inelastic region i, an unexpected permanent increase in the interest rate r or a decrease in the maximum loan-to-value ratio (θ_i) results in a discrete decline in house prices (q_{it}), housing consumption (h_{it}) and non-housing consumption (c_{it}). The initial decline in house prices, housing and non-housing consumption is followed by a steady increase in all of them (q_{it}, h_{it}, c_{it}) until the economy reaches its new steady state. Throughout the transition the borrowing constraint remains binding, and house prices grow at rate r.*

For the proof and a full characterization of the transition path see Appendix C.

Following an unexpected increase in the interest rate or collateral requirements house prices in inelastic regions will decline. Because the household borrowing constraint was binding before the shock hit the economy, the representative household should sell part of its stock of housing in order to reduce its debt and meet the collateral constraint.[27] However, this reduces house prices furthermore and the household needs to sell even a higher fraction of its housing stock to meet the collateral constraint. After house prices

[27] A decline in consumption by itself cannot help a household meet its borrowing constraints because that will not change the stock of debt immediately, whereas house prices drop immediately after a shock hits the economy.

decline enough, investors who are not benefiting from the housing services of the house itself buy part of the land in the inelastic region i from the representative household. This is because of their anticipation of future growth of the price of land in the region i. Because of the consumption smoothing between housing services and non-housing consumption, the representative household consumption also declines. The initial decline in consumption and housing stock increases household saving rate which enables household to buy a larger house and increase its consumption throughout the transition. In the steady state the representative household buys back all the lands that was sold to the investors and therefore $h_{ss} = L_i$. steady state house prices and consumption are also given by equations (1.19) and (1.20).

Proposition 6': *In elastic region i, an unexpected permanent increase in the interest rate results in a gradual decrease in both housing* (h_{it}) *and non-housing consumption* (c_{it}) *until the economy reaches the new steady-state.*

In elastic regions, house prices are constant. Therefore changes in the interest rate do not have any immediate impact on the household's housing wealth. However, because higher interest rates increase the user cost of housing, households decrease their stock of housing gradually until they arrive at the new steady state.

Proposition 7': *In elastic region i, an unexpected permanent decrease in the maximum loan-to-value ratio results in a discrete decline in both housing* (h_{it}) *and non-housing consumption* (c_{it})*. The initial decline in housing and non-housing consumption are followed by a gradual increase in both of them* (h_{it}, c_{it}) *until the economy reaches the new steady state.*

In the elastic region, as a result of an increase in collateral requirements households will need to sell a fraction of their housing stock in order to meet the new borrowing constraint. Because of the complementarity between housing and non-housing, their non-housing consumption also declines. However they gradually use the extra resources released from lower consumption to buy a larger house until the economy reaches the new steady state.

1.3 Data

In order to test implications of the model for the impacts of a decline in interest rates and an increase in the maximum loan-to-value ratio, I exploit the fact that there is a great deal of heterogeneity in the elasticity of the housing supply in different regions of US. In the reduced-form analysis of the next section, each county in US with a population of over 150,000 in 2000 comprises a single observation. The main reason for choosing the county as the level of aggregation (instead of MSA) is that Census contains many detailed information about the characteristics of counties. Aggregating at the state level not only reduces the number of observations considerably, but also reduces the variation of elasticity and changes in securitization rate by more than one half. The postal ZIP code level is also not a good option since much regional information is not available at the ZIP code level or its accuracy is questionable. Moreover, there are other important factors that affect the housing market at the ZIP code level such as gentrification that are not included in my model.[28]

In what follows I briefly discuss data the sources used for the empirical portion of this paper as well as their limitations.

Federal Reserve Bank of New York Consumer Credit Panel (FRBNY CCP) The FRBNY Consumer Credit Panel consists of the credit reports of anonymous and nationally-representative 5% random sample of all individuals in the US with a credit file which is released on a quarterly basis. The data begins in the first quarter of 1999.[29] FRBNY CCP contains information on the total debt holdings of individuals with its breakdown into mortgage and home equity loans, auto loans, student loans and credit cards. In order to test the predictions of the model about the dynamics of households debt in different regions and its co-movement with home prices and consumption, I have aggregated the data on the *total mortgage and home equity holdings* of individuals at the county level.[30]

Another challenge is to come up with a measure of *consumption* at the county level. Since I could not find any direct measure of consumption at the county level, I construct a measure of *car sales* at the county level using the data on auto loans of individuals. The idea here is that whenever the auto-loan holding of an individual increases by an amount larger than a threshold between two consecutive quarters,[31] it is assumed the individual has bought a new car, with the value of the car set at a constant times the change in the total auto-loan holding. Given the low interest rates car companies are charging for financing new cars, this assumption does not seem implausible when considering the sale of new cars.[32] However, using this measure as a measure of consumption presents a number of limitations. Most importantly, as is documented by Mian, Sufi and Rao (2012) and Berger and Vavra (2012), car sales response to the financial crisis has been significantly larger than other components of consumption. Therefore the differential response of consumption in regions with different supply of housing and different changes in securitization rate during the boom period and the bust period may be overestimated. For this reason, I check the robustness of results on consumption by using employment in food services and in the retail trade sector as proxies for consumption.[33]

[28]Guerrieri, Hartley and Hurst (2012) presents evidence in support of gentrification channel at the zip code level.

[29]In addition to this 5% primary sample, credit reports of all the other members of the family of these individuals are also available. However in order to keep the calculations straight simple, I am just using the primary sample. More information on FRBNY CCP can be find in Lee and van der Klaauw (2010). Aggregation of this data at the county level has recently been made available at: http://www.newyorkfed.org/householdcredit/

[30]Using total debt instead of mortgage debt did not really affect the results. This is partly because mortgage loan counts for almost 80% of the consumer debt. The other reason for using mortgage debt instead of total debt is that my model is silent about other forms of debt like student loan and credit cards.

[31]I used $5000 as the threshold. But the result are robust to changes in this threshold.

[32]Of course this may underestimate the volume of cars sold on the secondary market. But on the other hand unless used cars are sold from one region to another region, we are double counting the volume of cars that are bought within a county.

[33]The result for changes in employment in food services and retail trade sectors are presented in Appendix F.

CoreLogic Home Price Index (HPI) For data on counties *home prices*, CoreLogic Home Price Index (HPI) is used. CoreLogic HPI has number of advantages over other indices that makes it a very good match for the purpose of my model: First of all unlike the Case-Shiller home price index it is available at the county level for most US counties on a monthly basis. Secondly, HPI is a price index constructed by the repeat-sales. Therefore one need not have concerns about the change in the characteristics of houses that are traded. Finally the fact that HPI is using the distribution of houses in its entirety for constructing the index gives HPI an advantage over the FHFA price index, which is limited to transactions involving conforming, conventional mortgages purchased or securitized by Fannie Mae or Freddie Mac. The conforming loan limit especially biases the results in the case of the large cities with many houses carrying a mortgage above the conforming-loan limit.

Home Mortgage Disclosure Act (HMDA) The HMDA, which was enacted in 1975, requires most mortgage lenders to record a number of important details about each loan applicant, such as the final decision of the lender, the loan amount, the purpose of the loan, and most importantly whether the loan has been kept on the bank balance sheet, sold to a government-sponsored enterprise (like Fannie Mae and Freddie Mac) or has been sold on the secondary market. The data is publicly available at the individual applicant level.

One of the main parameters of the model discussed in the previous part is the maximum loan-to-value ratio θ. But since I do not have a direct measure of θ,[34] I use changes in the *fraction of purchase loans within the conforming loan-size limit*[35] *that were sold into non-government sponsored organizations* (non-GSEs) as a proxy for the change inθ. The idea here is that since GSEs have an explicit subsidy from the government, if there is a loan within the conforming loan limit and it is sold to non-GSEs (instead of GSEs) this is most likely because the loan had a loan-to-value ratio that is not within the criteria imposed by GSEs. Therefore the change in the fraction of loans sold to non-GSEs can be a measure of the extent to which lending standards has become more relaxed. In the empirical part, I show that the change in the fraction of loans sold to non-GSEs goes a long way towards explaining the debt accumulation of households. For more evidence on the relation between the increase in the fraction of loans sold to non-GSEs and the relaxation of lending standards, see Mian and Sufi (2009).

Of course, there are a number of limitations in using changes in the fraction of loans sold to non-GSEs as a proxy for θ. First of all even if there was no change in the lending standards to households, the

[34]As it is documented in Keys, Piskorski, Seru and Vig (2012) most of the increase in the loan-to-value ratio during the boom period comes from the usage of second and third lien loans and not the first lien by itself. Therefore one needs to have a comprehensive measure of all the loans that home buyers took out to purchase or refinance a house. Another equally important point is that one must control for the quality of borrowers and their characteristics. For example it could be the case that individual LTVs are not changing, but rather, lending standards are getting relaxed. For example as it is well documented, there was a rise in number of loans with low or no documentation such that at the pick they were counting for half of the issued loans. In terms of the model this means that some households can borrow more than before, which one can think of as an increase in θ.

[35]This is a limit set by Office of Federal Housing Enterprise Oversight and changes based on the October-to-October changes in median home price. More information on the historical limits can be find at: http://www.fhfa.gov/webfiles/860/loanlimitshistory07.pdf

fact that rating agencies began to give higher ratings to mortgage backed securitized assets (see Ashcraft, Goldsmith-Pinkham and Vickery (2010)) induces lenders to sell a higher fraction of their loans to non-GSEs and therefore this fraction may increase without an increase in θ. Another shortcoming of this measure is that it mostly captures the extensive margin of financial liberalization. For example, if the loan-to-value ratio of the pool of loans sold to non-GSEs also increases, this measure underestimates the change in θ. As long as the extensive margin of financial liberalization and the intensive margin are not perfectly correlated, this results in an underestimation of the importance of relaxed credit standards.

Another measure that I construct using the HMDA dataset is the ***share of investors*** in the housing market of each county. This is measured as a fraction of purchase loans that the mortgage applicant's occupancy is non-owner-occupied. Misreporting the occupancy status of applicants may result in underestimation of this measure.

Local Housing Elasticity and Land Share In the Value of House The main implication of the model is the differential response of various regions with inelastic supply of housing versus regions with elastic supply to interest rates shocks and to shocks to the maximum loan-to-value ratio. In order to test the implications of the model, I use the measure of elasticity provided by Saiz (2010). Saiz (2010)'s measure of elasticity is based on the availability of land as well as on regulatory restrictions on building new houses. Since the Saiz (2010) measure is estimated for MSAs, I match MSAs with counties and use the average elasticity of matched MSAs for each county.[36] Finally in order to construct a measure of inelasticity, I take minus logarithm of Saiz (2010) measure and normalize it such that it has a mean of zero and a variance equal to one.

Davis and Heathcote (2007) also provides an estimate of the time series of the average share of land in the value of houses for 46 large US MSAs. In the calibration part, I use both the cross section and the time series of this data in order to estimate the supply of housing for different regions in the US.

Census Data on the income and population of each county on a yearly basis comes from USA Counties,[37] which contains a collection of data at the county level from the U.S. Census Bureau and other Federal agencies such as the IRS. Data on the aggregate value of owner-occupied homes is taken the American Community Surveys of 2000, 2005 and 2008.[38]

Anti-Predatory Lending Law Measure In order to curtail predatory lending practices, Congress enacted the Home Ownership and Equity Protection Act (HOEPA) in 1994. This legislation places some restrictions on refinance mortgages or on home equity lines with excessively high interest rates or fees. Following a rise in predatory practices, some states began to add restrictions to HOEPA usually referred to as mini-HOEPA. One of the main amendments to HOEPA was the addition of home purchase loans with

[36]For most MSAs each MSA is matched with only one county.
[37]Available at http://www.census.gov/support/USACdata.html
[38]Available at http://factfinder2.census.gov

high rate or high fees into the regulation. In particular according to Choi (2011) as of 2005, nineteen states included home purchase loans into anti-predatory lending legislation. For a measure of the restrictiveness of anti-predatory law, I have constructed a dummy variable that is equal to one if the state added purchase loans under the coverage of its anti-predatory lending laws and zero if the state's law regulates only refinance and equity mortgages.

1.4 Empirical Model

1.4.1 Motivation

As Figure 1.11 shows, a motivating fact in the data is that regions that experienced a greater boom in home prices and in consumption during the interval of 2000 to 2006 suffered from a more severe bust during the period of 2006 to 2009. The main prediction of the model in the previous section is that this boom-bust pattern in consumption and house prices should occur in regions with a less elastic supply of housing and in regions that experienced a greater easing of collateral constraints.

Indeed, Figure 1.12 shows that regions with an inelastic supply of housing on average experienced a larger boom and bust in house prices and consumption. The figure also shows that among inelastic regions, the boom-bust pattern is magnified in regions that experienced a larger change in the fraction of loans sold to non-GSEs from 2003 to 2006. The bottom graph in Figure 1.12 also indicates that total mortgage liability per capita in inelastic regions and regions with higher changes in the fraction of loans sold to non-GSEs grow faster during the period of 2000 to 2008. What is more important for the purpose of this paper is the fact that a significant fraction of the decline in house prices and in car sales occured between 2006 and mid-2008, a period during which households continued to increase their mortgage liabilities. This suggests that a significant fraction of the decline in house prices and consumption is not driven by the inability of households to rollover their debt, but instead, is driven by the reduction in the amount that households could increase their debt holding.

Motivated by these figures, the next subsection addresses the relation between inelasticity of housing supply and changes in the fraction of loans sold to non-GSEs and house prices, consumption and debt accumulation in a reduced-form regression framework.

1.4.2 The Main Results

The model in the previous section shows that a decline in interest rates leads to a boom in house prices and in consumption in regions with less elastic supply of housing which is then followed by a bust in those regions. A decline in collateral requirements (i.e. increase in θ) also results in a boom-bust in consumption and in house prices that is more extreme in regions with more inelastic supply of housing.

In what follows I divide the sample into the period of the boom from 2000 to 2006, and the period of bust from 2006 to mid-2008.[39] And I run the following regression:

$$\Delta log\left(Y_{it}\right) = \alpha + \beta_1 Inelasticity_i + \beta_2 \Delta Securitization\,Rate_i + \beta_3\left(Inelasticity_i \times \Delta Securitization\,Rate_i\right) + X_{it}\Gamma + \epsilon_i \quad (1.42)$$

where Y_{it} is a dependent variable of interest which represents either house prices,[40] or a measure of car sales in county i at time t, or total mortgage liabilities. *Inelasticity* is based on Saiz (2010) measure of elasticity of housing supply. $\Delta Securitization\,Rate_i$ is the change in the fraction of loans sold to non-GSEs in county i from 2003 to 2006. I chose this period because the aggregate changes in the fraction of loans sold to non-GSEs has the fastest growth rate during this period.[41] The baseline controls include the growth in average income[42] of county residents during the associated period and its interaction with inelasticity, population growth and the change in fraction of homes purchased by investors.[43] The interaction terms are averaged out and, therefore, β_1 and β_2 capture the average impact of housing supply and of changes in the securitization rate on the variables of interest. In general because both personal income and the fraction of investors are influenced by the change in house prices, controlling for these two factors may result in an underestimation of the impact of changes in interest rates and the maximum loan-to-value ratio on house prices and consumption. Therefore, one would expect that estimated coefficients of β_1, β_2 and β_3 in regressions that controls for characteristics of counties would be closer to zero than their estimates in regressions without controls. In order to compute the aggregate implications of changes in interest rates and securitization rate on the growth rate of variable Y, I use estimates of β_1, β_2 and β_3 from estimation of equation (1.42) and compute in-sample difference between $\Delta\widehat{log(Y_{it})} - \Delta\widehat{log(Y_{lt})}$ for each county i, where l is the average predicted value for counties in the lowest 10 percent of inelasticity measure and the lowest 10 percent of the change in securitization rate. Then I take the average of these differences weighted by the population of the county in 2000. It is worth to mention that this procedure may underestimate the aggregate impact of securitization. This is due to the fact that during the period of 2003 to 2006, even

[39] The reason for choosing mid-2008 is to make sure we are not capturing the impact of events that followed the bankruptcy of Lehman Brothers. This period is also prior to the period when households start to deleverage their debt-holding and therefore is more useful for the purpose of differentiating between inability to borrow more and inability to rollover the debt. Extending the period of bust to 2009 or afterward results in a larger bust and gives greater significance to the result.

[40] Since I use the same deflator (CPI deflator) for all regions, the coefficients are the same for both nominal and real house prices.

[41] The results are robust to using changes in the fraction of loans sold to non-GSEs between 2003 and 2005 or the in maximum change in fraction of loans sold to non-GSEs that the regions experienced during the period of 2003 to 2006.

[42] This is based on aggregation of IRS data on ZIP codes income at the county level.

[43] Recent studies like Bayer, Geissler and Roberts (2011) and Haughwout, Lee, Tracy, van der Klaauw and Wilbert (2011) provide evidence on the role of speculators and investors in destabilizing house prices and, therefore,I control for the share of investors to make sure the result is robust to controlling for them. However, in general there are two problems with addressing the role of investors: First, because of data availability, it is hard to distinguish between those who buy leisure homes and speculators (investors) in the housing market. Therefore one should be cautious in interpreting the results on the role of investors. In terms of the model, buying a leisure house is like increasing the housing consumption, which is a direct consequence of lower interest rates and collateral requirements. Moreover, introduction of news shocks to the model shows that investors may jump in the markets they expect house prices to grow in the future. Therefore the rise of their share can be a symptom of expectations about future house prices and not its driver.

regions in the lowest 10 percent of the change in securitization rates experienced a more than five percent increase in the fraction of loans sold to non-GSEs. On top of this, we would also expect that the aggregate impact of changes in interest rates on mortgage liabilities growth to be underestimated. This is due to the fact that a decline in interest rates occured in all places which induces even households in elastic regions to buy a larger house and increase their debt holding. Therefore we should expect that the actual and the estimated in-sample differences for mortgage liabilities to be smaller than the aggregate changes.

1.4.2.1 The Boom Period of 2000 to 2006

From Figure (1.1a) one can see that during the period of 2000 to mid-2003, there was a steady decline of more than two percent in the long-term real interest rates, followed by more than a 20 percent increase in the fraction of loans sold to non-GSEs in the interval 2003-2006. Table 1.1 shows that during the boom years, house prices, consumption and mortgage liabilities of more inelastic regions and of regions that experienced a larger increase in the fraction of loans sold to non-GSEs grew faster than other regions. Not controlling for the investor shares and changes in average income, the implied aggregate impact of the interest rate and changes in securitization rate explains about 75 percent of the growth in house prices, 95 percent of the growth in car sales per capita, and 20 percent of total mortgage growth. Controlling for the share of investors and average income growth reduce the number for house prices to 70 percent and the number for consumption to 85 percent. The fact that during the boom years, the estimated in-sample difference explains a lower fraction of the change in total mortgages is consistent with the model. This is because here a decline in interest rates does not change house prices in the elastic regions, but it reduces the user cost of housing and induces households in those regions to build larger houses, thereby increasing their mortgage liabilities over time. In fact focusing on the actual in-sample differences in total mortgage growth, the estimated coefficients predict all the difference in mortgage liability growth between the most elastic regions which experienced the lowest change in securitization rate and the rest of the regions.

1.4.2.2 The Bust Period of 2006 to 2008

As we saw in Figure 1.11, most of the decline in house prices and in consumption happened in the places that experienced a boom during the period 2000-2006. In the previous section I show that most of the boom portion of the cycle can be explained by variations in the elasticity of housing and in variations in the change in securitization rate. In this part I examine to what extent the decline in house prices and in consumption can be attributed to the very same factors that created the boom: changes in fraction of loans sold to non-GSEs during the boom years and differences in the elasticity of housing supply.

The results in Table 1.2, shows that more inelastic regions and regions that experienced greater changes in securitization rates in the years preceding the bust years, experienced larger declines in house prices and in consumption. Interestingly, even during the bust years the total mortgage liability in these regions increased faster than other regions. In terms of the model and in line with the evidence depicted by Figure 1.12, this is due to the fact that households in inelastic regions and in regions that experienced a large change in securitization rates do not use up all of their borrowing capacity during the boom years, rather their borrowing capacity is exhausted over time. Table 1.2 also shows that on average about 35 percent of the decline in aggregate house prices and in consumption can be explained by the variations in the inelasticity measure and by changes in securitization rates during the boom years. These variables explain about 50 percent of the growth in aggregate mortgage liability, which is considerably higher than the fraction that is explained by these factors during the boom years. In terms of the model this is explained by the fact that households in elastic regions exhaust their borrowing capacity faster than their counterparts in inelastic regions. This is because decline in interest rates or in collateral requirements do not have a wealth effect in those regions and house prices remain constant. Therefore households in these regions experienced less of an expansion in their borrowing capacities.

1.4.3 Instrumental Variable Approach

So far we have seen that 75 percent of the variation in consumption and in house prices during the boom period and about 40 percent of the variation in consumption and in house prices during the bust is associated with variations in the elasticity of housing supply and variations in the change in securitization rate. However one concern that arises is that variations in changes in the securitization rate may not be exogenous and, in particular, increasing house prices or expectations of future growth in house prices, can induce financial institutions to relax borrowing standards and make investors of securitized assets more willing to buy these assets.

In order to address this problem, I use two sources of variations in different regions as an instrument for changes in the securitization rate: (i) variations in population characteristics of counties and (ii) variations of different states in adopting anti-predatory lending laws. In particular let us assume there is a "national securitization" shock that increases the supply of loan contracts with relaxed terms in all regions. This change in the supply has a larger impact in regions where there is a higher demand for these products. The demand for loans with more relaxed terms can be higher when the fraction of the population whose income barely covers below the required down-payment is higher. In line with this prediction and motivated by Ouazad and Rancière (2011), that shows the volume of mortgage origination to Hispanics almost doubled between 2003 and 2005 (compared to less than 40 percent increase for whites during the same period),[44] I find that the percentage of Hispanic population in a county in 2000 is positively correlated with the subsequent changes in the securitization rate.[45] As another source of variation for the changes in securitization rate, I use the fact that by the end of 2004 many states adopted new anti-predatory lending regulations which slowed down the increase in the securitization rate between 2003 and 2006. In fact Anti-predatory lending

[44] See Figure 1.18 for the time series of volume of mortgage originations among different races.

[45] State of California is among the states with the highest fraction of Hispanic population and one may concern the result are driven with observations in that state. However the following results were robust to the exclusion of counties in the state of California.

laws have been in effect since 1994 however only refinance loans were included in those laws. After the rise of predatory practices during the securitization boom, some states began to include purchase loans into the loans subject to anti-predatory lending laws. By the early 2005, nineteen states amended home purchase loans into anti-predatory lending laws. I construct an Anti-Predatory dummy that is equal to one for states that included purchase loans in their Anti-Predatory lending laws. The first column of Table 1.3 shows that on average states that included purchase loans in the law, experienced four percent fewer increase in securitization rates.[46]

Columns three to eight of Table 1.3 show the results of the same regressions as in the previous part when changes in the securitization rate are instrumented by the percentage of Hispanic population in each county. Qualitatively, the impact of the changes in securitization on house prices, on consumption and on total mortgage liability during the boom period and the bust period are the same as before: more extreme change in securitization rates result in more accumulation of mortgage debt and a larger boom in house prices and in consumption followed by a larger bust. However the estimated coefficients for the impact of the change in securitization rate on house prices, on consumption and on total mortgage liability are significantly larger than the OLS estimates. One possible reason for this result is that IV is capturing the local average treatment effect of change in securitization, which is larger for borrowers with incomes just below the required down-payment.

1.4.4 Long Run Results

Table 1.4 shows OLS estimates relating house-price growth, car sales growth and total mortgage liability growth during the period of 2000 to mid-2008 to the *Inelasticity* measure and the change in the securitization rates during the period of 2003 to 2006. From the coefficients of *Inelasticity* in Table 1.4, one can see that even after the bust, house-price growth in inelastic regions is still higher than that for elastic regions which, in terms of the model, this is because steady-state house prices in inelastic regions is a decreasing function of interest rates. Therefore, lower interest rates results in permanently higher house prices in regions with less elastic supply of housing. The table also shows that inelastic regions and regions that experienced a greater changes in securitization rates accumulated greater amount of mortgage liability. In terms of aggregate impact, variations in securitization rates and in the elasticity measure can accounts for about 75 percent of the total change in household mortgage liabilities. It is interesting to see that the appreciation of home prices that occured due to the rise in securitization during the period of 2003 to 2006 is all gone by mid-2008.

1.5 Calibration

The reduced form evidence presented in the previous section has some important limitations. First of all it cannot distinguish between the bust that is driven purely by front-loading behavior of households and

[46]Interaction of instruments with inelasticity is also used to instrument for the interaction term of inelasticity times changes in securitization rate.

the bust resulted from the reversal of the initial decline in collateral requirements. Additionally the model reveals that the impact of a decline in collateral requirements on house prices and consumption is a function of real interest rate. Therefore the reduced-form results cannot inform us about what would have happened in the case in which there was the same decline in collateral requirements but the real interest rates differed.

In the sub-section that follows, I first extend the model to allow for a more flexible supply of housing. Then, in order to analyze implications of the extended model, I calibrate the model for three types of regions: (i) inelastic regions that experienced high change in the fraction of loans sold to non-GSEs, (ii) inelastic regions that experienced low change in the fraction of loans sold to non-GSEs and (iii) elastic regions.[47] The calibration is based on data on actual changes in the mortgage liabilities of households in these regions and on other static characteristics of these regions. Then I compare the predictions of the model with and without a reversal in the decline in collateral requirements on house prices and on consumption. Finally the model is used to consider two sets of counterfactuals. The first set considers the counterfactuals related to past events: what would have happened if there were the same decline in the interest rate but no change in collateral requirements and what would have happened if there were the same change in collateral requirements but no change in interest rates. The second set considers two different policy choices following the tightening of credit: (i) further reduction in real interest rates and (ii) loan modification.

1.5.1 Extension of Housing Supply

One problem with the basic model is that assuming a fixed supply of housing in inelastic regions results an overestimation ofthe impact of a decline in interest rates and in collateral requirements on house prices and on consumption. The other problem with a fixed supply of housing is that during the boom period there was a rapid rise in activity in the construction sector even in the most inelastic regions (see Charles, Hurst, and Notowidigdo (2012)). In order to tackle this problem, I extend the model by replacing the Leontief production function for the housing sector (equation (1.3)) with the following CES function:

$$h = \left[\omega_k^{1/\sigma} k^{\frac{\sigma-1}{\sigma}} + (1-\omega_k)^{1/\sigma} l^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

Here k and l are the capital and the land used in building a home, ω_k is the weight of capital in the housing aggregator, and σ is the elasticity of substitution between land and capital. As before I assume that there is no adjustment cost in building (or destroying) a house. Additionally I assume house producers maximize their instantaneous profit. This pins down the relation between house prices and aggregate stock of housing in region i :

$$H_{it} = \left(1-\omega_k^i\right)^{-1/(1-\sigma)} \left(\frac{q_{it}^{1-\sigma} - \omega_k^i}{q_{it}^{1-\sigma}}\right)^{\sigma/(1-\sigma)} L_i \tag{1.43}$$

Now, equilibrium consumption, house prices and house quantities are obtained by adding equation (1.43)

[47] These regions are the same as those we used in constructing Figure 1.12.

to the first-order conditions of the household-maximization problem, given by equations (1.12)-(1.14).[48] One interesting result from the solution of the CES case is that there is a critical threshold price q_{cr} given by:

$$q_{cr} = \left(\frac{1-\theta}{\theta}\sigma\omega_k + \omega_k\right)^{1/(1-\sigma)} \tag{1.44}$$

that if the steady state price of a home falls above this threshold, the dynamics of house prices and of consumption resemble the dynamics of an inelastic region in the basic model: As a result of a decline in interest rates, household borrowing constraint becomes relaxed and remains relaxed throughout the transition, and there is a boom-bust pattern in consumption and in house prices. On the other hand if the steady-state price falls below this threshold, the economy has a saddle path similar to that of elastic regions in the basic model.

With lower interest rates, steady-state house prices increase, which leads to more regions experiencing a boom-bust cycle in response to interest rate shocks. This result is in line with the finding of Glaeser, Gottlieb and Gyourko (2012) which finds that even for elastic regions, the impact of a change in interest rates is larger when interest rates are relatively low. But more interestingly, q_{cr} is a decreasing function of θ, the collateralizable fraction of housing wealth. This means that as a result of declines in collateral requirements more regions will experience cyclical behavior in response to an interest rate or a collateral-requirement shock.

1.5.2 Calibrating Parameters

In order to analyze the main insights of the model, I calibrate the model for three different types of regions: Inelastic regions that experienced high change in securitization rates, Inelastic regions that experienced low change in securitization rates and elastic regions. Inelastic and elastic regions are defined as regions in the top and bottom quintiles of the inelasticity measure. High (low) change in securitization rates is defined as being above (below) the median level of change in securitization rates for inelastic regions.

1.5.2.1 Static Parameters

For estimating σ and ω_k, I use the database on the home prices and the share of land provided by Davis and Heathcote (2007). In particular with the CES production function for housing one can see that the relation between the share of capital (structure) and house prices is:

$$log\left(\frac{k_{it}}{q_{it}h_{it}}\right) = log\left(\omega_k\right) + \left(\sigma - 1\right) log\left(q_{it}\right) \tag{1.45}$$

Using land shares and house prices data in Davis and Heathcote (2007), I run a panel regression of the time series of average structure share in the value of house on house prices with a fixed effect for each city,

[48]For the full characterization of the equilibrium in the CES case see Appendix D.

and the coefficient of house prices in this regression is equal to $\sigma - 1$.[49] This results in $\sigma = 0.5$ which is in between a Cobb-Douglas production for housing ($\sigma = 1$) and the Leontief case ($\sigma = 0$). Moreover from equation (1.45), one can see that if we normalize the price of a reference year (say, year 2000) to one, then ω_k is equal to the share of structure in the value of house in that year. This pins down $\omega_k^{inelastic} = 0.3$ and $\omega_k^{elastic} = 0.8$. ρ is chosen equal to 6 percent in order to capture the idea that households are relatively impatient. The wage rate, w is assumed to be constant and is normalized to one. η, δ and L for each region are chosen to match the share of mortgage payments and other housing costs in household income.[50] Using data from the American Community Survey in the year 2000, median mortgage expenditure in inelastic regions is about 12 percent of the household income. This figure is equal to 8 percent for elastic regions. The median expenditure of households without a mortgage on housing is relatively constant among different regions and it is around 10 percent. This results in:

$$\begin{aligned} \eta^{Inelastic} &= 0.38\,,\ \delta^{Inelastic} = 0.078\,,\ L^{Inelastic} = 6.12 \\ \eta^{Elastic} &= 0.28\ ,\ \delta^{Elastic} = 0.044\ ,\ L^{Elastic} = 14.29 \end{aligned}$$

$\eta^{Inelastic} > \eta^{Elastic}$ is a direct consequence of the fact that in the data the share of mortgage expenditures in inelastic regions, on average, is four percent more than this share for elastic regions.

1.5.2.2 Dynamic Parameters (r_t, θ_{it})

Based on the yields rate on Ten-year treasury inflation-protected securities (TIPS), the real interest rate, r, is chosen to be equal to 4.3 percent in the year 2000 and gradually declining to 2.1 percent by mid-2003. For the model without a financial crisis (i.e. reversal in the initial decline in collateral requirements), I assume the interest rate remains constant from that point afterward. For the model with a financial crisis, I incorporate the fact that in response to the financial crisis real interest rates declined further (see Figure 1.1a) and I assume that from 2008 to 2011 real interest rates declined further by one more percentage point to 1.1 percent.

Using data from the NY Fed Consumer Credit Panel on total mortgage liability for households in different regions, I compute the time series of changes in total mortgage liability per capita for different regions. For the model without a financial crisis I use the time series of household mortgage liabilities from 2000 to 2006 to calibrate the time series of θ_{it} for each region and I assume from 2006 onward that the maximum loan-to-value ratio in that region (θ_{it}) remains at its 2006 level. For the model with a financial crisis, I extend the calibration of θ_{it} in order to match changes in household mortgage liability in the period 2007-2010. It is important to mention that no information about the time series of house prices or consumption is used in calibrating the parameters of the model and therefore the performance of the model can be evaluated upon matching those time series.

[49] I used the period of 1995 to 2005 in the panel regression.
[50] In terms of the model, here I assume all the expenses other than mortgage payments is the depreciation cost of capital (δk).

Finally it is assumed whenever there is a change in the interest rate or in the maximum loan-to-value ratio households are surprised.[51]

1.5.3 Calibration Results

In this section, I compare the performance of the model with a financial crisis and without a financial crisis with the actual data. It should be mentioned that the parameters of the model without a financial crisis and with a financial crisis are the same for the time period before the year 2007 and therefore, by construction, the predictions of the two models for this period are the same.

Figure 1.13 shows the results of the calibration of the model for inelastic regions that experienced high change in securitization rates. In order to match the time series of total mortgage liability between 2000 and 2006, $\theta_t^{Inelastic,HighSec}$ remained constant at 0.6 until 2003, when it began to steadily increase to 0.97 by 2006.[52] The model without a financial crisis predicts slightly more than a 60 percent increase in house prices for these regions compared to about an 85 percent appreciation that occured in the data. Non-housing consumption in the model also replicates the time series of car sales during the boom years. However, since car sales have been more volatile than other components of consumption, the model perhaps overestimates the consumption boom.[53] Even in the model without any reversal of the initial decline in collateral requirements, house prices and consumption begin to decline by the time that decline in the interest rate or collateral requirements slows down. The decline in house prices and in non-housing consumption predicted by the model without a financial crisis is smoother than what is revealed in the data. This is due to the fact that in the model without a surprise, during the transitional period, the borrowing constraints of households in inelastic regions are unconstrained and therefore non-housing consumption declines at the rate $\rho - r$, which is about 4 percent in the model. As the time series of mortgage liabilities shows, it is important to notice that the decline in consumption is not happening because of households inability to roll-over their debt. This decline happens because the level of consumption during the boom is financed by borrowing more, and households realize they cannot increase their debt holding forever. Therefore as they see their untapped borrowing capacity decline, they reduce their consumption-which also leads to lower house prices. Extending the calibration of the model to match changes in mortgage liability from 2007 to 2010 significantly improves the performance of the model in predicting the rapid decline in house prices and in consumption that one observes in the data. The model also predicts that as a result of the financial crisis maximum the loan-to-value ratio in inelastic regions with high change in securitization rate declined by 0.3 to 0.67 which

[51] At least for interest rates this does not seem unreasonable. This is because the baseline interest rate used for calibration is the yield on 10-year TIPS, which its movements are usually assumed to be a surprise for the market. On the other hand, the assumption that households assume interest rates and collateral requirements remain constant forever is a relatively strong assumption. In general the role of expectations about interest rates, growth rates and collateral requirements is an important dimension that in the future work it ought to be incorporated into the model.

[52] Since for each region in the model there is only one representative household, one should think of changes in θ as capturing both the extensive margin of adjustment(people who have been excluded from the lending market are now able to borrow) and the intensive margin (controlling for the quality of the borrower loans have more relaxed terms).

[53] Replacing the Cobb-Douglas assumption for housing and non-housing consumption with a CES function with complementarities between housing and non-housing can magnify the boom-bust in house prices and can dampen the boom-bust in non-housing consumption.

is close to its level in 2000. There are two reasons for the impact of an increase in collateral requirements on house prices and on consumption. First, as a result of decline in θ, the total amount that households can borrow throughout their lifetime declines. This is both because of the direct impact of lower loan-to-value ratios and because of the indirect impact of a lower θ on house prices. This induces households to reduce their consumption in order to smooth their consumption for the rest of their lives. Second, if the increase in collateral requirements is high enough, the current debt holding of the household may well exceed the maximum amount that a household can borrow. In this case, on top of consumption smoothing motivation, the household should give up a higher fraction of its housing stock to meet the new borrowing constraint. Only in this case, households deleverage their debt holding. Moreover in the cases that households are forced to deleverage their debt holdings, part of the decline in consumption and in house prices will be recovered in the following years.[54] This is because households' deleveraging results in a "fire sale" of houses. But after they reduce their debt, households begin to increase their housing stock and consumption.

Calibration of the model for inelastic regions with changes in the securitization rate that are lower than the median for inelastic regions, results in a time path for $\theta_t^{Inelastic,LowSec}$ that starts out at 0.6, and, by 2003, it increases only slightly to 0.65. From 2003 to 2006, $\theta_t^{Inelastic,LowSec}$ increases by another 0.17 units. The time paths of house prices and of consumption are similar to the previous case except that for these regions the model correctly predicts both the timing of increase in house prices and the level of house prices growth (see Figure 1.14).

Calibration of the model for the most elastic regions results in lower estimates of changes in collateral requirements in comparison with changes in collateral requirements in inelastic regions (Figure 1.15). In elastic regions, a decline in interest rates does not lead to a boom in consumption. This is because house-price change is insignificant and therefore household borrowing constraint remains binding. The model predicts that the impact of a financial crisis on consumption and house prices in elastic regions is less severe than this impact for inelastic regions. In fact the model fails in capturing the level of decline in consumption and house prices that happened for elastic regions in the data. This is, partly, due to an assumption of the model that is more problematic for elastic regions: The model assumes that households can disinvest the capital used in their house and pay back their debt. This assumption is less problematic for the model without a financial crisis since the adjustment in housing stock is happening slowly. But for the model with a financial crisis, it is more realistic to assume the stock of existing houses cannot decline, and instead of house quantities, house prices should adjust. This can help the model to predict the sharp decline in house prices and in consumption even in elastic regions.

1.5.4 Past Events Counterfactual

After testing the performance of the model, in this section I want to consider two informative counterfactuals about past events: first, what was happening for the house prices and consumption if there was the same

[54]This is related to proposition 5' in the model.

decline in the real interest rate but there has been no change in collateral requirements.[55] Second, what was the impact of the same decline in collateral requirements if there was not a decline in the real interest rate during the period of 2000 to 2003.[56] In order to simplify the comparison, in the following graphs I just show the time path of consumption and of house prices for inelastic regions that experienced high change in securitization rate and for elastic regions.

The model predicts only 30 percent increase in house prices of inelastic regions if there was not a decline in collateral requirements compared to more than 60 percent increase when decline in interest rates was followed by decline in collateral requirements. The growth in consumption would have been 60 percent less if there was no decline in collateral requirements. The model predicts that absent a decline in collateral requirements, decline in house prices and consumption would have started by mid-2003. In terms of the model, decline in consumption and house prices were postponed to mid-2006 as a result of a continuous decline in collateral requirements, which led to a gradual increase in the steady-state borrowing capacity of households. Finally as is emphasized before, decline in interest rates, by itself, does not generate a boom-bust in elastic regions.

The model shows that if there was not a decline in interest rates, the impact of the same decline in collateral requirements on house prices and consumption was significantly milder. The reason for this is that with interest rates closer to the rate of time preference ρ, households have less motivation to frontload and distribute the new borrowing capacity more evenly over their life time. The other channel through which the real interest rate influences the impact of a decline in collateral requirements is through its impact on the steady-state house prices. Lower collateral requirements results in larger debt holding in the steady state and therefore a larger interest payments. This reduces demand for consumption and housing services. On the other hand lower collateral requirements makes housing more affordable and increases demand for housing. Whether house prices in the steady-state increase or decrease depends on the interest rate. The main message from this experiment is that the impact of collateral requirements on consumption and house prices depends crucially on the level of interest rates.

1.5.5 Policy Experiment: Interest Rate Cuts versus Loan Modification

The next step is to compare the prediction of the model with a financial crisis with two scenarios: First, in response to the financial shock, there is an even stronger monetary policy that reduces real interest rates by another 50 basis points. Second, households are given more time to deleverage and the decline in the maximum loan-to-value ratio occurs over a longer period of time. In particular I assume the same decline that occured in θ during the period of 2008 to 2011 to occur during the period of 2008 to 2013. Of course the

[55] In models with endogenous collateral requirements like Rampini and Viswanathan (2012) decline in real interest rates, themselves, results in a decline in collateral requirements. Therefore the way one should think about this policy is that in contrast to market forces, financial regulation is preventing banks from relaxing their standards. For example in the early 90s, in response to rising house prices, Hong Kong Commissioner of Banking restricted loan-to-value ratios.

[56] Perhaps the main reason that collateral requirements get relaxed was the fast appreciation of house prices which was fueled by declining interest rates. Therefore one should think of this experiment as an "upper bound" on the impact of changes in collateral requirements by themselves

model abstracts from monetary policy or a micro-foundation for collateral requirements and, therefore, one should think of these policy experiments as qualitative exercises that can highlight some of the mechanisms of the model.

The policy experiment (Figure 1.17) shows that lower interest rates is not effective in increasing consumption of households living in elastic regions, whereas it does increase consumption in regions with inelastic supply of housing. This result is driven by the asymmetric impact of real interest rates on house prices in regions with elastic supply of housing and regions with inelastic supply of housing. On the other hand, loan modification increases the consumption in all regions temporarily. However loan modification delays the recovery procedure and the initial increase in consumption is followed by a decline in consumption and house prices in the following years. The main reason that in this framework effectiveness of policy is limited is because the decline in consumption is not only driven by some households deleveraging their debt holding, but more importantly because the level of consumption during the boom years, itself, was financed by the fast growth in household liabilities.

1.6 Conclusion

During the period from 2000 to mid-2008 the stock of US household liabilities more than doubled. During the same period house prices and consumption experienced a boom-bust pattern that is magnified in regions with a more inelastic supply of housing and in regions with higher change is securitization rate during the boom years.

The purpose of this paper is to provide an economic framework that can help in understanding the increase in liabilities of households as well as the swing in house prices and in consumption. At the heart of the theory is an unsustainable increase in consumption driven both by expanded access to credit and the endogenous increase in house prices that relax credit constraints. My theoretical mechanism highlights the importance of low interest rates and of elasticity of housing supply to explain how pronounced the dynamics implied by a credit expansion will be. Reduced-form empirical evidence supports the predictions of the model and shows that variations in the elasticity of the supply of housing and changes in securitization rates during the boom years can explain most of the increases and declines in house prices and consumption during the boom years (2000-2006) and bust years (2006-mid-2008). The quantitative exercise illustrates the importance of the reversal in the initial relaxation of credit standards to explain the precipitous decline in consumption and house prices. However, the model constructed in this paper shows that even without a reversal in credit standards, most of the decline would have taken place, but over a longer period of time.

From a broader perspective, this paper is also related to two recent strands of literature. First, this paper is related to the literature on macroprudential policy (see Hanson, Kashyap, and Stein (2011)) and shows the interaction between interest rates and collateral constraints for the macroeconomy. The model shows that this interaction is more pronounced during periods of low interest rates. The model is also suggestive that an impatient policy maker has more incentives for financial deregulation which can results in excessive fluctuations in the economy. This paper is also related to the recent literature on the distributional impacts of monetary policy like Piazzesi and Schneider (2012), Coibion, Gorodnichenko, Kueng and Silvia (2012) and Brunnermeier and Sannikov (2012). In particular the model implies that impacts of lower interest rates and financial deregulation can be very different for households in different regions.

There are a number of important theoretical dimensions that are currently beyond the scope of this paper. First, one can study the role of expectations about future interest rates, collateral requirements and growth rates in this economy.[57] Second, the model abstract from savers in the economy. My preliminary results of the inclusion of households with temporary high incomes shows that income inequality can be an important factor in explaining the decline in real interest rates and the boom-bust in house prices and consumption.[58] Third, any welfare implications of the boom-bust cycles within this framework needs a further study.[59] Fourth, understanding the micro-foundation of changes in collateral requirements contributes to a better understanding of the boom-bust cycles caused by an expansion of credit.

Also from the empirical point of view, there are a number of extensions that I should conduct. First of all the logic of the model is applicable to the European countries that experienced a surge in capital inflows and a housing boom and bust (like Spain and Ireland). The boom-bust cycle of housing market in US coastal areas in mid-80s to mid-90s is another related episode that can be used for testing the model.[60] Secondly, a better measure of changes in lending standards and a better measure of consumption can be very useful for a better testing of the model. Also for the quantitative exercise, addition of adjustment costs for housing seems to be of a first order of importance.

[57] My preliminary result shows expectations about future growth can also generate very long-lasting periods of boom followed by a bust.

[58] The relation between rise in inequality and higher household leverages is also discussed in Kumhof and Ranciere (2010).

[59] In particular the framework of this paper is similar to the ones in Jeane and Korinek (2010). However in contrast to their framework, during the transition periods the borrowing constraint of households in inelastic regions is relaxed and therefore Pigouvian taxation is not necessarily welfare improving.

[60] Interestingly, during this period on one hand there was a decline in real interest rates and deregulation of financial institutions in the US. On the other hand this period also experienced a rise in household mortgage liabilities and in the US current account deficit.

Table 1.1: The Boom Period of 2000 to 2006

	House Prices Growth between 2000 and 2006			Car Sales Growth between 2000 and 2006			Total Mortgage Liabilities Growth between 2000 and 2006		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inelasticity	0.18***	0.16***	0.06***	0.07***	0.06***	0.05	0.10***	0.08***	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)
Change in Securitization Fraction 03_06	1.94***	1.63***	0.64***	0.74***	0.68**	0.78**	1.22***	0.95***	0.64*
	(0.29)	(0.26)	(0.24)	(0.28)	(0.28)	(0.37)	(0.29)	(0.27)	(0.36)
Inelasticity X Change in Securitization Fraction 03_06	0.99***	0.72***	0.08	0.13	0.09	0.02	0.75***	0.54**	0.18
	(0.21)	(0.21)	(0.19)	(0.25)	(0.24)	(0.29)	(0.27)	(0.27)	(0.31)
Implied Aggregate Impact	0.44	0.4	0.18	0.2	0.18	0.18	0.23	0.19	0.09
Percentage of Total	76	69	31	95	86	86	22	18	8
Controls	N	Y	Y	N	Y	Y	N	Y	Y
State Fixed Effect	N	N	Y	N	N	Y	N	N	Y
Regression Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	323	323	323	323	323	323	323	323	323
R-squared	0.43	0.55	0.84	0.18	0.19	0.40	0.29	0.37	0.51

Notes: This table presents estimates of the impact of variations in the elasticity of housing supply and changes in the securitization rate on house prices, car sales and total mortgage growth during the years of 2000 to 2006. *Inelasticity* is based on Saiz (2010) measure of the elasticity of housing. The *Securitization Fraction* is computed as the fraction of purchase loans sold to non-GSEs. Baseline controls include the growth of average income between 2000 and 2006 and its interaction with inelasticity measures, population growth during this period, and the change in the fraction of homes purchased by investors in this period. Each county with a population greater than 150,000 in 2000 is one unit of observation. Robust standard errors are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

Table 1.2: The Bust Period of 2006 to 2008

	House Prices Growth between 2006 and mid-2008			Car Sales Growth between 2006 and mid-2008			Total Mortgage Liabilities Growth between 2006 and mid-2008		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inelasticity	-0.02***	-0.01**	-0.00	-0.04***	-0.04***	-0.03**	0.02**	0.03***	0.03**
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Change in Securitization Fraction 03_06	-0.71***	-0.61***	-0.38***	-0.33**	-0.36**	-0.07	0.57***	0.61***	0.41***
	(0.08)	(0.08)	(0.09)	(0.15)	(0.15)	(0.17)	(0.10)	(0.10)	(0.12)
Inelasticity X Change in Securitization Fraction 03_06	-0.37***	-0.28***	-0.11	-0.29**	-0.35***	0.07	0.17*	0.18*	0.04
	(0.06)	(0.06)	(0.07)	(0.13)	(0.14)	(0.13)	(0.10)	(0.11)	(0.11)
Implied Aggregate Impact	-0.08	-0.07	-0.05	-0.09	-0.08	-0.08	0.1	0.12	0.11
Percentage of Total	42	37	26	38	33	33	43	52	48
Controls	N	Y	Y	N	Y	Y	N	Y	Y
State Fixed Effect	N	N	Y	N	N	Y	N	N	Y
Regression Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	323	323	323	323	323	323	323	323	323
R-squared	0.32	0.44	0.78	0.10	0.13	0.39	0.33	0.42	0.57

Notes: This table presents estimates of the impact of variations in the elasticity of housing supply and changes in the securitization rate on house prices, car sales and total mortgage growth during the years of 2006 to mid-2008. *Inelasticity* is based on Saiz (2010) measure of the elasticity of housing. The *Securitization Fraction* is computed as fraction of purchase loans sold to non-GSEs. Baseline controls include the growth in average income between 2006 and 2008 and its interaction with inelasticity measure, population growth during this period and the fraction of homes purchased by investors in 2006. Each county with a population greater than 150000 in 2000 is one unit of observation. Robust standard errors are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

Table 1.3: Instrumental Variable Approach

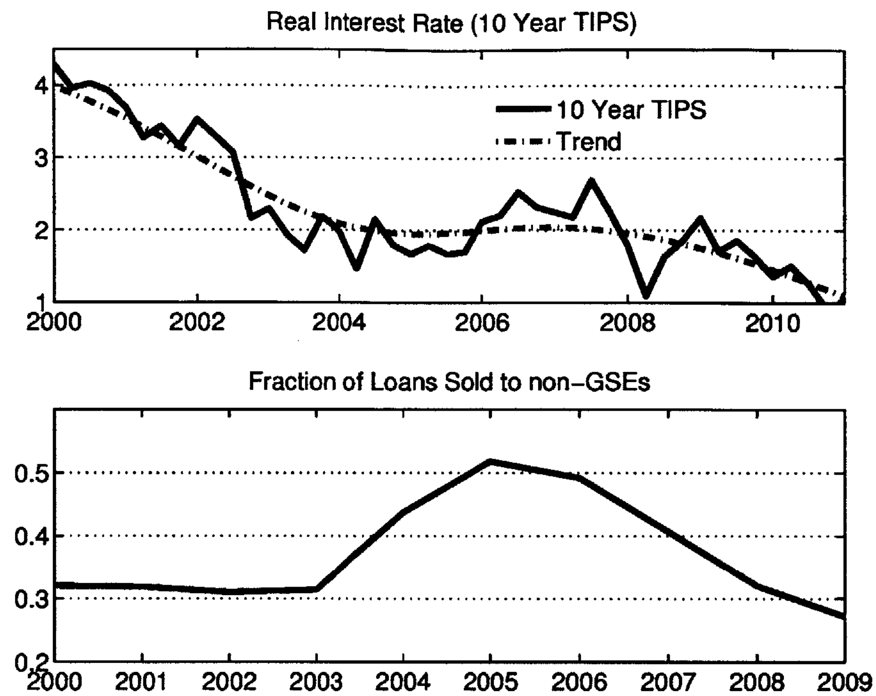
	Change in Securitization Fraction 03_06	Inelasticity X Change in Securitization Fraction 03_06	House Prices	Car Sales	Total Mortgage Liabilities	House Prices	Car Sales	Total Mortgage Liabilities
			Growth between 2000 and 2006			Growth between 2006 and mid-2008		
	(1)	(2)	(4)	(5)	(6)	(7)	(8)	(9)
Percentage Hispanics	0.17***	0.05*						
	(0.03)	(0.03)						
Percentage Hispancs X Inelasticity	-0.01	0.24***						
	(0.02)	(0.03)						
Anti-Predatory Dummy	-0.04***	0.00						
	(0.01)	(0.01)						
Anti-Pred X Inelasticity	-0.00	-0.05***						
	(0.01)	(0.01)						
Inelasticity	0.02***	-0.01	0.13***	0.02	0.06*	0.00	-0.04***	-0.01
	(0.00)	(0.01)	(0.02)	(0.03)	(0.04)	(0.01)	(0.01)	(0.02)
Change in Securitization Fraction 03_06			2.73***	2.27***	1.37	-1.26***	-0.46	1.68***
			(0.67)	(0.70)	(0.95)	(0.25)	(0.35)	(0.36)
Inelasticity X Change in Securitization Fraction 03_06			0.83*	0.32	-0.70	-0.29	-0.69**	0.20
			(0.50)	(0.60)	(0.59)	(0.20)	(0.30)	(0.22)
Controls	Y	Y	N	Y	Y	N	Y	Y
State Fixed Effect	N	N	N	N	N	N	N	N
Regression Type	OLS	OLS	IV	IV	IV	IV	IV	IV
Observations	323	323	323	323	323	323	323	323
R-squared	0.24	0.21	0.22		0.05	0.02	0.06	0.34

Notes: This table replicates the regressions of column (2), (5) , (8) in Tables 1.1 and 1.2 by using the fraction of Hispanic population and an Anti-Predatory Lending Laws dummy and their interactions with *Inelasticity* as instruments for the changes in securitization rate and its interaction with *Inelasticity*. Here, the Anti-Predatory dummy is equal to one for states that include purchase loans in Anti-Predatory Lending laws. *Inelasticity* is based on Saiz (2010) measure of elasticity of housing. Securitization Fraction is computed as fraction of purchase loans sold to non-GSEs. The change in securitization rate for the years of 2003 to 2006 is computed. The baseline controls include the growth of the average income and its interaction with inelasticity measure, population growth and the fraction of homes purchased by investors in the corresponding period. Each county with the population greater than 150000 in 2000 is a unit of observation. Robust standard errors are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

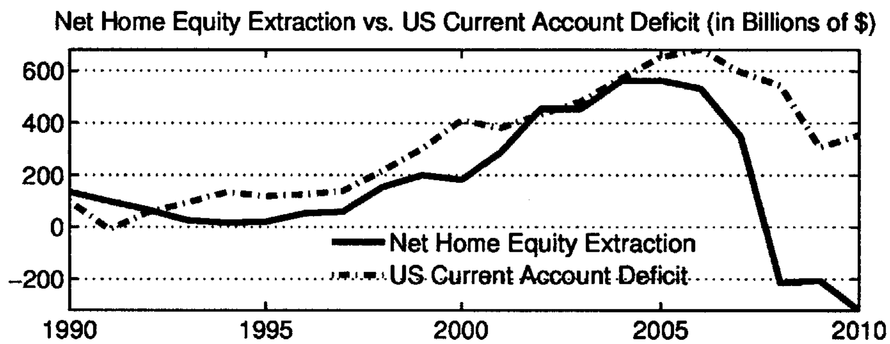
Table 1.4: Long Differences: 2000 to mid-2008

	House Prices Growth between 2000 and mid-2008			Car Sales Growth between 2000 and mid-2008			Total Mortgage Liabilities Growth between 2000 and mid-2008		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inelasticity	0.13***	0.12***	0.06***	-0.01	-0.01	-0.02	0.15***	0.14***	0.06
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Change in Securitization Fraction 03_06	0.26	0.16	-0.17	0.18	0.19	0.53**	2.76***	2.49***	1.70***
	(0.20)	(0.16)	(0.16)	(0.20)	(0.19)	(0.24)	(0.43)	(0.37)	(0.45)
Inelasticity X Change in Securitization Fraction 03_06	0.05	-0.04	-0.16	-0.40*	-0.36*	-0.02	1.37***	1.11***	0.37
	(0.16)	(0.13)	(0.16)	(0.21)	(0.19)	(0.22)	(0.37)	(0.32)	(0.38)
Implied Aggregate Impact	0.29	0.27	0.12	0.09	0.07	0.06	0.51	0.48	0.33
Percentage of Total	116	108	48	-64	-50	-43	31	29	20
Controls	N	Y	Y	N	Y	Y	N	Y	Y
State Fixed Effect	N	N	Y	N	N	Y	N	N	Y
Regression Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	323	323	323	323	323	323	323	323	323
R-squared	0.25	0.45	0.80	0.14	0.18	0.41	0.41	0.52	0.65

Notes: This table presents estimates of the impact of variations in the elasticity of housing supply and changes in the securitization rates on house prices, car sales and total mortgage growth during the years of 2000 to mid-2008. *Inelasticity* is based on Saiz (2010) measure of elasticity of housing. The *Securitization Fraction* is computed as fraction of purchase loans sold to non-GSEs. Baseline controls include the growth of average income between 2000 and 2008 and its interaction with the inelasticity measure, population growth during this period and the fraction of homes purchased by investors in 2006. Each county with population greater than 150,000 in 2000 is one unit of observation. Robust standard errors are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).



(a) Decline in Interest Rates and the Rise of Securitization



(b) Home Equity Extraction and Current Account

Figure 1.1: Expansion of Credit During 2000 to 2006

Notes: In Figure 1.1a,10-Year TIPS contains quarterly yields on treasury-inflation-protected securities (TIPS). Data are obtained from J. Huston McCulloch, http://www.econ.ohio-state.edu/jhm/ts/ts.html. HP filter with $\lambda = 400$ is used for the calculation of the interest rate trend. Fraction of Loans sold to non-GSEs are fraction of purchase loans that mortgage originators sold to an institution other than government sponsored organizations like Fannie Mae and Freddie Mac. In Figure 1.1b, Net Home Equity Extraction is defined as the change in the total mortgage liabilities of household minus the net investment of households in residential housing. Data are obtained from US Flow of Funds.

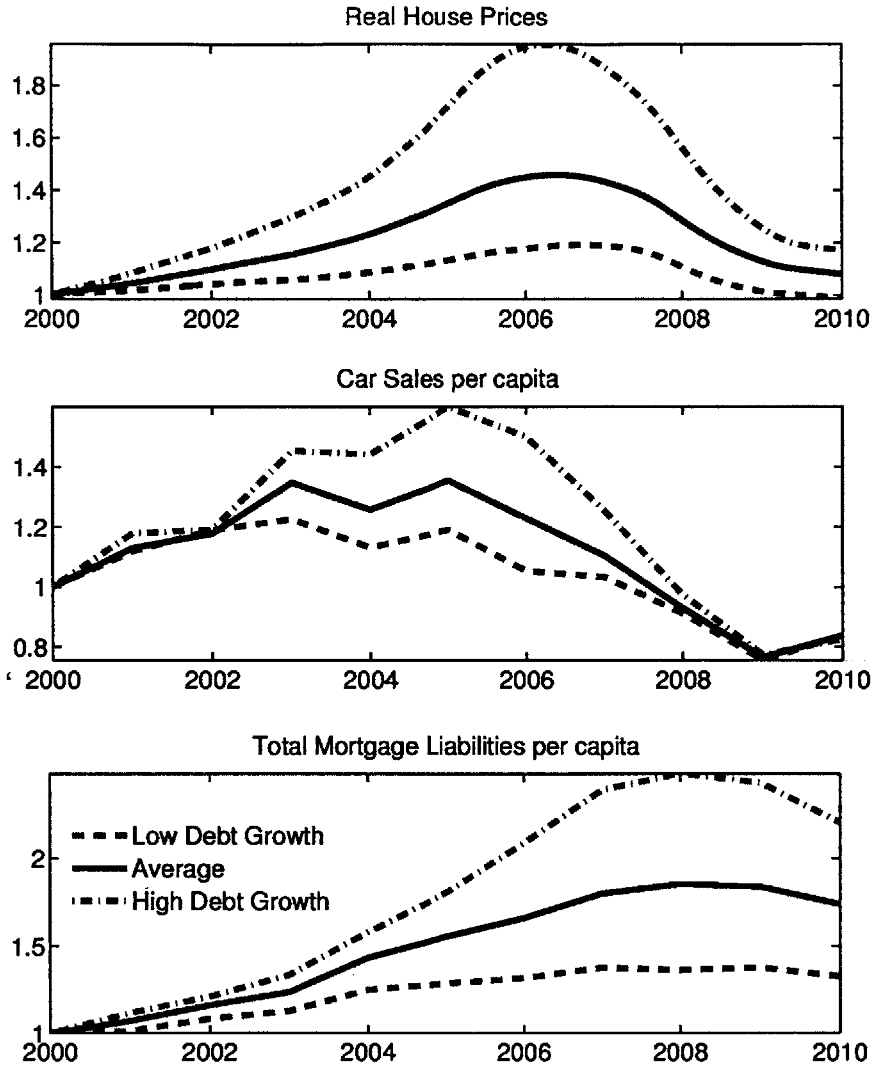


Figure 1.2: High Debt Growth versus Low Debt Growth Regions Dynamics

Notes: This figure shows the differential dynamics of house prices and car sales per capita for regions that experienced high and low growth in mortgage liabilities. In the above figures, high and low debt counties are defined to be the top and bottom quintile of counties (with more than 150,000 population in 2000) based on the growth in mortgage liabilities per capita between 2000 and mid-2008, and, the graphs show the average for each region as well as the average for all counties with a population of more than 150,000 in 2000. House prices are based on CoreLogic HPI. Car Sales per capita and Total Mortgage Liabilities are based on FRBNY CCP data.

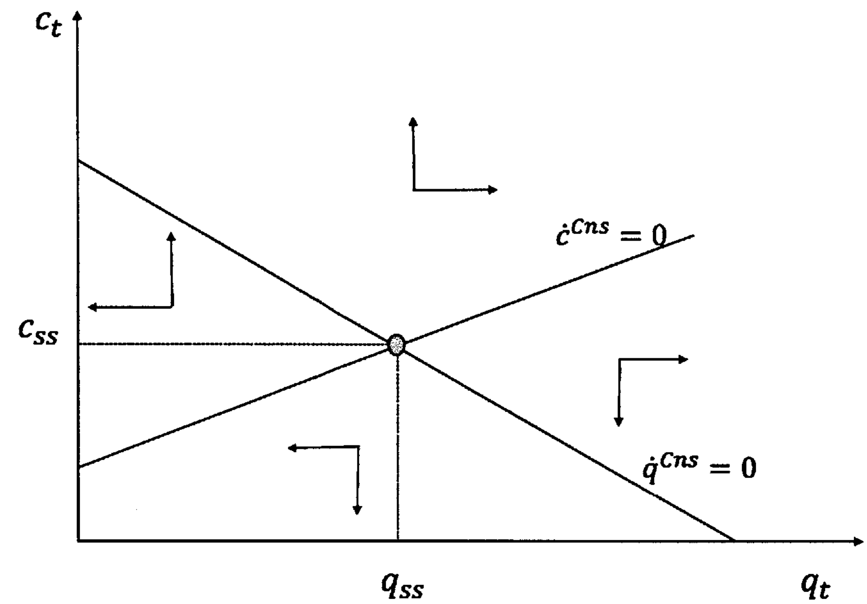


Figure 1.3: The phase diagram of (q_{it}, c_{it}) for an inelastic region when the borrowing constraint is binding. This graph is based on equations (1.16) and (1.17).

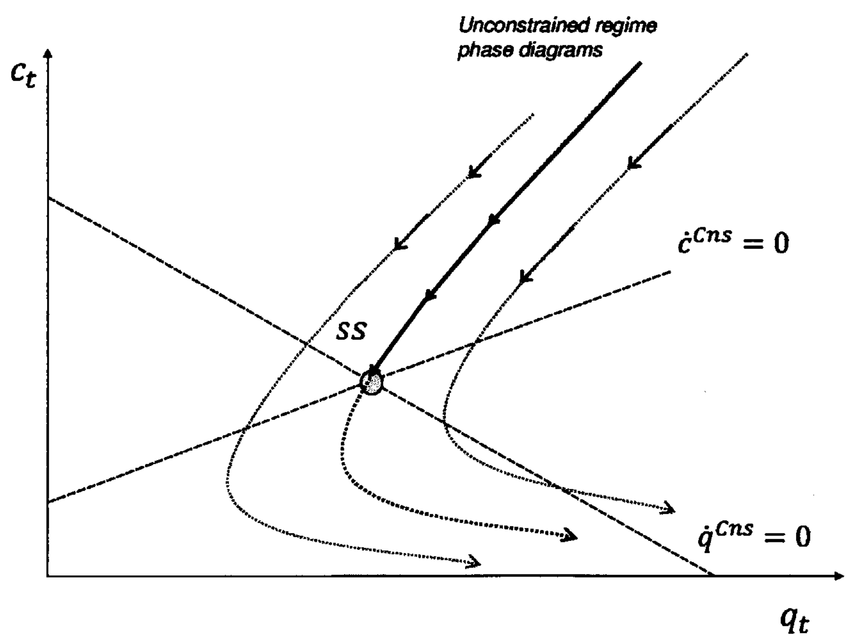


Figure 1.4: The equilibrium transition path for an inelastic region.

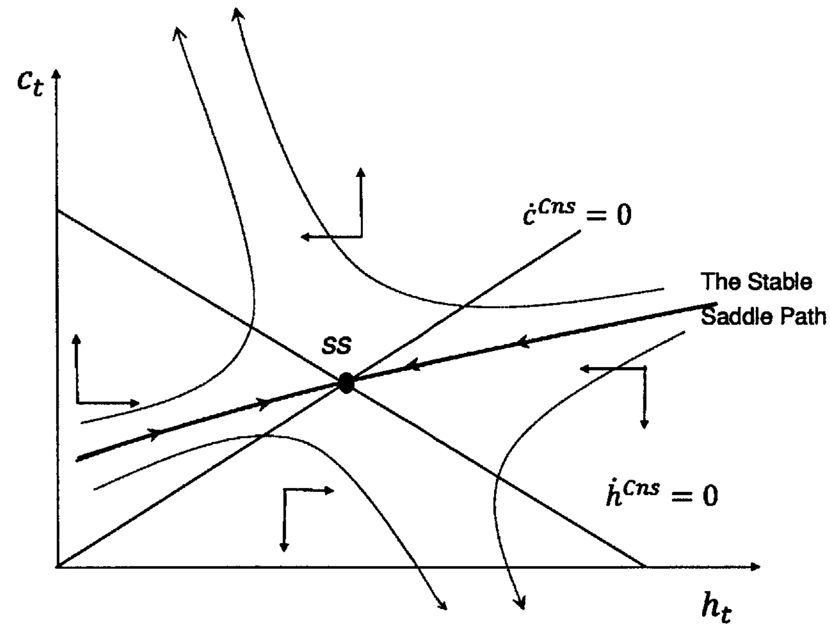


Figure 1.5: The phase diagram for (h_{it}, c_{it}) in elastic region when the borrowing constraint is binding. The saddle path is the solution to equations 1.31 and 1.32.

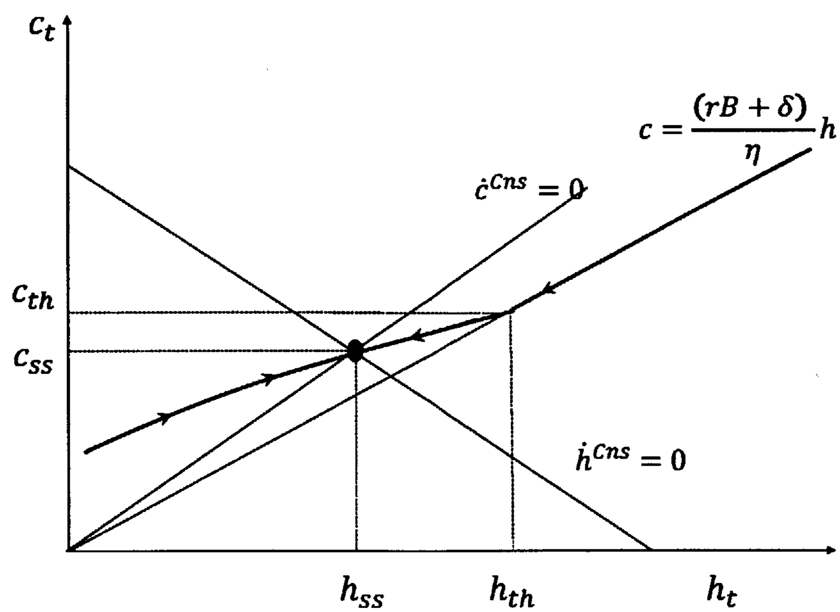


Figure 1.6: Equilibrium transition path for the elastic region

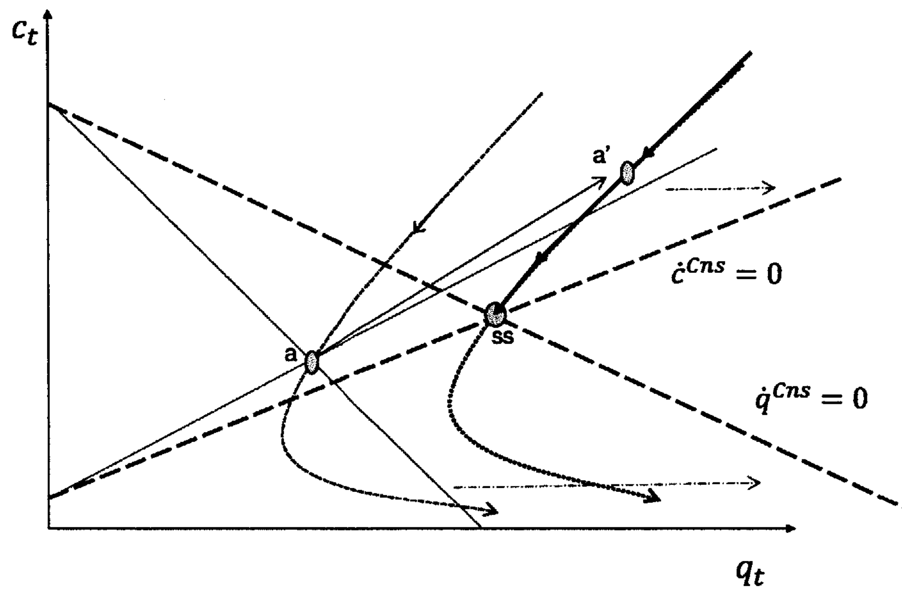


Figure 1.7: The Impact of an unexpected permanent decline in the interest rate in an inelastic region

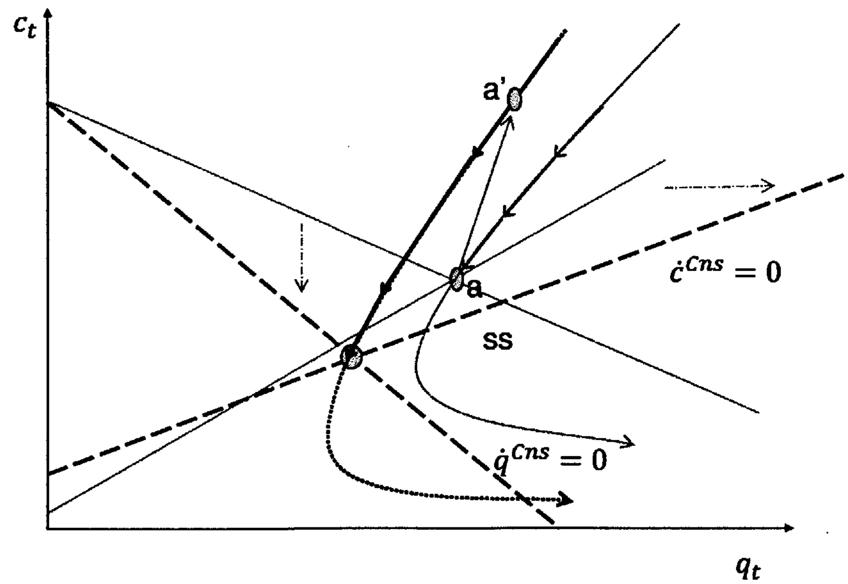


Figure 1.8: The Impact of an unexpected permanent increase in the maximum loan-to-value ratio in an inelastic region

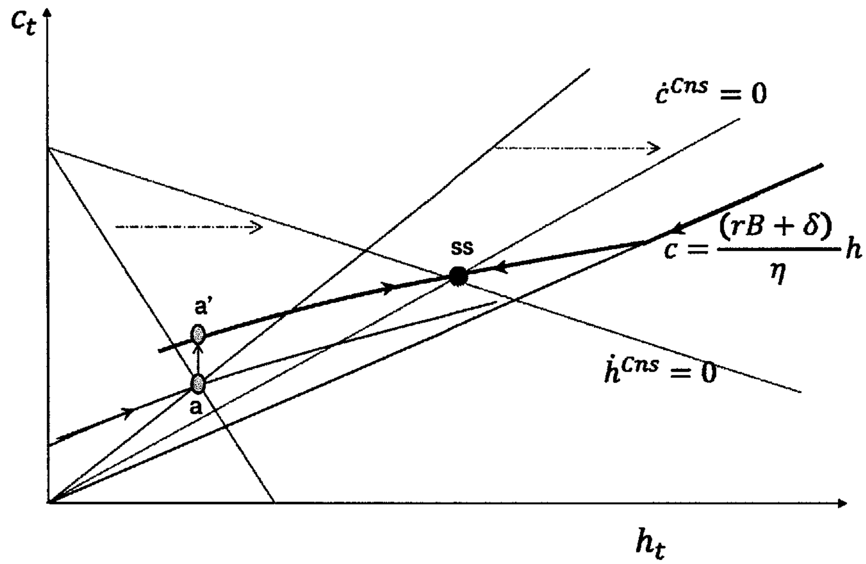


Figure 1.9: The impact of decline in interest rate in an elastic region

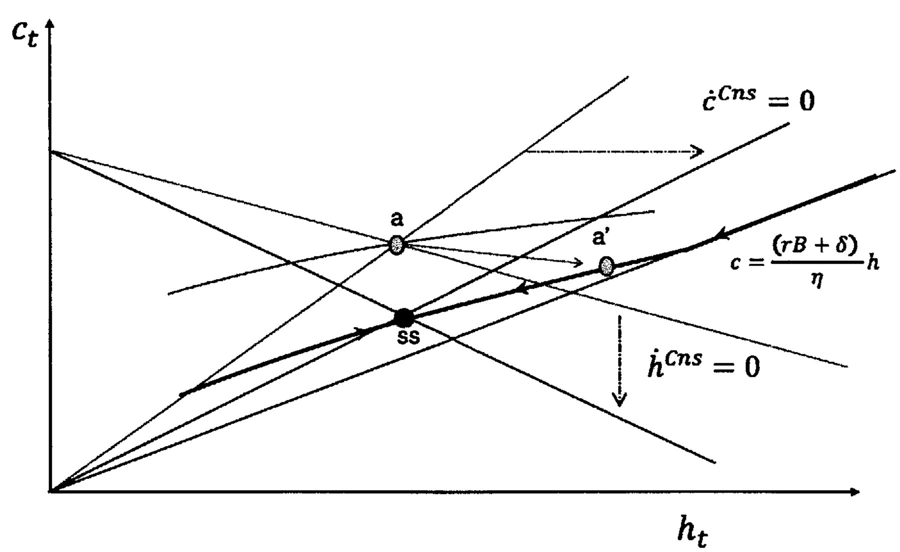


Figure 1.10: The impact of an increase in the maximum loan-to-value ratio in an elastic region

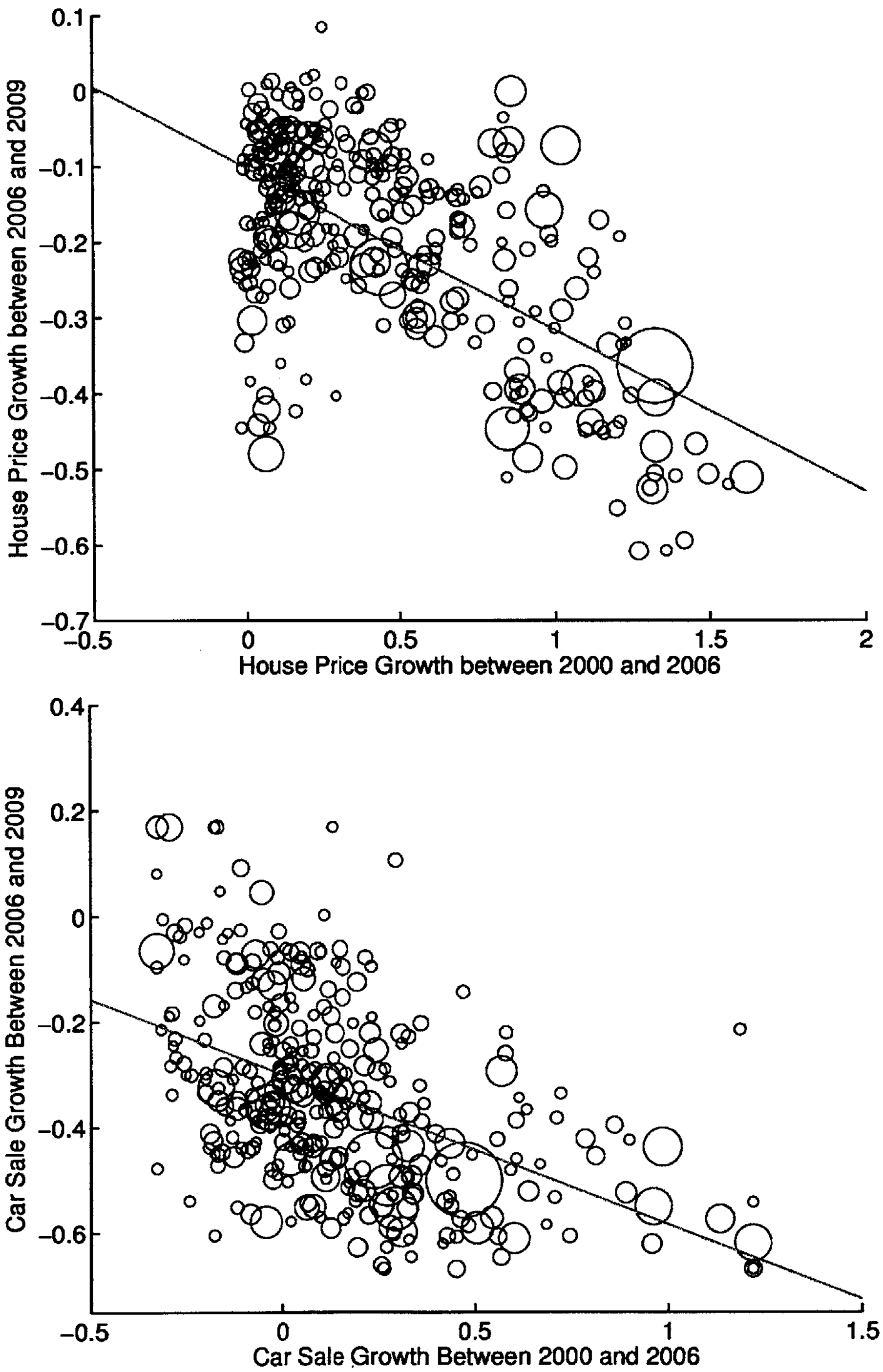


Figure 1.11: The Boom-Bust in House Prices and Consumption

Note: The graph in the top panel shows the correlation between house prices growth between 2000 and 2006 and house prices growth between 2006 and 2009 for counties with more than 150,000 population in 2000. The size of circles is proportional to the population of the corresponding county in 2000. The graph in the bottom panel replicates the same graph for car sales growth. The solid line represents the OLS regression line

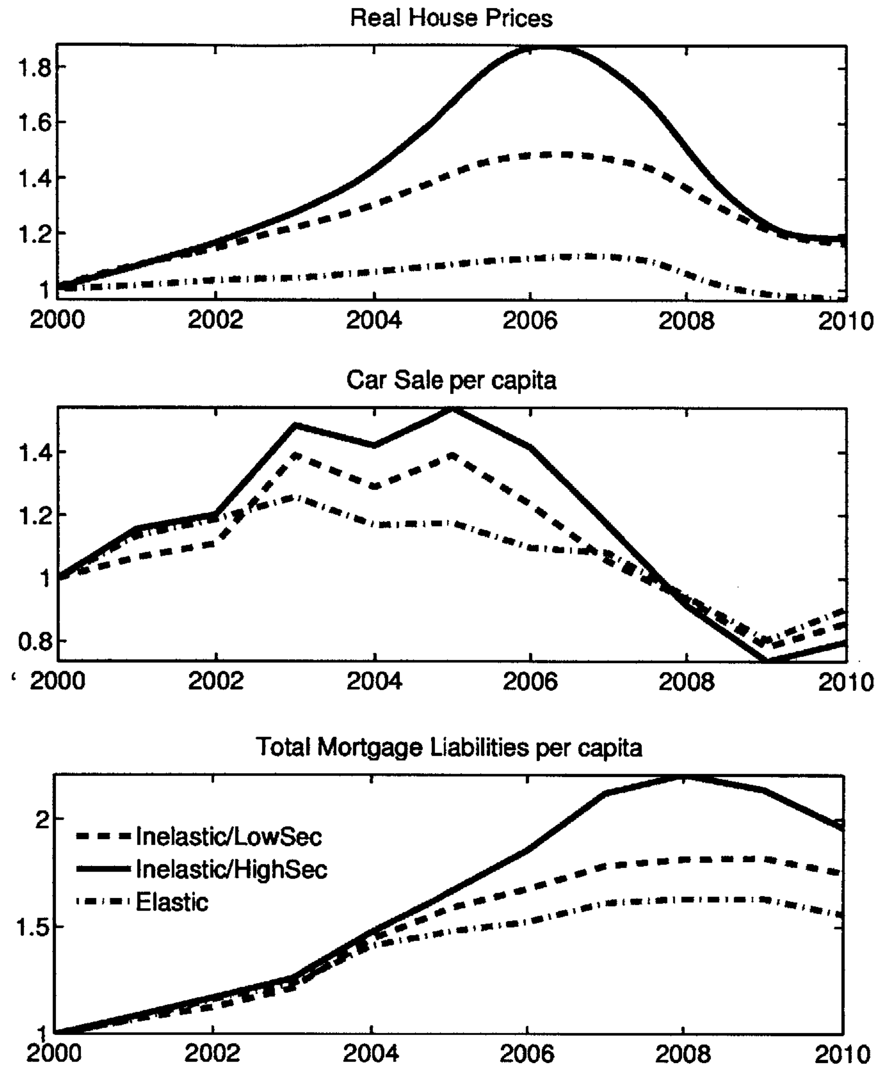


Figure 1.12: Differential Dynamics of House Prices, Consumption and Total Mortgage Liabilities in Different Regions

Notes: This figure shows the differential dynamics of house prices and car sales per capita for regions with different elasticities of housing and with different changes in the fraction of loans sold to non-GSEs. In the above figures, Inelastic (Elastic) regions are counties in the top (bottom) 20 percent distribution of inelasticity measure based on Saiz (2010). "Inelastic/Low Sec" ("Inelastic/High Sec") are inelastic counties in which the change in the fraction of loans sold to non-GSEs during 2003 to 2006 is less (more) than the median for Inelastic regions.

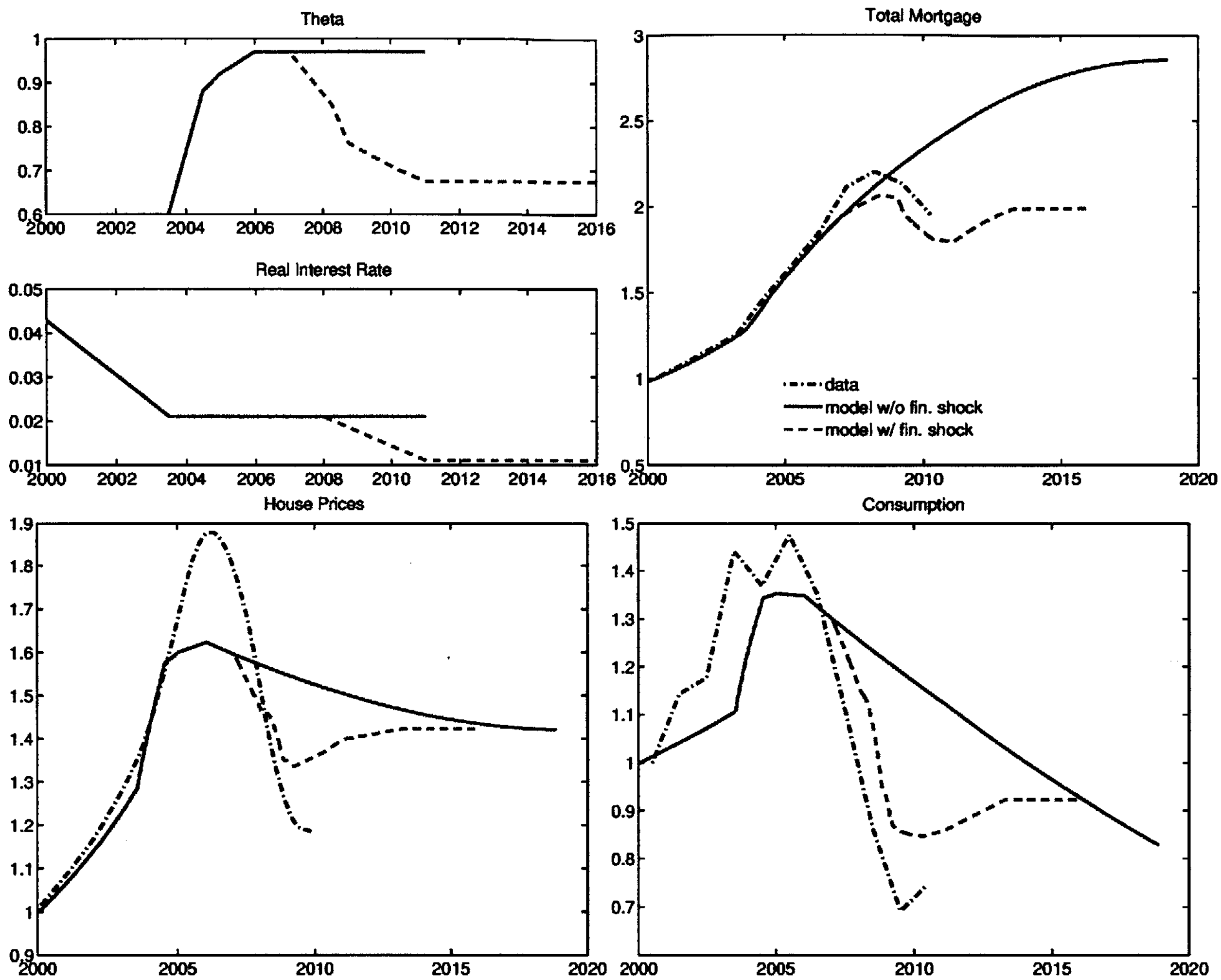


Figure 1.13: Inelastic Regions with High Change in Securitization Rate

Notes: This figure presents results of the calibration of the model without a financial crisis and the model with a financial crisis for inelastic regions that experienced high change in securitization rate and compares it with the time series of actual data on the average of house prices, total mortgage liabilities per capita and car sales per capita (as a proxy for consumption) in those regions. Inelastic Regions with High Change in Securitization Rate refers to regions in the top quintile of Inelasticity measured for which the change in securitization rate during the period of 2003 to 2006 has been more than the median of the change in securitization rate for inelastic regions.

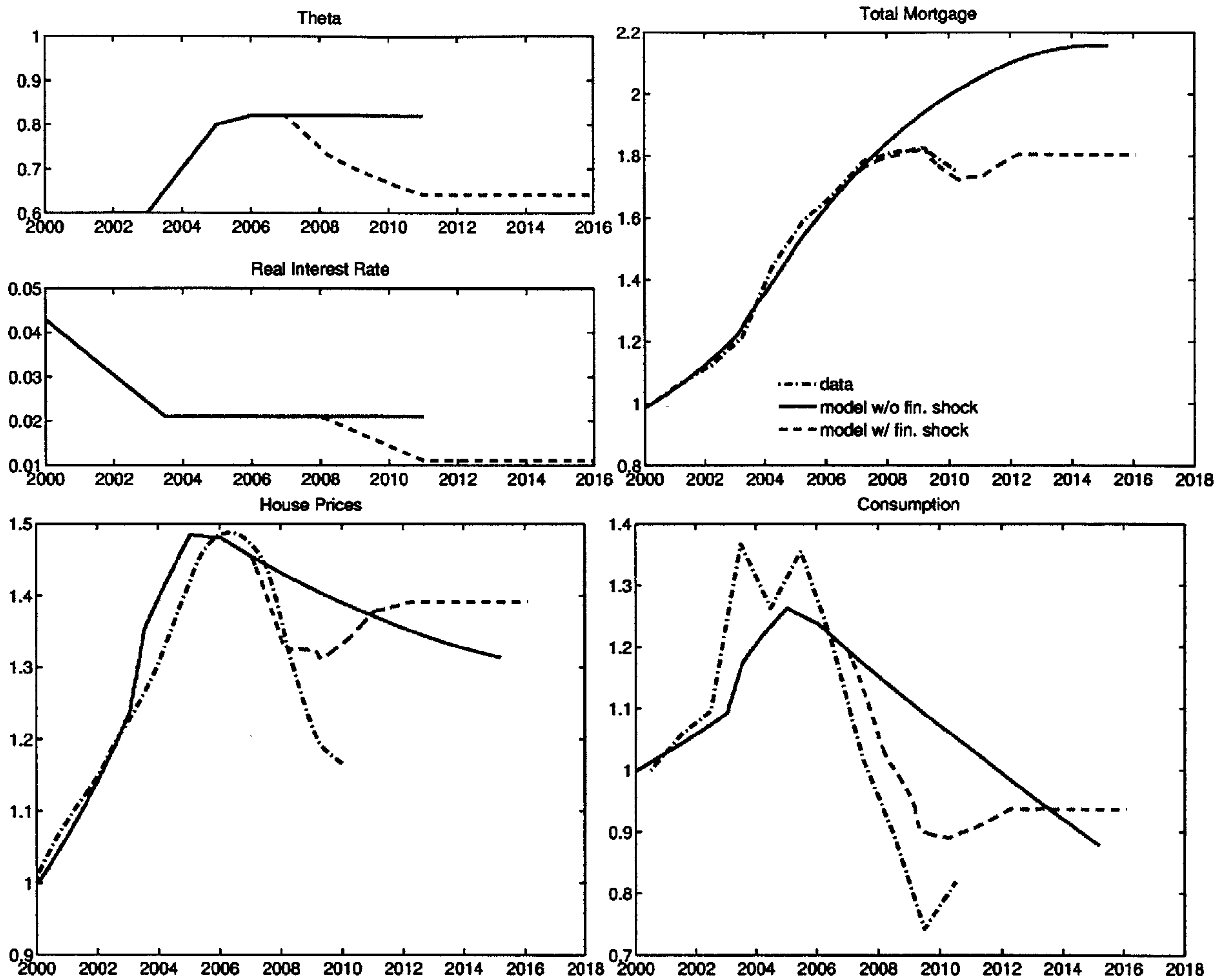


Figure 1.14: Inelastic Regions with Low Change in Securitization Rate

Notes: This figure presents the results of the calibration of the model without a financial crisis and the model with a financial crisis for inelastic regions that experienced low change in securitization rate and compares it with the time series of actual data on the average of house prices, total mortgage liabilities per capita and car sales per capita (as a proxy for consumption) in those regions. Inelastic Regions with Low Change in Securitization Rate refers to regions in the top quintile of Inelasticity measure for which the change in securitization rate during the period of 2003 to 2006 has been less than the median of the change in securitization rate for inelastic regions.

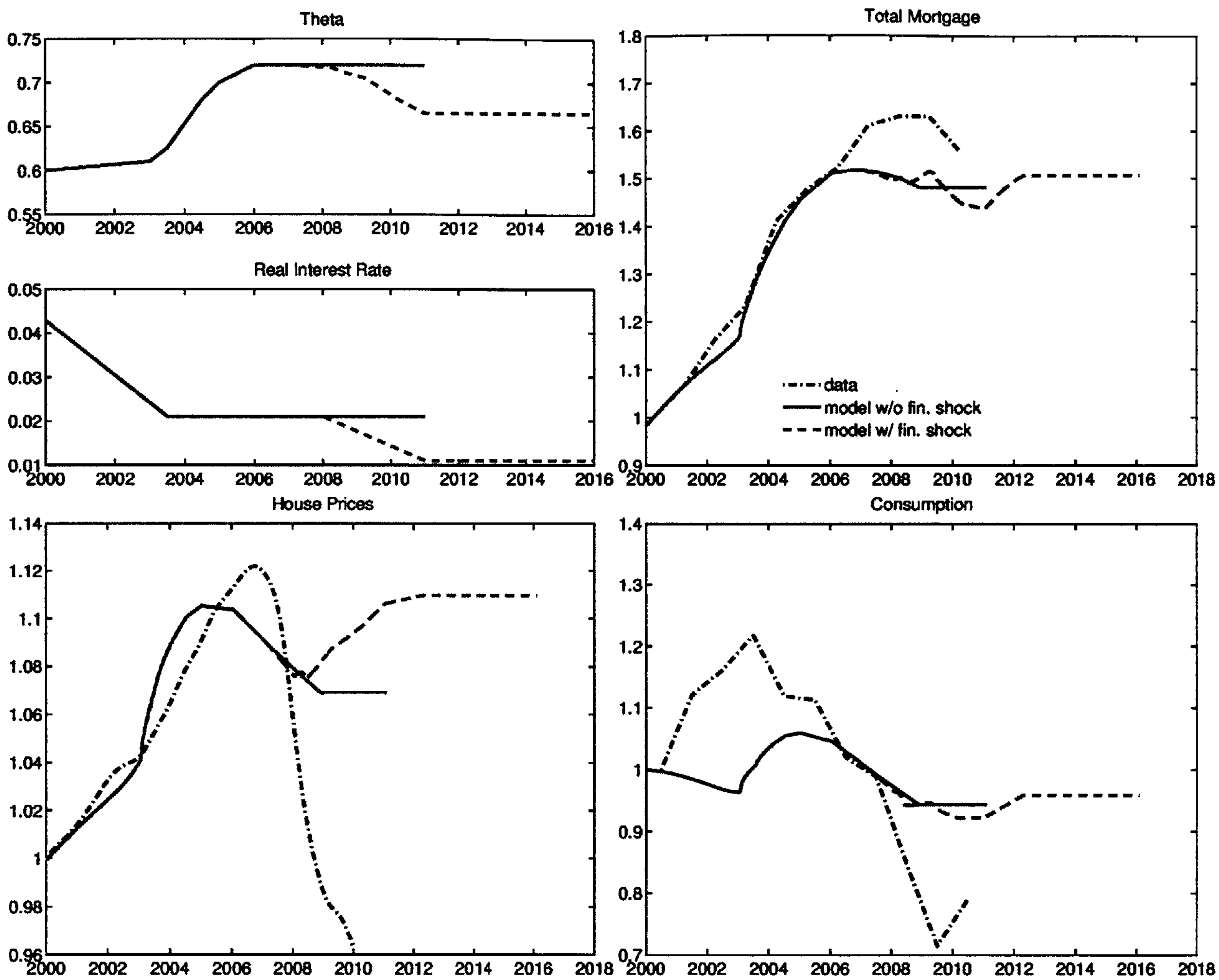


Figure 1.15: Elastic Regions

Notes: This figure presents the results of the calibration of the model without a financial crisis and the model with a financial crisis for Elastic regions and compares it with the time series of actual data on the average of house prices, total mortgage liabilities per capita and car sales per capita (as a proxy for consumption) in those regions. Elastic Regions refers to regions in the bottom quintile of Inelasticity measure.

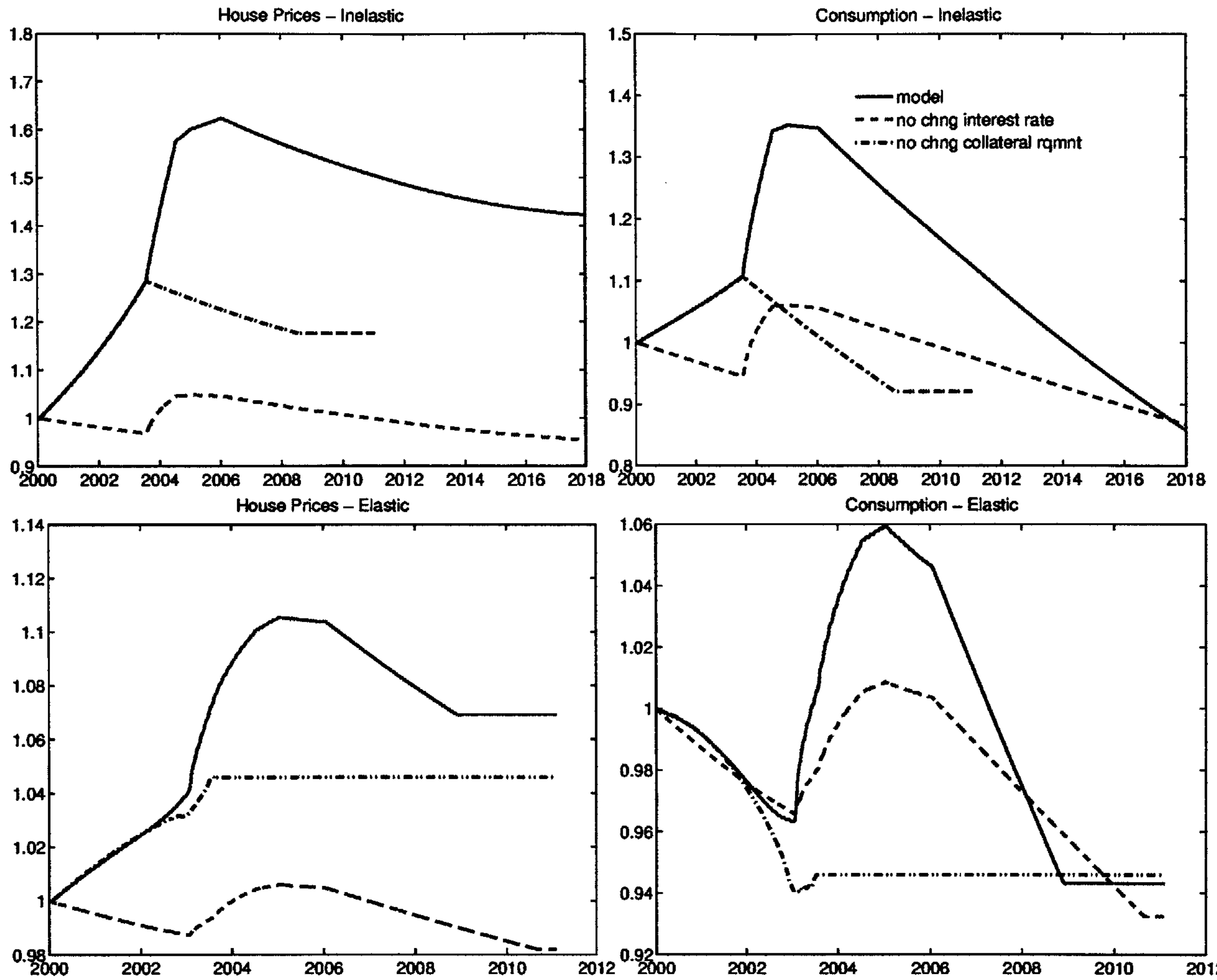


Figure 1.16: Counterfactual of Past Policies

Notes: This figure compares the predictions of the model without a financial crisis (baseline model) with two hypothetical scenarios; first, the interest rate remains at its level in 2000 but the decline in collateral requirements is the same as in the baseline model. Second, there is no decline in collateral requirements but decline in inters rates is the same is in the baseline model. Results are presented for inelastic regions that experienced high change in securitization rate and for elastic regions.

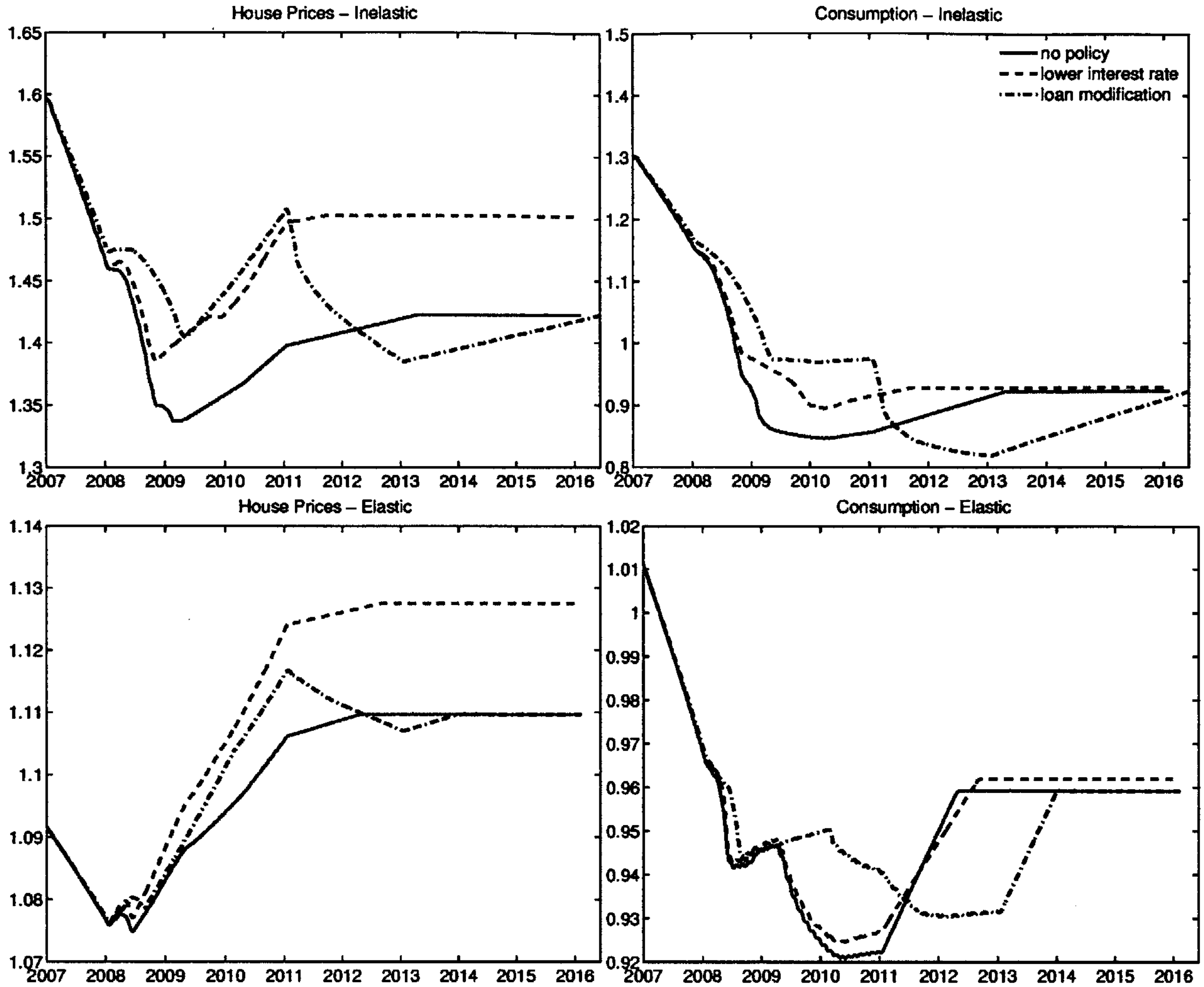


Figure 1.17: Policy Experiment

Notes: This figure compares the predictions of the model with a financial crisis with two scenarios; (i) during the period of 2008 to 2011, the interest rate declines by 1.5 percent as opposed to 1 percent in the baseline model with a financial crisis. (ii) Increase in collateral requirements is happening over a longer period of time. The result are presented for inelastic regions that experienced high change in securitization rate and for elastic regions.

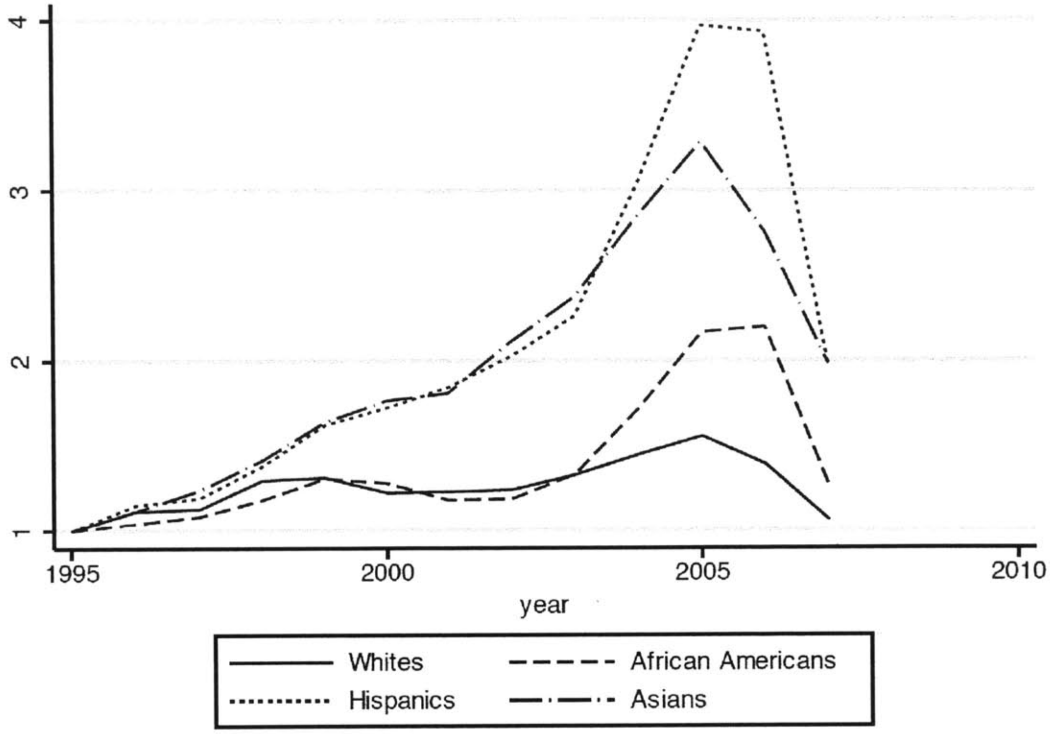


Figure 1.18: Volume of Mortgage Originations by Race

Notes: The volume of 1995 mortgage originations for each race is normalized to one. Calculations are based on the HMDA dataset. Source:Ouazad and Rancière (2011)

Appendix

A: Proof of Lemma 1

First I show in elastic regions ($q_{it} = B$), there cannot be an equilibrium in which the borrowing constraint never binds.

Proof by contradiction: Let assume there is an equilibrium in which the borrowing constraint is always relaxed. Imposing $\lambda_{it} = 0$ in the first order conditions, leads to:

$$\begin{aligned} \dot{c}_{it} &= (r - \rho)\, c_{it} \\ h_{it} &= \frac{\eta c_{it}}{rB + \delta} \\ \mu_{it} &= \frac{1}{c_{it}} \end{aligned}$$

And the wealth dynamics can be written as:

$$\begin{aligned} \dot{W}_{it} &= w - c_{it} + r\,(W_{it} - Bh_{it}) - \delta h_{it} \\ &= w + rW_{it} - c_{it} - (rB + \delta)\, h_{it} \\ &= w + rW_{it} - (1 + \eta)\, c_{it} \end{aligned}$$

This has the solution:

$$W_{it} = \frac{w}{r}\left(e^{rt} - 1\right) + \frac{(1+\eta)\, c_{i0}}{\rho}\left(e^{(r-\rho)t} - e^{rt}\right) + W_{i0}e^{rt}$$

imposing transversality condition $\lim\limits_{t\to\infty} [e^{-\rho t}\mu_{it}W_{it}] = \frac{\frac{w}{r} + W_{i0} - \frac{(1+\eta)c_{i0}}{\rho}}{c_{i0}} = 0$, pins down c_{i0}:

$$c_{i0} = \frac{\rho}{1+\eta}\left(\frac{w}{r} + W_{i0}\right)$$

Using this in the relation for W_{it}, results in:

$$W_{it} = -\frac{w}{r} + \left(\frac{w}{r} + W_{i0}\right)e^{(r-\rho)t}$$

Therefore $\lim\limits_{t\to\infty} W_{it} = -\frac{w}{r} < 0$. But this is violating the collateral constraint $W_{it} > (1 - \theta_i)\, Bh_{it}$. Therefore in elastic regions, independent of the initial wealth of the representative household, there is no equilibrium in which the borrowing constraint does not become binding.

Now for inelastic region, if the borrowing constraint never binds (independent of the time path for house prices) we have:

$$\dot{c}_{it} = (r - \rho)\, c_{it}$$

Then we show as long as there is no bubble in house prices, at some point land prices become zero and therefore at that point afterward the economy is characterized with the equations of the elastic economy. This is because as long as the borrowing constraint is not binding and housing supply is fixed, house prices are characterized by:

$$\dot{q}_{it} = rq_{it} + \delta - \frac{\eta c_{it}}{L}$$

Since c_{it} is declining and $\lim_{t\to\infty} c_{it} = 0$ we have $\lim_{t\to\infty} \frac{\dot{q}}{q} = r$ which is inconsistent with no-bubble condition in house prices.

Therefore at some time (T) land prices becomes zero and house prices are $q_{it} = B$, from that point afterward ($\forall t \geq T$). Since from that point afterward the economy is exactly the same as an economy with elastic housing supply, we have shown that independent of the W_{iT}, there cannot be any equilibrium in which borrowing constraint never becomes binding.

B: Proof of Lemma 2

Extended Lagrangian of the representative household in an inelastic region can be written as:

$$\hat{\mathcal{H}} = [logc_t + \eta logh_t] + \mu_t [w - c_t + r(W_t - q_t h_t) - \delta B h_t + \dot{q}_t H_t] + \lambda_t [W_t - (1-\theta) q_t h_t] \tag{1.46}$$

Imposing the fixed supply of housing ($h_t = L$) after taking the first order conditions results in:

$$\begin{aligned}
\hat{\mathcal{H}}_c: &\quad \tfrac{1}{c_t} - \mu_t && = 0 && (1.47)\\
\hat{\mathcal{H}}_H: &\quad \tfrac{\eta}{L} - \mu_t [rq_t + \delta - \dot{q}_t] && -\lambda_t(1-\theta)q_t = 0 && (1.48)\\
\hat{\mathcal{H}}_W: &\quad \mu_t r + \lambda_t && = \rho\mu_t - \dot{\mu}_t && (1.49)\\
&\quad [W_t - (1-\theta) q_t L] \lambda_t && = 0 && (1.50)\\
&\quad \lambda_t && \geq 0 && (1.51)
\end{aligned}$$

An extended Maximum principle (see Seierstad and Sydsæter (1987)) makes sure λ_t is piecewise continuous. Now I want to prove that if $\exists t | \lambda_t > 0 \Rightarrow \lambda_{t'} > 0, \forall t' > t$.

The proof is by contradiction: let assume there is a point of discontinuity in λ_t for which $\lambda_{t^+} = 0$ but $\lambda_{t^-} > 0$. ($t^- < t^+$)

As long as q_t is continuous[61] and c_t is finite, from equation 1.48 we can see λ_t is finite. finite λ_t in addition

[61]A negative jump in q_t is inconsistent with households maximization problem and cannot be an equilibrium. A positive jump in q_t also can be ruled out by assuming international investors do not benefit from housing services but can hold a piece of land and resell it in the future. This assumption do not change any other result in the model because as long as there is no change in r and θ, $\dot{q} < r$ and therefore these agents never invest in housing. This assumption just excludes possibility of positive jump in q from the expectation of households and makes the equilibrium unique.

to equation 1.49 results in $\dot{\mu}_t$ being finite and therefore μ_t is continuous. continuous μ_t plus equation 1.47 leads to c_t being continuous. Therefore without loss of generality we can write:

$$\begin{aligned} q_{t^-} &= q_{t^+} = q_t \\ c_{t^-} &= c_{t^+} = c_t \\ \mu_{t^-} &= \mu_{t^+} = \mu_t \end{aligned}$$

Now taking the difference of 1.48 for t^- and t^+, results in:

$$\dot{q}_{t^-} - \dot{q}_{t^+} = (1-\theta)\, q_t \frac{\lambda_{t^-} - \lambda_{t^+}}{\mu_t} > 0 \tag{1.52}$$

Equation 1.52, says for the borrowing constraint to become relaxed, it should be the case that there is a decline in house prices growth. This decline, increases the user cost of housing and reduces households demand for housing to a point that even they become unconstrained they do not demand more housing. Now I show this condition contradicts with the borrowing constraint when household budget constraint is added.

From the budget constraint we have:

$$\dot{W}_t = w - c_t + r\,(W_t - q_t L) - \delta B L + \dot{q}_t L$$

We can also define borrowing capacity as $C_t = W_t - (1-\theta)\, q_t L$ and the derivative of borrowing capacity w.r.t time is:

$$\dot{C}_t = \dot{W}_t - (1-\theta)\, \dot{q}_t L$$

Then taking the difference for t^- and t^+,

$$\begin{aligned} \dot{C}_{t^+} - \dot{C}_{t^-} &= \left(\dot{W}_{t^+} - (1-\theta)\, \dot{q}_{t^+} L\right) - \left(\dot{W}_{t^-} - (1-\theta)\, \dot{q}_{t^-} L\right) \\ &= \theta\, (\dot{q}_{t^+} - \dot{q}_{t^-})\, L < 0 \end{aligned}$$

But because the borrowing constraint is binding for $t = t^-$(or $\dot{C}_{t^-} = 0$),this result in $\dot{C}_{t^+} < 0$ which contradicts with the borrowing constraint becoming relaxed.

C: Proof of Proposition 5' and Characterization of "Fire Sales" in Inelastic Regions

If $a_0 < -\theta(q_{ss} H_{ss})$

households should sell enough land to investors to make sure they are satisfying the borrowing constraint. let us call a_{0^-} debt holding before the shock.

then $a_{0+} = a_{0-} + q_{0+}(h_{0-} - h_{0+})$

Also the borrowing constraint will be binding:

$$a_{0+} = -\theta q_{0+} h_{0+}$$

the economy goes directly to the steady state.

Characterizing the transition:

$$\frac{\dot{q}_{it}}{q_{it}} = r \tag{1.53}$$

$$(1-\theta_i)\, q_{it}\dot{h}_{it} = w - c_{it} - \delta h_{it} \tag{1.54}$$

$$(1-\theta_i)\, q_{it}\frac{\dot{c}_{it}}{c_{it}} = \frac{\eta c_{it}}{h_{it}} + (1-\theta_i)\, q_{it}\,(r-\rho) - \delta \tag{1.55}$$

Let assume the economy reaches the steady state at T. During the transition, house prices are characterized by

$$q_{it} = q_i^{ns}(t-T) = q_{ss}e^{r(t-T)}, t \in [0,T] \tag{1.56}$$

Substituting 1.56, in 1.54 and 1.55, and using $h_{iT} = h_{ss} = L_i$, shows the solution to 1.54 and 1.55, is a unique saddle path characterized by $c_{it} = c_i^{ns}(t-T)$ and $h_{it} = h_i^{ns}(t-T)$, in which:

$$\dot{c}_i^{ns} > 0, t \in [0,T]$$

$$\dot{h}_i^{ns} > 0, t \in [0,T]$$

The only remained unknown is the time it takes the economy to reach the steady state (T).

This is pinned down by the boundary condition at $t = 0^+$.

$$q_i^{ns}(-T)\left[(1-\theta)\, h_i^{ns}(-T) - L_i\right] = a_{0-}$$

D: Characterization of the Model with Extended Housing Supply

The extended Lagrangian in this case has the form:

$$\hat{\mathcal{L}} = [log c_t + \eta log H_t] + \mu_t\left[w - c_t + r\,(W_t - q_t h_t) - \delta\omega_k q_t^{\sigma} h_t + \dot{q}_t h_t\right] + \lambda_t\left[W_t - (1-\theta)\, q_t h_t\right] \tag{1.57}$$

so the system of equations for $\lambda = 0$ is:

$$\begin{cases} \frac{\dot{c}_t}{c_t} &= r - \rho \\ \eta c_t &= \left[r q_t + \delta \omega_k q_t^\sigma - \dot{q}_t \right] H_t \\ &= (1-\omega_k)^{-1/(1-\sigma)} L \left(\frac{q^{1-\sigma} - \omega_k}{q^{1-\sigma}} \right)^{\sigma/(1-\sigma)} \left[r q_t + \delta \omega_k q_t^\sigma - \dot{q}_t \right] \end{cases} \tag{1.58}$$

and if $\lambda > 0$

$$\begin{cases} (1-\theta)\, q_t h_t \frac{\dot{c}}{c} &= \eta c_t - \left[\theta r q_t + (1-\theta)\, \rho q_t + \delta \omega_k q_t^\sigma - \dot{q}_t \right] h_t \\ (1-\theta)\, q_t \dot{h}_t - \theta \dot{q}_t h_t &= w - c_t - r \theta q_t h_t - \delta \omega_k q_t^\sigma h_t \end{cases} \tag{1.59}$$

Adding the relation between q and h given by (1.43), (1.59) reduces to:

$$\begin{cases} (1-\theta)\, q_t h_t \frac{\dot{c}}{c} &= \eta c_t - \left[\theta r q_t + (1-\theta)\, \rho q_t + \delta \omega_k q_t^\sigma - \dot{q}_t \right] h_t \\ \left((1-\theta) \frac{\sigma \omega_k}{q^{1-\sigma} - \omega_k} - \theta \right) \dot{q}_t h_t &= w - c_t - r \theta q_t h_t - \delta \omega_k q_t^\sigma h_t \end{cases} \tag{1.60}$$

This system of equations has a stable saddle path if $q_{ss} < q_{cr}$ given by equation (1.44), and do not have any stable point other than the steady state if $q_{ss} > q_{cr}$.

F: Employment in Food Services and Retail Trade Sectors

Table 1.5

	Food Services and Retial Trade Growth between								
	2000 and 2006			2006 and 2009			2000 to 2009		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Inelasticity	0.01	0.01**	0.00	0.00	0.00	0.01*	0.01	0.02**	0.02**
	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Change in Securitization Fraction 03_06	0.23**	0.10*	-0.05	-0.14**	-0.03	-0.08	0.03	0.04	-0.17*
	(0.10)	(0.05)	(0.07)	(0.06)	(0.06)	(0.08)	(0.12)	(0.08)	(0.10)
Inelasticity X Change in Securitization Fraction 03_06	0.11	-0.01	-0.02	-0.08	-0.03	0.07	-0.03	-0.08	0.03
	(0.09)	(0.06)	(0.07)	(0.05)	(0.05)	(0.08)	(0.10)	(0.08)	(0.10)
Controls	N	Y	Y	N	Y	Y	N	Y	Y
State Fixed Effect	N	N	Y	N	N	Y	N	N	Y
Regression Type	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Observations	321	321	321	323	323	323	321	321	321
R-squared	0.02	0.63	0.72	0.01	0.20	0.36	0.00	0.64	0.70

Notes: This tables presents estimates of the impact of variations in the elasticity of housing supply and changes in securitization rate on growth in employment in food services and retail trade sectors during the years of 2000 to 2006, 2006 to 2009 and 2000 to 2009. Baseline controls include the growth of the average income and its interaction with inelasticity measure and population growth during the associated years and the fraction of houses purchased by investors in 2004. Each county with population greater than 150000 in the year 2000 is one uint of observation. Robust standard errors are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

Chapter 2

The Value of Connections In Turbulent Times: Evidence from the United States

With Daron Acemoglu, Simon Johnson, James Kwak and Todd Mitton

2.1 Introduction[1]

On Friday, November 21, 2008, the news leaked that Timothy Geithner – then president of the Federal Reserve Bank of New York – would be nominated by President-elect Barack Obama to become Treasury Secretary. Over the next 10 days, financial firms with a personal connection to Geithner experienced a cumulative abnormal return of about 15 percent (relative to other financial sector firms). When Geithner's nomination ran into trouble in January 2009, due to unexpected tax issues, there was a fall in the value of Geithner-connected firms, although this effect was smaller than the increases that were observed in November. How should we interpret these results?

This pattern seems unlikely to be a fluke of the data or the result of mismeasurement. We use three different ways of identifying personal connections between financial institutions and Geithner: (i) people who had meetings with Geithner during 2007-08; (ii) people who belonged to the same nonprofit boards as Geithner; and (iii) firms located in New York City, which are under the jurisdiction of the New York Fed. Our results are essentially the same across all three measures of personal connections, and they are robust across a wide range of checks, including various size controls and dropping outliers.

[1]For helpful comments we thank seminar participants at MIT, Harvard Business School, the International Monetary Fund, the University of Alberta, BYU, and the 2012 Econometric Society meetings. We are also grateful for very constructive comments from some former policymakers.

Perhaps firms with abnormal returns were simply those most affected by the crisis and therefore most likely to benefit from the appointment of a competent Treasury Secretary? But our results are also robust when we control for how intensely firms were affected in the most severe phase of the crisis in September-October 2008.

It is also plausible that Geithner's nomination was expected to benefit firms that were "too big to fail" and that these firms were more likely than others to have connections to the incoming Secretary. For example, Geithner had numerous connections to Citigroup, at the time the largest bank holding company in the country. To complicate matters, shortly after news of Geithner's nomination leaked, Citigroup received a bailout arranged by the outgoing George W. Bush administration (with Geithner's involvement).[2] Therefore, in addition to controlling for firm size and other measurable financial variables directly, we drop Citigroup from many of our regressions and also drop the other very large bank holding companies from our base sample (although they are included in our extended sample and in the full range of robustness checks). We also employ a matching estimator that allows us to establish a control sample (without Geithner connections) that has characteristics very similar to those in our treatment sample (with Geithner connections). In all cases our results remain robust: the market considered there to be value in being personally connected to Geithner, quite aside from any "too big to fail" issues.[3]

There are at least three reasons why market participants may have held this belief. First, they may have expected that some form of explicit corruption could take place. In some countries, such as Indonesia, Malaysia or Pakistan, potential corruption is a reasonable interpretation of stock price movements for connected firms, but it is highly unlikely to explain what happened in the United States. Political connections are valuable in countries with weak institutions: when formal property rights are weak, transparency is limited, and politicians have a great deal of discretion or not much accountability, personal ties to the people in power are worth a great deal.[4] However, it is implausible to suggest that the United States under Obama is anything like Indonesia under Suharto.[5] Studies of policy-making under the Obama administration by Suskind (2011) and Scheiber (2011) and first-hand accounts by Bair (2012) and Barofsky (2012) (none of which are particularly sympathetic to Geithner) contain no suggestion of corruption. Geithner has never

[2] Geithner was closely involved in the terms of rescuing Citigroup in fall 2008. However, on the Friday prior to the November Citigroup bailout, news of the nomination leaked. According to Sheila Bair (2012, p. 124), chair of the FDIC, Geithner ceased communications with Citigroup but "continued to advocate strongly for Citi in our internal discussions."

[3] We also examine evidence on the market-perceived probability of bankruptcy from credit default swap spreads, although the available sample for these data is smaller than for equities. In theory, investors might have expected that all financial firm debt would be "protected" from default by government action in fall 2008, while also believing that shareholders in favored firms would receive advantages relative to shareholders in other firms. In our data, we find the same pattern in CDS spread data as in equity data – i.e., there was a perceived benefit to creditors (in the form of lower implied default risk) when the firms' executives knew Geithner.

[4] For example, in a seminal study, Fisman (2001) found that being connected to President Suharto accounted for 23 percent of firms' value on average in the mid-1990s (where the events were rumors about the president's health). For Malaysia in the late 1990s, Johnson and Mitton (2003) found that connections to Prime Minister Mahathir accounted for around 20 percent of firms' total stock market value in a crisis, where the event was the fall from power of Anwar Ibrahim, the Minister of Finance.

[5] By most measures and at most times, the US has strong institutions (see Acemoglu and Robinson (2012)). The established results that show large effects for political connections are based on data from countries with much weaker institutions than the modern United States. For example, in Pakistan there are strong personal connections between the people who run firms and the directors of banks (Khwaja and Mian (2005)); Dinç (2005) has related cross-country findings. In Weimar Germany during the late 1920s, corporate executives shifted allegiances as the political winds changed (Ferguson and Voth (2008)).

run for public office and seems unlikely to ever do so, making political contributions irrelevant.[6]

Second, market participants may have believed that Geithner's policy preferences were generally consistent with the interests of the financial institutions with which he was connected. On this theory, instead of favoring firms because he had connections with them, Geithner's prior personal connections had already shaped his perspectives on the financial sector and financial crisis. In particular, his close connections to large, complex, Wall Street banks had persuaded him that broader economic prosperity required rescuing those banks on relatively generous terms (for shareholders, as well as executives and creditors). Our results, however, are not based on a comparison of financial to non-financial firms or of large to small financial firms. Rather, they are driven by a comparison of connected to non-connected firms of a similar size – the results hold when we drop all firms that were plausibly of systemic importance. Even if Geithner had adopted the worldview that Wall Street was "too big to fail", this cannot directly account for our results.

Third, the market may have subscribed to the "social connections meets the crisis" hypothesis: that personal connections would matter during a time of crisis and increased policy discretion. It was reasonable to suppose that immediate action with limited oversight would have to be taken, and that officials would rely on their small network of confidantes for advice and assistance.

Powerful government officials are no different from the rest of us; they know and trust a limited number of private sector people. It is therefore natural to tap these people for their expertise when needed – including asking them for advice and hiring them into government positions. Even with the best intentions, beliefs are presumably shaped by self-interest, particularly when the people involved were, are, or will be executives with fiduciary responsibility to shareholders. These tendencies can be checked to some degree during regular times by institutional constraints and oversight, but during times of crisis and urgency, social connections might become particularly powerful.

At the time of his nomination, Geithner knew some prominent individuals in the financial sector very well. He is a long-time protégé of Robert Rubin, who was Treasury Secretary under President Bill Clinton, former co-chair of Goldman Sachs, and more recently a leading board member at Citigroup (he resigned from the latter position in January 2009). Most notably, from November 2003, Geithner was president of the Federal Reserve Bank of New York – an institution that has traditionally served as the eyes and ears of the Federal Reserve on Wall Street, but which is sometimes considered to have become too much influenced by the thinking at large financial institutions.[7] We document below that, in line with this hypothesis, as Treasury Secretary, Geithner hired people from a few financial institutions that he knew well. These appointees and Geithner apparently shared the view that their specific financial institutions are essential to the wellbeing of the economy.

[6] Duchin and Sosyura (2012) find that politically connected firms were more likely to receive TARP funds, and also that such firms performed worse than unconnected firms. However, they measure connections to Congress, not to Secretary Geithner.

[7] Formal responsibility for supervision rests with the Board of Governors in Washington D.C., but the New York Fed is very much engaged in collecting information and interpreting what is going on. By tradition, the president of the New York Fed plays a particularly important role in managing relationships between the official sector and financial services executives who are based in New York ("Wall Street", broadly defined). He is also, ex officio, vice chair of the Federal Open Market Committee, which sets monetary policy. (All presidents of the New York Fed to date have been men.)

Our findings find a stronger effect of relationships compared with the standard results in seemingly related studies for the United States. In part, previous studies have examined different kinds of connections, focusing on the legislature, where the impact of a single individual is likely to be limited. For example, the so-called Jeffords Effect – named after a Senator who switched parties unexpectedly, causing a change of control in the U.S. Senate – is worth around 1 percent of firm value (Jayachandran (2006)). Roberts (1990) found significant but small effects on connected firms from the unexpected death of a U.S. Senator.

Also, the crisis conditions of 2008 are likely quite different from what happens in non-crisis episodes. Fisman, Fisman, Galef, and Khurana (2006) conducted a comprehensive assessment of the value of connections to former Vice President Dick Cheney, measured using the impact on connected firms' stock prices of events such as his heart attacks, surprise news about his political career, the original Bush-Cheney "hanging chad" presidential election victory, and Iraq war developments. They look carefully for evidence that his connections matter, but do not find significant effects.[8] Repeating our analysis for the nomination of Secretary Hank Paulson during regular times also leads to no connection premium.

Geithner ascended to the highest level of power at an unusual moment, with many ideas in flux and great differences in opinion between otherwise well-informed and experienced people. Specifically, opinions about responsible policy dealing with the financial sector have often been convergent in recent decades in the United States – as a practical matter, this meant that deregulation continued, irrespective of who became Treasury Secretary.[9] But during the intense crisis of 2008 there was a wide range of opinions among policy experts – and potential Treasury Secretaries – regarding what should be done, with significant potential implications for shareholders.

During such an episode where immediate action was or was thought to be necessary, it is plausible that the usual institutional checks may not work and social connections may become more important both as sources of ideas and sources of manpower.[10] This interpretation is also consistent with recent work by Querubin and Snyder (2011); using a regression discontinuity approach, they find that American politicians were not able to enrich themselves before or after the U.S. Civil War, but during the war, there were substantial opportunities for corruption – either because there was more government spending or because the media were distracted or both.

Section 2 reviews the historical context and why market participants may have expected Geithner to

[8]Fisman et al. (2006) write, "Contrary to conventional wisdom, we find that in all cases the value of ties to Cheney is precisely estimated as zero. We interpret this as evidence that U.S. institutions are effective in controlling rent-seeking through personal ties with high-level government officials."

Lower down the official hierarchy, there may be more issues. For example, Dube, Kaplan and Naidu (2011) find that (leaked) credible private information on coup attempts backed by the United States does move stock prices.

[9]Igan, Mishra, and Tressel (2011) find that lobbying of legislators by lenders was associated with more risk-taking before the crisis and worse outcomes in 2008, while Igan and Mishra (2012) examine how the political influence of the financial sector affected deregulation. Mian, Sufi, and Trebbi (2010) establish that members of Congress were more likely to support the Emergency Economic Stabilization Act of 2008 when they received higher contributions from the financial services industry.

[10]Faccio (2006) finds connections exist everywhere, but does not establish their relative value in various settings. Faccio, Masulis, and McConnell (2006) show connected firms are more likely to receive bailouts across a wide range of countries. But the probability of bailout is much lower in richer countries, and the size of bailouts as a percent of GDP - at least until recently - must have been lower in rich industrialized democracies (although this is not the focus of their study.) See also Chiu and Joh (2004) and Dinç (2005).

have the opportunity and inclination to favor certain firms. Section 3 explains our coding of connections and discusses the other variables we use. Section 4 presents our basic results and a range of robustness checks. Section 5 discusses the effects on firms with connections to other candidates for the post of Treasury Secretary. Section 6 analyzes the effects of Geithner's tax issues, which temporarily jeopardized his nomination in January 2009. Section 7 discusses the design and implementation of bailout policy and financial reform under the Geithner Treasury. Section 8 concludes.

2.2 The Context and Event

2.2.1 Context

The financial crisis first became clearly evident in mid-2007, when problems with subprime mortgages began causing major losses at specific hedge funds or structured investment vehicles with large exposures to securities backed by subprime debt. However, the crisis grew rapidly in severity over the spring and summer of 2008 - culminating in the collapse of Lehman Brothers and a full-blown ginancial panic.

These developments prompted Paulson and Bernanke to propose the bill that eventually became the Emergency Economic Stabilization Act (EESA), whose centerpiece was the $700 billion Troubled Assets Relief Program (TARP).[11] On October 14, Treasury, the Federal Reserve, and the Federal Deposit Insurance Corporation (FDIC) announced two measures that finally began to calm the markets. The first measure was that $250 billion of TARP money was available to recapitalize financial institutions, and $125 billion had already been accepted by nine major banks. The second was a program under which the FDIC would guarantee new debt issued by banks.[12] By mid-November, when President-elect Obama was selecting his Treasury Secretary, the crisis was far from over.

2.2.2 Channels of Influence

Why might market participants have believed that the nomination of Tim Geithner as Treasury Secretary would be good for Geithner-connected firms relative to unconnected firms? This inquiry can be separated into two more specific questions. First, in this subsection we discuss how being connected to powerful officials can benefit a firm in general. In the next subsection, we ask why people might think that such connections would be particularly beneficial in the case of Geithner at Treasury. In evaluating both questions, it is

[11] On Thursday, September 18, Paulson and Bernanke provided a dramatic briefing to congressional leaders. According to Chris Dodd, then chair of the Senate Banking Committee, they were told "that we're literally maybe days away from a complete meltdown of our financial system, with all the implications here at home and globally." (http://www.nytimes.com/2008/09/20/washington/19cnd-cong.html)

The initial Treasury proposal, published on September 20, was only three pages long and did not specify any independent oversight mechanisms. "Text of Draft Proposal for Bailout Plan," The New York Times, September 20, 2008. The initial legislative proposal was rejected by the House of Representatives on September 29. An amended version passed and was signed into law on October 3, 2008.

[12] "Joint Statement by Treasury, Federal Reserve and FDIC," Treasury Department Press Release, October 14, 2008, available at http://www.treas.gov/press/releases/hp1206.htm.

important to bear in mind that market reaction requires only some set of plausible expectations on the part of market participants, not any actual favoritism on the part of the person in question.

There are several potential channels of influence that we believe do not operate here – that is, there was probably not even a significant perception that they might have mattered in Geithner's case. These include: (a) outright corruption, where firms (or their lobbyists) pay officials directly for favors; (b) campaign financing, where elected officials know which firms contribute to their campaigns and what issues are important to them (Geithner, of course, was unelected); and (c) the revolving door, where government officials can maximize their expected income by being friendly with the firms they oversee and later securing lucrative jobs with them. (Before the Treasury nomination, Geithner already had ample opportunity to land jobs with seven- or eight-figure expected annual incomes.)

There are two remaining channels of influence that market participants in November 2008 could reasonably have expected to apply. One is the power of connections. This is the same currency that lobbyists trade in legally. When powerful people make decisions, they are going to be influenced by the people they talk to; and the people they talk to will be the people they know (Bertrand, Bombardini, and Trebbi (2011), and Blanes-i-Vidal, Draca, and Fons-Rosen (2012)). By November 2008, Geithner knew the leaders of the New York financial community very well, and it could reasonably be expected that he would continue to take their calls, and listen to them seriously, as Treasury Secretary.[13]

In addition to the simplest form of access through social connections – the fact that any official is more likely to take a phone call from and listen to someone he knows than someone he does not know – another form of access is provided by hiring. Any new administration must fill a large number of important positions, and personal connections are a main factor in hiring decisions. It would be expected that firms that were connected to Geithner would be more likely to place employees or alumni at Treasury and in related administration jobs than firms that lacked such connections. This was certainly the case for the Paulson Treasury, which brought on a seemingly disproportionate number of people with connections to Goldman Sachs. Even if Geithner were not to favor connected firms directly, they could still benefit through the influence of their alumni.

The second plausible channel of influence is the convergence of perspectives and interests that can occur through immersion in a certain social or institutional context. People's beliefs about the world tend to be shaped by the people and organizations that they spend time with. If a government official previously spent years regularly interacting with the executives of one set of firms and not with the executives of another set of firms, it is plausible that his policy preferences will be closer to those of the former group than the latter. Once in office, this could lead him to make decisions that favor connected over unconnected firms, even were he to provide equal access to all firms. We refer to this type of influence as "cultural capture" because it can lead to outcomes similar to those produced by traditional regulatory capture.

[13]We should emphasize that drawing on pre-existing relationships on Wall Street is well established practice for a Treasury Secretary, and did not begin with Geithner. For example, Henry Paulson brought in more and more Goldman Sachs "experts" as the crisis deepened, including Neel Kashkari, who was charged with running the original Troubled Asset Relief Program. Because of his expertise, Kashkari was initially kept on by Geithner.

In recent decades, the financial sector – particularly the large New York investment banks (Goldman Sachs, Morgan Stanley) and universal banks (Citigroup, JPMorgan Chase) – occupied an increasingly prominent position not only in the U.S. economy, but in Americans' perceptions of society.[14] The belief that financial innovation and large financial institutions are good for society became increasingly widespread and was largely adopted by the Bill Clinton and George W. Bush administrations.[15] Geithner, as a product of the Clinton Treasury Department and the New York Fed, seemed to share this attitude, and his years at the New York Fed had required him to pay particular attention to the views of a specific set of banks.

It is important to note that under the "access" hypothesis, market participants would expect Secretary Geithner to favor financial institutions based on actual connections; under the "cultural capture" hypothesis, by contrast, he would be expected to favor institutions based on how similar they were to the institutions he was connected to – not based on actual connections. Empirically, these two expectations would produce different results. If, controlling for firm type, it is only connected firms that enjoy abnormal returns in the post-announcement period, that implies that market participants believed the "access" hypothesis rather than the "cultural capture" hypothesis.

2.2.3 Expectations in November 2008

The Treasury Secretary has considerable influence over the fate of the banking industry under any circumstances, with significant responsibility for economic policy and financial regulation.[16] By November 2008, however, Treasury was also intervening much more directly in the banking system than had been previously thought possible. That intervention took two main forms: emergency bailouts (or not) of major financial institutions; and TARP, which was intended as support for the financial sector more broadly.

TARP explicitly granted broad powers to Treasury to intervene in the financial sector, and Paulson had used them to pressure nine major banks into accepting $125 billion of new government capital.[17] TARP was especially significant because it gave the Treasury Department a direct role in determining which banks succeeded or failed. Although the Capital Purchase Program distributed capital on relatively generous terms, access to capital was controlled by Treasury. In late October, for example, National City was acquired by PNC after learning that its application might not be approved.[18] At the time, there was little transparency about how applications were being reviewed and what criteria were being used to determine which banks received capital. Because the Capital Purchase Program appeared to convey a government seal of approval

[14]Bhagwati (1998) makes this point in the context of arguing that Wall Street pushed Washington to lobby for capital market liberalization around the world.

[15]For a history of financial sector lobbying and regulatory capture by financial sector interests in the United States, see Johnson and Kwak (2011), chapters 3 through 6.

[16]Two of the major banking regulators, the Office of the Comptroller of the Currency (OCC) and the Office of Thrift Supervision (OTS), were part of the department, although with some degree of independence. Treasury works closely with the other major banking regulators. OTS was abolished by the Dodd-Frank reforms.

[17]Damian Paletta, Jon Hilsenrath, and Deborah Solomon, "At Moment of Truth, U.S. Forced Big Bankers to Blink," The Wall Street Journal, October 15, 2008.

[18]Dan Fitzpatrick, David Enrich, and Damian Paletta, "PNC Buys National City in Bank Shakeout," The Wall Street Journal, October 25, 2008.

while providing capital on relatively favorable terms,[19] it provided an example of how the government could provide benefits to financial institutions – with the Treasury Department determining who received those benefits (Veronesi and Zingales, 2010).

In addition, the Capital Purchase Program placed significant holdings of preferred stock in the hands of the Treasury Department, as well as warrants on common stock. Although the preferred stock was non-voting and Treasury committed not to vote its shares of common stock, this still left open the prospect of increased government influence; participating institutions were also subject to executive compensation and corporate governance requirements.[20] The mechanics of implementing TARP were housed within Treasury, and managed by people appointed by the Treasury Secretary – initially, largely by people whom Secretary Paulson knew from his tenure at Goldman Sachs, vividly demonstrating the potential importance of personal relationships.[21] Because there was considerable uncertainty about how and to what degree Treasury would attempt to exercise influence over banks that had received TARP money, knowing the Treasury Secretary could easily be seen as a major advantage for a bank.

Geithner was known to have personal connections to several major New York banks. He had worked for then-Treasury Secretary Robert Rubin during the Clinton administration; Rubin, the former co-chair of Goldman Sachs, later served as chair of the executive committee of Citigroup's board of directors. As president of the New York Fed, he met frequently, and in private, with the heads of all of the major New York banks, and was even approached by Sanford Weill as a potential CEO of Citigroup.[22]

In addition to these personal connections, Geithner's record as head of the New York Fed and his stated policy positions were generally thought to be favorable to the large, sophisticated institutions that often showed up on his schedule. For example, he argued for the adoption of the Basel II standards for capital adequacy, which allowed large banks to use their own risk management models to determine their capital requirements.[23]

[19]The investment terms were considerably more favorable than those available from the private sector, such as in Warren Buffett's investment in Goldman Sachs. According to Bloomberg, the government received warrants worth $13.8 billion in connection with its 25 largest equity injections; under the terms Buffett got from Goldman, those warrants would have been worth $130.8 billion. In addition, TARP received a lower interest rate (5%) on its preferred stock investments than did Buffett (10%). Nobel prize-winner economist Joseph Stiglitz said, "Paulson said he had to make it attractive to banks, which is code for 'I'm going to give money away.'" Mark Pittman, "Paulson Bank Bailout in 'Great Stress' Misses Terms Buffett Won," Bloomberg, January 10, 2009, available at http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aAvhtiFdLyaQ. The TARP Congressional Oversight Panel had similar findings. TARP Congressional Oversight Panel, "February Oversight Report: Valuing Treasury's Acquisitions," available at http://cop.senate.gov/documents/cop-020609-report.pdf. Although there were justifications for this subsidy – in particular, Treasury wanted broad participation in order to avoid stigmatizing particular banks – it still constituted potential expected value that the government was willing and able to transfer to specific financial institutions.

[20]"TARP Capital Purchase Program: Senior Preferred Stock and Warrants," available at http://www.treas.gov/press/releases/reports/document5hp1207.pdf.

[21]Neel Kashkari, a Goldman Sachs alumnus, was named as interim head of TARP. Reuben Jeffrey, another Goldman alumnus, was named as interim chief investment officer, and several other ex-Goldman executives played important roles in the Paulson Treasury, as profiled in contemporaneous articles in both The New York Times and The Wall Street Journal. Julie Creswell and Ben White, "The Guys from 'Government Sachs'," The New York Times, October 17, 2008, available at http://www.nytimes.com/2008/10/19/business/19gold.html; Deborah Solomon, "The Financial Crisis: Amid Turmoil, Tireless Team Of Advisers Backed Paulson," The Wall Street Journal, September 17, 2008.

[22]Jo Becker and Gretchen Morgenson, "Geithner, Member and Overseer of Finance Club," The New York Times, April 26, 2009, available at http://www.nytimes.com/2009/04/27/business/27geithner.html.

[23]Jo Becker and Gretchen Morgenson, "Geithner, Member and Overseer of Finance Club," The New York Times, April 26, 2009, available at http://www.nytimes.com/2009/04/27/business/27geithner.html.

The New York Fed-supported sale of Bear Stearns to JPMorgan Chase was seen at the time as a very good deal for the acquirer, which was one of the largest New York banks and whose CEO, Jamie Dimon, was then a director of the New York Fed. Geithner supported using government funds to purchase troubled assets from banks directly, which would benefit the banks with the largest portfolios of those assets.[24]

Market participants reacted to news of Geithner's impending nomination by evaluating his likely future behavior relative to that of other plausible alternatives. As of November 15, 2008, the top candidates for the job, according to Intrade's prediction market, were Geithner (45% chance), Lawrence Summers (26%), Jon Corzine (10%), Paul Volcker (9%), and Sheila Bair (8%).[25] In comparing Geithner to these other possibilities, market participants would have been interested in three distinct issues: what policies they were likely to follow; the set of firms to which they were connected; and the degree to which they might be influenced (through any channel) by those firms.

There are reasons why people might have expected some other candidates to follow different policies as Treasury Secretary – policies that might have been less favorable to the types of banks that Geithner was connected to. For example, Corzine, despite having served as chair of Goldman Sachs in the 1990s, was now the favored candidate of at least part of the labor movement.[26] Bair favored a narrower loan guarantee program than Geithner and eventually supported the sale of Wachovia to Wells Fargo rather than Citigroup; she also advocated for relatively more assistance for homeowners and relatively less for financial institutions. Geithner's nomination would then have been seen as a good thing for some of the banks to which he was connected (e.g., Citigroup); but it could also have been seen as a good thing for other, similar banks to which he was less connected (e.g., Bank of America).

For connections to have positive value in and of themselves, two other factors could be at work. First, Geithner could have a different set of connections than the other candidates. This was generally the case, although there was considerable overlap between his and Summers's networks. Second, connections could be thought to have different value for different potential Treasury Secretaries. For example, Summers had a reputation as a brilliant, independent-minded academic economist and as a controversial figure; this could have reduced the perceived value of access to him. Volcker's primary reputational attribute was the idea that he was willing to make hard choices for the good of the country, including inflicting pain when necessary, a reputation earned in combating high inflation in the early 1980s. Although he had worked for Chase Manhattan in the 1950s and 1960s, and had been president of the New York Fed in the 1970s, by 2008 he was considered highly independent of any influence.[27] So if a banking executive had connections to both Geithner and Volcker, he might have expected the connection to Geithner to be more valuable.

[24] According to Jeffrey Lacker, president of the Richmond Fed, Geithner in 2007 discussed an upcoming reduction in the Federal Reserve's discount rate (a rate at which banks can borrow directly from the Fed) with a few large banks; although Lacker's allegation was not made public until 2013, if true, it would certainly have been known by executives at the banks in question. Alister Bull, "Fed Official Alleges Geithner May Have Alerted Banks to Rate Cut," Reuters, January 19, 2013.

[25] James Pethokoukis, "Geithner Tops Odds for Next Treasury Secretary," U.S. News & World Report, November 15, 2008 (online).

[26] Elizabeth Holmes, "Corzine Emerges as a Candidate for Treasury Secretary," The Wall Street Journal, November 13, 2008.

[27] "[Politicians] certainly will not accuse Mr. Volcker of doing Wall Street's bidding at the expense of Main Street." Joe Nocera, "Paul Volcker for Treasury Secretary," The New York Times, October 17, 2008.

2.3 Data and Descriptive Statistics

Our sample consists of all firms that trade on the NYSE or NASDAQ that are categorized as banks or financial services firms in the Datastream database. Of these 678 firms we exclude firms that lack sufficient stock return data in the Datastream or TAQ databases to calculate abnormal returns for our Geithner announcement event. The remaining sample of 603 firms we refer to as the "full sample".

A potential complication is Citigroup's bailout which occurred between the news leak of Geithner's expected nomination on November 21 and the official announcement on November 24. On Sunday, November 23, the U.S. government entered into a bailout agreement with Citigroup that provided Citigroup with a $20 billion capital infusion through TARP, as well as guarantees on a pool of $306 billion of troubled assets.[28]

Because the bailout occurred in the middle of the event window for the Geithner announcement, and because the bailout (or at least the timing of the event) was not entirely anticipated, it could confound the estimation of the effect of the Geithner announcement, to the extent that there is any correlation between firms connected to Geithner and firms impacted by the Citigroup bailout news.[29] In our tests, we address this issue in two ways. First, we report results for stock price reactions on November 21 only, which is prior to the Citigroup bailout announcement. While this approach avoids the confounding effects of the Citigroup bailout, it is not entirely appealing because the post-leak return on November 21 is only one hour in length, and because some uncertainty about the nomination remained until the official announcement on November 24. So as a second approach, we exclude from our tests the firms that would be most likely to be affected by the bailout announcement. We rank all firms in the sample based on their return correlation with Citigroup during the period beginning the day of the Lehman collapse and ending the day before the Geithner nomination announcement. We exclude all firms that rank among the top 10% in correlation with Citigroup, and call this reduced sample our "base sample". The use of this base sample should eliminate, to a great extent, the impact of the bailout announcement on our estimations.

Table 2.1 reports summary statistics of our variables for political connections and financial data. We identify connections to Geithner in three different ways. The first measure of connections, which we refer to as "schedule connections", identifies the number of times that Geithner interacted with executives from each firm while he was president of the New York Fed. We identify these interactions by searching Geithner's daily schedule for each day from January 2007 through January 2009.[30] For example, a search of Geithner's schedule for Moody's Corporation reveals two interactions between Geithner and executives of Moody's. On July 5, 2007, the schedule reads, "11:30 a.m. to 12:00 p.m. Meeting w/Raymond McDaniel, Chairman &

[28] "Joint Statement by Treasury, Federal Reserve, and the FDIC on Citigroup"(press release), November 23, 2008.

[29] It is not certain that a bailout would be positive news for Geithner-connected firms. We test the effect of Geithner connections on returns surrounding another significant government bailout, the bailout of Bank of America on January 16, 2009. The Bank of America bailout was similar in structure to the Citigroup bailout, and confirmed the government's willingness to take unprecedented measures to keep the largest banks afloat. However, our tests show that cumulative abnormal returns for Geithner-connected firms surrounding the Bank of America bailout are generally negative, which suggests that Geithner-connected firms do not generally have positive responses to the news of significant government bailouts of major banks.

[30] "Geithner's Calendar at the New York Fed," The New York Times, available at http://documents.nytimes.com/geithner-schedule-new-york-fed.

CEO, *Moody's Corporation*", and on September 15, 2008, the schedule reads "11:00 a.m. to 12:00 p.m. Rating Agencies Meeting" and Raymond McDaniel is listed as one of the participants. Based on this information, we code Moody's schedule connections as two. Row 1 of Panel A of Table 2.2.1 reports descriptive statistics for this variable. By far the firm with the greatest number of interactions listed on Geithner's schedule is Citigroup, with a total of 34. Panel A of Appendix Table 2.14 lists all of the sample firms found on Geithner's schedule and the number of interactions.

The second measure of connections to Geithner, which we refer to as "personal connections", identifies the number of links that Geithner has with each firm through personal relationships. We identify these links using the relationship maps provided by muckety.com (run by reputable independent journalists).[31] The maps on muckety.com show the links for a given individual to other people or to organizations.[32] We count a link between Geithner and a firm if he has a personal link with a person who is a director of the firm, or if he shares a board or similar position (e.g., trustees of the Economic Club of New York) with someone who works for the firm.[33] We require that those links be active as of the time of the announcement of Geithner's nomination. For example, we find a link between Geithner and American Express on muckety.com through Kenneth Chenault, chairman and CEO of American Express, who is associated with Geithner through the National Academy Foundation, where they are both directors, and through the Partnership for New York City, where Chenault is a vice chairman and Geithner is a board member. Based on this information we code personal connections for American Express as one. Descriptive statistics for this variable are reported in Row 2 of Table 2.1. Geithner has the greatest number of personal connections (nine) to Citigroup; in contrast, he has only one connection with Bank of America (a company not based in New York). Appendix Table 2.12 lists all of the identified personal connections between Geithner and sample firms. We use the same methodology to identify personal connections for other candidates for Treasury Secretary including Lawrence Summers, Jon Corzine, Paul Volcker, and Sheila Bair. These identified connections are listed in Appendix Table A2.

To independently verify the accuracy of the information provided by muckety.com we search the annual reports of each company with an identified personal connection to Geithner, as well as other publicly available information. We are able to verify 52 of the 58 connections reported by muckety.com, 45 of those using the annual report filed most immediately subsequent to the Geithner nomination announcement (typically, for years ending December 31, 2008), and another seven using other sources such as Forbes and Bloomberg. Of the remaining six connections, two are confirmed to be errors and are excluded from our data. The other four are unique to the list of connections in that the connected individuals are identified as legal counsel for

[31] These data are broadly similar to what is available for emerging markets, e.g., Gomez and Jomo (1997 and 1998) on Malaysia. Many connections in emerging markets are formed early in careers. Most of the Geithner connections seem to come from his time at the New York Fed, but that job and many of his connections appear to arise from his relationship with Robert Rubin. We use muckety.com relationship maps from 2009.

[32] Measuring connections in ths way is standard in the network sociology literature. See, for example, Useem (1984). Fisman et al. (2006) review the sociology literature on why board ties matter, including for the flow of information.

[33] Most of our data are board memberships, which are a matter of public record. However, the muckety.com coding also contains some well-known mentor/adviser relationships, with Robert Rubin and a few others.

financial firms in the sample. These have also been excluded from our data due to the difficulty of verifying the connection and because of the different nature of the connections. These exclusions leave us with a set of 52 personal connections to Geithner from 21 different financial firms.

The third measure of connections to Geithner is based on firm location, under the reasonable assumption that Geithner would have greater contact with executives of firms headquartered in New York City, where Geithner was located as president of the New York Fed. This variable is a dummy variable set to one if the headquarters of the firm is identified as New York City in the Datastream database. Descriptive statistics are reported in Row 3 of Table 2.1. Forty-five of the sample firms have headquarters in New York City; these firms are listed in Appendix Table 2.14.

Rows 4 through 6 of Panel A of Table 2.1 report basic financial information for the sample firms as obtained from the Worldscope database for the year 2008. Size (Row 4) is reported as the logarithm of total assets, profitability (Row 5) is return on equity, and leverage (Row 6) is the ratio of total debt to total capital. As shown in Panel A, financial information is missing for a few of these firms. Rows 7 through 9 report summary statistics for our primary measure of firm performance, cumulative abnormal stock returns (CARs). Calculation of CARs is discussed in the next section. Rows 10 through 12 report statistics for our secondary measure of performance, changes in credit default swap (CDS) spreads, which are also discussed in the next section.

Panel B of Table 2.1 reports differences in the means of these variables between firms connected to Geithner and non-connected firms; for this panel his schedule connections are converted to a dummy variable for any connections. Row 13 of Panel B shows that connected firms are significantly larger than non-connected firms for all three measures of connections. Row 14 shows that profitability is significantly lower for connected firms, but only when we use the New York measure. Row 15 shows that leverage is higher for connected firms, but the difference is only significant for the schedule measure of connections. Panel C repeats the analysis of Panel B for the base sample. The differences reported in Panel C are broadly similar to those reported in Panel B. Because of the performance differences shown in Panels B and C, we will control for these variables in subsequent analysis. Finally, Panel D of Table 2.1 reports correlation coefficients between the explanatory variables reported in Panel A.

2.4 Geithner Connections and Stock Returns

In this section we study whether connections to Geithner, as defined in the previous section, are associated with differences in returns at the time of the announcement of Geithner's nomination. We begin by calculating returns for each firm in the sample on the relevant dates. Geithner's nomination was officially announced by President-elect Barack Obama early on Monday, November 24, 2008. However, news of his impending nomination was leaked to the press late in the trading day on Friday, November 21, 2008 at approximately 3:00 p.m. ET, a time that coincides with the beginning of a stock market rally. For the purposes of studying stock reactions, we define event day 0 as November 21 and event day 1 as November 24, with subsequent event days corresponding to subsequent trading days. We obtain daily stock returns for each sample firm from the Datastream database. In order to more carefully delineate the response to the Geithner announcement on event day 0, we calculate returns on that day as only the returns from 3:00 p.m. until the market close at 4:00 p.m. We obtain intraday returns from the TAQ database.

2.4.1 Univariate Tests

Panel A of Table 2.2 compares actual returns between connected and non-connected firms in the base sample for event days 0 through 10. Panel A shows that on event day 0, using schedule connections, connected firms outperformed non-connected firms by 4.3 percentage points, a difference that is significant at the 5% level. Results are similar for the other measures of connections, though not statistically significant for personal connections. On event day 1, when the nomination was officially announced, return differences are even more pronounced. Using the schedule measure, connected firms outperformed non-connected firms by 8.4 percentage points on this day. The corresponding outperformance for firms with personal connections is 9.6 percentage points, and for firms with New York connections it is 3.1 percentage points. In all cases the difference is significant at the 1% or 10% level.

Panel A shows that connected firms continued to outperform non-connected firms on each day through event day 10, with the primary exception being event day 5, in which connected firms sharply underperformed non-connected firms.[34] The final row of Panel A reports cumulative performance for event days 0 through 10. Using the schedule measure of connections, connected firms outperformed non-connected firms by 37.2 percentage points over this period. For personal connections the difference was 46.3 percentage points, and for New York connections the difference was 29.9 percentage points. By any measure of connections, the outperformance of connected firms over this period was economically large and highly statistically significant.

Because there were large market movements during the event window, it is important to also calculate abnormal returns for the event days. Our procedure for calculating abnormal returns is outlined in Campbell, Lo, and MacKinlay (1997). We calculate cumulative abnormal returns using the market model as follows:

$$CAR[0,n]_i = \Sigma_{t=0}^{n} AR_{it},$$

where $CAR[0,n]_i$ is the cumulative abnormal return for firm i for event days 0 through n. AR_{it} is calculated as

$$AR_{it} = R_{it} - [\hat{\alpha}_i + \hat{\beta}_i R_{mt}],$$

where AR_{it} is the abnormal return for firm i on event day t, R_{it} is the actual return on firm i for event day t, and R_{mt} is the return on the market for event day t, with the market return represented by the return on

[34]On event day 5 (December 1, 2008), a day in which there was a large market decline, the NBER officially declared a recession, Ben Bernanke warned of a protracted downturn, Henry Paulson announced the need to further tap bailout funds, and large banks announced layoffs.

the S&P 500 index. The parameters $\hat{\alpha}_i$ and $\hat{\beta}_i$ are estimated from the following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it},$$

on a pre-event period of 250 trading days ending 30 days prior to event day 0. Although the choice of estimation period length is subjective, a length of 250 days corresponds to roughly one year of trading and is a length that has been used in other studies such as Jayachandran (2006) and Li and Lie (2006). The cumulative abnormal returns show the actual returns of each firm less the predicted returns of each firm based on that firm's performance relative to the market over the estimation period.

Panel B of Table 2.2 compares cumulative abnormal returns between connected firms and non-connected firms in the base sample for event days 0 through 10. In contrast to the actual returns reported in Panel A, no significant difference is reported between CARs of connected firms and non-connected firms for the one hour of event day 0. Beginning on event day 1, the differences in CARs between connected firms and non-connected firms are relatively large, though also not statistically significant. Significant differences in CARs increase on subsequent event days. The final row of Panel B shows that using the schedule measure, $CAR[0,10]$ for connected firms is higher than $CAR[0,10]$ for non-connected firms by 15.7 percentage points. The corresponding differences for the other measures are 15.8 percentage points and 11.0 percentage points, and in all cases the difference between the CARs is significant at the 5% level or higher. Panels C and D of Table 2.2 repeat the analysis of Panels A and B, but for the full sample. The results are fairly similar to those reported for the base sample.

In summary, Table 2.2 shows strong performance of connected firms relative to non-connected firms in response to Geithner's nomination as Treasury Secretary, with higher returns for connected firms in the range of 40 percentage points for actual returns and in the range of 15 percentage points for abnormal returns over event days 0 through 10. In the tests that follow, we assess whether these results hold when controlling for other firm characteristics in a multivariate setting.

2.4.2 OLS Regression Results

To control for additional characteristics of the sample firms, we test the relation between connections to Geithner and cumulative abnormal returns in a regression framework. We estimate the following equation:

$$CAR_i = \alpha + \beta x_i + \mathbf{z}_i'\phi + \varepsilon_i, \tag{2.1}$$

where CAR_i is either $CAR[0]$, $CAR[0,1]$, or $CAR[0,10]$ for firm i, x_i is a measure of connections for firm i, and $\mathbf{z}_i$ is a set of firm-level covariates for firm i (such as firm size, profitability, and leverage).

The firm-level covariates are included to control for other basic firm characteristics that could have some effect on the observed relationship between connectedness and returns. A common practice in regressions of this type in previous literature is to not control for firm-level characteristics (see, e.g., Fisman (2001), Jayachandran (2006), Fisman et al. (2006)), although Johnson and Mitton (2003) control for firm size and leverage, and Jayachandran (2006) controls for firm size in robustness checks. Nevertheless, results from such regressions can be confounded by the differential effects of events following Geithner's nomination on firms with different characteristics. For this reason, in the regressions that follow we control for a range of firm-level characteristics (and as a further step in this direction, we will also report results from a synthetic matching estimation). In particular, firm size is included as a control because if Geithner had more interaction with larger firms (Panel B of Table 2.1 indicates that this is the case), then the observed performance of Geithner-connected firms could be due to their size rather than to their connections. Profitability is also an important control because it is an indicator of how hard each firm had been hit by the crisis, and it is possible that the firms that had been hit the hardest had the most to gain from Geithner's appointment. Finally, leverage is included as an additional indicator of the vulnerability of each firm during the crisis.

Similar considerations suggest that there might be other factors causing correlation of error terms (residual returns) across firms. Unadjusted OLS standard errors would be biased in this case. To adjust for this possibility, we estimate adjusted standard errors that account for potential cross-firm correlation of residual returns. We estimate the covariance matrix of returns using pre-event return data on a window of 250 trading days ending 30 days prior to event day 0. This estimated covariance matrix is then used to calculate our standard errors, under the assumption that the pre-event covariance matrix is an appropriate estimate of the covariance matrix during the event. These adjusted standard errors should account for observed cross-sectional correlation of returns between firms in our sample (see Greenwood (2005); Becker, Bergstresser, and Subramanian (2012)). We use these adjusted standard errors throughout the paper unless otherwise noted.

Table 2.3 reports results of the estimation of equation (2.1). The adjusted standard errors are reported below coefficients in parentheses. The three measures of Geithner connections (schedule, personal, and New York) are tested in turn. Although there is no established standard in the literature for the appropriate length of the event window, we follow the practice of reporting results for shorter event windows ($CAR[0]$ and $CAR[0,1]$) and a longer event window ($CAR[0,10]$) for comparison. The first three columns of the table report results on the full sample with $CAR[0]$ as the dependent variable (correlation with Citigroup occurs after the first trading day and is thus not a concern when we use $CAR[0]$). In Column 1 the coefficient on schedule connections is 0.0025, which is not particularly large economically (it represents an abnormal return of under 0.3% for each additional connection), but it is statistically significant at the 10% level. The coefficient for personal connections is not statistically significant, and the coefficient on New York connections is significant at the 10% level and indicates that firms with New York connections had abnormal returns of 1.4% during the last hour of trading on November 21.[35]

[35]Given that the day 0 returns occurred prior to the Citigroup bailout announcement, we do not report results for the base sample for $CAR[0]$, but for reference the corresponding coefficients in the base sample are generally positive and statistically insignificant.

Columns 4 through 6 of Table 2.3 report results for $CAR[0,1]$ focusing on our base sample.[36] The coefficients on schedule connections and personal connections are both positive and significant at the 1% level. The magnitude of the coefficient on schedule connections indicates that each additional interaction between Geithner and a firm during his tenure at the New York Fed is associated with an abnormal return of 1.4% for event days 0 and 1. Likewise, the coefficient on personal connections indicates an abnormal return of 5.5% for each additional personal connection between Geithner and the firm. The coefficient on New York connections is not statistically significant.

The last three columns of Table 2.3 report results for the estimation of equation (2.1) with $CAR[0,10]$ as the dependent variable. In these three columns the coefficient on Geithner connections is positive and significant at the 10%, 1% and 1% level respectively. In contrast to the results for $CAR[0,1]$, here the coefficients on New York connections are also significant, with the coefficient in Column 9 indicating that firms headquartered in New York City had abnormal returns of 10.2% relative to non-New York firms. In summary, Table 2.3 reports economically large and statistically significant cumulative abnormal returns for Geithner-connected firms following the announcement of his nomination as Treasury Secretary, particularly for longer event windows.

2.4.2.1 Robustness Checks for OLS Results

We perform additional tests to assess the robustness of our baseline results reported in Table 2.3, and these are presented in Table 2.4. In this table and in other tables that follow, we suppress reporting of the coefficients of control variables for brevity, although we always include the control variables (size, profitability, and leverage) in all specifications. Also in the interest of brevity we do not report results for New York connections.

We first address the question of whether Geithner-connected firms performed well after the announcement of his nomination because of their personal connections to Geithner or because they were firms that had the most to gain from a rebound precipitated by Geithner's appointment. To address this question, we first posit that firms that had the greatest potential for rebound were those that had the greatest declines in the aftermath of the collapse of Lehman Brothers on September 15, 2008. For each firm we calculate the cumulative abnormal return beginning on the day of Lehman's collapse (a Monday) through the end of the trading week (Friday). We use this $CAR[0,4]$ as a proxy for each firm's vulnerability to the crisis and potential for rebound. As a second variable to control for crisis vulnerability, we control for whether the firm is a deposit-taking institution, as deposit-taking institutions may have differed in vulnerability to the crisis from other financial firms. Using Worldscope data, we create a dummy variable equal to one for firms that have a ratio of deposits to total assets greater than zero. Finally we also control for whether firms had already received TARP funding prior to the announcement of Geithner's nomination, which can act as another proxy for the systemic importance of a firm. Columns 1 and 2 of Table 2.4 report results controlling

[36] To save space, we do not report results for the full sample for $CAR[0,1]$ and $CAR[0,10]$, but for reference the corresponding coefficients in the full sample are generally stronger than those reported for the base sample.

for all three of these proxies for crisis vulnerability (coefficients not reported). Columns 1 and 2 show that the results are similar to our baseline results when controlling for crisis vulnerability, except that the results for $CAR[0,10]$ are somewhat weaker (Panel C).

As another robustness check we recalculate abnormal returns using an estimation window that is focused on the turbulent period surrounding Lehman's collapse. Our intent is to have our measure of expected returns be based on β's that reflect the response of each firm to market movements during this particular period. We calculate abnormal returns as described above, except that the estimation period begins two weeks prior to the Lehman collapse (Monday, September 1, 2008) and ends three weeks after the Lehman collapse (Friday, October 3, 2008), when Congress ultimately approved EESA (which included TARP). Results using this measure of abnormal returns are reported in Columns 3 and 4. The results show that the coefficients on Geithner connections are significant across all three panels in this specification and are all larger in magnitude than the coefficients in our baseline results.

Although we control for firm size throughout our analysis, in Columns 5 and 6 we take another approach to controlling for size by limiting the sample to only the top size decile of sample firms, thereby creating a subsample that is more homogenous in terms of size. With one exception, the results are statistically significant across all three panels in this small subsample. In Columns 7 and 8 we exclude firms that the administration deemed to be of systemic importance, in that they were later included in the government-administered stress tests. The firms that the government included in the stress tests (i.e., the Supervisory Capital Assessment Program, SCAP) are those viewed as systemically important by the administration and thus may have been more likely to have benefited from bailouts similar to the one given to Citigroup or other policies.[37] These estimates are significant when we look at the longer-term CARs but not for $CAR[0]$.

In Columns 9 and 10 of Table 2.4 we check for the influence of outliers by excluding firms with extreme CARs, defined as those larger than the 99th percentile or smaller than the 1st percentile. Panel A shows that these results are not significant for $CAR[0]$, but in the other two panels the results are robust. In Columns 11 and 12 we add controls for a quartic in firm size. The motivation for this control is to assess if results are driven especially by very large firms. For completeness, we also include higher-degree powers of profitability and leverage up to the quartic. The results in Columns 11 and 12 show that the coefficients are statistically significant in all six cases.

As an additional robustness test, we consider whether the results for the schedule measure of connections are robust when we calculate the number of connections using only Geithner's appointments from the year 2007. By 2008, the initial stages of the crisis were underway, so Geithner may have had an increased number of meetings during this time with firms affected by the crisis. Using only 2007 appointments as the schedule measure of connections puts the focus on pre-crisis relationships. The results using the 2007 measure are reported in Column 13. The coefficient on schedule connections is significant in two of the three panels,

[37]This excludes the following 17 firms from our sample: American Express, Bank of America, BB&T, Bank of New York Mellon, Capital One, Citigroup, Fifth Third Bank, Goldman Sachs, J.P. Morgan Chase, Key Corp., Morgan Stanley, PNC Financial Services, Regions Financial, State Street, SunTrust, U.S. Bancorp, and Wells Fargo. The two other SCAP participants, GMAC and MetLife, are not part of our sample.

and in all three panels, the magnitude of the Geithner effect is larger than the comparable coefficient in the baseline regressions.

To summarize the results of the robustness checks in Table 2.4, the coefficients on Geithner connections are always positive across the different specifications. The coefficients generally retain statistical significance, although there are some exceptions. The magnitudes of the coefficients vary but are often larger than those reported in the corresponding baseline results in Table 2.3. Taken as a whole, Table 2.4 shows that the positive relation between Geithner connections and abnormal returns surrounding his nomination announcement is a fairly robust result.[38]

2.4.3 Synthetic Matching Methodology

The results presented so far – and most event studies of this type – implicitly assume that the differences between the test group (in this case, Geithner-connected firms) and the control group (in this case, non-connected firms) can be captured by a combination of the excess return adjustment and the covariates included in the regression model. But connected and non-connected firms may be different in other ways, which might be, at least partially, responsible for our results.

To further address these concerns, we turn to the method of synthetic matching developed in Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2009). The main idea of this method is to construct a synthetic match for each firm in the treatment group (i.e., firms connected to Geithner) by using the firms in the control group in such a way that the synthetic firm has similar behavior to the actual firm before the event of interest. The effect of the event can be measured as a function of the difference between the behavior of the firm and its synthetic match after the event. Abadie, Diamond, and Hainmueller (2009) show that a primary reason to use this method is to control for the effect of unobservable factors that have an effect on the common time trend of samples in the treatment and control groups.

Most previous papers employ synthetic matching for the case of one entity in the treatment group and one intervention. Since our sample includes many connected firms we extend this method for the case of many firms in the treatment group. Inference is based on confidence intervals we construct from the distribution of the "Geithner effect" for "placebo treatment" groups before Geithner's nomination as we explain below.[39]

More formally, our synthetic matching procedure is as follows. First, we divide the firms into treatment and control groups according to our measures of connection to Geithner. Then we construct a synthetic

[38]In an unreported test, we examine the connections of Henry Paulson, the previous Treasury Secretary, applying the same method of identifying personal connections. His only identifiable connection on muckety.com is with Goldman Sachs. On the day of Paulson's announcement (May 30, 2006), Goldman Sachs stock fell by 2.0% (the S&P 500 fell by 1.6% that day), and in the 10 days following the announcement, Goldman fell by 5.2% (the S&P fell by 3.3%). Clearly this is only one observation, but Paulson's appointment (during an economic boom) did not appear to have a positive effect on his connections, consistent with the idea that connections matter more during crisis periods.

[39]These intervals are constructed for testing the hypothesis of whether the effect of Geithner connections is zero or not (and are thus not standard confidence intervals).

match for each firm in the treatment group by solving the following optimization problem:

$$\forall i \in \textit{treatment group}, \{w_j^{i*}\}_{j\in Control\ Group} = \underset{\{w_j^i\}_{j\in Control\ Group}}{\arg\min} \sum_{t\in Estimation\ Window}[R_{it} - \sum_{j\in Control\ Group} w_j^i R_{jt}]^2$$

$$s.t. \quad \sum_{j\in Control\ Group} w_j^i = 1 \quad \text{and} \quad \forall j \in Control\ Group, \forall i \in Treatment\ Group \quad w_j^i \geq 0$$

where R_{it} is the daily return on date t and w_j^i is the weight of control firm j employed in the optimal weighting for firm i. It is important that the estimation window not include the period of intervention and it is typically selected as some period prior to the intervention. As before, we use 250 trading days ending 30 days prior to the Geithner nomination announcement as our estimation window.[40] Imposing the two criteria ($\sum_j w_j^i = 1$, $w_j^i \geq 0$) means the return for firms in the treatment group belong to convex combinations of returns for firms in the control group.

After finding the optimal weights through iteration for each firm in the treatment group, the return for the synthetic firm is constructed by:

$$\widehat{R_{it}} = \sum_{j\in Control\ Group} w_j^i R_{jt} \quad ,$$

and the abnormal return is computed as the difference between the actual return and the synthetic firm return ($\widehat{R_{it}}$).

To estimate the effect of intervention, we compute

$$\widehat{\phi}(\tau, k) = \frac{\sum_{i\in Treatment\ Group} \frac{\sum_{t=0}^{k} R_{it} - \widehat{R_{it}}}{\widehat{\sigma_i}}}{\sum_{i\in Treatment\ Group} \frac{1}{\widehat{\sigma_i}}},$$

where

$$\widehat{\sigma_i} = \sqrt{\frac{\sum_{t\in Estimation\ Window} [R_{it} - \widehat{R_{it}}]^2}{T}}.$$

In the above formula, $\widehat{\phi}(\tau, k)$ is the effect of intervention at date τ when we are computing this effect using cumulative abnormal returns of dates $[\tau, \tau + k]$, $\widehat{\sigma_i}$ is a measure of goodness of the match in the estimation window, and T is the length of the estimation window. Note that this formula for the average effect of intervention on the treatment group is a weighted average formula which gives more weight to better matches. This is because the difference between actual returns and synthetic firm returns should contain more information about the intervention when we are better able to predict the return of the firms during the estimation window.

[40] We find that the main results are robust to using other estimation windows. The results are somewhat stronger when we use estimation windows closer to Geithner's nomination starting from September 2008.

To construct the confidence intervals, we randomly draw 1000 placebo treatment groups from the control group – with each group having the same size as the real treatment group. We compute the Geithner-connection effect for these placebo treatment groups on non-event days, and construct the confidence intervals for hypothesis testing of whether the coefficient is significantly different from zero. The effect of Geithner connections is significant at 5% if it does not belong to the interval that contains the [2.5, 97.5] percentiles of the effect of the Geithner connection for placebo treatment groups.[41]

Table 2.5 presents the results from the synthetic matching estimation. Because synthetic matching requires a dichotomous definition of the treatment group and control group, we also looked at two additional definitions of connections: "highly connected" firms which are defined as those with more than two identified meetings with Geithner, and "mildly connected" firms which are those with one or two identified meetings.

Panel A of Table 2.5 presents results for $CAR[0]$, and Columns 1 through 3 present results for all Geithner connections (highly and mildly connected). Column 1 reports standard OLS results, which differ from those presented in Tables 3 and 4 for two reasons. First, in order to be comparable to the synthetic matching results, the connections variable is a dummy (equal to one for firms with any number of connections). Second, the significance of OLS coefficients is provided as a reference point to the synthetic matching results, and thus is determined using typical OLS standard errors – whereas in Tables 3 and 4 the standard errors are adjusted for pre-event correlations between firms. The OLS regressions control for size, profitability, and leverage as before. Column 1 shows that Geithner connections are associated with an abnormal return of 1.6% for the one-hour return on day 0, and that this coefficient is significant at the 5% level. Below the coefficient we report the number of significant coefficients obtained at each significance level when we test the effect of Geithner connections on 100 trading days between October 31, 2008, and April 7, 2009, excluding key event dates. The number of significant coefficients on non-event days is indicative of the drawback of using unadjusted OLS standard errors in that the Geithner connections coefficient is significant more often than would be expected.

Column 2 presents the synthetic matching results as outlined above. The coefficient on Geithner connections is smaller than in the OLS results, and is not found to be statistically significant. The number of significant coefficients shows that in the non-event-day tests, the Geithner connections coefficient is significant with a frequency that is much closer to what would be expected in theory. This makes us more confident that in the synthetic matching method we are isolating the true effect of Geithner connections rather than the effect of some other correlation among Geithner-connected firms (which would have led to more frequent rejections on non-event days).

Column 3 presents "corrected" synthetic matching results in which for our inference procedure we eliminate firms for which we do not have a good synthetic match, defined as the firms in the control group with

[41] In the synthetic matching approach it is theoretically possible to use another approach to address the confounding effect of the Citigroup bailout. This could be based on using a convex combination of firms in the control group to replicate the effects of Citigroup bailout for treatment group firms. For transparency and simplicity, we continue to focus on the base sample (which excludes the top 10% of Citigroup-correlated firms) in our tests.

$\widehat{\sigma}$ more than $\sqrt{3}$ times the average $\widehat{\sigma}$ for the real treatment group firms.[42] Although the formula used in the synthetic matching method already gives greater weight to firms with better matches, we present the corrected results as a robustness check to ensure that our confidence intervals are appropriate. The corrected results are similar to the uncorrected results in Column 2. Columns 4 through 6 present a similar set of results for the "highly connected" indicator, and Columns 7 through 9 for the "mildly connected" indicator. As would be expected, the results are stronger for highly connected firms. Overall, Panel A suggests that the effect of Geithner connections on the one-hour day 0 returns is positive but not statistically significant once the synthetic matching adjustments are made.

Panel B of Table 2.5 repeats the tests of Panel A but for $CAR[0,1]$. These tests show a much stronger effect of Geithner connections, even in the synthetic matching results. Column 2 shows that Geithner connections are associated with an abnormal return of 5.9%, which, though smaller than the OLS estimate, is still economically significant and statistically significant at the 1% level. As expected, the results are even stronger for highly connected firms relative to mildly connected firms.

Finally, Panel C repeats the results for $CAR[0,10]$. The coefficients in columns 2 and 3 indicate a 12.4% abnormal return associated with Geithner connections. Once again the matching estimate for highly connected firms is larger than for mildly connected firms, although the coefficient is significant for highly connected firms only with the corrected estimates.[43] Taken as a whole, Panels B and C suggest that the synthetic matching methodology confirms the presence of a positive and significant effect of Geithner connections at horizons longer than the one-hour day 0 returns.

2.4.3.1 Robustness Checks for Synthetic Matching

Table 2.6 presents robustness checks for the synthetic matching results, focusing on $CAR[0,1]$. In Panel A, we use the financial crisis estimation window (September 1, 2008 to October 3, 2008) as reported above in the OLS robustness checks. The main results are similar to those presented in Panel B of Table 2.5. The primary difference is that the effect is stronger for highly connected firms while it is no longer significant for mildly connected firms. Panel B uses the personal measure of connections. In these regressions the coefficient on Geithner connections is significant at standard levels in all cases, except for mildly connected firms.

In Panel C, we use the New York measure of connections to Geithner. Again the results show the estimated Geithner connection coefficient is statistically significant, although the size of the coefficient is smaller than with the other measures. This could be due to attenuation bias since having headquarters in New York is a noisier measure of connections to Geithner. In Panel D we use just information from Geithner's 2007 schedule to create the connections variable (as done in the OLS robustness checks) and find that the synthetic matching results are robust to this change.

Table 2.7 provides an additional robustness check to determine whether the positive response of Geithner-

[42] Our results are not sensitive to different cutoffs.

[43] In Panel C, the Geithner connections coefficient tends to have more significant coefficients in the non-event-day tests, relative to the shorter-horizon CARs.

connected firms is due to mean reversion of returns prior to the nomination announcement, perhaps due to a Citigroup downturn prior to its bailout. We test whether Geithner connections were significant in the days before the announcement using, in turn, $CAR[-1,0]$ in Panel A, $CAR[-5,0]$ in Panel B, and $CAR[-10,0]$ in Panel C. In Columns 1 through 3 of Table 2.7 we present results for schedule connections. These columns show that there is a negative trend for Geithner-connected firms prior to the announcement, but none of the estimates is statistically significant. In Columns 4 and 5 we present results comparable to Column 1, but for personal and New York connections. Again, the pre-trend is negative, but not statistically significant except for $CAR[-10,0]$ for New York connections.

Figures 2.1 and 2.2 show the pre-trends graphically. Figure 1 shows the Geithner connection coefficient for 20 trading days prior to the nomination announcement as well as confidence intervals for hypothesis testing for cumulative abnormal returns of days $[x, x+1]$ for the base sample. Figure 2.1 shows that the nomination event stands out as the most significant event during the period. Figure 2.2 is the same as Figure 2.1 except that it is for highly connected firms in the base sample. Figure 2.2 shows no pre-trend after exclusion of Citigroup-correlated firms since the Geithner connection coefficient lies inside confidence intervals before the nomination. These results suggest that the positive reaction of Geithner-connected firms to the nomination announcement was not just a reversal of previous trends.

2.4.4 CDS Spreads

If the market perceived that benefits would accrue to Geithner-connected firms from his appointment as Treasury Secretary, then the news of his nomination should have impacted not just stock returns of connected firms but also the probability of default for connected firms – as reflected in their Credit Default Swap (CDS) spreads. Specifically, if market participants expected that Geithner could protect connected firms from bankruptcy or other trigger events, then one would expect CDS spreads on the debt of connected firms to fall relative to nonconnected firms upon the Geithner nomination announcement.

Because data on CDS spreads are available for relatively few firms, we view CDS spreads as a secondary measure of firm performance. We obtain CDS data from the data provider Markit for every firm in the full sample for which Markit has data available. After eliminating three firms which have missing control variables, we have a sample of 27 firms for our CDS tests. Each firm has multiple CDS listings for various maturities and contract specifications. For our tests we use CDS contracts of five-year maturities (the most common tenor) on senior unsecured debt (the most common priority level) with modified restructuring provisions (the most common provision). Summary statistics for CDS spreads are reported in row 10 of Table 2.1. At the time of the Geithner nomination announcement, the average spread among sample firms was 465 basis points, while the median spread was 233 basis points.

Table 2.8 reports estimations of equation (2.1) in which the dependent variable is the percentage change in the CDS spread rather than the CAR in stock prices. (Summary statistics for CDS spread changes are reported in rows 11 and 12 of Table 2.1). Panel A reports OLS results, first for the percentage change in

CDS spreads on day 1, and then for the percentage change in CDS spreads from day 1 to day 10. Results are not reported for day 0 because of the unavailability of intra-day quotes on CDS spreads. Included but not reported in the regressions are the same control variables from previous regressions. As in the CAR results, the standard errors in these regressions are adjusted for pre-event correlations between firms. Panel A shows that for all three measures of connections the coefficient on Geithner connections is negative whether Citigroup is included or not and for both return horizons. In the first three columns, the coefficient is statistically significant. The negative coefficient is as predicted, in that the Geithner nomination is associated with a reduction in the premium required for insurance on the debt of Geithner-connected firms. As an example of how to interpret the magnitude of these effects, the coefficient of -0.013 in column 1 indicates that each additional schedule connection is associated with a 1.3% drop in a firm's CDS spread on day 1. For an average-spread firm with, say, 5 schedule connections, this would indicate a fall of about 33 basis points.

Panel B of Table 2.8 reports synthetic matching results. Again the coefficient on Geithner connections is negative in all cases, and the coefficients are statistically significant in all but two cases. In some specifications the estimated effects are particularly large. For example, in Column 9, the coefficient of -0.213 indicates that New York connections are associated with a 21.3% drop in a firm's CDS spread from day 1 to day 10 (about 107 basis points for an average-spread firm). In short, the results in Table 2.8 are complementary to the results for stock returns and are broadly supportive of the hypothesis that the market expected benefits for Geithner-connected firms when the Geithner nomination was announced.

2.5 Reactions of Firms Linked to Other Candidates

The previous section documents the positive reaction of Geithner-connected firms to the announcement of Geithner's nomination as Treasury Secretary. We also study the reaction of firms linked to other leading candidates for the position. This is particularly useful as a falsification exercise. If some unobservable characteristic makes firms both more likely to be connected to Geithner and also more likely to perform well during our event window, then we might expect the same characteristic to lead to greater connections to other candidates. If connections to other candidates also matter during the event window, this would be a rejection of our identifying assumption. Our results in this section do not indicate such a pattern and are thus reassuring.

After Geithner, the next leading candidates in the week prior to the announcement were Lawrence Summers, Jon Corzine, Paul Volcker, and Sheila Bair. We follow the procedure discussed above, using data from Muckety, for determining Geithner personal connections to find personal connections to firms for Summers, Corzine, Volcker, and Bair. We list the firms connected to the other candidates and the nature of those connections in Appendix Table 2.13.

In principle, we might expect to see a negative reaction of Summers-connected firms in contrast to the positive reaction of Geithner-connected firms when Geithner's nomination was announced. In practice, however, this prediction is clouded by two factors. First, because Geithner and Summers themselves are closely connected, and because they have interacted with people in similar circles, there is a great deal of overlap between Geithner connections and Summers connections. The correlation between Geithner personal connections and Summers personal connections is 0.92. Second, the day of Geithner's official announcement as Treasury Secretary did not bring all bad news for Summers, because Barack Obama announced Summers as his choice as director of the National Economic Council on the same day. It is likely that Summers would still have been expected to have major influence over economic decisions.

We conduct regressions to test the effect of connections to all candidates on cumulative abnormal returns following the Geithner announcement.[44] We employ the full sample in these tests in order to retain a reasonable number of connections to the other candidates (although we continue to exclude Citigroup from the regressions). Results of these tests are reported in Table 2.9. The first five columns report results with $CAR[0,1]$ as the dependent variable. For purposes of comparison, Column 1 reports coefficients for Geithner connections alone. Column 2 reports the result with the measure of Summers connections included. The coefficient on Summers connections is smaller than the Geithner coefficient and is not significant, whereas the coefficient on Geithner connections remains significant at the 1% level. In Columns 3 through 5 we run a similar regression but test Corzine, Volcker, and Bair connections in turn. The coefficient on connections for Corzine is positive and slightly larger in magnitude than the coefficient on Geithner connections, suggesting some positive effect of the announcement on firms connected to Corzine. The coefficient is negative for the other two candidates, and in all cases, the coefficient on Geithner connections remains positive and significant.

In the final four columns of Table 2.9 we repeat the same regressions but with the percentage change in CDS spreads as the dependent variable. The coefficient on Geithner connections is negative and significant in all cases, again indicating that the market expected benefits for Geithner-connected firms. The coefficients are positive for the alternative candidates. (Bair has no connections to firms in the CDS sample.) Overall, Table 2.9 shows that the strong reactions for Geithner-connected firms were not matched by firms connected to other candidates.

2.6 Geithner's Tax Problems

A secondary event related to Geithner's nomination as Treasury Secretary allows us to further test the relation between Geithner connections and firm value. On Tuesday, January 13, 2009, the Senate Finance Committee publicly disclosed that Geithner had failed to pay over $34,000 in taxes while an employee of the International Monetary Fund. This disclosure cast doubt on whether Geithner would be confirmed by the Senate. If the market expected Geithner-connected firms to derive value from his position as Treasury

[44] The synthetic matching approach cannot be used as there are multiple potential effects of this form.

Secretary, then this event should have been associated with negative stock returns for Geithner-connected firms relative to non-connected firms.

Event day 0 is defined as January 14, 2009, given that the Senate Finance Committee announcement was made after the market closing on January 13, 2009. As for the end of the event period, it is impossible to determine exactly when it became clear to most market participants that Geithner would be confirmed, despite the tax issue. We examined all articles concerning Geithner and his taxes appearing in The Wall Street Journal, beginning on January 14. The first article to predict that Geithner would be confirmed appeared on Wednesday, January 21, or event day 4.[45] (The markets were closed on Monday, January 19 for Martin Luther King Day.)

Panel A of Table 2.10 compares actual returns between connected and non-connected firms for event days 0 through 4 for the base sample. In these tests we alter the base sample to also exclude the top 10% of firms based on return correlation with Bank of America, as this event occurred shortly after the Bank of America bailout was announced. Panel A shows that from event day 0 through event day 3, using the schedule measure of connections, connected firms underperformed non-connected firms by 7.9 percentage points, a difference that is significant at the 5% level. Results are weaker using the other measures of connections. Panel A also shows that the fortunes of connected firms reversed on event day 4, as connected firms outperformed non-connected firms on this day.

Panel B of Table 2.10 compares cumulative abnormal returns between connected firms and non-connected firms for event days 0 through 4. Cumulative abnormal returns are again calculated as described above. Again in Panel B the returns are negative for the schedule measure and the personal measure though the differences are not significant. For the New York measure, the CAR is only negative on day 0. Panels C and D of Table 2.10 repeat the results for the full sample, and the results tend to be stronger in this sample. Panels C and D both show a pattern of negative and significant returns through day 3 that tend to reverse on day 4. The pattern of returns demonstrated in Table 2.10 is supportive of the hypothesis that Geithner's tax problems created a negative shock to Geithner connections, and that concern over the news dissipated after a few days, particularly on event day 4.

We also estimate the effect of Geithner connections during his tax problems in a regression framework. Table 2.11 reports results of the estimation of equation (2.1) for the tax event. Panel A of Table 2.11 reports OLS estimates, and Panel B reports synthetic matching estimates. The first six columns of the table report results with $CAR[0,1]$ as the dependent variable, and the last six columns report results with with $CAR[0,3]$ as the dependent variable. Table 2.11 shows that Geithner connections tend to be associated with negative returns when Geithner's tax problems were disclosed, though these estimates are less precise than our main results. In Panel A, the results are mixed, and only Columns 4 and 10 report a significant negative coefficient on Geithner Connections. In Panel B, the results are also mixed, but more negative and significant returns are reported. Overall, although the regression results are fairly weak, Tables 10 and 11

[45] Deborah Solomon, "The Inauguration: Tax Issue Won't Derail Geithner," The Wall Street Journal, January 21, 2009, p. A3, available at http://online.wsj.com/article/SB123249640035200279.html.

together are consistent with the hypothesis that connections to Geithner were a source of value for connected firms. The relatively weak results may just be due to market participants correctly anticipating that these tax issues would not derail Geithner's nomination.

2.7 After the Announcement

The results above imply that market participants, in aggregate, expected a Geithner Treasury to benefit financial institutions that had connections to the incoming Secretary. Even without specifying a precise channel of influence, the finding that people, via the markets, thought that connections to the incoming Treasury Secretary would pay off in financial terms is itself noteworthy.

There is a further question that still deserves consideration, however: whether the expectations revealed by this event study were subsequently borne out. It is possible that those expectations were mistaken, in which case this is a story in which markets do not provide additional information about the future. Alternatively, it is possible that Secretary Geithner did go on to take actions that benefited certain segments of the financial sector over others and that the "winners" were more likely than not to be those firms with which he had preexisting connections.

Unfortunately, this question does not lend itself to a definitive answer. First, it is not always clear who are the winners and losers in particular policy decisions. Second, even when the beneficiaries can be tentatively identified, they will rarely be strictly limited to firms with prior connections to Geithner. For illustration, assume that Citigroup was able to use its superior connections to gain preferential access and nudge the Treasury Department toward a policy that favored its interests. Such a policy would be likely to also benefit other financial institutions to the extent that they are similar to Citigroup, regardless of their place in Geithner's network. At most, then, we can assess Treasury Department policies to see whether they favored the kinds of institutions with which Geithner had the most contact in the years prior to his nomination. If so, then the abnormal returns enjoyed by connected firms might have foreshadowed the direction of future policy.

2.7.1 Hiring

Geithner hired a number of key people from prominent Wall Street firms, including from those with which he had a strong connection. Mark Patterson, a former Goldman Sachs lobbyist, became his chief of staff. Lee Sachs, previously with Bear Stearns and Mariner Investment Group, became a senior adviser to Geithner with responsibility for helping to design financial sector policies. Herb Allison, who was brought in to run TARP as assistant secretary, was formerly a senior executive at Merrill Lynch and TIAA-CREF. David Miller, a Goldman Sachs alumnus, became TARP's chief investment officer; as a member of the Paulson Treasury, he had been involved in the bailouts of late 2008 and early 2009.[46]

[46] http://dealbook.nytimes.com/2011/01/31/treasurys-warrior-at-the-negotiating-table/

Not all of Geithner's staff came from Wall Street, however. For example, Neal Wolin, whose private sector experience was at The Hartford, an insurance company, became Deputy Treasury Secretary. However, Wolin had previously worked in the Rubin-Summers Treasury. Geithner hired people from within his personal network (and that of Robert Rubin).

2.7.2 From Nomination to Confirmation

Geithner's nomination was leaked to the press on November 21, 2008, but he was not confirmed by the Senate until January 26, 2009. In the interim, he undoubtedly had influence on policymaking within Treasury, both as president of the New York Fed and the likely incoming Treasury Secretary. This period was marked by two high-profile interventions: the bailout of Citigroup in late November and the bailout of Bank of America in January.

These bailouts represented major emergency subsidies from the Treasury Department. In each case, the bank received additional TARP capital, but the government also agreed to guarantee a pool of assets against declines in value. These guarantees were effectively a non-transparent and underpriced form of insurance (compared with what such guarantees would have cost in the free market).[47]

While the Citigroup bailout (November 2008 edition) was always understood as a means of saving the bank, it was reported in January 2009 that the Bank of America bailout had been promised in exchange for the bank agreeing to complete its acquisition of Merrill Lynch, then the third-largest investment bank on Wall Street. In April 2009, an investigation by New York Attorney General Andrew Cuomo further revealed that then-Treasury Secretary Hank Paulson had threatened to replace Ken Lewis as CEO of Bank of America if he refused to complete the Merrill acquisition. These interventions clearly benefited Citigroup, which otherwise might have failed, and Merrill Lynch, which otherwise would almost certainly have failed. Whether they benefited Bank of America is another question that is difficult to answer. As losses mounted at Merrill in December 2008, it may have become rational for Bank of America to walk away from the planned acquisition; the subsidy provided by the government in the form of the January bailout may or may not have compensated it for those additional losses. The net effect was to pressure a North Carolina-based retail bank (with relatively small investment banking operations) to complete its acquisition of a New York-based investment bank.[48]

2.7.3 Rescue Programs Under Geithner

The Capital Assistance Program (CAP) was one mechanism for providing capital to banks that needed it. The terms of CAP were generally favorable to the recipients of capital, but it is not obvious whether the program was more or less favorable than the Capital Purchase Program that was created by Paulson in

[47] As a result, according to the TARP Congressional Oversight Panel, the Citigroup bailout contained an implicit subsidy percentage of 50%, as compared to a subsidy of 22% in the TARP Capital Purchase Program. Congressional Oversight Panel, "February Oversight Report: Valuing Treasury's Acquisitions," February 6, 2009, p. 7.

[48] According to Bair (2012), Geithner went to bat repeatedly for Citigroup and its shareholders (see Bair (2012), Chapter 10).

October 2008. Investments under the CAP were in convertible preferred stock, which has the potential to dilute existing bank shareholders. However, the conversion option was held by the bank, not by Treasury, essentially giving the bank a valuable option.[49]

At the same time, the CAP was coupled with bank stress tests that were conducted in March and April 2009 on nineteen major financial institutions. Of the nineteen institutions, ten were found to need additional capital. The complexity of individual bank balance sheets, and the process by which the test results were released, left significant room for firm-specific negotiation. At least Citigroup, Bank of America, PNC Financial, and Wells Fargo negotiated with the government over the final stress test results. According to The Wall Street Journal, "The Federal Reserve significantly scaled back the size of the capital hole facing some of the nation's biggest banks shortly before concluding its stress tests, following two weeks of intense bargaining."[50] This created latitude for regulators to take actions that might favor some banks over others.[51]

The Public-Private Investment Program (PPIP) delivered on the expectation that Geithner would revive Paulson's original plan to use government money to purchase banks' troubled assets. The PPIP offered non-recourse government loans and FDIC loan guarantees to private sector investors willing to acquire troubled assets. This plan effectively provided a subsidy to these investors in order to increase their willingness-to-pay for the assets and help close the gap that separated bids and asks in the open market. Therefore, the plan aimed to benefit banks holding large amounts of troubled assets, but it also benefited buy-side institutions such as hedge funds, private equity firms, and asset management firms that could participate in the program.

According to Neil Barofsky, then Special Inspector General for TARP, "PPIP had been designed by Wall Street, for Wall Street" – in particular, by BlackRock, the Trust Company of the West Group, and PIMCO.[52] Barofsky was particularly concerned by the opportunities PPIP created for fraud and money laundering.[53] This example shows the potential for well-connected financial institutions to influence government policy at key moments during the financial crisis.

Following Geithner's confirmation, Treasury engaged in fewer firm-specific interventions than in the November 2008-January 2009 period. The two big exceptions were the Citigroup bailout on February 27, 2009, and the AIG bailout on March 2, 2009.

In late February 2009, there were signs that Citigroup was facing another wholesale bank run, most evident in its declining stock price, the falling price of its subordinated bonds, and the rising price of credit default swap protection on its senior bonds. Geithner's initial proposal was to split Citigroup into a "good

[49] "Capital Assistance Program, Summary of Mandatorily Convertible Preferred Stock ('Convertible Preferred') Terms," Treasury Department fact sheet, February 25, 2009, available at http://www.ustreas.gov/press/releases/reports/tg40_captermsheet.pdf.

[50] David Enrich, Dan Fitzpatrick, and Marshall Eckblad, "Banks Won Concessions on Tests," The Wall Street Journal, May 9, 2009.

[51] For example, the decision to base capital requirements on Tier 1 common capital rather than tangible common equity affected different banks differently, arguably hurting Wells Fargo the most. Ibid.; Felix Salmon, "Chart of the Day: Common Capital vs. TCE," Reuters, May 9, 2009.

[52] Barofsky (2012), p.129.

[53] "We saw Geithner's Financial Stability Plan for what it was: an unprecedented trillion-dollar playground for fraud and self-dealing." Barofsky (2012), p. 132. In Barofsky's opinion, Geithner was dismissive of attempts to improve oversight and compliance of TARP programs. Ibid., p. 113.

bank" and a "bad bank". According to Sheila Bair, this would have transferred all of the bank's losses to the FDIC, "without imposing any loss absorption on shareholders and bondholders" and letting "Citi's private stakeholders take all of the upside" (Bair (2012), p. 167). The government's eventual response was to engineer a preferred-for-common swap including both the Treasury Department and several large investors in Citigroup; however, many of the preferred shareholders and subordinated debt investors were not required to convert their investments into common stock.[54] The bank's common stock price fell on the news, so presumably the market was expecting an even more generous bailout.[55]

After a disastrous fourth quarter of 2008 that threatened AIG's viability as a going concern, the government improved the terms on its existing preferred stock, invested more cash in exchange for more preferred stock, and improved the terms on AIG's credit line.[56] By this point, AIG was largely owned by the U.S. government, so the bailout was not intended to benefit AIG's shareholders; instead, its goal was to keep AIG afloat in order to minimize collateral damage to other firms. Because it was still supposedly solvent, AIG was able to honor its commitments to its counterparties, largely credit default swap protection it had sold to other financial institutions – most notably (excluding European banks) Goldman Sachs, Merrill Lynch, Bank of America, Citigroup, Wachovia, Morgan Stanley, and JPMorgan Chase. Because AIG was able to make its counterparties whole, these banks – including, after the acquisitions of September-October 2008, the six largest banks – received more cash than they would have if AIG had failed.[57]

2.8 Conclusion

The announcement of Timothy Geithner as President-elect Obama's nominee for Treasury Secretary in November 2008 produced a cumulative abnormal return for financial firms with which he had a personal connection relative to other comparable, non-connected firms. This return, which was about 15 percent from day 0 through day 10, appears fairly robust. It is present using different measures of connections, with flexible controls for firm size and other characteristics, and using synthetic matching methodology. There were subsequently abnormal *negative* returns for connected firms when news broke that Geithner's confirmation might be derailed by tax issues, even though these returns are less precisely estimated.

In our view, these excess returns reflect the market's expectation that, during a period of turbulence and unusually high policy discretion, the new Treasury Secretary would need to rely on a core group of employees and a small social network for real-time advice, and that these employees were likely to be hired

[54] "Transaction Outline," Treasury Department fact sheet, February 27, 2009, available at http://www.treas.gov/press/releases/reports/transaction_outline.pdf. According to Bair, Geithner resisted requiring any of Citigroup's private stakeholders to convert, against the wishes of the FDIC. Bair (2012), Chapter 15.

[55] Citigroup (along with GM and AIG) also benefited from "Notices" issued by the Treasury Department allowing the company to keep the tax benefits provided by its past net operating losses – a policy that has been contested by a number of commentators and legal scholars. See, for example, Ramseyer and Rasmussen (2011).

[56] "U.S. Treasury and Federal Reserve Board Announce Participation in AIG Restructuring Plan," Treasury Department press release, March 2, 2009.

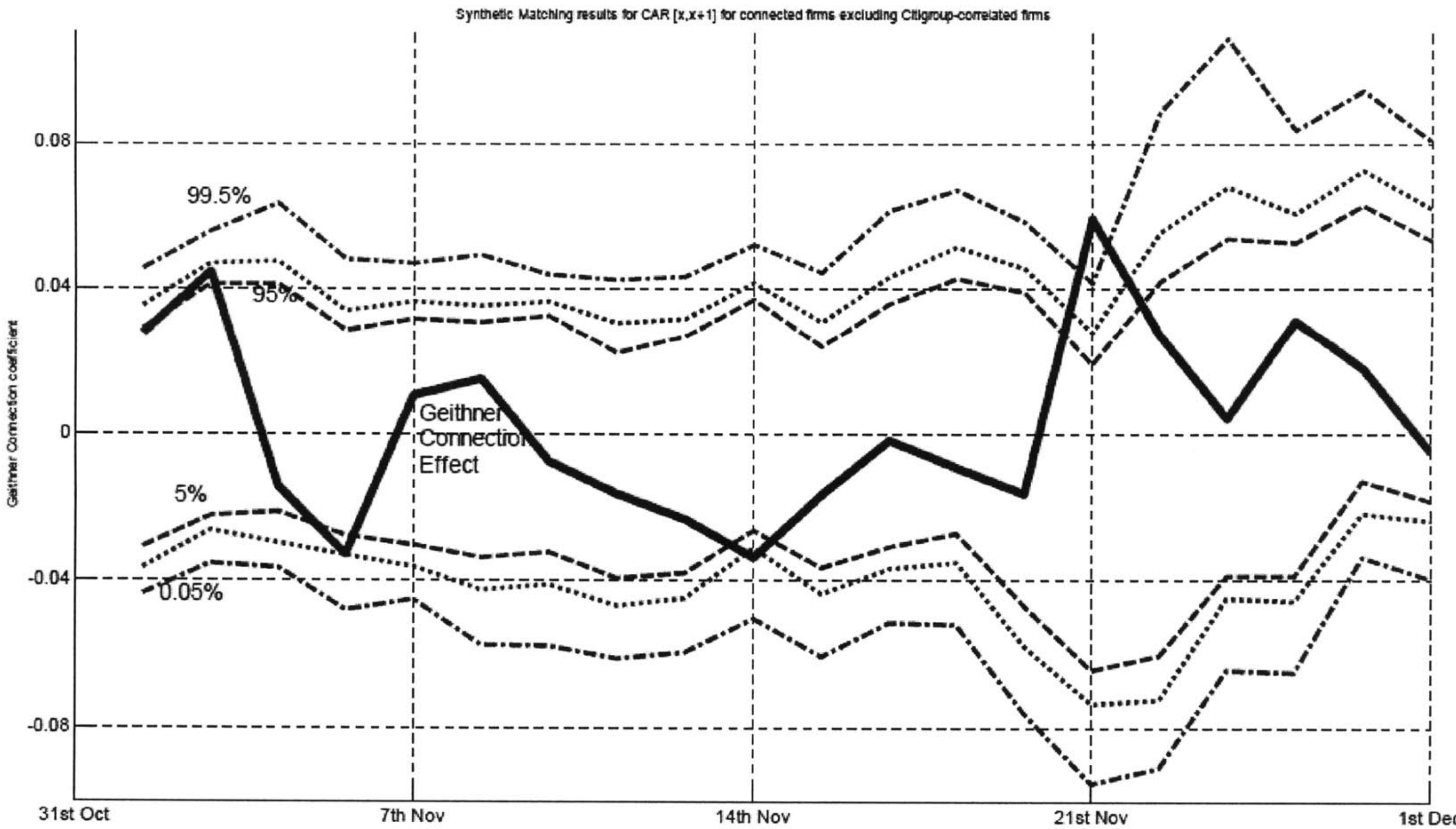
[57] Goldman Sachs claimed that even if AIG had collapsed, its positions with AIG were fully hedged. Peter Edmonston, "Goldman Insists It Would Have Lost Little If A.I.G. Had Failed," The New York Times, March 20, 2009. Barofsky argues that AIG did not need to pay 100 cents on the dollar, but there was no serious attempt to negotiate a reduction in payments (Barofsky (2012), pp. 186-187.)

from financial institutions with which Geithner had connections. This is the "social connections meets the crisis" interpretation.

We lean towards this interpretation because our results cannot be explained by Geithner bringing a safe pair of hands to the management of the economy or by Geithner and his advisors solely favoring large, complex Wall Street firms at the expense of other financial institutions. This is because our results are derived from specifications that control flexibly for firm size. Put differently, they are derived from differences between connected and non-connected financial institutions of roughly the same size. Consistent with this interpretation, Geithner's Treasury employed key personnel from financial institutions with which he was connected, and some of the decisions of his department can be interpreted as being, at the margin, favorable to connected firms (at least for Citigroup, on which we have the best anecdotal data).

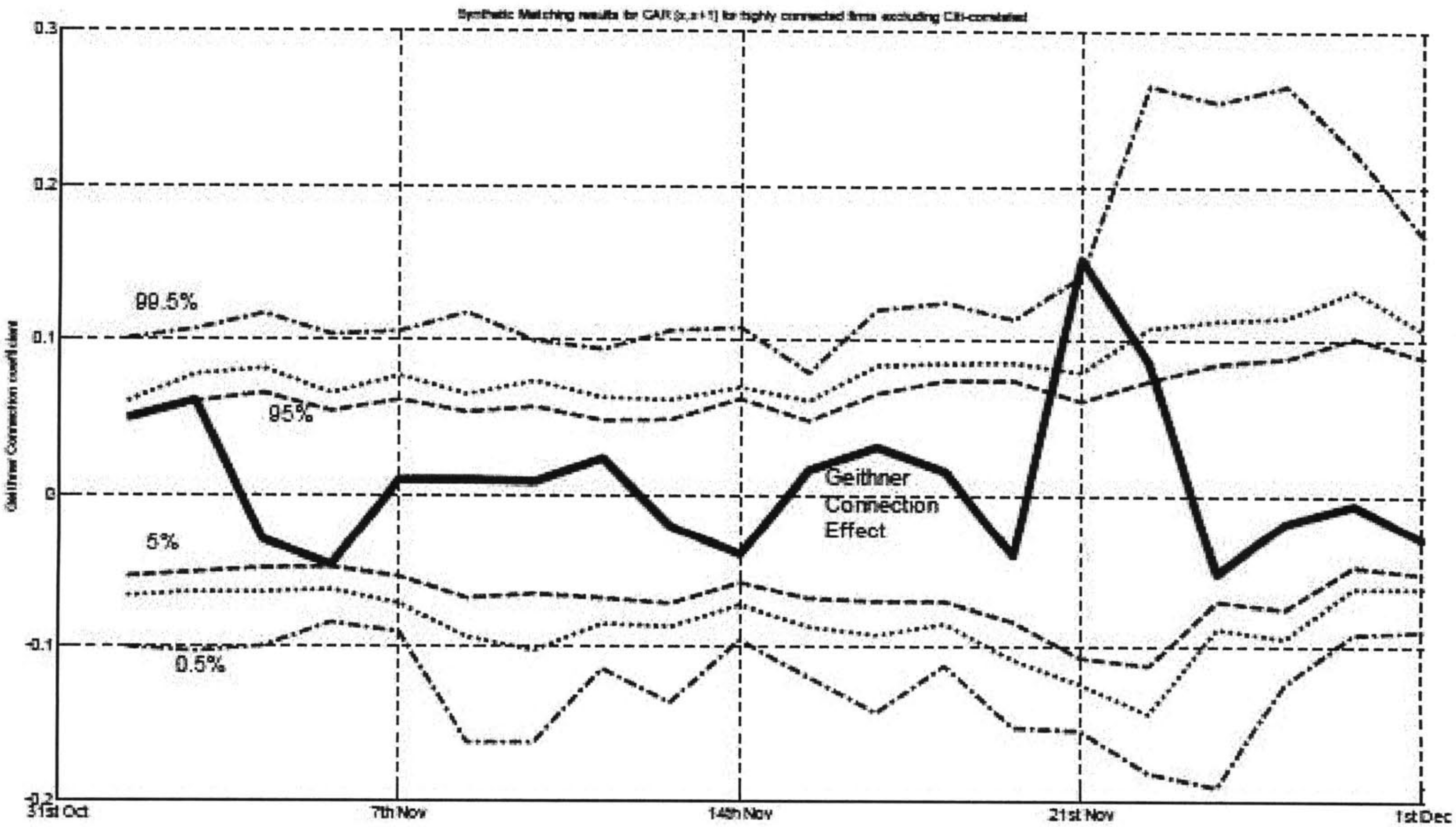
If our interpretation is correct, the benefit to connected firms is temporary – and very much related to the crisis atmosphere of November 2008. Once policy discretion declines and the speed with which important decisions have to be taken slows down, these connections should become less important. Whether this is the case remains an area for further research.

Figure 2.1: Geithner Connections Coefficient



Note: This figure shows the time-series plot for November 2008 of the coefficient on Geithner Connections for cumulative abnormal returns measured over the interval [x, x+1]. Citigroup-correlated firms are excluded. Confidence intervals at the 1%, 5%, and 10% levels are also presented. November 21, 2008 is the day of the Geithner nomination announcement.

Figure 2.2: Geithner Connections Coefficient (Highly Connected Firms)



Notes: This figure shows time-series plot for November 2008 of the coefficient on Geithner Connections for cumulative abnormal returns measured over the interval [x, x+1]. Only highly connected firms are included. Citigroup-correlated firms are excluded. Confidence intervals at the 1%, 5%, and 10% levels are also presented. November 21, 2008 is the day of the Geithner nomination announcement.

Table 2.1: Descriptive statistics

The table presents descriptive statistics of firm-level data used in subsequent tables. The sample includes firms listed on NYSE or NASDAQ and classified as banks or financial services firms in the Datastream database. The base sample excludes firms with returns highly correlated to Citigroup. Schedule connections are the number of times the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed; personal connections are as compiled from muckety.com; and New York connections are defined as firms having headquarters in New York City. Size, profitability, and leverage are from the Worldscope database for the year 2008. CDS spreads are for five-year contracts and are stated in percents.

Panel A: Summary Statistics (Full sample)

	Mean	Min	25th Pctile	Median	75th Pctile	Max	St. Dev.	N
(1) Geithner Connections (Schedule)	0.21	0.00	0.00	0.00	0.00	34.00	1.74	603
(2) Geithner Connections (Personal)	0.08	0.00	0.00	0.00	0.00	9.00	0.60	603
(3) Geithner Connection (New York)	0.07	0.00	0.00	0.00	0.00	1.00	0.26	603
(4) Size (Log of Total Assets)	21.33	16.32	20.23	21.03	22.10	28.41	1.72	596
(5) Profitability (ROE)	-0.05	-3.62	-0.06	0.04	0.09	0.82	0.35	585
(6) Leverage (Total Debt/Total Capital)	0.57	0.00	0.43	0.61	0.71	3.10	0.27	592
(7) CAR[0]	-0.02	-0.24	-0.04	-0.01	0.01	0.35	0.06	603
(8) CAR[0,1]	-0.02	-0.46	-0.07	-0.02	0.03	0.48	0.11	603
(9) CAR[0,10]	0.02	-0.69	-0.10	-0.02	0.09	1.38	0.21	603
(10) CDS Spread, Day 1	4.65	0.23	1.16	2.33	5.32	29.29	6.15	30
(11) % Change in CDS Spread[1]	-0.04	-0.49	-0.03	0.00	0.00	0.02	0.10	30
(12) % Change in CDS Spread[1,10]	-0.06	-0.49	-0.12	-0.04	0.00	0.15	0.13	30

Panel B: Geithner Connected vs. Non-connected (Full sample)

	Schedule	Non	Diff.	Personal	Non	Diff.	New York	Non	Diff.
(13) Size (Log of Total Assets)	24.40	21.20	3.20***	25.00	21.20	3.80***	21.78	21.30	0.48*
(14) Profitability (ROE)	0.04	-0.06	0.10	-0.15	-0.05	-0.10	-0.17	-0.04	-0.13**
(15) Leverage (Total Debt/Total Capital)	0.73	0.56	0.17***	0.60	0.56	0.04	0.57	0.56	0.00
(16) Number of obseravations in full sample	25	578		21	582		45	558	

Panel C: Geithner Connected vs. Non-connected (Base sample)

	Schedule	Non	Diff.	Personal	Non	Diff.	New York	Non	Diff.
(17) Size (Log of Total Assets)	23.13	20.98	2.16***	23.17	21.00	2.17***	20.95	21.04	-0.09
(18) Profitability (ROE)	0.06	-0.07	0.13	-0.42	-0.06	-0.36***	-0.20	-0.05	-0.14**
(19) Leverage (Total Debt/Total Capital)	0.71	0.56	0.15**	0.52	0.57	-0.05	0.54	0.57	-0.03
(20) Number of observations in base sample	15	530		9	536		38	507	

Panel D: Correlation Coefficients (Full sample)

	Schedule	Personal	New York	Size	Profitability	Leverage
(21) Geithner Connections (Schedule)	1.00					
(22) Geithner Connections (Personal)	0.86	1.00				
(23) Geithner Connection (New York)	0.35	0.39	1.00			
(24) Size (Log of Total Assets)	0.35	0.37	0.10	1.00		
(25) Profitability (ROE)	0.00	-0.03	-0.11	0.05	1.00	
(26) Leverage (Total Debt/Total Capital)	0.04	0.06	-0.15	0.28	-0.16	1.00

Table 2.2: Connections to Geithner and Stock Price Reactions to Treasury Secretary Announcement

The table presents returns of stocks of financial firms around the announcement of Barack Obama's nomination of Timothy Geithner as treasury secretary. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and returns on that day are measured from 3pm to market closing. The announcement was officially made on event day 1. Panels A and C present actual returns while Panels B and D present cumulative abnormal returns. The base sample excludes firms with returns highly correlated to Citigroup. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. Schedule connections indicate that the firm was on Geithner's schedule during his tenure as president of the New York Fed, personal connections are as compiled from muckety.com, and New York connections are defined as firms having headquarters in New York City. Asterisks denote significance level of a two-tailed t-test (***=1%, **=5%, *=10%).

Panel A: Actual Returns (Base sample)

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	11/21/2008	0.086	0.042	0.043 **	0.075	0.043	0.033	0.085	0.040	0.044 ***
1	11/24/2008	0.130	0.046	0.084 ***	0.143	0.047	0.096 ***	0.078	0.046	0.031 *
2	11/25/2008	0.026	0.015	0.011	0.057	0.014	0.043	0.032	0.014	0.018
3	11/26/2008	0.112	0.041	0.071 ***	0.112	0.042	0.071 **	0.087	0.040	0.048 ***
4	11/28/2008	0.056	0.018	0.038 *	0.085	0.018	0.067 **	0.016	0.019	-0.003
5	12/1/2008	-0.131	-0.076	-0.056 **	-0.144	-0.076	-0.067 **	-0.105	-0.075	-0.030 *
6	12/2/2008	0.046	0.043	0.003	0.044	0.043	0.001	0.090	0.040	0.050 ***
7	12/3/2008	0.034	0.018	0.016	0.043	0.018	0.024	0.031	0.018	0.013
8	12/4/2008	-0.009	-0.013	0.005	0.005	-0.014	0.019	-0.020	-0.013	-0.008
9	12/5/2008	0.063	0.024	0.038 **	0.042	0.025	0.017	0.050	0.024	0.026 **
10	12/8/2008	0.064	0.027	0.037	0.072	0.028	0.045 **	0.050	0.027	0.023
0-10	(Cumulative)	0.551	0.180	0.372 ***	0.645	0.183	0.463 ***	0.468	0.169	0.299 ***

Panel B: Cumulative Abnormal Returns (Base sample)

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	11/21/2008	-0.013	-0.015	0.001	-0.034	-0.014	-0.020	-0.005	-0.015	0.011
1	11/24/2008	0.024	-0.022	0.046	0.005	-0.021	0.026	-0.011	-0.021	0.010
2	11/25/2008	0.039	-0.013	0.052	0.052	-0.012	0.064	0.012	-0.013	0.025
3	11/26/2008	0.099	-0.001	0.101 **	0.107	0.000	0.108 *	0.053	-0.002	0.055 *
4	11/28/2008	0.141	0.009	0.132 ***	0.177	0.009	0.167 ***	0.056	0.009	0.048
5	12/1/2008	0.136	0.006	0.129 ***	0.175	0.007	0.168 ***	0.067	0.006	0.061 **
6	12/2/2008	0.124	0.017	0.107 **	0.156	0.017	0.138 **	0.105	0.013	0.092 ***
7	12/3/2008	0.120	0.013	0.107 **	0.156	0.014	0.142 **	0.101	0.010	0.091 ***
8	12/4/2008	0.152	0.024	0.129 **	0.208	0.024	0.184 ***	0.118	0.021	0.098 ***
9	12/5/2008	0.162	0.018	0.144 ***	0.192	0.019	0.172 ***	0.121	0.015	0.106 ***
10	12/8/2008	0.171	0.014	0.157 ***	0.173	0.015	0.158 **	0.120	0.010	0.110 ***

Table 2.2: continued

Panel C: Actual Returns (Full sample)

Event Day	Date	Schedule Connections: Conn.	Schedule Connections: Non-Conn.	Schedule Connections: Difference	Personal Connections: Conn.	Personal Connections: Non-Conn.	Personal Connections: Difference	New York Connections: Conn.	New York Connections: Non-Conn.	New York Connections: Difference
0	11/21/2008	0.093	0.047	0.046 ***	0.096	0.047	0.049 ***	0.089	0.046	0.043 ***
1	11/24/2008	0.165	0.054	0.111 ***	0.185	0.054	0.131 ***	0.107	0.055	0.052 ***
2	11/25/2008	0.032	0.015	0.017	0.047	0.015	0.032	0.033	0.014	0.019
3	11/26/2008	0.087	0.042	0.045 **	0.076	0.043	0.034	0.085	0.040	0.045 ***
4	11/28/2008	0.051	0.018	0.033 **	0.054	0.018	0.036 **	0.021	0.019	0.002
5	12/1/2008	-0.151	-0.083	-0.068 ***	-0.165	-0.083	-0.082 ***	-0.118	-0.083	-0.034 **
6	12/2/2008	0.054	0.046	0.008	0.058	0.046	0.012	0.086	0.043	0.043 ***
7	12/3/2008	0.045	0.020	0.024	0.056	0.020	0.036 **	0.035	0.020	0.015
8	12/4/2008	-0.009	-0.014	0.005	-0.003	-0.015	0.011	-0.021	-0.014	-0.008
9	12/5/2008	0.060	0.029	0.031 **	0.056	0.029	0.027 *	0.054	0.028	0.026 **
10	12/8/2008	0.073	0.027	0.046 **	0.072	0.028	0.045 **	0.057	0.027	0.030 **
0-10	(Cumulative)	0.584	0.197	0.387 ***	0.646	0.197	0.448 ***	0.512	0.189	0.323 ***

Panel D: Cumulative Abnormal Returns (Full sample)

Event Day	Date	Schedule Connections: Conn.	Schedule Connections: Non-Conn.	Schedule Connections: Difference	Personal Connections: Conn.	Personal Connections: Non-Conn.	Personal Connections: Difference	New York Connections: Conn.	New York Connections: Non-Conn.	New York Connections: Difference
0	11/21/2008	-0.016	-0.015	0.000	-0.025	-0.015	-0.010	-0.007	-0.016	0.009
1	11/24/2008	0.046	-0.020	0.066 ***	0.046	-0.020	0.065 ***	0.010	-0.020	0.029 *
2	11/25/2008	0.067	-0.011	0.079 ***	0.080	0.011	0.069 ***	0.033	-0.011	0.045 **
3	11/26/2008	0.097	-0.002	0.099 ***	0.093	-0.001	0.094 ***	0.069	-0.003	0.072 ***
4	11/28/2008	0.131	0.007	0.124 ***	0.130	0.008	0.121 ***	0.076	0.007	0.069 **
5	12/1/2008	0.120	0.005	0.115 ***	0.120	0.005	0.115 ***	0.083	0.003	0.079 ***
6	12/2/2008	0.110	0.014	0.096 ***	0.107	0.015	0.092 **	0.113	0.010	0.103 ***
7	12/3/2008	0.112	0.010	0.102 ***	0.116	0.011	0.105 **	0.111	0.007	0.104 ***
8	12/4/2008	0.149	0.022	0.126 ***	0.163	0.023	0.140 ***	0.130	0.019	0.111 ***
9	12/5/2008	0.150	0.018	0.132 ***	0.154	0.018	0.135 ***	0.133	0.014	0.119 ***
10	12/8/2008	0.161	0.010	0.151 ***	0.157	0.011	0.147 ***	0.136	0.006	0.129 ***

Table 2.3: Connections to Geithner and Reactions to Treasury Secretary Announcement, OLS Regression Results

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) surrounding the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and returns on that day are measured from 3pm to market closing. The announcement was officially made on event day 1. The CAR is measured as day 0 only, from day 0 to day 1, or from day 0 to day 10, as indicated. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. The base sample excludes firms with returns highly correlated to Citigroup. Schedule connections are the number of times the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed; personal connections are as compiled from muckety.com; and New York connections are defined as firms having headquarters in New York City. Basic control variables are measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. Robust standard errors, adjusted for pre-event correlations between firms, are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent variable is CAR [0] (Full sample)			*Dependent variable is CAR [0,1] (Base sample)*			*Dependent variable is CAR [0,10] (Base sample)*		
	Schedule	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*
Geithner Connections	0.0025 *	0.0057	0.0141 *	0.014 ***	0.055 ***	0.012	0.016 *	0.074 ***	0.102 ***
	(0.0013)	(0.0040)	(0.0081)	(0.004)	(0.011)	(0.012)	(0.009)	(0.026)	(0.029)
Size	-0.004 ***	-0.004 ***	-0.004 ***	-0.006 ***	-0.006 ***	-0.004 ***	-0.017 ***	-0.017 ***	-0.016 ***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Profitability	0.022 ***	0.022 ***	0.023 ***	0.043 ***	0.048 ***	0.044 ***	-0.048 ***	-0.042 ***	-0.036 ***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)	(0.004)
Leverage	-0.005 ***	-0.006 ***	-0.003	0.000	0.000	-0.006 *	-0.048 ***	-0.045 ***	-0.029 ***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.005)	(0.004)	(0.008)
Number of firms	583	583	583	525	525	525	525	525	525
R-squared	0.029	0.027	0.028	0.031	0.037	0.023	0.024	0.027	0.034

Table 2.4: Connections to Geithner and Reactions to Treasury Secretary Announcement, OLS Robustness Checks

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) surrounding the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and returns on that day are measured from 3pm to market closing. The announcement was officially made on event day 1. The CAR is measured as day 0 only, from day 0 to day 1, or from day 0 to day 10, as indicated. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. The base sample excludes firms with returns highly correlated to Citigroup. Schedule connections are the number of times the firm was on Geithner's schedule during 2007-08 (only 2007 in column 13), when he was president of the New York Fed; personal connections are as compiled from muckety.com. Also included in the regressions but not reported are control variables measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. "Systemic importance" firms are those that were later evaluated in government-administered stress tests. In Columns 1 and 2 other controls (not reported) include the CAR[0,4] for the firm subsequent to the collapse of Lehman Brothers, a dummy variable equal to one if the firm takes deposits, and a dummy variable equal to one if the firm had accepted TARP funding as of Geithner's nomination announcement. In Columns 3 and 4, the estimation window is a five-week window surrounding the collapse of Lehman Brothers on September 15, 2008. In Columns 11 and 12, powers of the basic control variables (size, profitability, and leverage, up to the fourth power) are also included but not reported. Robust standard errors, adjusted for pre-event correlations between firms, are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	Control for crisis vulnerability		*Lehman collapse estimation beta*		*Top size decile only*		*Exclude "systemic importance" firms*		*Exclude extreme CARs (1%/99%)*		*Include powers of control variables*		*2007 appts. only*
	Schedule	*Personal*	*Schedule*	*Personal*	*Schedule*	*Personal*	*Schedule*	*Personal*	*Schedule*	*Personal*	*Schedule*	*Personal*	*Schedule*
Panel A: Dependent variable is CAR [0] (Full sample)													
Geithner Connections	0.0023 **	0.0051 *	0.0025 *	0.0075 *	0.0031 ***	0.0071 **	0.0035	0.0036	0.0021	0.0046	0.0032 ***	0.0068 **	0.0033 *
	(0.0010)	(0.0031)	(0.0013)	(0.0040)	(0.0009)	(0.0034)	(0.0023)	(0.0072)	(0.0013)	(0.0040)	(0.0009)	(0.0032)	(0.0019)
Number of firms	576	576	583	583	58	58	566	566	571	571	583	583	583
R-squared	0.030	0.028	0.050	0.050	0.225	0.154	0.026	0.025	0.027	0.024	0.043	0.041	0.028
Panel B: Dependent variable is CAR [0,1] (Base sample)													
Geithner Connections	0.012 ***	0.054 ***	0.015 ***	0.069 ***	0.012 ***	0.046 ***	0.013 ***	0.056 ***	0.012 ***	0.052 ***	0.012 ***	0.047 ***	0.035 ***
	(0.003)	(0.011)	(0.004)	(0.011)	(0.003)	(0.011)	(0.004)	(0.011)	(0.004)	(0.011)	(0.003)	(0.007)	(0.007)
Number of firms	518	518	525	525	52	52	523	523	517	517	525	525	525
R-squared	0.037	0.044	0.038	0.047	0.068	0.104	0.029	0.039	0.043	0.051	0.048	0.052	0.038
Panel C: Dependent variable is CAR [0,10] (Base sample)													
Geithner Connections	0.006	0.042 *	0.029 ***	0.128 ***	0.011	0.109 ***	0.020 **	0.074 ***	0.016 *	0.076 ***	0.011 *	0.064 ***	0.016
	(0.006)	(0.023)	(0.009)	(0.026)	(0.006)	(0.024)	(0.008)	(0.027)	(0.009)	(0.026)	(0.006)	(0.007)	(0.016)
Number of firms	518	518	525	525	52	52	523	523	516	516	525	525	525
R-squared	0.086	0.087	0.054	0.060	0.034	0.146	0.025	0.028	0.020	0.026	0.080	0.083	0.022

Table 2.5: Connections to Geithner and Reactions to Treasury Secretary Announcement, Synthetic Matching Estimation

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) surrounding the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. Standard OLS estimates (without standard error adjustments) as well as synthetic matching estimates are reported. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and returns on that day are measured from 3pm to market closing. The announcement was officially made on event day 1. The CAR is measured for day 0 only in Panel A, from day 0 to day 1 in Panel B, and from day 0 to day 10 in Panel C. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. The base sample excludes firms with returns highly correlated to Citigroup. "Geithner Connections" is a dummy variable equal to one if the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed. "Highly connected" indicates more than two meetings with Geithner, and "Mildly connected" indicates one or two meetings. Basic control variables (not reported) are measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. For matching estimators, the matching window is the 250 days ending 30 days before the Geithner nomination announcement. Confidence intervals in columns for matching estimators are computed according to a placebo exercise (5,000 simulations) of finding Geithner coefficients for non-connected firms. The number of times in which the Geithner coefficient is significant for a test window are also reported (based on 100 trading days from 10/31/08 through 4/7/09, with key event dates excluded). Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All Geithner connections			*Highly connected*			*Mildly connected*		
	OLS	*Matching*	*Corrected*	*OLS*	*Matching*	*Corrected*	*OLS*	*Matching*	*Corrected*
Panel A: Dependent variable is CAR [0] (Full sample)									
Geithner Connections	0.016 **	0.004	0.001	0.024 **	0.010	0.004	0.011 *	0.000	0.000
Confidence interval (2.5%)		-0.032	-0.029		-0.044	-0.046		-0.036	-0.036
Confidence interval (97.5%)		0.013	0.011		0.025	0.025		0.021	0.018
Number of sig. coefficients (10%)	40	7	8	37	11	11	30	0	2
Number of sig. coefficients (5%)	35	4	4	30	6	4	22	0	1
Number of sig. coefficients (1%)	16	0	0	14	1	0	10	0	0
Number of firms	583	583	469	583	583	469	574	574	460
Number in treatment group	22	22	21	9	9	8	13	13	13
Panel B: Dependent variable is CAR [0,1] (Base sample)									
Geithner Connections	0.073 ***	0.059 ***	0.059 ***	0.171 ***	0.153 **	0.153 ***	0.041 **	0.033 *	0.033 *
Confidence interval (2.5%)		-0.074	-0.072		-0.133	-0.125		-0.083	-0.077
Confidence interval (97.5%)		0.030	0.026		0.107	0.080		0.039	0.037
Number of sig. coefficients (10%)	23	13	17	12	4	7	23	8	13
Number of sig. coefficients (5%)	12	5	9	7	0	3	16	1	3
Number of sig. coefficients (1%)	7	0	1	6	0	0	10	0	1
Number of firms	525	525	443	525	525	455	522	522	436
Number in treatment group	12	12	12	3	3	3	9	9	9
Panel C: Dependent variable is CAR [0,10] (Base sample)									
Geithner Connections	0.138 ***	0.124 **	0.124 ***	0.130	0.151	0.151 *	0.136 ***	0.117 **	0.117 **
Confidence interval (2.5%)		-0.110	-0.103		-0.198	-0.180		-0.115	-0.105
Confidence interval (97.5%)		0.089	0.072		0.229	0.181		0.099	0.093
Number of sig. coefficients (10%)	35	21	32	11	13	19	46	15	19
Number of sig. coefficients (5%)	29	13	14	8	8	11	40	5	6
Number of sig. coefficients (1%)	10	3	3	2	1	1	26	0	1
Number of firms	525	525	443	525	525	455	522	522	436
Number in treatment group	12	12	12	3	3	3	9	9	9

Table 2.6: Connections to Geithner and Reactions to Treasury Secretary Announcement, Synthetic Matching Estimation - Robustness Checks

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) surrounding the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. OLS estimates as well as synthetic matching estimates are reported. Event day 0 is defined as November 21, 2008, and returns on that day are measured from 3pm to market closing. The announcement was officiallymade on event day 1. In all panels the dependent variable is CAR[0,1], and the base sample (excluding firms with returns highly correlated to Citigroup) is used. In Panel A, the estimation window is the most severe phase of financial crisis, from September 2008 through mid-October 2008. "Geithner Connections" is a dummy variable equal to one if the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed. "Highly connected" indicates more than two meetings with Geithner, and "Mildly connected" indicates one or two meetings. In Panel B, personal connections are as compiled from muckety.com, and highly connected means having more than one connection with Geithner while mildlyconnected means having one connection. In Panel C, New York connections are defined as having headquarters in New York. In Panel D, only schedule connections from 2007 are counted as connections. For OLS results basic control variables (not reported) are measured as of year-end 2008; size is the log of total assets, profitabilityis return on equity, and leverage is total debt to total capital. For matching estimators the matching window is the 250 days ending 30 days before the Geithner nomination announcement. Confidence intervals for hypothesis testing of the effect of Geithner connections being equal to zero are computed according to 1,000 placebo simulations. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All Geithner connections			*Highly connected*			*Mildly connected*		
	OLS	*Matching*	*Corrected*	*OLS*	*Matching*	*Corrected*	*OLS*	*Matching*	*Corrected*
					Dependent variable is CAR [0,1]				
Panel A: Financial Crisis estimation window, Schedule connections									
Geithner Connections	0.073 ***	0.071 *	0.071 *	0.171 ***	0.181 **	0.181 **	0.041 **	0.042	0.042
Confidence interval (2.5%)		-0.065	-0.067		-0.121	-0.127		-0.079	-0.075
Confidence interval (97.5%)		0.053	0.053		0.114	0.139		0.079	0.061
Number of firms	525	525	479	525	525	492	522	522	478
Number in treatment group	12	12	12	3	3	3	9	9	9
Panel B: Personal connections									
Geithner Connections	0.067 ***	0.030 *	0.030 *	0.115 ***	0.096 **	0.096 **	0.038	-0.009	-0.009
Confidence interval (2.5%)		-0.086	-0.077		-0.121	-0.133		-0.107	-0.098
Confidence interval (97.5%)		0.039	0.047		0.096	0.095		0.070	0.065
Number of firms	525	525	501	525	525	511	522	525	493
Number in treatment group	8	8	8	3	3	3	5	5	5
Panel C: New York connections									
Geithner Connections	0.013	0.010 **	0.010 ***						
Confidence interval (2.5%)		-0.053	-0.053						
Confidence interval (97.5%)		0.007	0.005						
Number of firms	525	525	508						
Number in treatment group	34	34	34						
Panel D: 2007 Schedule									
Geithner Connections	0.063	0.058 **	0.058 **	0.050	0.120 **	0.120 **	0.074 **	-0.001	-0.009
Confidence interval (2.5%)		-0.098	-0.094		-0.123	-0.124		-0.131	-0.098
Confidence interval (97.5%)		0.052	0.043		0.099	0.079		0.094	0.065
Number of firms	525	525	392	525	525	398	522	522	493
Number in treatment group	6	6	6	3	3	3	3	3	3

Table 2.7: Connections to Geithner and Returns Prior to Treasury Secretary Announcement

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) prior to the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. Synthetic matching estimates are reported. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and returns on that day are measured from the market opening to 3pm. The CAR is measured from event day -1 to event day 0, day -5 to day 0, or day-10 to day 0 as indicated. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. The base sample excludes firms with returns highly correlated to Citigroup. Schedule connections indicate whether the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed; personal connections are as compiled from muckety.com; and New York connections are defined as firms having headquarters in New York City. "Highly connected" indicates more than two meetings with Geithner, and "Mildly connected" indicates one or two meetings. The 95% confidence interval (generated from 5,000 simulations) is reported. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)
	All Conn.	*Highly Conn.*	*Mildly Conn.*	*All Conn.*	
		Schedule		*Personal*	*New York*
Panel A: Dependent variable is CAR[-1,0]					
Geithner Connections	-0.016	-0.039	-0.010	-0.015	-0.015
Confidence interval (2.5%)	-0.050	-0.118	-0.061	-0.067	-0.029
Confidence interval (97.5%)	0.044	0.101	0.051	0.052	0.024
Number of firms	525	525	522	525	525
Number in treatment group	12	3	9	8	34
Panel B: Dependent variable is CAR[-5,0]					
Geithner Connections	-0.052	-0.049	-0.053	-0.034	-0.0155
Confidence interval (2.5%)	-0.064	-0.186	-0.079	-0.086	-0.0279
Confidence interval (97.5%)	0.079	0.148	0.084	0.086	0.0511
Number of firms	525	525	522	525	525
Number in treatment group	12	3	9	8	34
Panel C: Dependent variable is CAR[-10,0]					
Geithner Connections	-0.064	-0.027	-0.075	-0.080	-0.045 *
Confidence interval (2.5%)	-0.097	-0.238	-0.111	-0.121	-0.047
Confidence interval (97.5%)	0.087	0.172	0.103	0.103	0.054
Number of firms	525	525	522	525	525
Number in treatment group	12	3	9	8	34

Table 2.8: Connections to Geithner and Reactions to Treasury Secretary Announcement, CDS Spreads

The table reports coefficient estimates of regressions of percent changes in CDS spreads surrounding the announcement of Geithner as treasury secretary on measures of connections to Geithner and control variables. CDS spreads are on 5-year $US-denominated contracts. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, but due to a lack of liquidity and a lack of intraday quotes, the changes are measured beginning on day 1, when the announcement was officially made. The % change in CDS spread is measured as day 1 only, or from day 1 to day 10, as indicated. Schedule connections are the number of times the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed; personal connections are as compiled from muckety.com; and New York connections are defined as firms having headquarters in New York City. For OLS results basic control variables (not reported) are measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. For matching estimators the matching window is the 100 days ending 30 days before the Geithner nomination announcement. Robust standard errors, adjusted for pre-event correlations between firms, are below coefficients in parentheses, and asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Panel A: OLS estimates												
	Dependent variable is % change in CDS spread [1]						*Dependent variable is % change in CDS spread [1,10]*					
	Citigroup included			*Citigroup excluded*			*Citigroup included*			*Citigroup excluded*		
	Schedule	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*
Geithner Connections	-0.013 ***	-0.037 ***	-0.127 **	-0.009	-0.020	-0.073	-0.012	-0.037	-0.226	-0.010	-0.025	-0.189
	(0.003)	(0.010)	(0.056)	(0.006)	(0.013)	(0.058)	(0.009)	(0.035)	(0.054)	(0.023)	(0.013)	(0.189)
Number of firms	27	27	27	26	26	26	27	27	27	26	26	26
R-squared	0.917	0.776	0.512	0.683	0.774	0.627	0.541	0.526	0.605	0.274	0.321	0.530
Panel B: Synthetic matching estimates												
	Dependent variable is % change in CDS spread [1]						*Dependent variable is % change in CDS spread [1,10]*					
	Citigroup included			*Citigroup excluded*			*Citigroup included*			*Citigroup excluded*		
	Schedule	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*
Geithner Connections	-0.090 ***	-0.024 **	-0.115 ***	-0.036 ***	-0.004 **	-0.046 ***	-0.043	-0.122 ***	-0.213 ***	0.015	-0.100 ***	-0.158 ***
Confidence interval (2.5%)	-0.010	-0.001	-0.012	-0.012	-0.001	-0.020	-0.064	-0.021	-0.069	-0.072	-0.023	-0.071
Confidence interval (97.5%)	0.008	0.000	0.008	0.013	0.000	0.010	0.026	0.000	0.042	0.043	0.001	0.065
Number of firms	27	27	27	26	26	26	27	27	27	26	26	26
Number in treatment group	7	11	6	6	10	5	7	11	6	6	10	5

Table 2.9: Connections to Other Treasury Secretary Candidates and Reactions to Treasury Secretary Announcement

The table reports coefficient estimates of regressions of cumulative abnormal stock returns (CARs) and percent changes in CDS spreads surrounding the announcement of Geithner as treasury secretary on measures of connections to treasury secretary candidates and control variables. Estimates for the full sample (excluding Citigroup in CAR results) are reported. Event day 0 is defined as November 21, 2008, when the pending announcement was leaked late in the trading day, and stock returns on that day are measured from 3pm to market closing. The announcement was officially made on event day 1. In Columns 1 to 5, the CAR is measured from day 0 to day 1, and in Columns 6 to 9, the percent change in CDS spreads are measured for day 1. Abnormal stock returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. Connections are the number of connections to each firm for Geithner or other candidates as compiled from muckety.com. Control variables (included but not reported) are measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. Robust standard errors, adjusted for pre-event correlations between firms, are below coefficients in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent variable is CAR [0,1]					*Dependent variable is % change in CDS spread [1]*			
Geithner Connections	0.030 ***	0.026 ***	0.026 ***	0.034 ***	0.030 ***	-0.037 ***	-0.045 **	-0.047 ***	-0.061 ***
	(0.007)	(0.007)	(0.007)	(0.011)	(0.007)	(0.010)	(0.013)	(0.012)	(0.011)
Summers Connections		0.006					0.015		
		(0.013)					(0.015)		
Corzine Connections			0.028 *					0.090 ***	
			(0.017)					(0.028)	
Volcker Connections				-0.006					0.047 ***
				(0.013)					(0.016)
Bair Connections					-0.040				
					(0.034)				
Number of firms	582	582	582	582	582	27	27	27	27
R-squared	0.037	0.037	0.038	0.037	0.037	0.774	0.781	0.849	0.850

Table 2.10: Connections to Geithner and Stock Price Reactions to Tax Problems

The table presents returns of stocks of financial firms around the announcement of Timothy Geithner's tax errors and delayed confirmation hearing. Event day 0 is defined as January 14, 2009; the tax problems were disclosed by the Senate Finance Committee on January 13, 2009 after the market closed on that day. The base sample excludes firms with returns highly correlated to Citigroup or Bank of America. Panels A and C present actual returns and Panels B and D present cumulative abnormal returns. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to Event Day 0. Schedule connections indicate that the firm was on Geithner's schedule during his tenure as president of the New York Fed, personal connections are as compiled from muckety.com, and New York connections are defined as firms having headquarters in New York City. Asterisks denote significance level of a two-tailed t-test (***=1%, **=5%, *=10%).

Panel A: Actual Returns, Base sample

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	1/14/2009	-0.054	-0.029	-0.025	-0.053	-0.029	-0.024	-0.054	-0.028	-0.027 **
1	1/15/2009	-0.008	0.000	-0.009	-0.024	0.001	-0.025	0.020	-0.001	0.021 **
2	1/16/2009	0.005	-0.002	0.007	-0.011	-0.002	-0.009	-0.002	-0.002	0.000
3	1/19/2009	-0.119	-0.061	-0.058 **	-0.070	-0.062	-0.009	-0.076	-0.061	-0.015
0-3	(Cumulative)	-0.169	-0.090	-0.079 **	-0.145	-0.091	-0.054	-0.110	-0.090	-0.020
4	1/20/2009	0.071	0.039	0.032	0.101	0.038	0.062 **	0.085	0.036	0.049 ***

Panel B: Cumulative Abnormal Returns, Base sample

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	1/14/2009	-0.014	-0.006	-0.008	-0.008	-0.006	-0.002	-0.018	-0.006	-0.012
1	1/15/2009	-0.024	-0.007	-0.018	-0.034	-0.007	-0.028	0.000	-0.008	0.008
2	1/16/2009	-0.029	-0.014	-0.015	-0.056	-0.014	-0.042	-0.010	-0.015	0.005
3	1/19/2009	-0.085	-0.039	-0.046	-0.056	-0.040	-0.016	-0.028	-0.041	0.013
4	1/20/2009	-0.066	-0.030	-0.037	-0.014	-0.031	0.017	0.009	-0.034	0.043 **

Panel C: Actual Returns, Full sample

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	1/14/2009	-0.058	-0.032	-0.026 **	-0.063	-0.032	-0.031 **	-0.059	-0.031	-0.028 ***
1	1/15/2009	-0.026	-0.003	-0.023 *	-0.051	-0.003	-0.048 ***	0.007	-0.005	0.012
2	1/16/2009	-0.011	-0.003	-0.009	-0.031	-0.002	-0.029 **	-0.006	-0.003	-0.003
3	1/19/2009	-0.145	-0.066	-0.078 ***	-0.132	-0.067	-0.065 ***	-0.091	-0.068	-0.023 *
0-3	(Cumulative)	-0.217	-0.101	-0.116 ***	-0.243	-0.101	-0.142 ***	-0.140	-0.103	-0.037 *
4	1/20/2009	0.130	0.043	0.087 ***	0.148	0.043	0.105 ***	0.104	0.042	0.063 ***

Panel D: Cumulative Abnormal Returns, Full sample

		Schedule Connections			Personal Connections			New York Connections		
Event Day	Date	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference	Conn.	Non-Conn.	Difference
0	1/14/2009	-0.013	-0.007	-0.006	-0.015	-0.007	-0.008	-0.018	-0.006	-0.012
1	1/15/2009	-0.041	-0.011	-0.030 *	-0.068	-0.010	-0.058 ***	-0.013	-0.012	-0.001
2	1/16/2009	-0.064	-0.020	-0.044 **	-0.111	-0.018	-0.093 ***	-0.028	-0.021	-0.007
3	1/19/2009	-0.137	-0.047	-0.091 ***	-0.166	-0.046	-0.120 ***	-0.055	-0.050	-0.005
4	1/20/2009	-0.067	-0.037	-0.031	-0.083	-0.006	-0.077 *	-0.004	-0.041	0.037 **

Table 2.11: Connections to Geithner and Reactions to Tax Problems, Regression Results

The table reports coefficient estimates of regressions of cumulative abnormal returns (CARs) surrounding the announcement of Geithner's tax problems on measures of connections to Geithner and control variables. OLS estimates (Panel A) and synthetic matching estimates (Panel B) are reported. Event day 0 is defined as January 14, 2009; the tax problems were disclosed by the Senate Finance Committee on January 13, 2009 after the market closed on that day. The base sample excludes firms with returns highly correlated to Citigroup or Bank of America. In Columns 1 to 6, the CAR is measured from day 0 to day 1, and in Columns 7 to 12, the CAR is measured from day 0 to day 3. Abnormal returns are calculated using the market model with an estimation window of 250 trading days ending 30 days prior to event day 0. Schedule connections are the number of times the firm was on Geithner's schedule during 2007-08, when he was president of the New York Fed (a 0/1 indicator in Panel B); personal connections are as compiled from muckety.com; and New York connections are defined as firms having headquarters in New York City. "Highly connected" indicates more than two meetings with Geithner, and "Mildly connected" indicates one or two meetings. Control variables (not reported) are measured as of year-end 2008: size is the log of total assets, profitability is return on equity, and leverage is total debt to total capital. In Panel A, robust standard errors, adjusted for pre-event correlations between firms, are below coefficients in parentheses, and in Panel B the 95% confidence interval (generated from 5,000 simulations) is reported. Asterisks denote significance levels (***=1%, **=5%, *=10%).

Panel A: OLS estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Dependent variable is CAR [0,1]						*Dependent variable is CAR [0,3]*					
	Base sample			*Full sample*			*Base sample*			*Full sample*		
	Schedule	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*	*Schedule*	*Personal*	*New York*
Geithner Connections	-0.002	-0.011	0.012	-0.004 *	-0.008	0.010	0.002	0.003	0.026	-0.005 *	-0.010	0.022
	(0.004)	(0.011)	(0.012)	(0.002)	(0.006)	(0.012)	(0.005)	(0.016)	(0.016)	(0.003)	(0.009)	(0.018)
Number of firms	515	515	515	583	583	583	515	515	515	583	583	583
R-squared	0.021	0.022	0.022	0.076	0.072	0.070	0.092	0.092	0.095	0.178	0.176	0.176

Panel B: Synthetic matching estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Dependent variable is CAR [0,1]						*Dependent variable is CAR [0,3]*					
	Base sample			*Full sample*			*Base sample*			*Full sample*		
	All Conn.	*Highly Conn.*	*Mildly Conn.*	*All Conn.*	*Highly Conn.*	*Mildly Conn.*	*All Conn.*	*Highly Conn.*	*Mildly Conn.*	*All Conn.*	*Highly Conn.*	*Mildly Conn.*
Geithner Connections	-0.021	-0.048	-0.016	0.003	-0.027 *	0.019	-0.053 **	-0.079	-0.047 *	-0.044 ***	-0.148 ***	0.014
Confidence interval (2.5%)	-0.032	-0.108	-0.039	-0.017	-0.033	-0.027	-0.038	-0.128	-0.050	-0.019	-0.039	-0.032
Confidence interval (97.5%)	0.049	0.094	0.053	0.033	0.050	0.042	0.072	0.155	0.078	0.057	0.084	0.069
Number of firms	515	515	513	583	583	574	515	515	513	583	583	574
Number in treatment group	10	2	8	22	9	13	10	2	8	22	9	13

Table 2.12: Connections of Timothy Geithner to Financial Firms

The table lists firms to which Timothy Geithner has connections through one or more individuals. The connections are compiled from muckety.com. The connections represent either known connections between Geithner and an individual or potential connections in that Geithner and the individual are associated with the same organization.

Firm	Connected Person	Position with Firm	Connection to Geithner	Geithner's Position with Connection	Connected Person's Position with Connection
American Express	Kenneth I. Chenault	chairman & CEO	National Academy Foundation	director	director
American Express	Kenneth I. Chenault	chairman & CEO	Partnership for New York City	board member	vice chair
Bank of America	Patricia E. Mitchell	director	Council on Foreign Relations	member	member
BlackRock	James E. Rohr	director	RAND Corporation	trustee	trustee
BlackRock	John A. Thain	director	Unofficial Adviser to Geithner	NA	NA
Blackstone Group	J. Tomilson Hill	vice chairman	Council on Foreign Relations	member	director
Blackstone Group	Paul H. O'Neill	special adviser	RAND Corporation	trustee	trustee
Blackstone Group	Peter G. Peterson	chairman and co-founder	Unofficial Adviser to Geithner	NA	NA
Blackstone Group	Richard E. Salomon	adv. board chair, alt. asset mgt.	Council on Foreign Relations	member	vice chairman
Capital One	Patrick W. Gross	director	Council on Foreign Relations	member	member
Carver Bancorp	Deborah C. Wright	chairman & president & CEO	Partnership for New York City	board member	director
CIT Group	Jeffrey M. Peek	chairman & CEO	Partnership for New York City	board member	director
CIT Group	Seymour Sternberg	director	Council on Foreign Relations	member	member
CIT Group	Seymour Sternberg	director	Partnership for New York City	board member	director
Citigroup	Alain J.P. Belda	director	Partnership for New York City	board member	director
Citigroup	C. Michael Armstrong	director	Council on Foreign Relations	member	member
Citigroup	Judith Rodin	director	Council on Foreign Relations	member	member
Citigroup	Kenneth T. Derr	director	Council on Foreign Relations	member	member
Citigroup	Michael B.G. Froman	managing director	Council on Foreign Relations	member	member
Citigroup	Pamela P. Flaherty	director, corporate citizenship	Council on Foreign Relations	member	member
Citigroup	Richard D. Parsons	chairman	Partnership for New York City	board member	chair emeritus, director
Citigroup	Robert E. Rubin	director	Geithner is Protégé of Rubin	NA	NA
Citigroup	Roberto H. Ramirez	director	Federal Reserve Bank of New York	president	int'l advisory board
Fannie Mae	Herbert M. Allison Jr.	President & CEO	Economic Club of New York	trustee	trustee
Fannie Mae	Herbert M. Allison Jr.	President & CEO	Partnership for New York City	board member	director
Fortress Inv. Group	Richard N. Haass	director	Council on Foreign Relations	member	president
Franklin Resources	Anne M. Tatlock	director	Council on Foreign Relations	member	member
GAMCO Investors	Eugene R. McGrath	director	Economic Club of New York	trustee	trustee
Goldman Sachs	Ashton B. Carter	consultant	Council on Foreign Relations	member	member
Goldman Sachs	E. Gerald Corrigan	managing director	Unofficial Adviser to Geithner	NA	NA
Goldman Sachs	James A. Johnson	director	Council on Foreign Relations	member	member
Goldman Sachs	John C. Whitehead	foundation chairman	International Rescue Committee	trustee	trustee
Goldman Sachs	Lloyd C. Blankfein	chairman & CEO	Partnership for New York City	board member	director
Goldman Sachs	Robert D. Hormats	vice chairman, GS International	Economic Club of New York	trustee	trustee, vice chair
Goldman Sachs	Ruth J. Simmons	director	Council on Foreign Relations	member	member
Goldman Sachs	Stephen Friedman	director	Council on Foreign Relations	member	director
Goldman Sachs	Stephen Friedman	director	Federal Reserve Bank of New York	president	chair
JP Morgan Chase	Andrew D. Crockett	executive committee member	Group of Thirty	member	member
JP Morgan Chase	Ellen V. Futter	director	Council on Foreign Relations	member	member
JP Morgan Chase	James Dimon	chairman & CEO	Federal Reserve Bank of New York	president	director
JP Morgan Chase	James Dimon	chairman & CEO	Partnership for New York City	board member	director
JP Morgan Chase	Ratan N. Tata	international advisory board	RAND Corporation	trustee	trustee
JP Morgan Chase	William M. Daley	chairman midwest region	Council on Foreign Relations	member	member
M&T Bank	Robert G. Wilmers	chairman & CEO	Council on Foreign Relations	member	member
Morgan Stanley	Frederick B. Whittemore	partner & managing director	Council on Foreign Relations	member	trustee
Morgan Stanley	John J. Mack	chairman & CEO	Partnership for New York City	board member	director
Morgan Stanley	Philip Lader	senior adviser	RAND Corporation	trustee	trustee
NASDAQ	Robert Greifeld	president & CEO	Partnership for New York City	board member	director
NYSE	Shirley Ann Jackson	director	Council on Foreign Relations	member	director
PNC Fin. Services	James E. Rohr	chairman & CEO	RAND Corporation	trustee	trustee
Popular	Richard L. Carrion	chairman, president, & CEO	Federal Reserve Bank of New York	president	director
Wells Fargo	Donald B. Rice	director	RAND Corporation	trustee	trustee

Table 2.13: Connections of Other Treasury Secretary Candidates to Financial Firms

The table lists firms to which other treasury secretary candidates have connections through one or more individuals. The connections are compiled from muckety.com. The connections represent either known connections between the candidate and an individual or potential connections in that the candidate and the individual are associated with the same organization.

Firm	Connected Person	Position with Firm	Connection to Candidate	Candidates' Position with Connection	Connected Person's Position with
Panel A: Lawrence Summers					
BlackRock	Laurence D. Fink	chairman & CEO	Informal Adviser	NA	NA
Blackstone Group	Richard E. Salomon	adv. board chair, alt. asset mgt.	Peterson Institute for International Economics	director	director
Blackstone Group	Peter G. Peterson	chairman and co-founder	Peterson Institute for International Economics	director	chairman
Charles Schwab	Donald G. Fisher	director	Teach for America	director	director
Charles Schwab	Paula A. Sneed	director	Teach for America	director	director
Citigroup	Robert E. Rubin	director	Summers is Protégé of Rubin	NA	NA
Citigroup	Richard D. Parsons	chairman	Obama-Biden economic advisory team	member	member
Citigroup	Judith Rodin	director	Brookings Institution	trustee	honorary trustee
Citigroup	Anne M. Mulcahy	director	Obama-Biden economic advisory team	member	member
Goldman Sachs	James A. Johnson	director	Brookings Institution	trustee	honorary trustee
Goldman Sachs	John C. Whitehead	foundation chairman	Brookings Institution	trustee	honorary trustee
Goldman Sachs	Richard A. Friedman	managing director	Mount Sinai Medical Center (New York)	trustee	trustee
Goldman Sachs	Suzanne Nora Johnson	senior director	Brookings Institution	trustee	trustee
Goldman Sachs	Abby Joseph Cohen	senior investment strategist	Brookings Institution	trustee	trustee
Icahn Enterprises	Carl C. Icahn	owner	Mount Sinai Medical Center (New York)	trustee	trustee
JP Morgan Chase	George P. Shultz	chairman international council	American Corporate Partners	adv. council member	adv. council member
JP Morgan Chase	William M. Daley	chairman Midwest division	Obama-Biden economic advisory team	member	member
JP Morgan Chase	Ernesto Zedillo	int'l advisory board member	Peterson Institute for International Economics	director	director
Lazard	Vernon E. Jordan Jr.	director	Brookings Institution	trustee	honorary trustee
Morgan Stanley	Laura D'Andrea Tyson	director	Brookings Institution	trustee	trustee
Morgan Stanley	Laura D'Andrea Tyson	director	Obama-Biden economic advisory team	member	member
Morgan Stanley	Hutham S. Olayan	director	Peterson Institute for International Economics	director	director
Morgan Stanley	Laura D'Andrea Tyson	director	Peterson Institute for International Economics	director	director
NASDAQ	Glenn H. Hutchins	director	Brookings Institution	trustee	trustee
NYSE	Shirley Ann Jackson	director	Brookings Institution	trustee	trustee
Och-Ziff	David Windreich	partner	Mount Sinai Medical Center (New York)	trustee	trustee
Sallie Mae	Barry A. Munitz	director	Broad Foundations	governor	governor
VISA	Suzanne Nora Johnson	director	Brookings Institution	trustee	trustee
Panel B: Paul Volcker					
Blackstone Group	Peter G. Peterson	chairman & co-founder	Concord Coalition	director	founding president
Blackstone Group	Peter G. Peterson	chairman & co-founder	Japan Society	life director	life director
Blackstone Group	Peter G. Peterson	chairman & co-founder	Peterson Institute for International Economics	director	chairman
Blackstone Group	Richard E. Salomon	adv. board chair, alt. asset mgt.	Peterson Institute for International Economics	director	director
Capital One	Patrick W. Gross	director	Aspen Institute	lifetime trustee	trustee
CIT Group	James S. McDonald	director	Japan Society	life director	director
Citigroup	Richard D. Parsons	chairman	Obama-Biden economic advisory team	member	member
Citigroup	Robert E. Rubin	director	Concord Coalition	director	director
Citigroup	Anne M. Mulcahy	director	Obama-Biden economic advisory team	member	member
Goldman Sachs	Stephen Friedman	director	Aspen Institute	lifetime trustee	trustee
Goldman Sachs	John C. Whitehead	foundation chairman	Financial Services Volunteer Corps	honorary chairman	co-founder & chairman
Goldman Sachs	John C. Whitehead	foundation chairman	International House	chairman	honorary trustee
Goldman Sachs	Josef Joffe	foundation member	Aspen Institute	lifetime trustee	member
Goldman Sachs	E. Gerald Corrigan	managing director	Group of Thirty	chairman of the board	member
Goldman Sachs	Henry Cornell	managing director	Japan Society	life director	director
JP Morgan Chase	William M. Daley	chairman Midwest division	Obama-Biden economic advisory team	member	member
JP Morgan Chase	William H. Gray III	director	Concord Coalition	director	director
JP Morgan Chase	Andrew D. Crockett	executive committee member	Group of Thirty	chairman of the board	member
JP Morgan Chase	Ernesto Zedillo	int'l advisory board member	Peterson Institute for International Economics	director	director
Moody's	Henry A. McKinnell Jr.	director	Japan Society	life director	life director
Morgan Stanley	Laura D'Andrea Tyson	director	Obama-Biden economic advisory team	member	member
Morgan Stanley	Hutham S. Olayan	director	Peterson Institute for International Economics	director	director
Morgan Stanley	Laura D'Andrea Tyson	director	Peterson Institute for International Economics	director	director
Morgan Stanley	Frederick B. Whittemore	partner/managing director	Aspen Institute	lifetime trustee	trustee
NASDAQ	Merit E. Janow	director	Japan Society	life director	director
NYSE	James S. McDonald	director	Japan Society	life director	director
Panel C: Sheila Bair					
NYSE	Self	senior vice president (former)	NA	NA	NA
Panel D: Jon Corzine					
Bank of New York	Gerald L. Hassell	president	New York Philharmonic	director emeritus	director
Fannie Mae	Philip A. Laskawy	chairman	New York Philharmonic	director emeritus	director
Goldman Sachs	Self	chairman & CEO (former)	NA	NA	NA
Goldman Sachs	John F. W. Rogers	partner & foundation trustee	Corzine's former chief of staff	NA	NA
Lazard	Philip A. Laskawy	director	New York Philharmonic	director emeritus	director
US Bancorp	Jerry W. Levin	director	New York Philharmonic	director emeritus	director

Table 2.14: Comparison of Geithner-Connected Firms with Non-Connected Firms

The table compares firms with identifiable connections to Geithner to those with no connections. In Panel A, connected firms are those that were listed on Geithner's schedule during his tenure as president of the New York Fed. In Panel B, connected firms are those with a personal connection to Geithner as identified on muckety.com. In both panels "Base Sample" indicates whether the firm is included in our base sample (by virtue of not being highly correlated to Citigroup). CAR [0,10] is the cumulative abnormal return for the firm surrounding the announcement of Geithner as treasury secretary. Total assets are for the year 2008 from Worldscope.

Panel A: Schedule Connections

On Geithner's Schedule					Not on Geithner's Schedule (25 Largest)		
Firm	Occurrences	Base Sample	CAR [0,10]	Total Assets ($Bn)	Firm	CAR [0,10]	Total Assets ($Bn)
JP MORGAN CHASE & CO.	14	N	0.186	2,175.00	WELLS FARGO & CO	0.124	1,310.00
CITIGROUP INCO.	34	N	0.743	1,938.00	FREDDIE MAC	0.659	835.60
BANK OF AMERICA CORP.	4	N	0.168	1,818.00	US BANCORP	0.078	265.90
FANNIE MAE	1	N	1.008	908.50	SUNTRUST BANKS INCO.	0.200	189.10
THE GOLDMAN SACHS GPIN.	10	N	0.192	876.20	SLM CORP.	0.064	168.80
MORGAN STANLEY	9	N	0.224	658.80	CAPITAL ONE FINL.CORP.	-0.053	165.90
PNC FINL.SVS.GP.INCO.	3	N	0.044	291.10	BB&T CORP.	-0.131	152.00
BANK OF NY.MELLON CORP.	7	Y	-0.095	237.50	REGIONS FINL.CORP.	-0.206	146.20
STATE STREET CORP.	1	Y	0.091	173.60	FIFTH THIRD BANCORP	-0.232	119.50
AMERICAN EXPRESS CO.	2	N	0.029	122.60	KEYCORP	0.062	104.50
NORTHERN TRUST CORP.	1	Y	0.117	82.05	AMERIPRISE FINL.INCO.	0.297	94.67
CME GROUP INCO.	2	Y	0.010	48.16	CIT GROUP INCO.	0.500	80.45
NY.CMTY.BANC.INCO.	2	N	-0.078	32.33	COMERICA INCO.	0.037	67.55
ASTORIA FINL.CORP.	2	N	-0.132	21.98	M&T BK.CORP.	-0.045	65.82
BLACKROCK INCO.	13	Y	0.082	19.91	MARSHALL & ILSLEY CORP.	-0.300	62.34
NYSE EURONEXT	2	N	0.089	13.28	ZIONS BANCORPORATION	-0.255	54.61
THE NASDAQ OMX GP.INCO.	2	Y	0.212	12.05	HUNTINGTON BCSH.INCO.	-0.073	54.35
THE BLACKSTONE GROUP LP.	6	Y	0.345	8.41	HUDSON CITY BANC.INCO.	-0.231	54.09
PROVIDENT FINL.SVS.INCO.	2	Y	-0.145	6.51	CHARLES SCHWAB CORP.	-0.141	51.17
LAZARD LTD.	1	Y	0.126	2.79	MF GLOBAL LTD.	-0.180	49.18
MOODY'S CORP.	2	N	0.114	1.55	E*TRADE FINANCIAL CORP.	0.051	47.50
OCH-ZIFF CAP.MAN.GP.LLC.	1	N	0.107	1.02	DISCOVER FINANCIAL SVS.	0.122	39.20
BEACON FED.BANC.INCORP.	1	Y	0.039	1.02	POPULAR INCO.	-0.194	38.53
FEDERATED INVRS.INCO.	1	Y	0.065	0.85	SYNOVUS FINL.CORP.	-0.031	35.62
EVERCORE PARTNERS INCO.	1	Y	0.485	0.68	FIRST HORIZON NAT. CORP.	-0.124	31.02

Panel B: Personal Connections

Personal Connection to Geithner					No Personal Connection (21 Largest)		
Firm	Connections	Base Sample	CAR [0,10]	Total Assets ($Bn)	Firm	CAR [0,10]	Total Assets ($Bn)
JP MORGAN CHASE & CO.	5	N	0.186	2,175.00	FREDDIE MAC	0.659	835.60
CITIGROUP INCO.	9	N	0.743	1,938.00	US BANCORP	0.078	265.90
BANK OF AMERICA CORP.	1	N	0.168	1,818.00	BANK OF NY.MELLON CORP.	-0.095	237.50
WELLS FARGO & CO	1	N	0.124	1,310.00	SUNTRUST BANKS INCO.	0.200	189.10
FANNIE MAE	1	N	1.008	908.50	STATE STREET CORP.	0.091	173.60
THE GOLDMAN SACHS GPIN.	8	N	0.192	876.20	SLM CORP.	0.064	168.80
MORGAN STANLEY	3	N	0.224	658.80	BB&T CORP.	-0.131	152.00
PNC FINL.SVS.GP.INCO.	1	N	0.044	291.10	REGIONS FINL.CORP.	-0.206	146.20
CAPITAL ONE FINL.CORP.	1	N	-0.053	165.90	FIFTH THIRD BANCORP	-0.232	119.50
AMERICAN EXPRESS CO.	1	N	0.029	122.60	KEYCORP	0.062	104.50
CIT GROUP INCO.	2	Y	0.500	80.45	AMERIPRISE FINL.INCO.	0.297	94.67
M&T BK.CORP.	1	N	-0.045	65.82	NORTHERN TRUST CORP.	0.117	82.05
POPULAR INCO.	1	Y	-0.194	38.53	COMERICA INCO.	0.037	67.55
BLACKROCK INCO.	2	Y	0.082	19.91	MARSHALL & ILSLEY CORP.	-0.300	62.34
NYSE EURONEXT	1	N	0.089	13.28	ZIONS BANCORPORATION	-0.255	54.61
THE NASDAQ OMX GP.INCO.	1	Y	0.212	12.05	HUNTINGTON BCSH.INCO.	-0.073	54.35
FRANKLIN RESOURCES INCO.	1	N	0.046	9.18	HUDSON CITY BANC.INCO.	-0.231	54.09
THE BLACKSTONE GROUP LP.	4	Y	0.345	8.41	CHARLES SCHWAB CORP.	-0.141	51.17
FORTRESS INV.GP.LLC.	1	Y	-0.131	1.17	MF GLOBAL LTD.	-0.180	49.18
CARVER BANCORP INCO.	1	Y	-0.116	0.79	CME GROUP INCO.	0.010	48.16
GAMCO INVESTORS INCO.	1	Y	-0.147	0.67	E*TRADE FINANCIAL CORP.	0.051	47.50

Table 2.15: Comparison of New York Firms to Non-New York Firms

The table compares firms in the sample headquartered in New York City with firms in the sample headquartered elsewhere. CAR [0,10] is the cumulative abnormal return for the firm surrounding the announcement of Geithner as treasury secretary. Total assets are for the year 2008 from Worldscope.

New York				Non-New York (Largest 45)		
Firm	Base Sample	CAR [0,10]	Total Assets ($Bn)	Firm	CAR [0,10]	Total Assets ($Bn)
JP MORGAN CHASE & CO.	N	0.186	2,175.00	BANK OF AMERICA CORP.	0.168	1,818.00
CITIGROUP INCO.	N	0.743	1,938.00	WELLS FARGO & CO	0.124	1,310.00
THE GOLDMAN SACHS GPIN.	N	0.192	876.20	FANNIE MAE	1.008	908.50
MORGAN STANLEY	N	0.224	658.80	FREDDIE MAC	0.659	835.60
BANK OF NY.MELLON CORP.	Y	-0.095	237.50	PNC FINL.SVS.GP.INCO.	0.044	291.10
AMERICAN EXPRESS CO.	N	0.029	122.60	US BANCORP	0.078	265.90
CIT GROUP INCO.	Y	0.500	80.45	SUNTRUST BANKS INCO.	0.200	189.10
E*TRADE FINANCIAL CORP.	Y	0.051	47.50	STATE STREET CORP.	0.091	173.60
BLACKROCK INCO.	Y	0.082	19.91	SLM CORP.	0.064	168.80
JEFFERIES GP.INCO.	N	0.071	19.60	CAPITAL ONE FINL.CORP.	-0.053	165.90
ICAHN ENTERPRISES LP.	Y	0.764	18.82	BB&T CORP.	-0.131	152.00
NYSE EURONEXT	N	0.089	13.28	REGIONS FINL.CORP.	-0.206	146.20
THE NASDAQ OMX GP.INCO.	Y	0.212	12.05	FIFTH THIRD BANCORP	-0.232	119.50
THE BLACKSTONE GROUP LP.	Y	0.345	8.41	KEYCORP	0.062	104.50
SIGNATURE BK.	Y	-0.064	7.11	AMERIPRISE FINL.INCO.	0.297	94.67
LABRANCHE & CO.INCO.	Y	0.127	3.73	NORTHERN TRUST CORP.	0.117	82.05
INTERVEST BCSH.CORP.	Y	-0.259	2.26	COMERICA INCO.	0.037	67.55
STERLING BANC.	Y	-0.137	2.19	M&T BK.CORP.	-0.045	65.82
FINL.FED.CORP.	Y	0.277	1.94	MARSHALL & ILSLEY CORP.	-0.300	62.34
INV.TECH.GP.	Y	0.164	1.68	ZIONS BANCORPORATION	-0.255	54.61
ALLBERN.HLDG.LP.	Y	0.401	1.60	HUNTINGTON BCSH.INCO.	-0.073	54.35
MOODY'S CORP.	Y	0.114	1.55	HUDSON CITY BANC.INCO.	-0.231	54.09
NAT.FINL.PTNS.CORP.	Y	0.989	1.52	CHARLES SCHWAB CORP.	-0.141	51.17
FORTRESS INV.GP.LLC.	Y	-0.131	1.17	MF GLOBAL LTD.	-0.180	49.18
GFI GROUP INCO.	Y	-0.278	1.09	CME GROUP INCO.	0.010	48.16
BGC PARTNERS INCO.	Y	0.328	1.07	DISCOVER FINANCIAL SVS.	0.122	39.20
OCH-ZIFF CAP.MAN.GP.LLC.	Y	0.107	1.02	POPULAR INCO.	-0.194	38.53
MSCI INCO.	Y	0.090	1.02	SYNOVUS FINL.CORP.	-0.031	35.62
BERKSHIRE BANCORP INCO.	Y	-0.190	0.91	NY.CMTY.BANC.INCO.	-0.078	32.33
CARVER BANCORP INCO.	Y	-0.116	0.79	FIRST HORIZON NAT.CORP.	-0.124	31.02
BROADPOINT SECS.GP.INCO.	Y	0.204	0.69	THE STUDENT LN.CORP.	0.321	28.14
EVERCORE PARTNERS INCO.	Y	0.485	0.68	INTACT.BCK.GP.INCORP.	0.073	28.00
MEDALLION FINL.CORP.	Y	0.146	0.65	THE COLO.BANCGROUP INCO.	0.020	25.50
KBW INCO.	Y	-0.382	0.57	ASSOCIATED BANC-CORP	-0.056	24.19
GLG PARTNERS INCO.	Y	-0.012	0.49	BOK FINL.CORP.	-0.065	22.73
DUFF & PHELPS CORP.	Y	0.438	0.35	ASTORIA FINL.CORP.	-0.132	21.98
COHEN & STEERS INCO.	Y	0.204	0.28	RAYMOND JAMES FINL.INCO.	-0.020	20.62
GREENHILL & CO.INCO.	Y	-0.064	0.23	PEOPLES UTD.FINL.INCO.	-0.174	20.17
MARKETAXESS HDG.INCO.	Y	0.040	0.21	FIRST BANC.	-0.093	19.49
COWEN GROUP INCORPORATED	Y	0.057	0.20	CAPITALSOURCE INCO.	0.135	18.41
CMS BANCORP INCO.	Y	0.100	0.20	COMMERCE BCSH.INCO.	-0.106	17.53
PZENA INV.MAN.INCO.	Y	-0.151	0.06	WEBSTER FINL.CORP.	0.067	17.39
EPOCH HOLDING CORP.	Y	0.030	0.05	FIRST CTZN.BCSH.INCO.	-0.053	16.75
RODMAN & RENSHAW CAP.GP.	Y	0.217	0.05	TCF FINANCIAL CORP.	-0.026	16.74
SIEBERT FINANCIAL CORP.	Y	-0.031	0.04	AMERICREDIT CORP.	0.363	16.23

Chapter 3

Does Skin-in-the-Game Affect Security Performance? Evidence from the Conduit CMBS Market

With Adam Ashcraft and Kunal Gooriah

3.1 Introduction

One of responses by Congress to the collapse of securities markets during the recent financial crisis was Section 941 of the Dodd Frank Act, which instructs regulatory agencies to require the sponsor of new issue securitization transactions to retain at least five percent of the credit risk of those securities. The purpose of requiring the sponsor to retain risk from the transaction, hereafter referred to as risk retention, is to ensure adequate skin-in-th-game, which aligns the incentives of the sponsor with those of a balance sheet lender. In principle, meaningful sponsor risk retention has the potential to improve the underwriting of loans sold into the securitization transaction, leading to less procyclicality in credit markets and more predictable performance of securities.

Why should the sponsor of a securitization transaction have different incentives than those of a balance sheet lender? One explanation, described by Adrian and Ashcraft (2012), is that when investors provide risk-insensitive debt funding to the sponsor, limited liability of the sponsor creates well-known incentives for risk-shifting, especially when not offset by franchise value.[1,2] These incentives to increase asset risk

[1]Rajan (2005) provides on explanation for why investors would provide risk-insensitive debt funding. He focuses on the compensation structure of the asset management industry, which combines limited liability with peer evaluation, which together creates incentives for herding and excessive risk-taking.

[2]As an example, Keeley (1990) documents evidence that the de-regulation of banks in the 1970s eroded their franchise value, which consequently lead to increases in asset risk and leverage.

and leverage are manifested though weaker loan underwriting and a push to reduce credit enhancement levels through ratings shopping. This hypothesis is based on growing circumstantial empirical support in the academic literature. See Adelino (2009), Ashcraft et. al. (2011), Ashcraft et. al. (2010), Stanton and Wallace (2011) for evidence that investors and rating agencies are inadequately risk-sensitive.[3] See Cohen (2011) or Giffin and Tang (2012) for evidence of successful ratings shopping.[4]See Keys et al. (2010), Loutskina and Strahan (2000), Purnanandam (2010), and Demiroglu and James for evidence that the originate-to-distribute form of securitization affects loan underwriting and performance.[5]

While the above literature provides evidence that the frictions which would make risk retention important appear to exist, the literature lacks direct evidence that retention itself is significant. The purpose of this paper is to fill this gap in the literature by identifying and measuring the impact of risk retention on performance.

In order to do this, we focus on the conduit commercial mortgage backed securities (CMBS) market in order to exploit measurable variation in the amount of risk retained. As described below, this market is unique in that the bottom five percent of the capital structure is sold to a sophisticated investor known as a B-piece buyer who re-underwrites all of the loans in the underlying pool. Consequently, there is no adverse information problem between the sponsor and the B-piece investor, and senior investors can free ride off of this investor's screening activities at issue. Historically, B-piece investors funded their positions with equity and minimal leverage. However, the development of the commercial real estate collateralized debt obligation (CRE CDO) market in the early 2000s created a new funding strategy for B-piece investors.[6] In particular, the risk-insensitive provision of funding by the CRE CDO market created the incentives for

[3] Adelino (2009) documents that while the junior tranches of residential mortgage backed securities (RMBS) tranches were sensitive to ex ante measures of risk, the senior AAA-rated tranches were not. Ashcraft et. al. (2011) investigate further, documenting that while the junior tranches of RMBS deals were sensitive to risk, they were too sensitive to credit ratings (measured by the amount of credit enhancement) relative to the information about future performance. Ashcraft et. al. (2010) document that the credit enhancement of subprime and Alt-A RMBS deals fell in ex ante risk-adjusted terms throughout the boom. In the market for commercial mortgage backed securities, Stanton and Wallace (2010) provide evidence of continuous decline in subordination levels from 2001 to 2006 despite no significant change in the quality of underlying assets, consistent with market pressure on rating agencies. Titman and Tsyplakov (2010) find that commercial mortgages that are originated by institutions with large negative stock returns in the quarters prior to the origination date tend to have higher credit spreads and default more than other mortgages with similar observable characteristics. Focusing on the period before 2003, they find that rating agencies reacted by requiring higher level of subordination for deals with higher share of underperforming originators.

[4] Cohen (2011) documents that a sponsor which hired a rating agency is had not used recently in the CMBS market could reduce required credit enhancement levels by 100 bps. Griffin and Tang (2012) used an internal model of a top credit rating agency and show the rating agency on average gave 12 percent more AAA rating to CDO deals than the output of the rating agency own model. Moreover they show CDOs with smaller model-implied AAA sizes receive larger adjustments. In the market for RMBS, Ashcraft et al. (2010) document a progressive decline in credit rating agencies standards around the peak of the market for residential mortgage backed securities and show the problem is more severe for deals with a higher fraction of opaque low-documentation loans. He et al. (2012) show large issuers in RMBS market received relatively better ratings for their deals however the market reacted partially to these inflated ratings by asking a higher initial yield for securitized assets issued by large issuers.

[5] Keys et al. (2010), Loutskina and Strahan (2000) and Purnanandam (2010) document lower performance of loans that were issued for "originate-to-distribute" and argue that loan sales lowered incentive of loan originators in ex ante screening of applicants. Demiroglu and James (2012) find that ex post loss and foreclosure rates are significantly higher for RMBS in which originators are not affiliated with the sponsor or servicer and argue this is caused by unaffiliated originators having less "skin in the game". However Bubb and Kaufman (2009) and Kermani (2013) question some of these findings and show that lower performance of these loans can be part of market structure as opposed to evidence of moral hazard.

[6] Barnett-Hart (2009) and Cordell et al. (2011) gathered data on the underlying assets of CDOs and provide a comprehensive description of type of assets that went into CDOs. Both of these studies find a central role played by CDO deal underwriters in determining the performance of CDO deals. Coval et al. (2009) indicates extreme fragility of CDOs not only to the assumptions about the performance of underlying assets but also the estimation of the correlation of underlying assets (or systemic risk).

greater risk and leverage alluded to above, and is thus the ideal source of variation to study the importance of skin-in-the-game for security performance.[7]

In this paper, we exploit variation in the amount of retention over time and across B-piece investors as measured by the amount sold to the CRE CDO market in order to measure the impact on the conduit CMBS market. The results are not surprising. In particular, we document that after controlling for all information available at issue, including market pricing, rating agency credit enhancement levels, and other deal characteristics, the percent of the B-piece sold to CRE CDOs has a significant adverse impact on the probability that more senior tranches ultimately default. The result is robust to alternative specifications, including dealer or B-piece buyer fixed effects. Moreover, the result is robust to the use of an instrumental variables strategy which relies on the greater ability of larger B-piece buyers to create CRE CDOs given the need for large pools of collateral. The paper is organized as follows. The next section describes CMBS securitization process and the role of B-piece buyers in this market. Section 3 describes our data sources and trends in the CMBS and CRE CDO market. Our main empirical analysis result is presented in section 4. Section 5 present some additional robustness checks and section 6 concludes.

3.2 CMBS Market and the Role of B-Piece Buyers

In the early 1990s, the Resolution Trust Company (RTC) gave rise to the CMBS market by issuing the first CMBS deal collateralized by the commercial real estate loans of failed savings and loan institutions. The RTC issued subsequent deals with simple, largely overcollateralized structures, where equity pieces were retained by the RTC. By the time the RTC wound down the assets it inherited, sufficient investor demand for CMBS had built to the extent that investment banks began engaging in commercial mortgage origination practices to securitize pools and issue CMBS deals.

The process of accumulating mortgages and issuing a CMBS deal is an intricate one involving several parties. Borrowers of commercial loans submit financial and property information to an originating banker, who initiates the underwriting process and assesses the amount of debt that can be sustained by the property. Thereafter, terms of the loan are agreed upon by both parties and the mortgage is originated. The CMBS issuer accumulates many of these mortgages and sells them into a trust called a REMIC.[8] Loans sold into the REMIC aim at satisfying several attributes of the total pool. These attributes can range from the total size of all loans and their geographic distribution to the risk measures of the mortgages.[9] By creating a pool of loans that is diversified and backed by properties generating sustainable cash flow, the originating

[7]Faltin-Traeger and Mayer (2011) provide evidence that CDO originators successfully sold securities and insurance against the worst performing securitized assets and show that even after controlling for the asset characteristics, CDO assets performed much worse than comparable securities that were not included in a CDO. Beltran et al. (2013) shed light on type of information asymmetries in asset backed securities CDOs and explain how these information asymmetries can account for the collapse of the CDO market.

[8]REMICs (Real Estate Mortgage Investment Conduit) are static pools of loans that are intended to be securitized and sold to investors as mortgage-backed securities.

[9]More concentrated pools to a geographic location require extra subordination for AAA tranches. Similarly, unfavorable risk measures such as high LTV's and low DSCR's also require extra subordination.

banker seeks to minimize the subordination of AAA tranches within the CMBS securitization. Financial reports and underwriting results of the pool are passed to the rating agencies that assign ratings and levels of subordination to the CMBS waterfall structure. The pool is then securitized and a CMBS deal is issued and sold to investors.

At the very bottom of the securitization is the first loss piece, known as the B-piece, which receives a higher coupon than all other tranches in the securitization. The tradeoff is the higher risk associated with absorbing the initial losses that pass through from defaults in the underlying pool. Prior to the issuance of the CMBS deal, the B-piece is auctioned off to investors, typically those who command real estate expertise or a high risk appetite. Bids are submitted and the winning bidder gains control of the pool underlying the deal. The winning B-piece buyer then has two to six weeks to perform the necessary due diligence. This typically entails underwriting the majority (if not all, which can amount to more than 100 loans) of the loans as well as physical inspection of the underlying properties. Upon completion of the due diligence process, the first loss buyer can decide whether or not to kick out particular loans within the pool.

The B-piece buyers are thought to be investors who have their "skin in the game". Typically, these buyers are the final underwriters of the mortgages before a CMBS deal is issued. In the 1990's and early 2000's, they represented a class of experts in the real estate market with extensive experience in property valuation and management. B-piece buyers were essential for the market to trust the quality of the underlying mortgage assets. During this period, buyers would sometimes kick out 10% of the collateral pool as they believed the fair value of these mortgages was less than the original price.[10] For undergoing the painstaking due diligence involved in assessing the value of the trust, buyers of the B-piece were rewarded with returns as high as 28% up until the early 2000s.

Since the B-piece is the most information sensitive tranche in the CMBS waterfall, historically B-piece buyers were unable to sell their positions to the market and kept their B-piece investments on their own balance sheet. However, development of commercial real estate CDO (CRE CDO) market in the early 2000s enabled large B-piece buyers to pool their B-piece positions in a deal and issue safe assets that were more liquid.[11] This development combined with generous ratings given to CDOs by rating agencies provided a relatively risk-insensitive source of funding for B-piece buyers, enabling them to have greater leverage and less risk retention in their B-piece positions.

3.3 Data Sources and Trends in CMBS and CRE CDO Markets

The primary source of data for this study is Intex. From Intex we identified the universe of CMBS deals that are classified as Conduit or Fusion deals (666 deals). In order to avoid problems with possible misclassification of deals, we eliminated deals with less than 30 loans (30 deals), deals consisting of only mezzanine loans (3

[10]Some of the most conservative players would kick out as high as 20% of the collateral pool for a particular deal. Alternatively, it was not uncommon for 0% of the collateral pool to be kicked out if the mortgage underwriting was found to be of high quality.

[11]DeMarzo (2005) provide the theoretical justification on how the process of pooling and tranching can produce safe assets that are less subject to information asymmetries.

deals), deals with no B-piece (49 deals) and deals with no BBB tranche (7 deals). Deals with more than 50 percent of collateral in Canada (42 deals) were also eliminated.[12] . Figure 3.1 shows the annual issuance of CMBS conduit/fusion deals in our database that satisfy these criteria. As Figure 3.1 shows, CMBS conduit/fusion annual issuance experienced fast growth between the years 2002 and 2007 and reached 200 billion dollars in annual issuance by 2007 before plummeting to only 10 billion dollars in 2008 and a complete collapse of the market by 2009. The pattern that is hardly different from other asset classes of non-agency structured products. Finally, for the main analysis we eliminated deals that were issued before 1997 (19 deals) or after 2007 (32).[13] This left us with 483 conduit or fusion CMBS deals.

Perhaps one of the factors that contributed to the fast growth of CMBS as a source of financing for commercial real estate loans has been generous ratings given to these deals by rating agencies (see Stanton and Wallace (2010) for a detailed discussion of inflated ratings in CMBS market). As Figure 3.2 shows, the average subordination levels below the BBB tranche of CMBS deals declined from more than 13 percent in 1996 to about 3 percent by 2006 before rating agencies reconsidered their models and their assumption about the probabilities of default of the underlying assets.

However it should be mentioned that despite this fast decline in subordination levels, as Figure 3.2 shows during the period of 2000 to 2005, Spread for BBB tranches, defined as the difference between the coupon rate of the BBB bonds and 10 year T-Notes[14] at issuance date, declined by more than 100 basis points. This suggests that perhaps markets were even more optimistic about the performance of these securitized assets than rating agencies.

In order to control for the characteristics of CMBS deals, we also collected data on the underlying collateral of these conduit/fusion CMBS deals and for each deal we constructed deal loan to value (LTV) and deal spread as the weighted averages of the loan to value ratio at origination and the weighted average of underlying commercial loans spread at origination, weighted by loans size.[15]

Figure 3.3 shows that during the period of 2001 to 2005 underlying commercial loans' spread rates also declined by more than 100 basis points.[16] Looking at LTV shows that overall loan to value ratios of underlying commercial loans did not change as much as the increase for loans underlying non-agency residential mortgage backed securities.[17] However, it is worth noting that there was significant commercial property price appreciation over this period. So while LTVs were stable, debt yields, defined as the ratio of

[12]Inclusion of Canadian deals makes all of our results more significant. However we want to minimize the bias due to possible differences in institutions and the state of the economy.

[13]The data for underlying collateral of deals that were issued before 1997 is less reliable than deals that were issued from 1997 afterward. All the results are robust to inclusion of deals that were issued from 2008 afterward. However one may be concerned that deals that were issued during and after the financial crisis have very different characteristics with different type of institutions.

[14]This is because almost all underlying commercial loans have fixed rates with a maturity of ten years and BBB tranche is among the last tranches to be paid back. Which means the maturity of BBB tranche is almost ten years.

[15]Spread is defined as the difference between loan interest rate and 10-year T-notes.

[16]One interesting question here is to what extent the decline in underlying loans' spread rate is driven by mis-pricing of risk in the securitization process.

[17]For example Keys et al. (2012) shows that cumulative loan to value ratios for non-agency RMBS deals increased from less than 85 percent in 2000 to more than 95 percent by 2006. However one caveat here is that we do not have data on cumulative loan to value ratios for commercial real estates.

net operating income (NOI) to the amount of debt outstanding, were declining significantly. As commercial real estate loans are balloons, debt yields are an important measure of maturity default risk.

For the baseline analysis we only focus on the performance of the most junior BBB (most junior investment grade) tranche of each deal. There are two reasons for focusing on the most junior investment grade tranche. First, since almost all investment grade tranches were traded at par, we can use the spread between tranche coupon rate and 10-year T-Notes as a measure of market perception of the riskiness of the tranche and therefore assess whether the risk associated with a tranche was reflected in its coupon rate or not.[18] Second, among investment grade tranches, the most junior BBB tranche performance has the highest sensitivity to the performance of underlying commercial real estates. Therefore, by focusing on the performance of these tranches, we minimize attenuation bias. At the tranche level, in order to measure the performance of a tranche, we used Bloomberg to collect data on the default status of each BBB tranche. For each tranche Default variable is equal to one if the default status of tranche in Bloomberg is equal to "Default" or "Paid in Full/Default" and is equal to zero if it is "Current" or "Paid in Full". An alternative to default status would be to use the number of downgrades of a tranche rating as an indicator of its performance. Default status has two advantages over the number of downgrades: first, there is no disagreement between different rating agencies about the default status of a tranche whereas current ratings are more prone to subjective assessments. Second, default status is available for all deals in our base sample whereas current ratings are missing for 53 deals in the base sample.

Figure 3.4 shows the average default rate of the most junior BBB tranche for deals that were issued in different years. This figure shows that almost all of the junior BBB tranches of deals issued in 2007 are currently in default. The figure also shows the average delinquency rate for the underlying commercial loans of the same CMBS deals. A commercial loan is defined as delinquent if it has any history of being serviced with a special servicer. Here it is worth mentioning that the average delinquency rate of deals issued in 2005 is less than the delinquency rate of deals issued in 2000. However BBB tranches of CMBS deals issued in 2000 defaulted much less often, primarily due to higher levels of subordinations for deals issued in 2000 compared to those issued in 2005. The chart illustrates the poor performance of bubble vintages (2005-2007), with default rates in excess of 80 percent. It is worth noting that these numbers are not final, and could increase further when the 7 and 10 year loans from these vintages finally mature and require refinancing.

Using data from Commercial Real Estate Direct.com as well CMAlert, we were able to identify the names of B-piece buyers for 383 deals in the base sample.[19] Table 3.1, Panel B shows information on the number of deals, the total notional value of deals and the total notional value of B-pieces that each of the fifteen top B-piece buyers bought. In regressions where we control for the B-piece buyer fixed effect, we drop deals for which we could not identify the B-piece buyer of the deal.

[18]In contrast to investment grade tranches, B-pieces are usually sold at large discounts and therefore the yield on the B-piece is not equal to the tranche coupon. Therefore it is impossible to assess whether the risk associated with these tranches was correctly priced or not by looking at the tranche coupon.

[19]Out of 100 deals for which we do not have information on the b-piece buyer, 79 deals were issued between 1997 and 1999 where our data sources have very limited coverage. The distribution of missing deals among different years is (22/1997, 32/1998, 25/1999, 7/2000, 8/2001, 2/2002, 1/2003, 1/2005, 2/2007)

Finally in order to construct a measure of risk retention of B-piece buyers, we identified the universe of Commercial Real Estate CDOs, which contains 190 deals issued between 1999 and 2008. Among these deals, Intex does not have information for the underlying assets of 20 CRE CDO deals.[20] Since many of these CRE CDOs have a dynamic pool (i.e. the collateral manager can replace or include new assets as collateral into the deal) we pulled the collateral information of each of the remaining 170 CRE CDO deals at the end of each quarter from the first quarter of 2000 to the last quarter of 2008. Since our main focus here is the risk retention of B-piece buyers we proceed by dropping synthetic collateral entries.[21] The reason for this is that a synthetic reference to a B-piece tranche in a CRE CDO deal does not change the risk retention of the original B-piece buyer in the CMBS deal.[22] This left us with 73 CRE CDO deals that had at least one CMBS tranche with a rating below BBB (B-piece) as part of the underlying collateral. Here it should be mentioned that issuers of all of these deals are specialized players in the commercial real estate industry and in fact many of these deals were constructed by large B-piece buyers in the CMBS market such as LNR, Anthracite, ARCap and JER.

For each deal we computed percent of B-piece sold in (after) 12 months as the percentage of the notional value of the tranches below BBB (B-piece) that was sold into a CRE CDO within a period of 12 months from the settle date of the CMBS deal. Figure 3.6 shows the evolution of the mean of percent of B-piece sold within 12 months as well as the 25th percentile to 75th percentiles of this percentage for each year. As we can see even after the rise of CRE CDOs from 2001 afterward there remains a lot of heterogeneity among different deals in the percentage of B-piece that was sold into CRE CDOs. This heterogeneity within each quarter is the source of variation that we use in our empirical analysis to assess the relation between the percentage of the B-piece that was sold into CRE CDOs and the performance of the CMBS deal.

3.4 Empirical Analysis

As we discussed in section two, the creation of CRE CDOs combined with generous ratings given to these CRE CDOs provided an exit strategy for B-piece buyers that enabled them to have less exposure to the risk associated with the underlying loans in conduit/fusion CMBS deals. In this environment we should expect inferior performance of deals in which the B-piece buyer sold a larger fraction of the B-piece into CRE CDOs and therefore had less "skin in the game". In this section, by using the default status of the most junior BBB tranche as a measure of the performance of the deal, we first document that this was indeed the case and CMBS deals with a higher percentage of the B-piece sold into CRE CDOs performed worse. Then we test a

[20] The distribution of CRE CDO deals with missing collateral information is (1/2002, 3/2005, 3/2006,11/2007, 2/2008).

[21] We first dropped all collateral entries which Intex classifies as synthetic. Moreover in order to address the problem with missing information about the synthetic field of collateral entries and possible misclassifications, we dropped all entries with the notional amount of collateral larger than the tranche notional original balance. Finally we dropped collateral entries with notional amounts equal to 5, 10, 15, 20 or 30 million dollars and missing synthetic information for cusips where the total amount of the tranche that was sold into CRE CDOs exceeded the cusip's original balance. This is because most of the synthetic collateral enteries have values that are multiples of 5 million dollars.

[22] Moreover Faltin-Traeger and Mayer (2011) find securitized assets that were included in synthetic CDOs performed worse than other type of assets, which is suggestive of an adverse selection problem with synthetic tranches that is not the focus of this paper.

number of rival theories that can explain the OLS results. Finally we use instrumental variable approach to establish the causal relation between the rise of CRE CDOs as a source of financing for B piece buyers and the inferior performance of CMBS deals.

3.4.1 OLS Estimation

Figure 3.7 shows the motivating fact for the OLS estimations. This figure shows the average default rate of the most junior BBB tranche for deals in which the B-piece was sold into a CRE CDO within a year from CMBS deal settle date performed worse than deals in which the B-piece was not sold into a CRE CDO in all years but 2002.[23] In order to establish this relation in a more systematic way we run the following regression:

$$Default_{i,j,t} = \alpha + \beta x_{i,j,t} + Z'_{i,j,t}\phi + \gamma_t + \delta_j + \epsilon_{i,j,t}$$

Where data varies by deal (i), quarter (t) and the B-piece buyer (j). $Defaut_{i,j,t}$ is equal to one if the most junior BBB tranche of the i^{th} deal (issued in quarter t where the B-piece was bought with the j^{th} B-piece buyer) is in default and it is equal to zero otherwise. $x_{i,j,t}$ is the percentage of the B-piece of deal i that was sold into CRE CDOs. $Z_{i,j,t}$ is the vector of controls which consists of original loan-to-value ratio of the deal, the percentage of the most junior BBB tranche of the deal that went into CDO, the spread rate on the most junior BBB tranche and Subordination below the most junior BBB tranche. LTV, tranche spread and Subordination all relates directly to observable characteristics related to the probability of the default of a tranche in a deal. It is possible that deal issuers had a harder time to sell more risky BBB tranches directly to the market and therefore they also used CRE CDO to sell those risky tranches. If this is the case, one can think of percent of BBB tranche that was sold to CRE CDO as another measure of market perception of the riskiness of the asset and therefore by we control for the percent of BBB sold into CRE CDO as well. Standard errors are clustered at the quarter level.[24]

Before looking at results, it is worth pausing to consider what could be interpreted from OLS estimation of β in the equation above. At a minimum, the estimate documents the correlation between the percent of the B-piece sold to CDOs and subsequent security performance, controlling for all information available at issue. It seems quite possible that the B-piece investor is choosing to sell risk in a fashion which is not exogenous to how the deals would perform if not sold. In particular, the B-piece might choose to sell more of deals with the worst unobserved information to the CDO market, where there is variation in unobservables across deals and over time, so the estimated coefficient is simply.measuring how a given amount of risk is being allocated between the B-piece investor and CDO market. However, one would expect that the presence of a risk-insensitive investor in CDOs would not just result in a shift in how risk is ultimately allocated, but would actually lead to an increase in the amount of risk taken by the B-piece investor at issue. To the

[23]A B-piece sold into CDO is defined as percent sold in 12 month being greater than 75 and not sold into CDO is defined as this percent being equal to zero.

[24]Clustering at quarter and B piece buyer resulted to very similar standard errors.

extent that the presence of CDOs affected the risk appetite of B-piece investors, these investors would want to unload this marginal risk rather quickly into the CDO market.[25] Consequently, we distinguish below between the percent sold within one year and the percent sold after one year, where the former measure should better capture impact of CRE CDO liquidity on the marginal risk-taking of the B-piece investors. Table 3.2 shows the results of this regression for the base sample. Column (1) shows the most junior BBB tranche of a deal in which the entire B-piece was sold into CRE CDOs within one year defaulted about 14 percent more often than deals in which the B-piece buyer kept the B-piece on their own balance sheet, controlling for the quarter fixed effect. On the other hand, the percent sold after one year has no statistical impact on the performance of the BBB tranche. Column (2) shows the same regression when we control for other characteristics of the deal and the tranche itself. These controls do not change the estimated coefficient of β mainly because, as we will see later, observable characteristics associated with a higher probability of default such as LTV, tranche coupon rate or subordination are not correlated with the percentage of the B-piece of the deal that was sold into CRE CDOs. Here it is worth mentioning that the tranche coupon rate significantly predicts the tranche default rate which assures that there has been some pricing of the risk beyond rating agencies action.[26] However as we will see, investors did not take into account the risk associated with a B-piece buyer having less skin in the game and therefore performing less due diligence before the deal is finalized.

Since our focus here is on the impact of CRE CDOs on the risk taking of B-piece buyers, in the rest of our analysis we only focus on the percentage of B-piece that was sold into CRE CDOs within 12 months. Column (3) of Table 3.2, repeats the same regression as column (2) when we do not control for the percent of B-piece that was sold after 12 months which results to almost identical results as before. One concern here is that it is possible that B-piece buyers who were specialized in buying more risky B-pieces for higher yields were also the ones that benefited the most from CDO financing and therefore the rise of CRE CDO market just provided a better source of funding for these B-piece buyers and enabled them to take more leverage but did not change their risk taking behavior.[27,28] To the extent that this was the case we should expect a lower estimated coefficient for β after controlling for the B-piece buyer fixed effect. In column (4) of Table 3.2 we control for the B-piece buyer fixed effect and the resulted estimate of β is just slightly smaller than before. This result suggests that the rise of CRE CDOs had an "intensive margin" impact and induced B-piece buyers to take more risk.

If there is heterogeneity in the quality of deals issued with different issuers, an increase in risk taking

[25]The sooner the B-piece is sold into CRE CDOs, the less exposure the B-piece buyer has to the performance of underlying assets. More importantly, as time passes, more information about the performance of the underlying assets becomes available and the B-piece buyer will have less information advantage over uninformed investors in selling underperforming assets. See Jiang et al. (2011) on how the time lag between loan origination and loan sales resulted in some of the worse loans remaining on the originating bank's balance sheet.

[26]Adelino (2009) and He, Qian and Strahan (2012) also found that in the case of residential mortgage backed securities, tranche coupon rates have predictive power in explaining default rates above the rating agencies action.

[27]For example because there is no maturity mismatch in CDO financing and therefore these B-piece buyers do not need to worry about roll-over risk, more risky B-piece buyers may benefit more from CRE CDO financing.

[28]Even in this case it can be argued that CRE CDOs contributed to lower performance of CMBS deals by allowing more risky players to take higher leverage.

of B-piece buyers can increase origination of more risky loans in two ways: First, more risky issuers have easier time to sell their B-piece and can take more leverage and issue more deals. Second, because B-piece buyers perform less due diligence, independent of the issuer identity CMBS deals become more risky. The more important is the first channel, the smaller should be our estimate of β after we control for the issuer fixed effect. In column (5) we control for the CMBS deal issuer fixed effect and again the result is almost the same as before which suggests that more risk-taking of B-piece buyers induces issuers to originate more risky deals. In column (6) we control both for the B-piece buyer fixed effect and CMBS deal issuer fixed effect. Although the estimated β is positive, it is not significant any more.

One question that arises here is whether the lower performance of deals in which the B-Piece was sold to CRE CDOs within a year was part of the optimal market structure[29] and whether the risk associated with this lower performance was priced or not. According to the optimal market structure hypothesis, we should observe that the percentage of the B-piece that was sold to CRE CDOs in 13 months is positively correlated with other descriptive characteristics of the CMBS deal that are associated with a lower performance such as higher LTV or higher spread rate of the underlying assets. We can also use the subordination level below BBB as a measure of the rating agencies' assessment of the riskiness of these deals. Table 3.3 columns (1) to (3) shows that there is no relation between deal's weighted average LTV, Spread, or Subordination level below BBB and the percentage of the B-piece that was sold into CRE CDOs (after we control for the time fixed effect) which is inconsistent with the optimal market structure hypothesis. Column (4) shows that there is a positive correlation between the percentage of the B-piece that was sold into CRE CDOs and the percentage of the most junior BBB tranche that was sold into CRE CDOs. Finally columns (5) and (6) show that despite higher default rates of deals in which the B-piece was sold into CRE CDOs, there is no relation between the tranche coupon and the percentage of the B-piece that was sold into CRE CDOs. This assures that this agency problem with B-piece buyers was not observable to investors and the risk associated with the CMBS deals in which a higher percentage of the B-piece was sold into CRE CDOs was not priced.

3.4.2 Instrumental Variable Approach

The OLS results show that CMBS deals in which a higher percentage of the B-piece was sold into CRE CDOs defaulted more often than other deals and this result was robust to controlling for other characteristics associated with the deal performance as well as the deal issuer fixed effect or the B-piece buyer fixed effect. However there can be two explanations that are consistent with this result. One explanation is that even after the rise of CRE CDOs, B-piece buyers continued to perform due diligence of deals. However they passed B-piece of deals that performed worse (or they expected to perform worse) to CRE CDOs. Therefore being sold to a CRE CDO is just a sign of underperformance of the deal and not the cause of it and even in the absence of CRE CDOs the same loans would have ended up in CMBS deals. The second explanation is

[29]For example one can argue that even in an environment with perfect information there are larger gains from diversification of more risky assets.

that a B-piece buyer that gets risk insensitive nonrecourse leverage from a CRE CDO has weaker incentives to screen which resulted in the CMBS deal performing worse. Therefore in the latter case there is a causal relation between the rise of CRE CDOs and the poor performance of CMBS deals. (See Adrian and Ashcraft (2012) for a formal model related to this argument.)

In order to differentiate between the two mechanisms explained above we use the fact that access to CRE CDOs and its evolution through time was very different for different B-piece buyers. Figure 3.8 shows both of these facts. First it shows that for the same group of B-piece buyers the average percentage that they sold into CRE CDOs was different in different periods. But more importantly it also shows that the percentage of the B-piece that was sold into CDOs by large B-piece buyers like LNR and GMac was significantly larger than the percentage of B-piece that was sold to CDOs by small B-piece buyers.[30] As we will see shortly, the size of the B-piece buyer was one of the important factors in determining this differential access to CRE CDO financing.

In order to rule out the selection mechanism, we construct our first instrument variable for deal i as the moving average of the percentage of the B-piece that was sold into CRE CDOs over deals that were issued by the same B-piece buyer in a two year window centered at deal i settle date when we take out the deal i itself. To be formal, our instrument is defined as:

$$\bar{x}_{i,j,t} = \frac{\sum_{k \neq i, j, \tau \in [t-4, t+4]} x_{k,j,\tau}}{\sum_{k \neq i, j, \tau \in [t-4, t+4]} 1}$$

Here as before subscription (i, j, t) refers to deal i, issued in quarter t where the B-piece was bought with B-piece buyer j and $x_{i,j,t}$ is the percentage of the B-piece of deal i that was sold into a CRE CDO within a year.

This instrument helps us to sort out the selection issue since the change in the percentage of deal i that was sold to CRE CDOs does not have any impact on our instrument and therefore there is no relation between ex post adverse selection for deal i and the average percentage of neighboring deals with the same issuer that were sold into CRE CDOs.

Another important reason for using an instrumental variable approach is that because of the timing of the sequence of events, what matters for the incentive of B-piece buyers to perform due diligence of the deal is, in fact, the B-piece buyer's *expectation of probability* of selling the B-piece into a CRECDO at the time B-piece buyer bids for the B-piece. Therefore the treatment effect that should be estimated is the impact of change in the probability of B-piece being sold into a CRE CDO on the performance of the deal. Since the actual percentage of the B-piece that was sold into a CRE CDO is a noisy measure of the expectation by the B-piece buyer about the probability of the B-piece being sold into a CRE CDO, in a small sample, OLS estimation will result in attenuation bias. Now using the fact that the probability of the B-piece sold into a CRE CDO differs across different B-piece buyers and different times, we can use our instrument to captures

[30]Small Bpiece buyers are defined as those who have been the Bpiece buyer of less than 10 deals during the period of 1999Q3 to the end of 2007.

the impact of change in the probability of B-piece being sold into a CRE CDO on the performance of the CMBS deal.

Figure 3.9 shows the difference in the average default rate of deals in the bottom quartile versus deals in the upper quartile of distribution of $\bar{x}_{i,j,t}$ after we take out quarter and B-piece buyer fixed effects from $\bar{x}_{i,j,t}$. As we can see in most of the years the junior BBB tranche of deals in the upper quartile defaulted more often than the junior BBB tranche of deals in the lower quartile.

Table 3.4 columns (1) and (2), shows that our instrument $\bar{x}_{i,j,t}$ has a very strong first stage even after we control for the B-piece buyer (and deal issuer) fixed effects. Column (3) shows that the estimated coefficient from IV regression for β is almost four times larger than the estimated coefficient from the OLS regression. Perhaps the main source of this difference is the attenuation bias that arises in OLS estimation as a result of using the actual percent of the B-piece that was sold into a CRE CDO as a measure for the ex-ante probability of the B-piece sold into a CRE CDO. Column (4) shows that the IV estimation results are robust to control for the issuer fixed effects (in addition to B-piece buyer fixed effects) as well.

However, one question that we have not addressed yet is, what is the source of variation among different B-piece buyers in their ability to sell their B-piece into a CRE CDO? It seems that one of the main reasons for this differential access of B-piece buyers to CRE CDO financing was the size of the B-piece buyer: Because of the significant information asymmetry associated with the B-piece, B-piece buyers usually used their own CRE CDOs to construct a CDO deal. However in order to construct a CDO deal they needed to have many B-piece tranches in order to be able to satisfy certain "diversification" and "size" thresholds imposed by rating agencies. In order to test this channel let us first define $S_{j,t}$ as the sum of the notional values of all deals in the window of two years centered at t in which the B-piece was bought with B-piece buyer j.

$$S_{j,t} = \sum_{i,j,\tau\in[t-4,t+4]} Deal\,Notional_{i,j,\tau}$$

Columns (5) and (6) of Table 3.4 confirm that larger B-piece buyers indeed sold a higher percentage of their B-piece into CRE CDOs.[31] The estimated coefficient shows that one billion dollar increase in $S_{j,t}$ results in about a one percent increase in the probability of the B-piece sold into CRE CDOs.[32] Columns (7) and (8) report the result of IV estimation when we use $S_{j,t}$ as an instrument for $x_{i,j,t}$, the percentage of deal i that was sold into a CRE CDO within a year. The estimated β without the B-piece buyer is almost the same as the estimated coefficient with the other IV. Controlling for the B-piece buyer fixed effect makes the estimated coefficient larger and more significant. Figure 3.10 also shows the difference in the average default rate of the most junior BBB tranches in the upper quartile versus the bottom quartile distribution of $S_{j,t}$ after the quarter and B-piece buyer fixed effect is taken out.

[31] It should be mentioned that one concern here is that there is reverse causality as well: better access to CRE CDOs helps the B-piece buyer to have a higher leverage and more resources for financing the purchase of a B-piece.

[32] It should be mentioned that one concern here is that there is reverse causality as well: better access to CRE CDOs helps the B-piece buyer to have a higher leverage and more resources for financing the purchase of a B-piece.

3.5 Robustness Check

In this section we test robustness of results in the previous section for a number of alternative specifications. Table 3.5 replicates the specifications used in Table 3.2 when the linear probability model is replaced with a probit model. In order to make the two tables comparable, in Table 3.5 we reported estimated average marginal effects. The reason for the significantly lower number of observations in the probit regressions of Table 3.5 is that there were many quarters in which none of the junior BBB tranches issued in those quarters defaulted and therefore the quarter fixed effect perfectly predicts those observations. In general, when we do not control for the B-piece buyer fixed effect or deal issuer fixed effect, probit model estimation results in larger estimates of the coefficient on the relation between the percentage of the B-piece sold into CRE CDOs within a year and probability of default of the most junior tranche. Controlling for the B-piece buyer fixed effects or the deal issuer fixed effects makes the coefficient smaller and insignificant. However this may be purely driven with the poor performance of non-linear models like probit when we have many fixed effects.

As the next set of robustness checks, we expand our sample to all BBB tranches (as opposed to the most junior BBB tranche) of conduit and fusion CMBS deals that were issued between 1997 and 2007 and investigate the relation between the default rate of these tranches and the percentage of the B-piece that was sold into CRE CDOs within a year. We also cluster standard errors at the deal level to address the fact that performances of different tranches within a deal are not independent of each other. Table 3.6 shows that the result of the linear probability model and the probit model for the sample of all BBB tranches is qualitatively the same as before although the estimated coefficient for the relation between the percentage of the B-piece sold within a year and the default rate is no longer significant when we control for the B-piece buyer fixed effect. However, because of the waterfall structure of CMBS tranches, we should have expected that estimated coefficients for the probability of default of BBB tranches to be slightly smaller. Finally it should be noted that the estimated β coefficient in the IV regression is no longer significant.

3.6 Conclusion

In this paper, we documented the importance of the risk retention by informed investors for the performance of securitized assets. In particular we exploit variation in the amount of retention over time and across B-piece investors as measured by the amount sold to the CRE CDO market and document that after controlling for all information available at issue, including market pricing, rating agency credit enhancement levels, and other deal characteristics, the percent of the B-piece sold to CRE CDOs has a significant adverse impact on the probability that more senior tranches ultimately default. The result of this paper is suggestive that regulations like the Dodd Frank act that requires informed investors in the securitization process to retain five percent of the credit risk of securitized assets can be beneficial and can make uninformed investors more confident about the quality of underlying assets. It should be emphasized here that we see our findings as a complement to other papers that document other information frictions in the securitization process such as inflated credit ratings and it is apparent from our estimations that even without the rise of CRE CDOs a large fraction of BBB tranches would have defaulted as a result of historically low subordination levels. There are a number of extensions to this paper that need to be conducted. First, using data for the underlying commercial real estate loans of CMBS deals, it would be interesting to provide more direct evidence of the relation between the B-piece buyers' risk retention and the performance of underlying loans. Second, since in many cases the B-piece buyer is the same as the special servicer, it would be interesting to compare the impact of risk retention rules on the ex-ante screening efforts of the B-piece buyers versus the ex-post performance of the special servicers in dealing with delinquent loans.

Table 3.1

Panel A: Descriptive Statistics	N	Mean	Std. Dev	Min	Max
Deal Level Variables					
1. Loan to Value (Weighted Average Loan to Value Ratio of Underlying Loans at Origination)	476	68.51	4.00	50.87	76.67
2. Spread (Weighted Average Spread of underlying Loans at Origination)	482	1.56	0.53	0.68	2.58
3. Number of Loans	483	164.98	74.50	32.00	664.00
4. Deal Original Balance (bil.$)	483	1.68	1.10	0.16	7.90
5. Percent of B-piece sold in 12 months	483	0.34	0.40	0.0	1
6. Percent of B-piece sold after 12 months	483	0.27	0.33	0.0	1
Tranche Level Variables (Base Sample)					
7. Default	483	0.42	0.49	0	1
8. Original Rating (8= BBB+, 2 =BBB, 3 =BBB-)	483	9.99	0.11	9.00	10.00
9. Subordination	483	5.79	3.15	1.38	13.50
10. Coupon Rate	483	1.52	0.56	0.48	3.01
11. Percent of BBB tranche sold	483	0.37	0.35	0	1
Tranche Level Variables (All BBB Tranches)					
12. Default	1314	0.38	0.49	0	1
13. Original Rating (8= BBB+, 9 =BBB, 10 =BBB-)	1314	9.09	0.79	8.00	10.00
14. Subordination	1314	6.45	3.17	1.38	21.59
15. Tranche Coupon Rate	1314	1.42	0.52	0.01	3.01
16. Percent of BBB tranche sold	1314	0.24	0.31	0	1

Panel B: Top B-Piece Buyers

B-Piece Buyer Name	Number of Deals	Value of Deals (bil$)	Value of B-Piece (bil $)	pct	pctwthnyear
LNR	89	170.16	6.19	0.84	0.54
ARCAP	53	69.16	2.69	0.78	0.44
ALLIED	31	35.46	1.99	0.7	0.36
ANTHRACITE	28	53.07	1.54	0.64	0.57
CW CAPITAL	28	75.11	2.29	0.85	0.35
GMAC	24	23.69	1.46	0.8	0.47
JER	22	50.78	1.33	0.88	0.83
ING	19	30.33	0.93	0.49	0.12
CENTERLINE	17	45.75	1.06	0.24	0.24
HYPERION	16	34.71	1.08	0.22	0.09
AMCAP	16	52.61	1.35	0.76	0.44
BANC ONE	10	13.19	0.46	0.23	0.15
CITIGROUP	8	11.88	0.35	0.07	0.05
INSIGNIA	4	3.43	0.17	0.2	0.06
PRESIDIO	4	11.33	0.3	0.06	0.06

Table 3.2: B-piece Buyer Skin in the Game and the Performance of CMBS Deal, OLS Regression Resuts

The table reports coefficient estiamtes of regressions of the linear probability model for the default of the most junior BBB tranche. Each observation refers to a CMBS deal that is originated between 1998 and 2007. *Percent of B-piece sold in (after) 12 months* is the percentage of B-piece tranches that were sold to CRE CDOs within (after) 12 months from the issuance of the CMBS deal. Controls include percentage of the most junior BBB tranche that was sold into CRE CDOs, coupon rate of the most junior BBB tranche, subordination below the BBB tranche, initial rating of the tranche and the average loan to value of the underlying commercial mortgages at the origination. Standard errors are adjusted for clustering for observations in each quarter and reported in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable is whether the most junior BBB tranche is in default or not					
Percent of B-piece sold in 12	0.14**	0.15**	0.15**	0.12*	0.12*	0.09
months	(0.07)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Percent of B-piece sold after 12	-0.00	-0.01				
months	(0.05)	(0.04)				
Percent of BBB tranche sold		0.03	0.03	0.06	0.04	0.07
		(0.05)	(0.05)	(0.07)	(0.06)	(0.07)
BBB tranche original spread		0.12*	0.12*	0.21**	0.12*	0.21**
		(0.06)	(0.06)	(0.08)	(0.06)	(0.09)
BBB tranche original subordination		-0.03	-0.03	-0.04	-0.02	-0.01
		(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Original loan to value		0.02***	0.02***	0.02**	0.02***	0.02**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
BBB tranche original rating		-0.09**	-0.09**	0.15	-0.03	0.28
		(0.04)	(0.04)	(0.14)	(0.08)	(0.17)
Quarter fixed effects	Y	Y	Y	Y	Y	Y
B-Piece Buyer fixed effects	N	N	N	Y	N	Y
Deal Issuer fixed effects	N	N	N	N	Y	Y
Observations	483	476	476	380	476	380
R-squared	0.63	0.64	0.64	0.62	0.66	0.64

Table 3.3: B-piece Buyer Skin in the Game, Market Structure and Risk Pricing

The table reports coefficient estimates of regressions of characteristics of CMBS deals on the percentage of B-piece that was sold into CRE CDO within a year . Each observation refers to a CMBS deal that is originated between 1998 and 2007. Percent of B-piece sold in (after) 12 months is the percentage of B-piece tranches that were sold to CRE CDOs within (after) 12 months from the issuance of the CMBS deal. Standard errors are adjusted for clustering for observations in each quarter and reported in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)
	Percentage of B-piece Sold into CRE CDO witin a Year				*Coupon Spread Rate of the Most Junior BBB Tranche*	
Percent of B-piece sold in 12 months					-0.03	-0.04
					(0.04)	(0.04)
Original loan to value	-0.00					0.00
	(0.00)					(0.00)
Deal average spread		0.01				0.61***
		(0.08)				(0.07)
BBB tranche original subordination			-0.01			0.01
			(0.01)			(0.02)
Percent of BBB tranche sold				0.11**		
				(0.05)		
Observations	476	482	483	483	483	476
R-squared	0.43	0.43	0.43	0.44	0.77	0.82

Table 3.4: B-piece Buyer Skin in the Game and the Performance of CMBS Deal, Instrumental Variable Approach

Columns (1) and (2) report the first stage: regression of percentage of B-piece sold into CRE CDOs within a year on the moving average of the percentage of the B-piece of neighboring deals with the same issuer that are sold into a CRE CDO. Columns (3) and (4) report coefficient estiamtes of 2SLS regressions of the linear probability model for the default of the most junior BBB tranche. Columns (5) to (8) report the similar first stage and 2SLS estimations when the sum of total balance of neighboring deals in which the B-piece was bought with the same B-piece buyer is used as an instrument for pctwthnyear. Each observation refers to a CMBS deal that is issued between 1998 and the second quarter of 2008. Standard errors are clustered by deal issuer quarter and by B-piece buyer and reported in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	percentage of B-piece sold into CRE CDO within a year		Default of the Most Junior BBB Tranche		percentage of B-piece sold into CRE CDO within a year		Default of the Most Junior BBB Tranche	
$\bar{x}_{i,j,t}$ (Percentage of B-piece of neighboring deals with same B-piece Buyer sold in 12 months)	0.82***	0.82***						
	(0.10)	(0.10)						
$S_{j,t}$ (Moving average size of B-piece buyer in 100 Billion $)					0.78***	0.74***		
					(0.20)	(0.21)		
Percent of B-piece sold in 12 months			0.37**	0.40***			0.59**	0.61**
			(0.15)	(0.14)			(0.24)	(0.27)
Percent of BBB tranche sold	0.07	0.07	0.04	0.05	0.07	0.07	0.03	0.04
	(0.06)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)	(0.07)
BBB tranche original spread	-0.01	-0.01	0.21***	0.21***	-0.00	0.01	0.21***	0.20***
	(0.03)	(0.04)	(0.05)	(0.06)	(0.04)	(0.05)	(0.05)	(0.06)
BBB tranche original subordination	0.01	0.02	-0.04	-0.02	-0.00	0.01	-0.04	-0.02
	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.03)
Original loan to value	-0.01	-0.01	0.02***	0.02***	-0.01	-0.01	0.02***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Quarter fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
B-Piece Buyer fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Deal Issuer fixed effects	N	Y	N	Y	N	Y	N	Y
Observations	376	376	376	376	380	380	380	380
R-squared	0.63	0.64	0.60	0.61	0.56	0.58	0.55	0.56

Table 3.5: B-piece Buyer Skin in the Game and the Performance of CMBS Deal, Probit Regression Resuts

The table reports estimates of average marginal effects of a probit model of default of the most junior BBB tranche. Each observation refers to a CMBS deal that is originated between 1998 and 2007. *Percent of B-piece sold in (after) 12 months* is the percentage of B-piece tranches that were sold to CRE CDOs within (after) 12 months from the issuance of the CMBS deal. Controls include percentage of the most junior BBB tranche that was sold into CRE CDOs, coupon rate of the most junior BBB tranche, subordination below the BBB tranche, initial rating of the tranche and the average loan to value of the underlying commercial mortgages at the origination. Standard errors are adjusted for clustering for observations in each quarter and reported in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable is whether the most junior BBB tranche is in default or not					
Percent of B-piece sold in 12 months	0.19**	0.18**	0.17**	0.10	0.11	0.04
	(0.09)	(0.08)	(0.07)	(0.08)	(0.08)	(0.08)
Percent of B-piece sold after 12 months	0.03	0.02				
	(0.08)	(0.06)				
Percent of BBB tranche sold		0.04	0.04	0.09	0.04	0.10
		(0.08)	(0.08)	(0.09)	(0.09)	(0.10)
BBB tranche original spread		0.23**	0.22**	0.41***	0.26**	0.43***
		(0.11)	(0.11)	(0.12)	(0.12)	(0.12)
BBB tranche original subordination		-0.04	-0.04	-0.06	-0.01	-0.01
		(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
Original loan to value		0.02**	0.02**	0.02**	0.02**	0.02**
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Quarter fixed effects	Y	Y	Y	Y	Y	Y
B-Piece Buyer fixed effects	N	N	N	Y	N	Y
Deal Issuer fixed effects	N	N	N	N	Y	Y
Observations	284	280	280	255	262	242

Table 3.6: B-piece Buyer Skin in the Game and Performance of All BBB Tranches, Robustness Check

The table reports robustness of relation between risk retention and deal performance when all BBB CMBS tranches are included in the sample. Each observation is a BBB tranche in a CMBS deal. Columns (1) to (3) replicate Columns (6) to (8) of Table 2 for all BBB tranches. Columns (4) to (6) correspond to Columns (6) to (8) of table 5 and Columns (7) and (8) replicate columns (3) and (4) of Table 4. Standard errors are adjusted for clustering for observations in each quarter and reported in parentheses. Asterisks denote significance levels (***=1%, **=5%, *=10%).

	Dependent Variable is whether a tranche is in default or not							
	Linear Probability Model			Probit Model			2SLS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Percent of B-piece sold in 12 months	0.10**	0.08*	0.07	0.10**	0.07*	0.05	0.15*	0.19
	(0.04)	(0.05)	(0.05)	(0.04)	(0.04)	(0.05)	(0.08)	(0.14)
Percent of BBB tranche sold	0.09**	0.09**	0.10**	0.06	0.05	0.09**	0.10**	0.10**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
BBB tranche original spread	0.09**	0.10**	0.12**	0.14***	0.15***	0.18***	0.13***	0.13***
	(0.04)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)
BBB tranche original subordination	-0.04***	-0.03**	-0.04***	-0.03**	-0.03**	-0.03**	-0.04***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Original loan to value	0.02***	0.02***	0.03***	0.02***	0.02***	0.02***	0.03***	0.03***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
BBB tranche original rating	0.02	0.03	0.02	0.04**	0.06***	0.04*	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Quarter fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
B-Piece Buyer fixed effects	N	N	Y	N	N	Y	N	Y
Deal Issuer fixed effects	N	Y	N	N	Y	N	N	N
Observations	1,294	1,294	1,127	1,048	976	949	1,109	1,109
R-squared	0.57	0.60	0.57				0.55	0.56

Figure 3.1: Annual Issuance of Conduit/Fusion CMBS deals

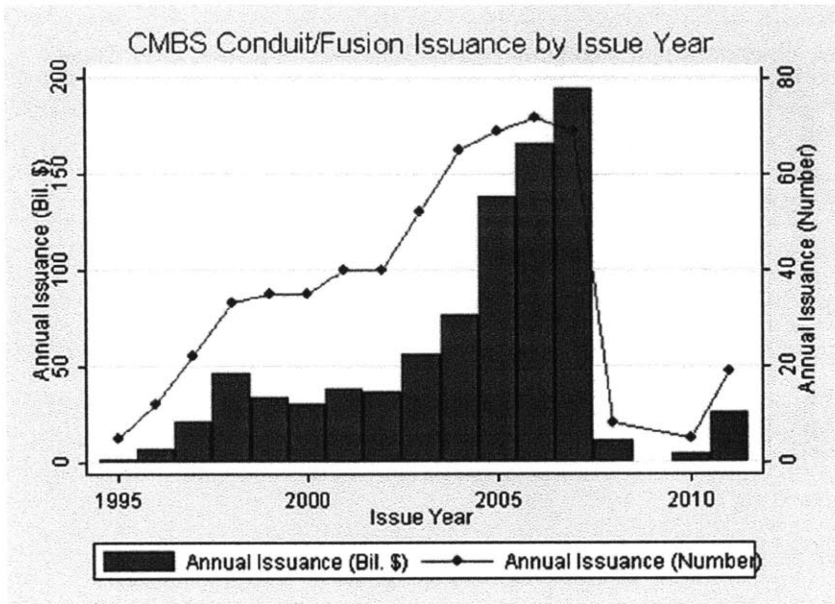
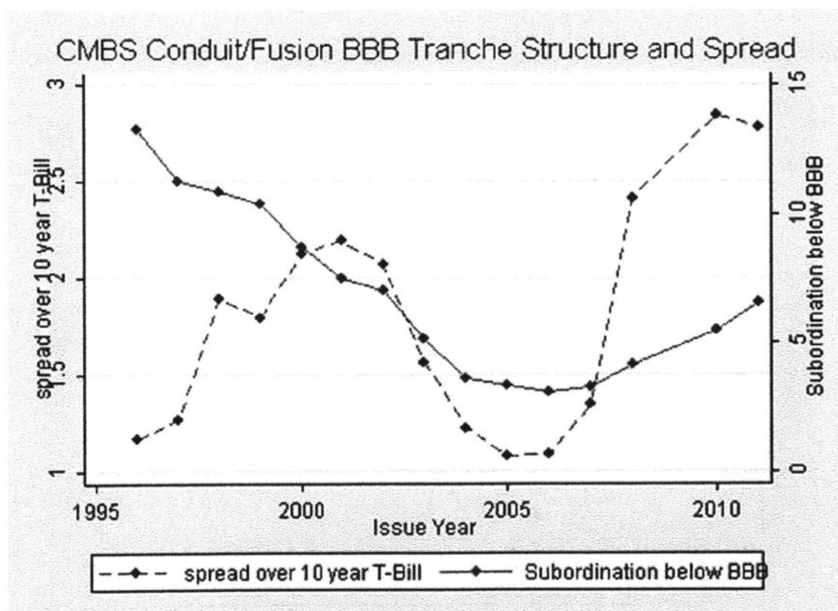
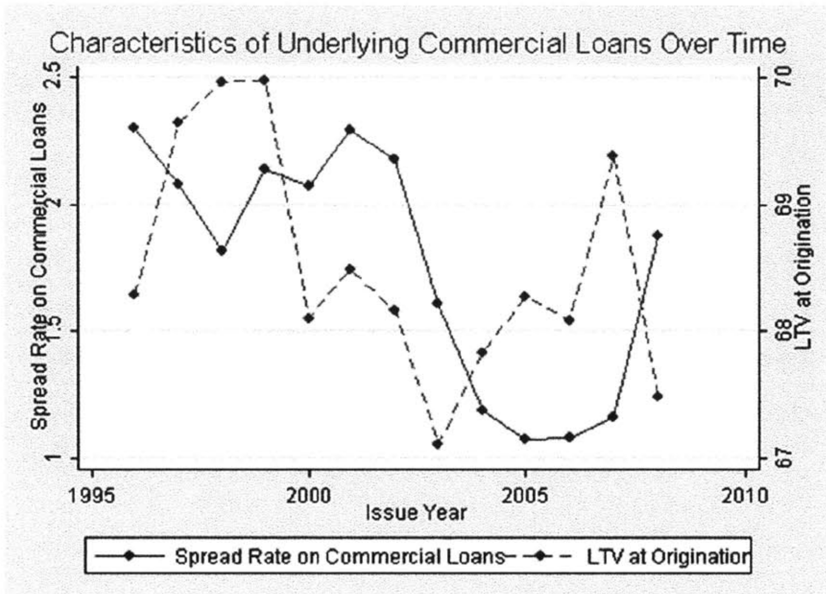


Figure 3.2: BBB Subordination and Spread Trends



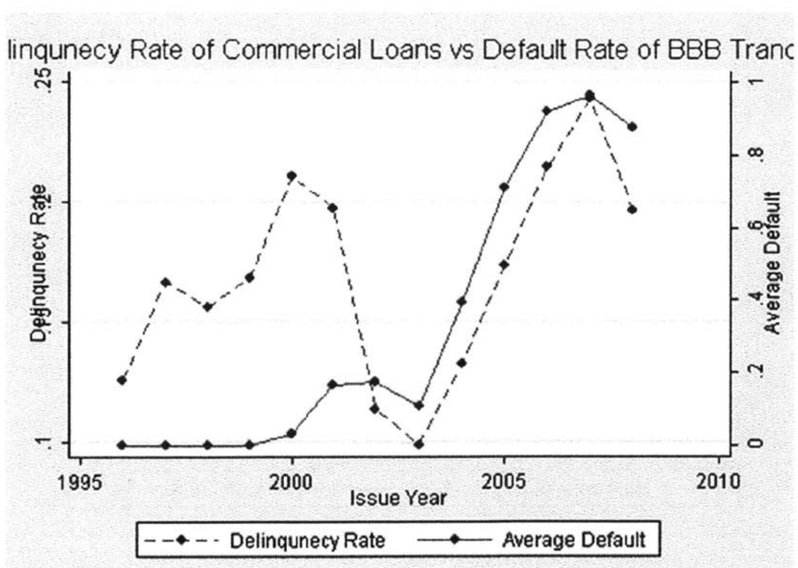
Notes: The graph shows the average subordination below the most junior BBB tranche as well as the average Spread Rate (defined as difference between the coupon rate and 10 year T-Notes at issuance date) of the most junior BBB bonds

Figure 3.3: Evolution of Characteristics of Commercial Loans Underlying CMBS Deals



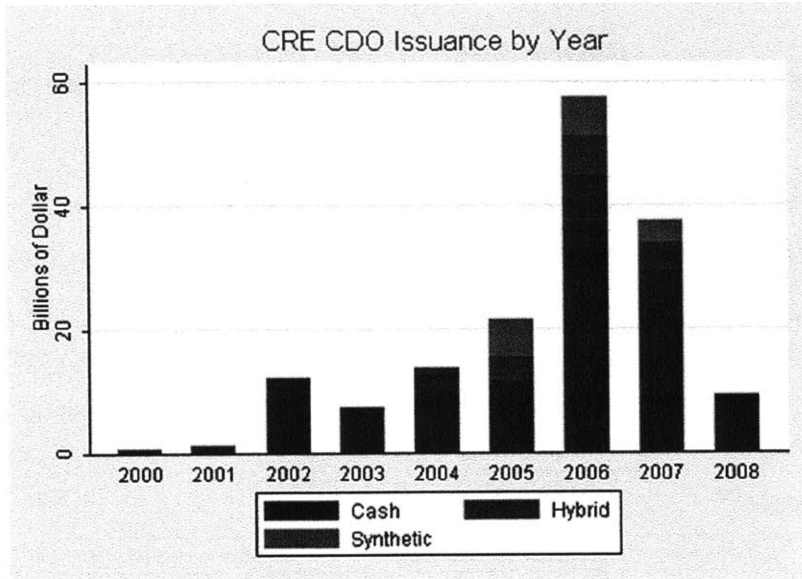
Notes: The figure shows the weighted average of LTV and Spread Rates (defined as the difference between loan coupon rate and 10 year T-Notes) of underlying commercial loans where the original loan size is used as the weight.

Figure 3.4: Delinquency Rate of Underlying Commercial Loans and Default Rate of the BBB Tranche



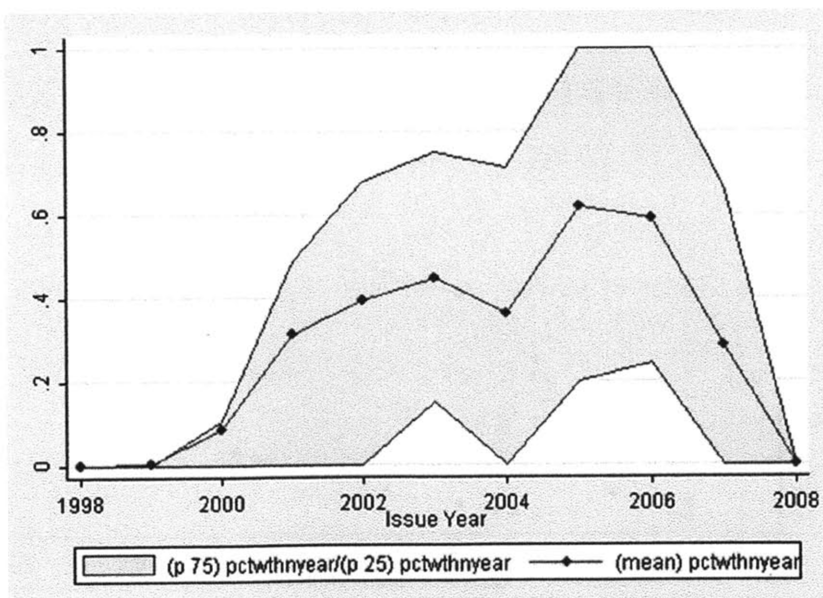
Notes: A loan is delinquent if it has any history of being serviced by a special servicer. A tranche is in default if the default status in Bloomberg is either "Default" or "Paid in Full/Default".

Figure 3.5: Commercial Real Estate CDOs Issuance by Year and Type



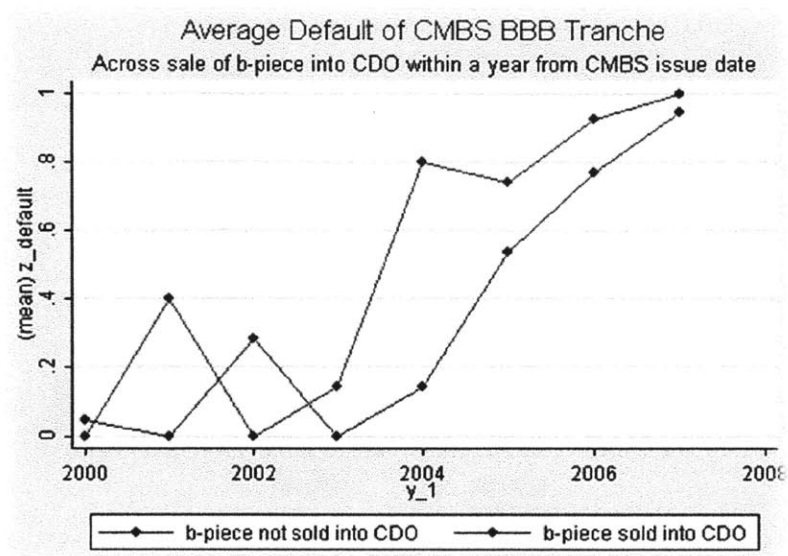
Notes: This graph shows the notional amount of deals issued in each quarter which may overstate the market value of new issuances since non-investment grade assets are sold at discount.

Figure 3.6: Evolution and Distribution of Percentage of B-piece Sold into CRE CDOs within a Year



Notes: The figure shows the average percentage as well as the 25th to 75th percentiles of the distribution of the B-piece that was sold into CRE CDOs within a year from CMBS deal issuance over the issue year of CMBS deals.

Figure 3.7: Performance of Deals across B-pieces sold into CDOs



Notes: The B-piece sold into CDO is defined as pctwthnyear>0.75 (i.e. within a period of one year from deal origination at least 75 percent of the notional value of the B-piece was sold into a CRE CDO). Not sold into CDO is defined as pctwthnyear=0.

Figure 3.8: Differential Access of Different B-piece Buyers to CRE CDO financing

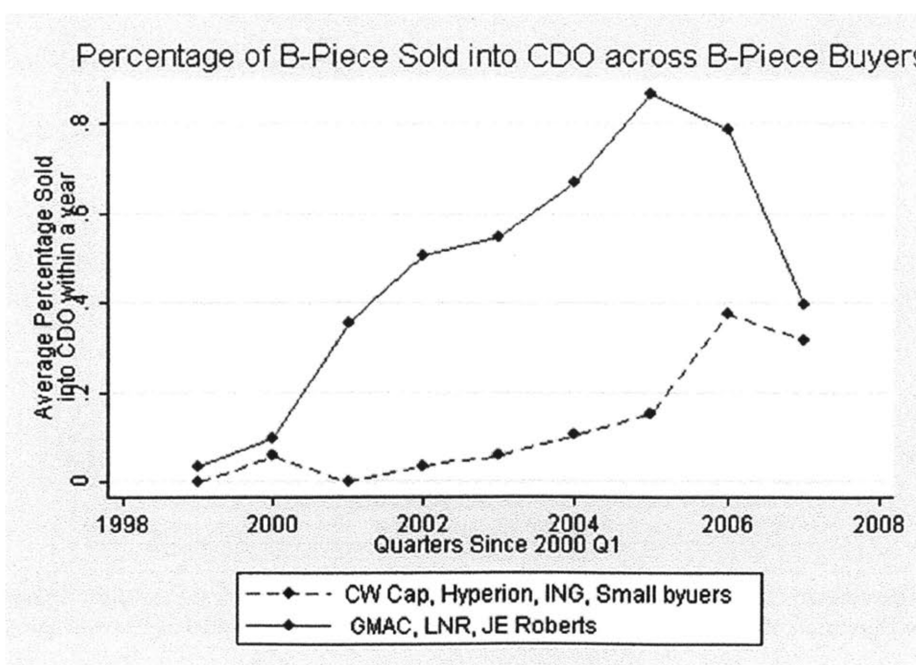
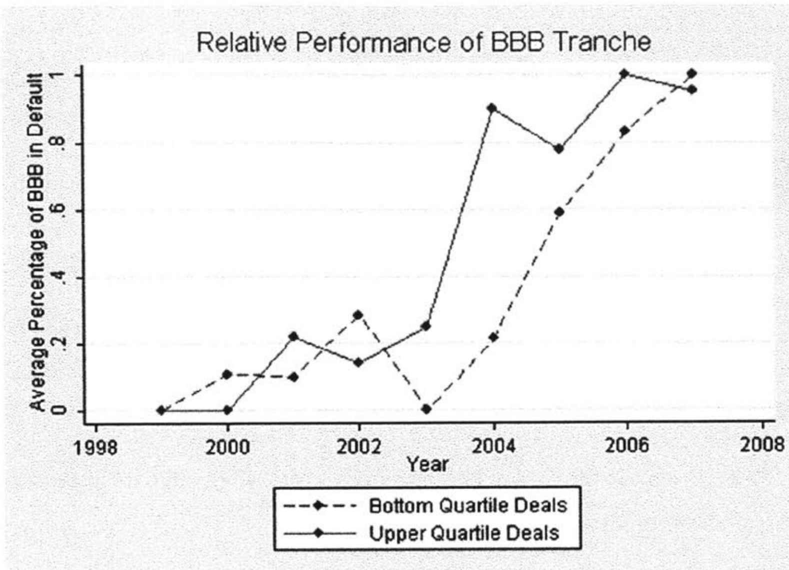
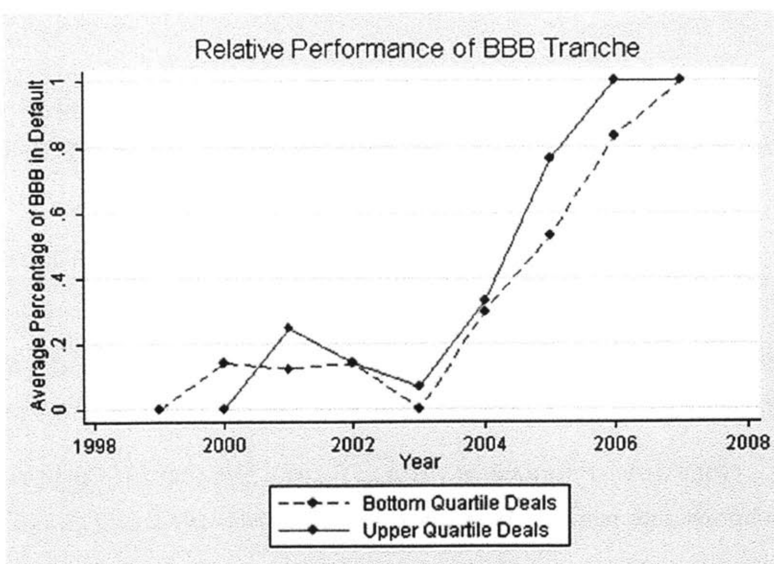


Figure 3.9: Performance of Deals Across the Moving Average of the Percentage Sold into CRE CDOs ($\bar{x}_{i,j,t}$)



Notes: In the above figure, the bottom (upper) quartile deals are deals in the bottom (upper) quartile distribution of our first instrument $\bar{x}_{i,j,t}$ (average pctwthnyear of neighboring deals that the B-piece was bought with the same B-piece buyer) after we take out the quarter and B-piece buyer fixed effects.

Figure 3.10: Performance of Deals across the Moving Average Size of the B-piece Buyer Portfolio ($S_{j,t}$)



Notes: In the above figure, the bottom (upper) quartile deals are deals in the bottom (upper) quartile distribution of our first instrument, $S_{j,t}$(sum of the original balance of deals in a window of two years centered at t in which the B-piece was bought with the same B-piece buyer) after we take out the quarter and B-piece buyer fixed effects.

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