ESSAYS ON EFFECTS OF THE HOUSING MARKET COLLAPSE

by

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Abstract

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The housing market collapse of 2008 had a number of economic effects. Chapter One addresses the history of the AAA financial guaranty insurance industry, which began in the 1980's, grew rapidly in the first few years of the 21st century, but ceased to exist following the housing market collapse. The factors that led to the industry's growth are explored, while the weaknesses that existed in its AAA façade all along are pointed out. This essay concludes that, while the collapse of the housing market was the immediate cause of the financial guaranty industry's downfall, any economic shock would have harmed this highly leveraged industry.

Declines in home values over the past five years have affected many homeowners, decreasing their asset values, and leaving some with negative equity. Besides financial harm, high indebtedness may adversely affect health. Chapter Two looks at the research done to date on the effects of consumer debt and mortgage debt/foreclosure on health.

Chapters Three and Four use different data sets to empirically test the effect of high mortgage loan to home value on a number of health outcomes. Chapter Three employs the Health and

Retirement Survey (HRS), a rich, nationally representative sample of the population over 50 years of age and finds significant correlation between high mortgage loan to value and negative health outcomes. Changes in home values are used as an instrument variable to further identify the effect of loan to value on health; results are not conclusive of causality.

Chapter Four uses the NLSY79 to explore the effect of mortgage debt on a younger cohort that, in comparison to the HRS, is more likely to rely on wage income and have lower net worth. Results point to higher loan to value in conjunction with unemployment as having a significant negative impact on health for this cohort, but higher loan to value alone does not significantly affect overall health.

These results point to the need for greater financial literacy for homeowners and potential homeowners, given the more frequent spells of unemployment and the volatility in home prices. Further research with data post 2008 is needed to further test causality.

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Chapter One

The Rise and Fall of the AAA Financial Guaranty Insurance Industry

Abstract

This essay addresses the underpinnings of the financial guarantee industry, the role it played in the U.S municipal bond market, its expansion into structured finance and international markets, the cracks that existed all along in its AAA facade. It highlights the effect the ratings' downgrades of the financial guarantors had on the auction-rate securities market and some smaller issuers of asset-backed securities.

JEL Classification: G

None of the four firms that dominated the financial guaranty industry for the past thirty years survived the financial crisis of 2008-2009 in pre-crisis form. Ambac went from AAA ratings by all three agencies and $6 billion of statutory capital to filing for Chapter 11 bankruptcy protection in November 2010. FGIC also lost its AAA ratings and in November of 2009 was ordered by the New York Department of Insurance to cease writing policies and paying claims. FSA was bought by Assured in 2009 for 37.5% of its book value. MBIA is now rated B instead of AAA. Assured was last man standing, but lost its AAA rating from S&P on October 25, 2010, when it was downgraded to AA+. (McGee P. , Market Loses last Triple-A Insurer as S&P Drops Assured Guaranty, 2010)

This paper addresses the history of the financial guarantee industry, the role it played in the U.S municipal bond market, its expansion into structured finance and international markets, and the cracks that existed all along in its AAA facade. It highlights the devastating effect the ratings downgrades of financial guarantors had on the auction-rate securities market and some smaller issuers of asset-backed securities. The first two sections will provide background and characterize the industry; the third section will show that financial guaranties did benefit the municipal debt market. The fourth section will look at its expansion out of municipal debt; Section V will critically examine the role of the rating agencies and the insurance regulators in this industry. Section VI will highlight two markets seriously affected by the fall of the monolines; the seventh section will conclude.

Background

Financial guaranties as a product were written back in the 19th century, most notably by Lloyds of London. However, Lloyds was prohibited from brokering financial guarantees in 1924 after a syndicate lost the equivalent of $171MM (2002 dollars), by guaranteeing the value of used cars. (Smith 2002)

Financial guaranty as an industry can be traced to the establishment of the American Municipal Bond Insurance Company (Ambac), by the Mortgage Guaranty Insurance Corporation (MGIC), in 1971. Two years later, the Municipal Bond Insurance Corporation (MBIA), was formed by a consortium of property and casualty companies: Aetna, Cigna, Continental, Firemen's Fund, Travelers, to insure municipal bonds, as its name implies. Both Ambac and MBIA evolved into publicly owned NYSE traded companies, even though rating agency analysis showed a preference for deep pocketed owners.[1]

In 1983, the Financial Guaranty Company (FGIC) became the third bond insurer, followed by Bond Investors Guaranty (BIG) in 1984. The financial guaranty industry was always oligopolistic: these four companies wrote 96% of the insurance on municipal bonds in the mid 1980s. (Kidwell, Sorensen, & Wachowicz, 1987). BIG was acquired by MBIA in 1989, after the Tax Reform Act of 1986 reduced municipal issuance and led to overcapacity in the bond insurance industry.

[1] MBIA's ability, in 1998, to acquire CapMac, another AAA monoline, but one which specialized in structured finance and had significant Asian exposure at the time of the Asian crisis, at a reduced share price, was potentially a missed sign of industry vulnerability.

Financial Security Assurance, Inc. began operations in September 1985, the first firm to specialize in structured finance; Assured Guaranty began operations three years later, in 1988. The cyclicality inherent in the industry (detailed in Section II), partially explains the proliferation of firms in this time period.

Characterization of the Industry

The providers of financial guaranty policies are classified as insurance companies, but operate quite differently. I distinguish financial guaranty insurance as a distinct industry, separate from the insurance industry, in eight key areas:

1) Definition

A financial guaranty is a form of credit insurance: it is an unconditional irrevocable obligation to pay timely interest and ultimate principal on a financial obligation. The fact that the policies written are unconditional and irrevocable immediately distinguishes this form of insurance from the more well-known property and casualty type contracts. The guarantor must pay when a claim is presented, even if there were errors of omission, neglect or outright fraud on the part of the issuer. The policy cannot be revoked, even if the guarantor discovers something which would have kept it from providing the guaranty originally. The guarantor can attempt to recover claims and damages from the issuer and/or the arranger of the bonds. Since the guarantor becomes responsible for payments on the bonds insured, the bonds carry the ratings of the guarantor.

The reason for the unconditional and irrevocable clause lies in the relationship of the parties involved. For most insurance, the policyholder contracts with the insurer. In financial guaranty,

the bond issuer or even bond arranger contracts with the insurer, while the policy is held by the bondholder. Besides exposing the insurer to claims based on fraud, this unusual arrangement also gives rise to moral hazard. The issuer who negotiates and pays for the policy is not the direct beneficiary. This should not be a problem in the normal course of business. If issuers are solid corporations or municipalities with future needs for the debt markets, they should act with prudence and integrity in their negotiations. But if the issuance is from a special purpose vehicle or backed by a onetime stream of payments, the relationship between the three parties may not be strong. There will be opportunity for the issuer to satisfy his own interest at the expense of the other two parties involved.

2) Non refundable Premiums

Since the policies issued by the guarantors are irrevocable, premiums cannot be clawed back. In the municipal and infrastructure business, premiums are paid up front for the life of the deal, but recognized into income over the expected life of the bonds, often 20 – 30 years, thereby creating a solid earnings stream. If the bonds are called or refinanced, the remaining unearned premium can be recognized immediately, providing a positive shock to current year's earnings. Premiums on structured finance transactions are paid over the life of the transaction: since the premiums are generally higher and the transactions short-lived, their major contribution is to current cash flow.

$Y = aM + pS + \epsilon$

Y = earnings and is composed of aM, a being an annuity stream based on M, municipal/infrastructure business written and outstanding, plus monthly premiums (p)

multiplied by S, structured finance exposure outstanding, plus ϵ, income shocks due to refinancing or calling of municipal bonds. In other insurance lines, unearned premiums are returned to the previously insured, not kept by the insurance company.

3) Cyclicality

As Hirtle (1987) succinctly explains, the financial guarantee market faces cyclicality of demand and supply, with both increasing when interest rates are higher and when credit spreads are wider. To put in economic terms of S = supply of bond insurance and D = demand for bond insurance, with P = price, and X_s and X_d the vectors of other variables affecting supply and demand, respectively:

$$S = S(P, X_s)$$

$$D = D(P, X_d)$$

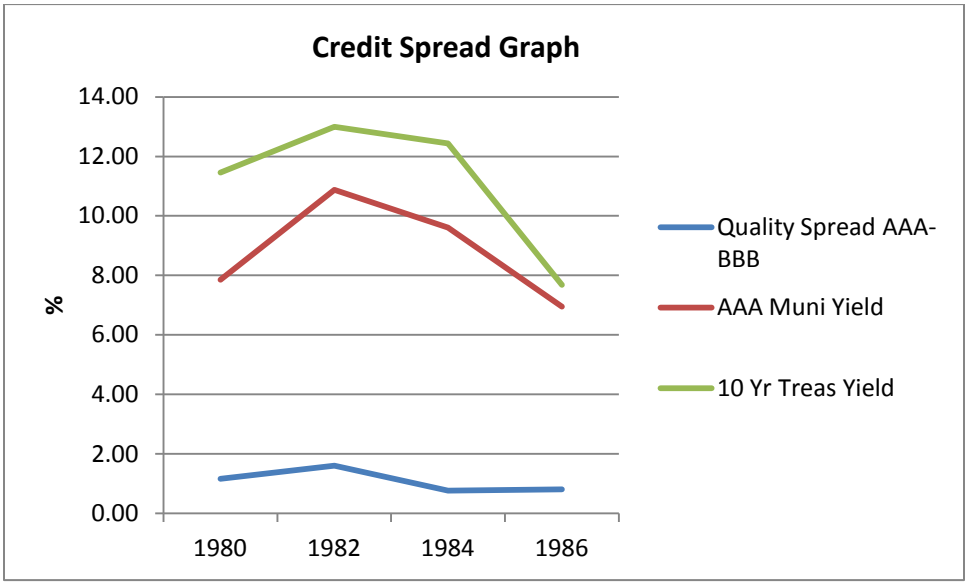
The cyclicality arises because two of the variables in X_d, interest rates and credit spreads, have a positive impact on demand for bond insurance, and an independent positive impact on price in the supply function, which in turn has a positive impact on supply. This should push the new equilibrium where supply equals demand higher when both rise, and should push the equilibrium point lower when both decrease. Duration is a third positive variable in X_d, but should be a negative variable in X_s, since longer transactions are inherently riskier. However, a major performance metric for bond insurance firms is gross premiums written, which increases with duration. Financial guaranty firms are therefore encouraged to insure longer transactions despite the higher risk involved.

The cyclicality is compounded by the fact that periods with high interest rates are typically times of high losses for property and casualty (P&C) companies, making financial guaranty firms an attractive place for these other companies to invest capital in high interest rate environments (Hirtle 1987), which expands capacity. What Hirtle does not point out is that, in the financial guaranty industry, capacity is harder to adjust downwards than in most other industries due to the capital requirements set by the rating agencies and the long term nature of most of the policies written. And since excess capacity means idle capital which leads to a lower return on equity (ROE) and unhappy shareholders, market discipline is difficult. Insurance providers continue to take on risk even if the terms are unfavorable in order to generate higher returns on equity. Additionally, ROE is part of the executive compensation equation, incentivizing management to write business.

Marginal cost does not vary with issuance size, but premium earned does, causing P to be a negative function of issuance size. That is, since it costs the insurer roughly the same to insure and monitor a small transaction as a large transaction, it generally charges more per dollar insured for smaller transactions. This partially explains the very large exposures the industry took on over the years.

As shown in Figure 1 below, the BBB to AAA spread reached a cyclical high of 1.60% in 1982, but declined to almost half that level, .81%, by 1986. (MBIA, BIG and FSA were all formed in the intervening years.) Insured municipal bonds dropped by 40% from $47 billion in 1985 to $26 billion in 1986: the insured share of new issuance fell from 23% to 19%. The much more modest drop in insured penetration of new issuance can be tied to higher demand brought on by the Washington Public Power Supply System default in 1983 and higher supply induced by the

poor conditions in the property and causality market, which encouraged insurance companies to devote capital to financial guarantee firms.



Source: Moody's Investor Services
Figure 1. Credit Spread Graph

Underwriting and pricing discipline are important in a cyclical business, especially if it is long tailed. If a firm uses up capacity when prices are very low, it will not be able to take advantage of higher prices when market conditions improve. If it writes riskier business to keep revenues up, it may suffer losses later, or at the very least exhibit an unfavorable credit profile. This may make its product less desirable to bond investors who are monitoring the portfolio of the financial guarantor. The guarantor may compensate for this lower demand by insuring riskier business at lower premiums, starting a downward spiral.

4) Underwriting

Another key to understanding this industry is that it is not primarily actuarially based as is traditional insurance. Instead, underwriting is to a zero-loss standard, with the industry insuring only investment grade credits for the most part. The strength of the guarantors is intrinsically tied to their risk analysis. Since a financial guaranty firm generally insures the whole or at least a significant portion of a transaction, it makes sense for it to do thorough due diligence, whereas a traditional investor might not have the where-with-all to thoroughly vet the transaction. Financial guarantors are continually making judgments on what to insure that are only partially model driven. Analytical problems arose due to historically low levels of default on insured bonds and the complexity of risk correlations across the portfolios. While sophisticated risk models that discounted tail risk may be partially to blame for the financial crisis, there is something to be said for pure analytics versus judgment calls, especially when those making the calls are compensated in part based on gross premiums written. This link between risk taking and compensation for financial institution executives is being explored extensively by other researchers and oversight committees currently, and is beyond the scope of this paper, but cannot be ignored.

5) Surveillance

Besides underwriting departments, financial guaranty firms have dedicated surveillance teams to monitor their exposures to a level beyond the scope of most investors, and to take proactive measures where possible. They generally have considerable control over transactions and can step in if conditions deteriorate. However, here again the tri-party arrangement can lead to

moral hazard. Since the debt holder is not the risk holder, he may not agree to eminently reasonable concessions requested by a struggling debt issuer. These concessions would lead to lower losses in the long run. A case often cited to illustrate this is the cooperation between financial institutions and New York City when it was on the brink of disaster in 1975: the financial institutions involved in saving the city were holders of NYC bonds. If the financial institutions had had recourse to a AAA insurance company, the outcome might have been radically different, with much less cooperation among the parties involved[2]. The monolines often have the right to step in and make concessions, but they would have to make bondholders whole, an unpalatable option.

6) Leverage

The industry is also characterized by high operating leverage and relatively low risk based capital ratios. Total capital ratios for the AAA monolines generally ranged between 1.4 to 1.6%, providing a small cushion above Moody's 1.3% requirement (Moody's). To put this in perspective, for a bank to be considered well capitalized, its risk based capital ratio must be 10% or higher; if the ratio is below 8%, the bank is considered undercapitalized. Additionally, a bank must limit its exposure to any one entity to below 10% of its capital. Ambac's largest exposure as of June 2006, approximately 18 months before the crisis, was to Countrywide, and accounted for 267% of its qualified statutory capital. (The risk was not direct, being to different securitized pools, but was still closely correlated.)

[2] When New York City was teetering on the edge of bankruptcy in 1975, the unions bought City debt with their pension funds, banks refinanced notes due, and individual bondholders agreed to a three-year moratorium on debt payments. If all these parties hadn't agreed to these terms, and the City defaulted, they could have ended up in worse positions. (Time 1975)

At yearend 2007, the operating leverage picture for the four major largest players in the industry is shown in Table 1:

	$ millions	As % of Net Par Outstanding
Net Par Outstanding	$1,942,977	
GAAP Equity	$8,074	0.42%
Claims Paying Resources	$41,179	2.12%

Table 1: Leverage 2007

7) Combined Ratio

Another key measure of an insurance company's performance is its combined ratio: (expenses + claims paid) / premiums earned. It is almost always close to 100% for traditional insurance companies as they operate in competitive markets: they truly make zero profit on their operations, in keeping with the classic economic model of perfect competition. Profit comes from returns on investments and can cover unexpected claims: losses not predicted by actuarial tables. The combined ratio is very different for the financial guarantors since they are oligopolistic in nature and have long tail risk. Historically, their combined ratios were well under 10%, but jumped to unsustainable levels in 2007, as illustrated in Table 2:

	2006	2007	2008
Bond Insurers	10%	133%	484%
P&C	92%	96%	105%

Source: SNL Financial Inc.

Table 2: Combined Ratios

Industry's Role in the Municipal Debt Market

Besides being a profitable niche for the guarantors, guarantees of municipal debt have benefits for the issuers and buyers. The issuers gain through lower interest costs. Investors are able to

buy more liquid, more stable, highly rated bonds.

$Y = Y(r, l, s, d)$

Yield (Y) on a debt instrument is a function of r, which captures credit and other risks (legal/structural/force majeure). The AAA rating the insurance provides greatly reduces the credit risk; the unconditional nature of the guaranty reduces regulatory and legal risk. Yield is also a negative function of liquidity (l), which increases with size and wider name recognition, and s: stability, which the profile of the monolines improves. Longer maturity of bonds (represented by d for duration) increases the yield required by investors.

For the debt issuer, bond insurance clearly makes sense if the net issuance cost to the issuer is equal to or less than the coupon which would have been paid without insurance minus the premium paid to the insurer and any other fees involved in using insurance (additional legal fees, rating fees, due diligence fees).

$E[nic] \leq E[uir] - p - c$

Nic = net issuance cost; uir = uninsured rate; p = premium; c = other costs

If insurance is being looked at pre-issuance, this equation is impossible to solve with certainty: nic and uir are exogenous variables that are functions of a host of uncertain market conditions. Additionally, the econometric principle of Stable Unit Treatment Value (SUTVA) does not apply. Insurance has a signaling effect: a guaranty on one bond affects the spread of other bonds of similar and the same issuance which are not insured. The policy signals that the insurer has done due diligence on the issuer and will be tracking its performance. Investors in uninsured

bonds of a municipality which also has insured bonds outstanding will therefore accept a lower yield based on the reputation of the insurer.

A number of empirical studies have shown that insurance lowers issuance costs. Bland (1987), uses the general obligation bonds issued by New Jersey (1981 – 1984) and Texas (1983-1984), to provide evidence that private insurance reduces interest costs for states. Bland regresses net interest cost on third party credit support, Moody's rating, average maturity, and a number of other variables which could affect interest rate levels. The estimated coefficients for both states point in almost all cases to private bond insurance lowering the cost of general obligation bonds.

Bland and Yu (1987) regress Moody's credit ratings on net interest costs and find a negative relationship between ratings and interest costs, with insured bonds trading as if rated between A and Baa1. In a study that controlled for more covariates, Kidwell (1987) finds gross interest savings of .34%, and average insurance premiums of 12 bps, for a net benefit of 22 bps for the issuer. Quigley and Rubinfeld (1991) take this further empirically by examining the same bond trading in the secondary market with and without insurance: insurance lowered the yield by 14 to 28 bps. Smaller issuance benefited more from insurance, since name recognition is less for smaller municipalities and smaller issuance is less liquid.

Other recent evidence that the credit protection provided by bond insurance reduces bond yields came when Assured raised capital and became a stronger credit itself in December, 2009. The day after the capital raise, yields on several Assured wrapped bonds fell by 50 – 60 bps, while the overall AAA market rallied 10 basis points (Seymour(2009)).

The larger benefits for smaller issuance are borne out by studies of the market after 2007. As pointed out in the Bond Buyer in February, 2010, many investors need more education and reassurance to understand the municipal bond market. Investors want familiarity and liquidity: general obligation bonds of Texas and New York, large, well-known states, are cited as more desirable (Williamson (2006)). Moody's report of February 2010 shows that the average size of A-rated issues in 2009 was more than double that of 2008, whereas the issuance size for AAA and AA bonds was on average slightly smaller, 2009 versus 2008. Larger single A issuances are finding a warmer reception in the current, less liquid market.

Finally, direct evidence of the benefits of bond insurance in the municipal markets is provided through the optional bidding program that became popular for municipal debt. "The optional bidding program allows the underwriter to market the offering with or without insurance. The underwriter then selects the lowest cost bid. Since the underwriter will incorporate insurance premiums and other miscellaneous costs of insurance in any bids on the insured package, the selected bid will be that which minimizes the net present value of costs to the issuer; regardless of whether that bid is on the insured or uninsured package. Since the underwriter will make the net present value calculation, the issuer need not do so." (Reid (1990))

A study (Green (1993)), comparing the yield curves for taxable and nontaxable debt finds an anomaly, with the curve widening more for nontaxable issues:

$Y_{nx}(t) > Y_{tx}(t)$ for all t

Yield (Y) on both taxable and non-taxable (some municipal) debt is a function of time, but grows more over time for non-taxable (nx subscript) than for taxable (tx subscript) bonds.

This gave municipal issuers of longer debt an added incentive to buy insurance. Insurance was also more popular with leveraged investors: those who invest borrowed money do not want to do research on each issue but purchase in bulk, relying on insurance (McGee (2009)0.

Insurance was also viewed as an arbitrage opportunity by some of the investors in the municipal market. Though technically arbitrage refers to simultaneous buying of a security in one market and selling in another, it has come to mean taking advantage of any imperfections in the market, often related to asymmetric information flows. A survey of commercial banks in 1980 with a 29% response rate found that two- thirds of the banks had bought insured bonds for their portfolios and/or trust accounts. They were attracted by the "risk" return profile: they could hold the bonds at Aaa in their portfolios, yet the yield was over 7.2%, versus 6.45% for Aa2 municipal bonds of similar duration (Miralia (1980)).

Some of the studies of the market also looked at the premiums charged by the monolines. According to empirical evidence, insurers captured between one-third and one-half the interest saving in the municipal market. As Kidwell points out (1987), if all that bond insurance provided was lower credit risk, and the insurers priced the risk exactly the way the market did, there should have been no savings for the issuers: the premium should have been equal the savings in interest costs. Two factors contribute to this anomaly. Firstly, it is an oligopolistic industry: the guarantors want to limit competition. Secondly, the rating agencies until recently applied a different, more stringent scale for municipalities than for corporate credits. The financial guarantors recognized the dichotomy between the rating and risk, and incorporated this difference in their pricing model. Financial guarantors' early concentration in the market was partly attributable to this arbitrage opportunity between public ratings and actual risk.

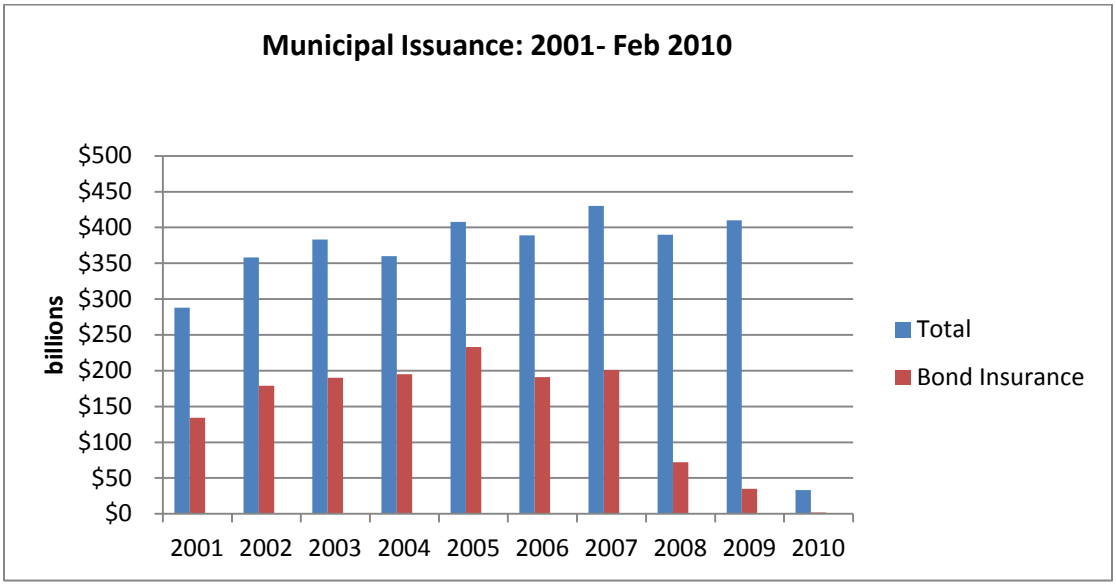
This difference in rating scales was not made explicit until recent actions of the rating agencies. The magnitude of the changes they made, which I outline below, shows the market significance of the difference. From 1981 to April 2010, Moody's rated municipal bonds according to distance to distress, not default probability. In March of 2010 the rating agency decided to align its municipal ratings with the rating of other issuers. It started by upgrading 34 states and Puerto Rico on April 19, 2010 (Seymour (2010)0. S&P started a similar recalibration process in 2001: between 2001 and 2009 it raised the rating on 57% of the municipalities it rates, upgrading 9,600 issuances. The percentage of municipalities rate AAA went from under 2% to over 4%; the AA category grew by 10%. Fitch also changed the way it looked at municipal debt, raising the ratings on 40 states, D.C., Puerto Rico and the Virgin Islands in April, 2010. [3]

While the various municipal debt studies cited in this section have slightly different hypotheses and use different data sets, the conclusions to be drawn are the same. Bond insurance did provide benefits to the issuers of municipal debt. Benefits were a combination of lower credit risk, increased liquidity, greater market recognition all of which are intertwined with lower pricing. The benefits were not limited to the insured bonds, but spilled over to the uninsured bonds of the same issuers, creating market externalities.

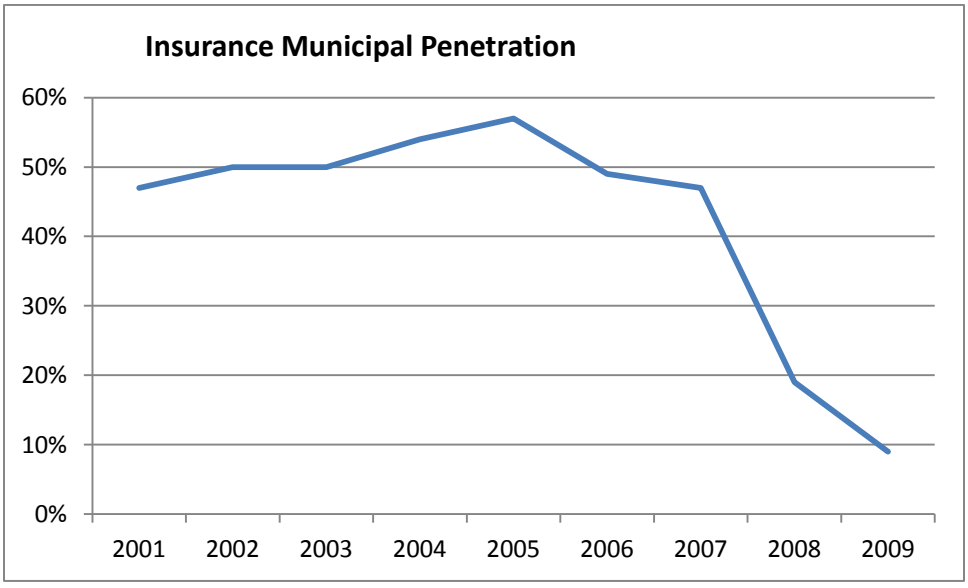
The rise of financial guaranty insurance in the municipal market from 2001 on, then its precipitous decline starting in 2008, is shown in Figures 2 and 3. The guarantors insured half or

[3] Interestingly, the immediate effect of the upgrades was to widen spreads on municipals: the law of supply and demand outweighed the role of credit in bond pricing. More municipal bonds became attractive, pushing out supply.

more of municipal bond issuance for several years, than insured less than ten percent in 2009, a year with very low issuance:



Source: Thomson Reuters
Figure 2. Municipal Issuance: 2001- Feb 2010



Source: Thomson Reuters
Figure 3. Insurance Municipal Penetration

Expansion Into Other Sectors

Pricing trends were critical in steering the industry to aggressively compete for municipal business and expand into securitization and international business. If we look at premium to par, we see pricing peak in 2003, averaging 113 bps overall. 2003 was the high point for two of the three segments of the par written by Ambac, MBIA, FGIC and FSA: premium to par for municipals peaked at 101 bps, for U.S structured finance it hit 95 bps, while for international business, premium to par reached 179 bps the following year, 2004. In 2005, international structured finance was 13.5% of the business written by the four largest monolines, but 21.5% of the total adjusted gross premiums (Moody's (2006)). The history of its involvement in these sectors is as follows:

1) Securitization

In 1986, FSA led the way in providing financial guaranty insurance to the securitization market. One could argue that this expansion was logical; securitization was based on cash flow analysis and bankruptcy remote structures so that insurers would not be directly exposed to the firms whose securitizations they were insuring, but rather to the pooled assets being securitized. (Financial guarantors' leverage precludes their taking on single name exposures.) Additionally, these securities were often complex and hard for an individual investor to analyze. The monolines, with their teams of credit personnel, told investors they were up to the task. When it came to surveillance, economies of scale existed; initially, it was difficult for an individual investor to have the staff to follow each transaction he purchased as part of a diversified portfolio. The guarantor earned a fee on the whole transaction, so could afford to be adequately

staffed to monitor these complex transactions. Additionally, the rating agencies encouraged and then insisted on the monolines diversifying away from insuring municipal debt only.

By 2001, 36% of Ambac's, 62% of MBIA's, and 51% of FSA's portfolios of insured bonds were in structured finance (Drake and Neale (2010)). If we look at new business, and concentrate on MBIA, we see that structured finance accounted for 8% of par insured in 1995, 34% only five years later, and dominated its new exposure in 2006, representing 75%.

While securitization was new, monolines could get strong credit terms and rewarding premiums. As securitization became better known and automated monitoring systems became available, more investors were willing to buy bonds without insurance. Monolines needed to compete on credit terms and price to keep even a declining share of business: monoline penetration of the structured finance market declined during 2005 (Moody's (2006)). While there is much anecdotal evidence about the monolines taking on more risk, it is hard to prove empirically, since transactions tended to be complex and were issued in different credit/interest rate environments and composed of different collateral. However, a review of Americredit's transactions clearly points toward a loosening of standards. In Table 3, I compare the "B" transaction for 2004 through 2007: the letter is a rough indication of when in the year the securitization occurred and since there is seasonality in subprime auto loans, the performance of transactions with the same letter should match more closely.

Transaction	ACF Score*	WAC**	Initial O/C***	Target O/C***	S.A.****
2004-BM	239	16.8%	8.5%	16.5%	2%
2005-BM	237	16.7%	7.5%	15%	2%
2007-BG	238	17.0%	7.5%	12%	2%
2007-BF	240	16.8%	7%	11%	2%

Source: Americredit's website: Investor section

*ACF Score is Americredit's internal credit score: higher is better.
**WAC is weighted average coupon on the underlying collateral.
***Initial O/C is the amount of overcollateralization available at issuance of the securities; it grows to target 0/C (overcollateralization), as the auto loans amortize.
****S.A. is the spread account, a cash account set up to protect the investors/monoline: it did not change in size.
Table 3. Changes in Credit Enhancement

In three years, initial overcollateralization went from 8.5% to 7% of the receivables being securitized, while target overcollateralization declined from 16.5% to 11%. In defense of the monolines' accepting less credit enhancement, Americredit's auto pools performed well during this period and Americredit had experienced management and a tested servicing platform. Yet clearly the guarantors were getting less protection over time, and this is illustrative of overall trends in the market.

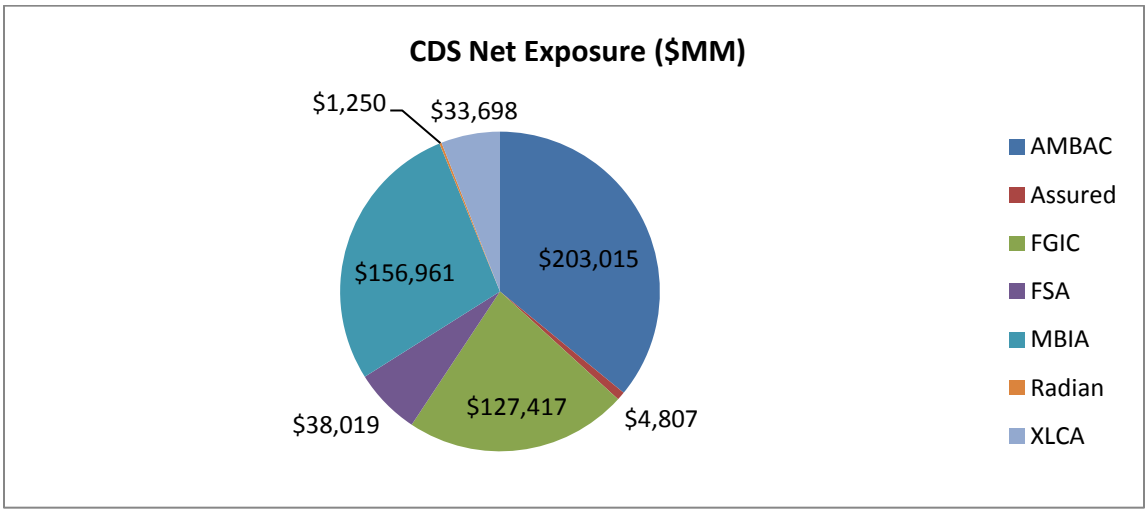
2) CDOs

In the 1990's, the financial guaranty industry expanded into insuring Collateral Debt Obligations (CDOs), ironically the "lone bright spot" for 2006, according to Moody's (2006). The first CDOs were pools of corporate bonds and loans on which the rating agencies imposed diversification requirements by obligor and industry. CDOs of ABS, pooled asset-backed bonds, did not become popular until after 2000. While there continued to be diversification

requirements, many of these deals had a preponderance of mortgage-backed bonds which proved to be highly correlated. Insuring super senior tranches of CDOs were accretive to capital for the monolines: that is, insuring these tranches reduced the guarantors' need for capital. This may these transactions fatally attractive.

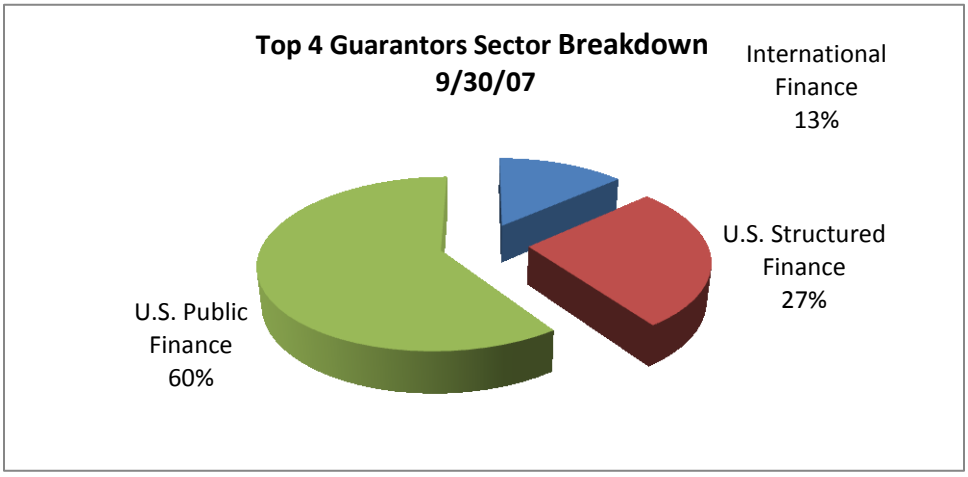
3) CDS

In 1997 credit default swaps (CDS) were approved as a form of enhancement that monolines could provide in addition to insurance policies. On one level, the risk was very similar. However, insurance policies and CDS are governed by different accounting regulations. Under a policy, a claim needs to be recognized when credit deterioration occurs. CDS need to be marked to market quarterly: an insurer's financial statements are affected if there is a change in pricing levels as well as a change in credit quality. On the other side, buyers of the protection were often trading desks of banks. These desks entered into CDS for capital relief and earnings recognition, not for default protection. If they had a AAA wrap on a AAA bond, the capital charge was reduced (to zero, in most cases), and the expected interest over the life of the bond could be present valued into the current year's earnings. As such, these desks were not really concerned with creditworthiness of their counterparty (the financial guarantor). If they had looked at the magnitude of trades, they might have stepped back. As Figure 4 depicts, by March 2008, the net notional value of CDS for the monolines was over $565 billion.



Source: ISDA
Figure 4. CDS Net Exposure

By September of 2007, the financial guaranty industry's business had clearly moved away from the staid world of municipal finance. The combined books of Ambac, MBIA, FGIC, and FSA, distributed among international finance, U.S. structured finance, and U.S. public finance as shown in Figure 5:



Source: FGIC Presentation
Figure 5. Top 4 Guarantors Sector Breakdown

Gatekeepers: Roles of Rating Agencies and Regulators

1) Rating Agencies

Since the financial guarantors were basically renting out their ratings, the rating agencies played an enormous role in the risks the industry underwrote. Standard and Poor's Corporation (S&P) was involved in rating the financial guarantors from 1971, requiring $100MM in primary capital and $100MM in reinsurance for a AAA rating. The monoline also had to convince S&P that it had the expertise to underwrite and monitor the exposures it took on. It had to pass a stress test based on municipal bond performance during the Great Depression, when 16% of debt service payments were in default during the fourth year. And while the guarantors found this quite stringent, S&P did begin to realize that the mix of business being guaranteed was far different from the Great Depression when 97% of the municipal market was represented by general obligation bonds (G.O.s), the most stable form of municipal debt. In the 1980s, only a third of new issues were G.O.s. The model assumed that the guarantor stopped writing business in the first year of the depression and that investment income was earned at the rate in existence when the model was run, obviously not conservative enough for the 2007-2008 environment with its very low interest rates. Investment portfolios were a question mark right from the beginning, since some of the companies held municipal bonds. S&P allowed this correlation because it felt that "a company can always sells assets" (American Banker (1985)), a proclamation that turned out not to be true. Other signs that the pace of growth and complexity of the industry were not being adequately dealt with were revealed by quotes of two of S&P's employees involved in rating financial guarantors: Managing Director Mebus's "We'd love the luxury of six months

off from rating," and Vice President Hayes' "We're very concerned that we're not addressing single-risk exposure enough." (American Banker (1985))

Moody's got involved in rating the financial guarantors in 1985, using a sophisticated model in which every credit insured was assigned a probability of default and an estimate of loss given default. The model simulated correlation between the risks. In 2006 Moody's added a report card where it graded its confidence in management. According to its estimates, expected losses for financial guarantors ranged between thirty and forty cents per $100 par insured (Moody's (2008)).

Fitch was also involved in rating the financial guarantors. Over time, Fitch built a statistical matrix model that used input from the side of Fitch rating the underlying transactions being wrapped by the monolines. Fitch (January 2007) hinted at its concern about portfolio concentration, noting the "concentration risk to single seller/servicers, [but taking] comfort [ ] in the high level of subordination in these deals and relatively fast amortization of the insured obligations and solid performance of this collateral." However, as collateral performance weakened, amortization slowed.

The capital charge for super senior risk was very low for all the agencies, and in the S&P model, insuring super senior CDOs actually created capital for the firm taking on the exposure. None of the agencies' models was able to prevent the huge build up of correlated risk that occurred.

2) Regulation of the Industry

State insurance regulators did not get involved in regulating the financial guaranty industry until 1985. For other types of insurance, regulators required $1 capital for every $3 of net premiums

written (American Banker (1985)). Implicit in this form of regulation is that insurers are pricing properly for risk. If insurers are under-pricing, then capital would be too low. In financial guaranty insurance, application of this rule would allow very large exposure compared to capital base. Regulators decided that the financial guarantors should not have access to state guaranty funds, which are designed to protect consumers whose insurers become insolvent. According to a joint report of the Insurance Commissioners of New York and Alabama dated December 1999, financial guarantors were reviewed once every five years. This seems woefully inadequate given the rate of growth and change of business mix occurring in the industry.

The frenetic pace of the industry's growth and the complexity of the lines of business it entered meant that the rating agencies and regulators were at least one step behind. To safeguard the holders of insured debt, they needed to be one step ahead, foreseeing what could go wrong in an economic downturn.

Effect of Financial Guarantor Rating Downgrades

When the financial guarantors were downgraded in 2008, trillions of dollars of investments were also downgraded. The values of the bonds plummeted. Investors whose portfolio guidelines restrict them to AAA investments were forced to sell in an illiquid market. This section highlights the implosion of the $40 billion auction-rate securities market that many people were unaware of until it made headlines in 2008, and the impact the monoline meltdown had on small issuers of asset-backed securities.

To retain or regain their AAA status, the guarantors would have needed to raise more capital: this was difficult to achieve since their franchise values were questionable without the ratings,

and since the complex nature of their troubled credits were hard to evaluate. There was no certainty about how much capital would be enough. Ambac and MBIA had some success, but it did not prove enough. I highlight two areas devastated by the guarantors' downgrades:

1) Auction-Rate Securities Market

Auction-rate securities were invented in 1984 in response to the high cost of funds: the Fed funds target rate had been raised to the 20% range in order to combat inflation. "Auction-rate securities (ARS) are long-term variable-rate instruments with their interest rates reset at periodic and frequent auctions." (Lee (2008)) Final maturities are usually 20 years or longer; some ARS are actually perpetual securities. On the auction dates, the holders of the securities bid on how much they want to continue to hold at what rate. The auction agent collects and ranks all bids: the new rate is the highest rate at which all bonds clear the market, so long as it is below the maximum rate. The maximum is set in the bond documentation. ARS differ from tender option bonds, where there is a tender agent who must take back the debt if the holder no longer wants to hold it, and a liquidity provider to fund what the tender agent cannot place in the market.

Basically, borrowers are getting long term funding at a rate close to short term rates. Pre-crisis, "the average ARS rate was 175 basis points below the Libor. Once the turmoil started, this pattern reversed. The rates converged on January 9, 2008, and subsequently the average ARS rate exceeded the Libor."(D'Silva et al. (2008)) Lenders, on the other hand are being paid interest which averaged 1% more than other short term rates, without tying up their money long term**,** as long as the auctions worked.

The market grew to $25 billion in 2002, was in the $45 billion range in 2003/2004; between $30 and $35 billion 2005/2006, then at $40 billion in 2007, as shown in Figure 6. Approximately half of the issuance was represented by municipal debt.

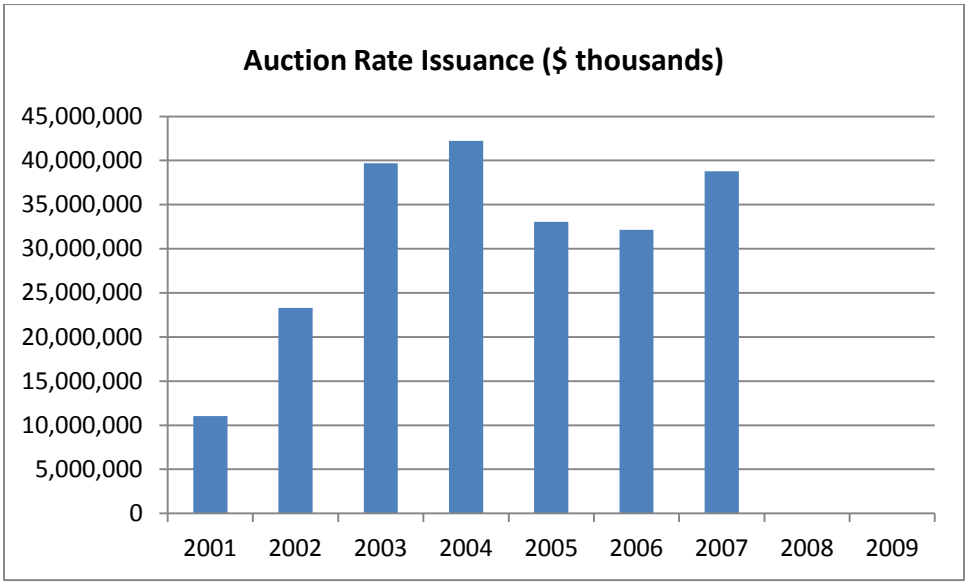


Figure 6. Auction Rate Issuance

The first auction failure was in 1987, but Lehman stepped in and redeemed the bonds, eventually writing off $35MM of the $117MM par redeemed. The ARS market was relatively stable for the next 10 years, with auction agents at times supporting bond issuances. As the monolines' AAA ratings came under fire and the credit markets deteriorated in the second half of 2007, auction failures became more common. This $40 billion market imploded in February, 2008: 87% of the auctions failed on February 14; 67% failed on February 22. In mid-February, 2008, the average 7-day rate on municipal auction bonds hit a record of 6.59%, 2.56% higher than the previous week. In concrete terms, this means that on February 12, 2008, an entity like the Port Authority of New York and New Jersey, which was rated A+ by S&P, saw the rate on $100MM of MBIA- insured bonds it had issued go from 4.3% to 20% when there were too few buyers for

the auction (conducted by Goldman Sachs), to clear. By February 20th, rates settled down to 8%, still almost twice their previous level. The Port Authority's weekly debt payments on just this debt increased from slightly over $80,000 to almost $400,000 then moderated to $155,000, still almost double what it had previously paid (Bloomberg).

Figure 7 shows the fluctuation in the ARS interest rate index caused by the crisis: rates moved very little in the last six months of 2007, then jumped up in early 2008, and were back down to normal by June 2008. (The last data point, from June 2008, is included to show the return to normalcy).

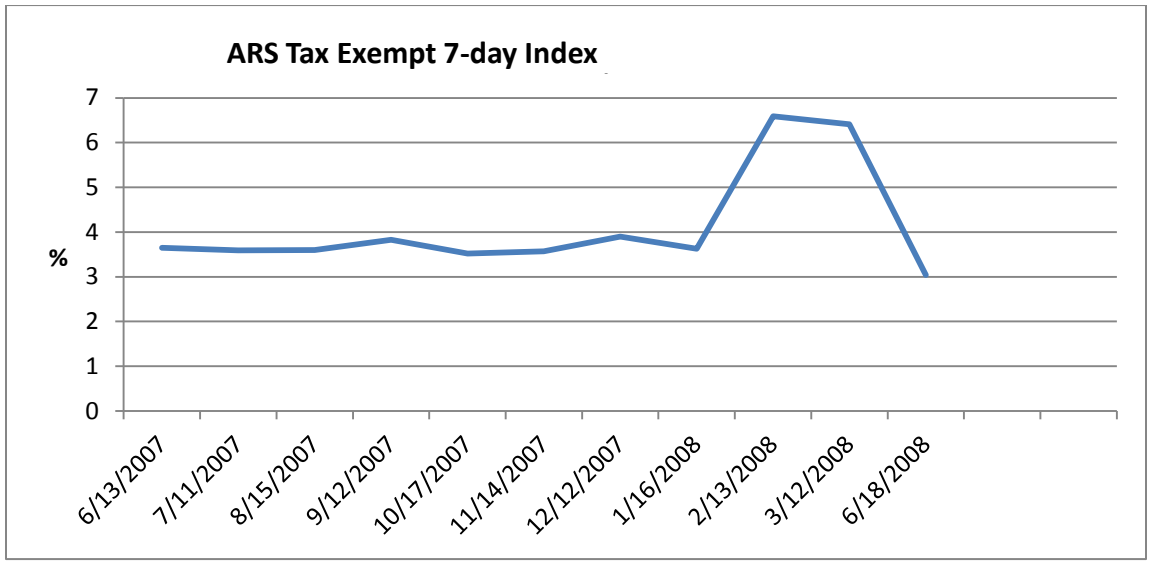


Figure 7. ARS Tax Exempt 7-day Index

Figure 8 below shows that the dispersion in rates was also much wider, with a peak at 11% in mid-February, 2008, then by June the highest rate is back down close to the average rate again:

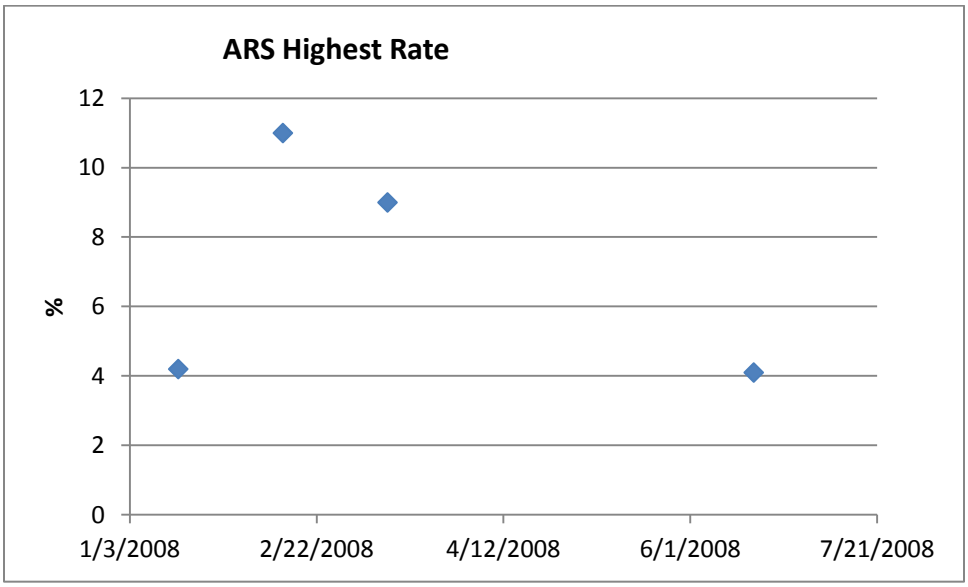


Figure 8. ARS Highest Rate

The participants in this $40 billion market had various levels of reliance on auction-rate securities for funding and differing financial profiles. The ARS issuers with less financial flexibility and stronger reliance on this market have been materially weakened by the market's implosion.

2) Small Issuers: Asset backed Securities Market

The rise and fall of the asset backed securities market is not being addressed in this paper. The financial guaranty industry played a role in this market, but was not the primary driver of the events that unfolded. However, over time, a number of smaller companies had become dependent on issuing insured asset backed securities (ABS), to fund their production. The events of 2008, primarily the unavailability of acceptable insurance for ABS issuance, severely curtailed their businesses. The chart of CPS's business production gives a stark picture of the effect:

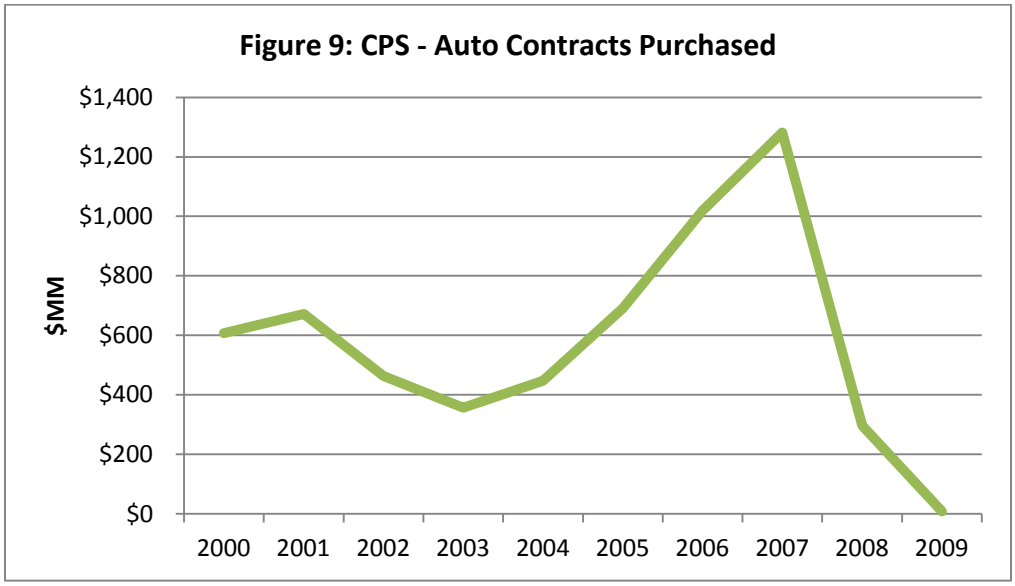


Figure 9: CPS Auto Contracts Purchased

Conclusion

The AAA/Aaa financial guaranty industry was relatively short lived. The first company got its ratings in 1971; in October, 2010, Assured Guaranty, the only monoline which remained AAA past 2008, lost its AAA rating from S&P. It had wrapped a paltry 7% of 2010 new issuance in the public finance market through September of 2010, but represented 100% of the monoline market. (McGee P. , Market Loses last Triple-A Insurer as S&P Drops Assured Guaranty, 2010) S&P cited "a struggling financial guarantee market," among its reasons for stripping Assured of its coveted AAA rating. This action came on the heels of Macquarie Group's pulling out of the financial guaranty market before the company it had been sponsoring, MIAC, ever wrote a policy, a clear sign that conditions were not propitious for the industry. (McGee P. , Macquarie Backs Out Of MIAC: Bond Insurer's Future is Bleak, 2010)

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The financial guaranty industry ventured far from its roots in municipal finance to build out its franchises and in the process it also seemed to neglect correlation across sectors, ending up with huge exposure to the mortgage market in both its direct MBS book and through CDOs of ABS. Like too many other players in the financial markets, the industry followed the creed of Chuck Prince, Chief Executive Officer of Citigroup, who, when asked about liquidity in July, 2007 by the *Financial Times* said: "When the music stops, in terms of liquidity, things will get complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing." (Fed Fails to Calm Money Markets, 2007). The financial guarantors partnered with investment banks through CDS and therefore had to take big mark-to market hits to earnings as soon as the music stopped. These hits made the sector highly unattractive to equity investors when it needed them the most.

As mentioned in other places in this paper, the business model for the majority of the firms in the financial guaranty industry were inextricably intertwined with their AAA ratings. Since the capital the rating agencies require each guarantor to hold to preserve its AAA ratings is a function of the ratings of the transactions they insure, as transactions got downgraded, the guarantors needed additional capital. Since return on equity was an important metric for the compensation of the management in most of the companies, they in the main operated with slim capital safety margins, which even a minor shock swallowed. That meant they had to go out and attempt to raise new capital at a time when their franchise values were in jeopardy, a Sisyphean task.

As soon as the guarantors' ratings were put on watch by the rating agencies, their continued existence was questionable. Once their ratings were lost, their ability to write business ceased. Yet management's ability to collect sizable cash compensation continued and their employment contracts, ensuring them comfortable lives even if their companies folded, remained in force. (SEC Filings: AMBAC, MBIA various years). The boards of these companies neglected to give the management proper incentives to be prudent. So while the mortgage/CDO market implosion was the direct cause of the industry's downfall, it is doubtful that this highly leveraged industry would have survived any substantial negative market shock.

What, if anything, can we conclude about this industry? Its downfall certainly hurt many bond investors and issuers, not to mention the investors in the stock of these companies themselves. It is perhaps best to look at the municipal picture apart from the structured finance business of these firms, since this is where the industry took root and where it survived the longest.

From 2001 to early 2010, the industry guaranteed approximately $287.7 billion par issuance of municipal bonds. As explained early in this work, the average savings was in the range of 20 basis points. We do not have information on the tenor of these issuances, but can estimate an average life of ten years. In this case, if we assume stationary supply and demand curves the math is simple: $5.75 billion in savings. Additionally, AAA/Aaa guaranties provided access to the markets to smaller issuers. To the extent these smaller issuers used the proceeds of the bonds for purposes that improved the welfare of their constituencies, credit can be given to the monolines. But making such a judgment call is very difficult. Access to more and cheaper funding may have led to higher debt levels than were prudent for many municipalities, and even to profligate spending of the bond proceeds.

Graphically, once the insurance option was virtually gone, demand for bonds which would be in the single A to AA range without insurance would move to the red demand curve, with the blue curve representing demand for the same bonds with insurance. Supply would not move initially, but then new issuance declined, so that pricing for these bonds recovered.

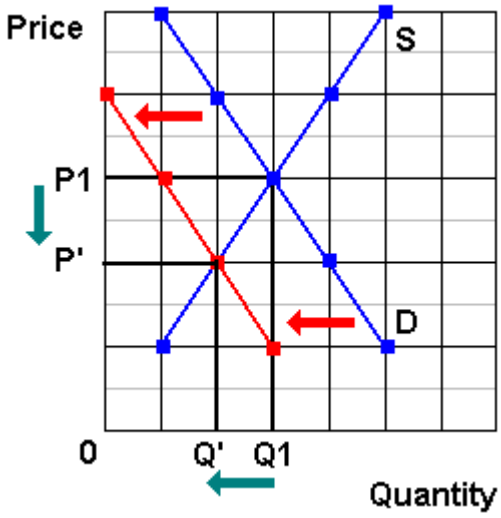

Figure 10: Supply and Demand

The demand curve for lower rated bonds without insurance would be significantly steeper.

The two large municipal bankruptcies in the last year involved insured debt; whether the insurance allowed Jefferson County, Alabama and Stockton, California to take on more debt than warranted and therefore played a role in their financial problems can be examined.

Chapter Two

Literature Review: the Effect of Debt on Health

Abstract

This essay begins by highlighting a few reasons for the growth of the mortgage market, then reviews the literature to date on the effect of debt on both mental and physical health. It looks at research on debt in general, before focusing on work on mortgage debt and foreclosure.

I. Introduction

In the decade between 1996 and 2006, the origination of subprime mortgages grew prodigiously, driving up house prices and average house size and giving multitudes of people mortgages they could not afford. (The average home price more than doubled between 1997 and 2005 (Cohan, (2009) p. 297). This was primarily driven by the profit motives of mortgage originators, mortgage brokers and investment banks, but was partially due to macroeconomic conditions, government policy and lax oversight by the rating agencies. This boom to bust adversely affected health through a number of paths. It harmed the mental and physical well being of defaulting homeowners, their families and sometimes their tenants, caused neighborhood blight in areas hard hit by foreclosure, and overtaxed resources by encouraging larger and more homes in areas often unsuited for residential building.

The unprecedented impact the housing market collapse has had on the global economy has been written about copiously and dissected from numerous angles. Much anger has been directed against the Wall Street banks that profited handsomely during the boom years. Solutions to the collapse which included any debt forgiveness for borrowers were soundly rejected. The majority feel that people should bear the consequences of their financial decisions without understanding how borrowers in some cases were pressured or fooled into taking loans they could not afford. The health consequences of those undergoing foreclosure have not made national or even local headlines. This paper attempts to shed some light on the negative health consequences as well as provide some context to the subprime mortgage explosion.

Since the collapse of the mortgage market had large macroeconomic effects, it may make sense to begin with the macroeconomic condition that set the stage for the mortgage boom: low interest rates. "The Federal Reserve had moved aggressively in 2001 to counter the weakness that had emerged in aggregate demand; by the end of the year, it had lowered the federal funds rate to 1-3/4 percent, the lowest level in forty years. With only tentative signs that activity was picking up, the Federal Open Market Committee (FOMC) decided to retain that unusual degree of monetary accommodation by leaving the federal funds rate unchanged at its January meeting." (Monetary Policy Report submitted to the Congress on July 16, 2002, pursuant to section 2B of the Federal Reserve Act).

Besides contributing to the mortgage boom by failing to control interest rates, the federal government contributed to the proliferation of the subprime market through other policies aimed at reducing discrimination in bank lending practices and increasing homeownership. Before 1994, homeownership in the United States was relatively stable at 64% of the population (Cohan (2009), p. 294). The Community Reinvestment Act of 1977 (CRA) sought to address discrimination in lending and to revitalize American cities by requiring that all banks with FDIC insured deposits be examined by federal regulators to ensure that they were serving all segments of communities in which they were chartered to operate. Prior to this act, redlining, or failing to lend at all in certain neighborhoods, was a common practice.

Seventeen years later, Congress lifted the ban on interstate banking through the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994. As banks attempted to avail themselves of this new privilege, they were often met with opposition based on their CRA record. To counter this, banks stepped up their community reinvestment activities by loosening

mortgage guidelines primarily by requiring lower down payments. At around the same time, Robert Achtenberg, the Assistant Secretary for Fair Housing and Equal Opportunity at HUD tried to be more creative in increasing homeownership among blacks and Hispanics, and in 1995, Clinton strengthened the CRA. The Taxpayer Relief Act of 1997 abolished taxes on capital gains up to $500,000 from home sales, which contributed to increasing house prices. Homeownership among the U.S. population rose 5% to 69% in a few years, and the number of bank loans going to low and moderate income families increased 80%. (Cohan (2009), p. 294) By 2000 Fannie Mae and Freddie Mac's targets for the percentage of mortgage financing they supported to borrowers with income below the median was 50%, by 2005, the target increased to 52%.

That subprime blossomed is clear: subprime increased from $35 billion in 1994 to $160 billion in 1999, 13% of overall mortgage origination (Bunce, Gruenstein, Herbert, & Scheessele(2000). It peaked in dollar terms in 2006 at $665 billion and as a percentage of total mortgage origination the year before: 23% in 2005. (Lin, Rosenblatt, & Yao (2009))

Home ownership is generally a positive event and therefore some expansion should have been good for overall health. Living in overcrowded rundown housing can cause physical and mental ill health. Research on "Housing and health in Germany" found self-rated health to be positively correlated with housing tenure, which is closely associated with home ownership. Home ownership is characterized as representing a stable investment that often generates income through appreciation, tax benefits, or other government subsidies. Homeowners in general keep their homes in better repair and have better relations with their neighbors. They stay in their

homes longer and are thus likely to be more committed to the neighborhood. (Pollack, von dem Knesebeck, & Siegrist (2004))

II. Subprime Link to Unaffordable Housing/ Foreclosure

Since home ownership in general is positive, as outlined above, if the number of new homeowners created by subprime lending far outweighed the number of subprime mortgages foreclosed upon or were even were roughly similar in number, it would be difficult to condemn subprime as having ill effects on health, even if a clear link between debt burden and ill health were found. And while the Center For Responsible Lending (CRL) found that 9% of subprime loans originated between 1998 and 2006 went to first time homebuyers, it also found that 15% of subprime loans in this period ended or will end in foreclosure, a net loss in homeownership. The CRL also disputes the argument that the poor performance of subprime loans resulted from local economic conditions by tabulating subprime foreclosures versus FHA loan foreclosures by market at the end of 2006; the table shows considerably higher foreclosure percentages for subprime in every region. (Center for Responsible Lending (2007)) That subprime mortgages often encouraged poor investments which landed borrowers in untenable situations with unmanageable expenses is further supported by multivariate analysis (Immergluck & Smith (2004)) which shows that subprime loans lead to forclosures at twenty times the rate prime loans do, after controlling for changes in demography and the economy that might drive foreclosure.

Schloemer et al. (2006) give some stark facts on subprime performance in their report as of the end of 2006: 2.2 million subprime mortgages have or will result in foreclosure, with

homeowners losing $164 billion, mostly in home equity. Nineteen percent of subprime loans made in 2005-2006 are projected to default.

The CRL provides more perspective on just who is being hurt by foreclosure in its research report of June 18, 2010: "Foreclosures by Race and Ethnicity: The Demographics of a Crisis." More than 2.5 million foreclosures were completed between January 2007 and December 2009. Over half of the foreclosures affected nonwhite borrowers. The forward-looking picture is even gloomier for non-whites, with over 20% of black and Hispanic borrowers versus 14% of white borrowers in immediate danger of foreclosure. (Bocian, Li, & Ernst(2010))

Government policies which were meant to foster homeownership aided subprime originators, whose lax standards and predatory practices contributed to a net decline in homeownership. Besides widening the financial gap between subprime credit borrowers and prime borrowers by causing more subprime borrowers to lose their homes and savings, the exposure to unmanageable debt burdens and the foreclosure process caused by subprime mortgages my also harmed the health of the borrowers and their families. The next section evalautes existing literature on debt and health.

III. Evidence of Effect of Debt on Health

Literature examining the effect of debt on health is surprisingly sparse. A link between wealth and health has long been recognized, starting with Grossman's seminal 1972 paper (Grossman, 1972). In general, research has shown the causality running from wealth to health, especially once the sample is restricted to developed countries. A few papers analyze the relationship between shocks to wealth and health: since these shocks could be similar to debt experiences,

three of these papers are briefly reviewed in subsection A below. A number of studies show that debt in general has adverse effects on health, while a few specifically point to overly burdensome housing debt and foreclosures as harming mental health. Subsection B will cover the more general studies on debt and health, plus a study of socio-economic position and mental disorders. Subsections C and D will discuss research done in the U.S. and the U.K, respectively, specific to mortgage debt, leading with the strongest work, in my estimation, for each country. Since much of the research uses self-reported health measures, evidence of the reliability of such measures as predictors of mortality is addressed directly below.

Idler and Benyamini (1997) review 27 longitudinal studies that use respondents' self-ratings of health as predictors of mortality. They limit their review to papers published in English on representative community studies which estimate the effect of self-rated health on mortality or survival after covariates are controlled for. "To sum up, in 23 of the 27 studies…the findings are consistent and quite large; self-ratings of health…reliably predict survival in populations even when known health risk factors have been accounted for." In the four studies where self-rating of health does not predict mortality, one may have been due to a confound, for two of the remaining three the loss of significance may have been due to questions about control over health, and in the fourth, other strong health measures may have led the self-rated variable to lose its significance. Overall, the work of Idler and Benyamini gives credence to using self-rated health measures as predictive of mortality or survival.

A. Wealth – Health Relationship

Meer, Miller and Rosen (2003) use inheritance as an instrumental variable to explore the health-wealth nexus, drawing data from four waves of the PSID. The IV is employed since wealth is possibly endogenous to health. The authors first model the relationship ignoring possible endogeneity and get results that support previous findings that changes in wealth have a positive and statistically significant effect on changes in health. When they re-estimate using inheritance as an IV for changes in wealth, the causal link previously found disappears. The shortcomings of this study are that the instrument can only serve as a positive change in wealth; it cannot be used to see the effect of a negative shock of wealth on health, which would be an interesting foundation from which to study debt's effect on health. Smith and Kington (1997) perform a similar study using spouse's social security as an instrument for wealth; they find zero effect of spousal social security on respondent functioning, the health measure they chose as their dependent variable, reinforcing Meer et al.'s work.

Interestingly, when Gardner and Oswald (2006), study medium-sized lottery wins affect on mental wellbeing, using the GHQ 12 score as a measure of mental health (with a higher score indicating worse mental state), they find that those with lottery wins greater than £1000 exhibited score decreases of 1.22 on average while the control gorup had increases of .18, yielding a difference in differences of 1.4. They measure GHQ at t_{-2} and t_{+2}, thereby ensuring that the effect is not just short term euphoria over winning the lottery. Their findings versus those of Meer et. al. highlight a problem in trying to examine the effect of wealth and/or debt on health in general: different measures are used for mental and physical health, there is

endogeneity between physical and mental health, a variable that affects mental health may not have a significant impact on physical health.

Hurd and Rohwedder (2010) look at how negative wealth shocks effect persons over 55, using data from the Heath and Retirement Survey. They find spending for the 55 to 64 year age group decreases by 7.6% more in the two years from 2007 to 2009 than in the two year periods from 2001 to 2007, and attribute this additional decrease to negative changes in asset values. While they do not look at health specifically, decreases in spending could have implications for outlays on health care, especially for those persons not covered by Medicare. The HRS data can therefore be used for further study in this area.

B. Financial Distress and Health

In "Financially Distressed Consumers: Their Financial Practices, Financial Well-being, and Health," nine hypotheses are tested. Self-reported health, with a higher number meaning poorer health, was positively correlated with self-reported financial stress and 65% of those who reported poor health said their health is affected by financial problems, while only 22% of those reporting good health tied health and financial problems. One hypothesis explored the relationship between negative financial events and the likelihood of reporting that financial problems affected one's health and found a correlation. However, some of the questions which when answered in the affirmative were considered to point towards financial stress are not very convincing. For example, one question asked if the respondent ever could not afford to go out, another asked about taking a cash advance on a credit card, while a third queried about ever paying a utility bill late. All these were deemed negative financial events, which could put an awful lot of us in the financial stress bucket. However, the population was sampled from credit

counseling agency clients, which means it was not representative of the overall population, but does mean that their finances were such that they felt they needed help. Yet while the results here are suggestive not causal, since the data is cross-sectional, they do point towards an association between financial stress and poorer health. "42% of the respondents in this study reported that their health is affected by financial problems," an impressive percentage. (O'Neill, Sorhaindo, Xiao, & Garman (2005))

"Over the limit: the association among health, race and debt," finds a positive relation between physical impairment and debt-to-income levels, even after controlling for socio-economic variables, from data collected via a telephone survey conducted in Ohio in June 1997. None of the other debt indicator variables modeled in this study produced significant results. When a debt stress indicator is added, it is positively associated with physical impairment: a higher stress number is associated with greater impairment and weakens the relationship between debt-to-income and impairment. In a model which includes all variables, debt-to-income has the fourth largest effect on impairment: age has the strongest relationship with impairment, followed by education and employment. Weaknesses of this study are its looking only at credit card debt, its lack of longitudinal data, and the failure of some of those surveyed to respond. The authors posit that this group is probably poorer and in worse health than those who did respond, making their results conservative; this assumption seems without basis. A minor complaint is Drentea and Lavrakas' (2000) definition of default as the number of times a minimum payment is missed: this is commonly termed delinquency, with default being reserved for 180 days overdue. A positive aspect of this study is its use of less subjective measures then most other studies for both the left and right hand side variables: debt to income is an objective number; impairment measures

people's ability to function. Overall, the study lends support to the hypothesis that debt is negatively associated with physical health.

In Drentea's next paper, "Age, Debt and Anxiety," she uses the same random digit dialing telephone survey as in "Over the limit: the association among health, race and debt," but this time examines the association between debt and anxiety rather than between debt and physical impairment. Multivariate analysis finds higher credit card debt to income increases anxiety: coefficient is 1.34; skipping a payment has a positive coefficient of .20 on anxiety. When Drentea includes a debt stress index as an explanatory variable, it explains most of the debt to income effect on anxiety, and all of the effect of default on anxiety. (Drentea, Age, Debt and Anxiety, 2000)

The next paper continues the discussion of debt's effect on mental health, but moves continents to the UK and is based on longitudinal data. Brown, Taylor, & Price (2005) empirically explore the influence of debt on psychological well-being from a sample of household heads drawn from the nationally representative, longitudinal British Household Panel Survey (BHPS), which has the advantage of containing information on both outstanding credit and psychological well-being. Their sample is a balanced panel of 2193 heads of households, of working age (16–65), who responded to both the 1995 and 2000 waves of the BHPS. Mental health is measured via the GHQ12 score, which ranges from 0–12.

The presence of unsecured household debt reduces the probability of scoring the maximum (best), on the GHQ12 score by nearly 5%. Mortgage debt is found to have no significant statistical relationship with GHQ12 scores. Households who save are found to be around 4%

more likely to report complete psychological well-being than non-savers, but the benefit from being a saver is outweighed by the negative effect of being in debt which suggests an asymmetry in the way financial behaviors affect psychological well-being. In direct contradiction to the lottery study referenced above, windfalls within the past year do not improve self-reported psychological well-being, nor do investments or more valuable houses.

Additionally, "a 10% increase in the level of outstanding credit (i.e. an additional £115.35) would reduce the probability, of a household head with otherwise mean characteristics, reporting a maximum GHQ12 score by 0.092….Similarly average annual savings, of the whole sample (£635.5), would need to increase by £116.93 or over 18% (.092/.005) in order to maintain the average probability of complete psychological well-being….Amongst those in debt the marginal increase in psychological well-being would be larger and the corresponding offsetting effects would need to be much more substantial." Interpreting these results as showing causality from debt to mental health is limited by being based on two observations only, 1995 and 2000.

The fourth paper in this subsection is also based on longitudinal data from the UK: Skapinakas et al (2006) used the UK Psychiatric Morbidity Survey, which is conducted by the Office of National Statistics. Individuals were questioned twice, eighteen months apart: those exhibiting no depression at time one, but experiencing financial difficulties, were found to be significantly at risk of depression at time 2: the odds ratio for major depression increases from 1 to 2.05. The odds ratio of major depression at time 2 for those with financial difficulties and depression at time 1 is 4.2. Individuals were classified as having financial difficulties if they responded affirmatively to any one of a number of questions about being seriously behind on bills, mortgage payments, credit card debt, if their utilities had been cut off due to failure to pay bills,

or if they used utilities less because of worry about the expense, or involvement in unorthodox borrowing. "Being seriously behind" adds subjectivity; the authors feel that subjective measures may be important in diagnosing mental health disorders.

Unlike the work of Reading and Reynolds (2001) discussed below, where all responses were used, only data for those who responded both times were kept, yielding a respectable sample size of 2406 inidividuals, and reducing the possiblity of selection bias. Social class was not associated with increased risk of a mental disorder episode, nor were lower education or lower living standards statisitically relevant once other variables were controlled for. This study adds to the research in this area by establishing a link between financial problems and depression.

Reading and Reynolds (2001) also link debt to depression in the U.K.: their study is however specific to maternal depression. Between 10 and 30 percent of mothers of young children are estimated to suffer from depression, not only postnatally, but connected to poor or unsupportive realtionships, pregnancy, life events, and disdavantage socioeconomically and financial hardship. Readings and Reynolds limit their analysis to the realtionship between debt and depression. The data they use come from a study on the effects of Citizen's Advice Bureau services on the health of mothers and young children. It includes two Edinburgh Postnatal Depression Scale questionnaires six months apart, along with SES information. Families with infants under one year of age were recruited from six urban practices which serve the moderately deprived in Norwich, U.K. between July 1997 and Februrary 1998. Families filled out questionnaires twice between 40 days and 14 months apart, with the average time elapsed between the two surveys

being six months. 919 families were invited to participate; 261 families responded the first time, 219 families responded the second time and 209 families responded both times.

OLS was used to model the relationship between a number of variables and Edinburgh Postnatal Depression Scores (EPDS) at times 1 and 2. Debt worries was an indicator variable with possible values of 0 to 6, with 0 indicating no debt worries and 6, extremely worried. EPDS is a 10-item measure of deprssion in women, with 13 or higher indicating a high risk of significant depressive disorder, which Reading and Reynolds feel is reliable and valid. (They cite other studies to that effect.) 25% of the women had EPDS scores of 13 or higher on the first questionnaire compared to 15% the second time. The drop was due to a number of women who scored high the first time not responding the second time: 84% of women who scored less than 13 returned the second questionnaire, but only 65% who had an EPDS equal to or higher than 13 responded the second time. Single parenthood, low socioeconomic status, as well as lack of availability of a lift all contributed to higher EPDS. Debt worries and single parenthood were the only significant variables at time one and together accounted for 16.5% of the variance in EPDS, with the coefficient on debt worries equal to .86 and that on single parent, 3.28. Being extremely worried about debt, level 6, added 5 points to the EPDS score. Since depressed women may worry more about debt, i.e., there could be reverse causation, model 2 of this study drops debt worry as an independent variable. The R^2 in this model is 12.9%; the coefficient on owing money is 2.13, with the dependent variable still EPDS. Model 3 has a longitudinal aspect: debt worries at time 1 is regressed against EPDS at time 2 and explains 15% of the variance. However, if EPDS at time 1 is controlled for, the effect of worries at time 1 on EPDS at time 2 disappears.

In the authors' own words: "the results beg more answers than they answer…, yet they imply that debt is an important aspect of the link between financial adversity and depression. Rather than a linear pathway there may be a circular one; worries about debt contribute to making depression worse, while depression causes women to worry more about their debt." (p.449). A weakeness of the study is that less than a third approached responded. The primary purpose of the study was to assess Citizen's Advice Bureau services, not the effct of debt on mothers' health. Also, while the authors state that they feel it is generalizable to the wider UK population, (they must mean of mothers with small children), they initially say that the population served tended to be moderately deprived. Since these are relative terms, the popuation can't be representative if it is more deprived, even moderately. And scaling debt worry on a scale of 1 to 6 then using in a regression is difficult to interpret: what does it meant that extremely worried is six points higher than not worried at all about debt? The variable "owing money" is preferable, but not defined. Reading and Reynolds' idea of comparing the effect of psycholigical intervention versus financial intervention on depression is good.

Bridges and Disney (2010) expand on Reading and Reynolds work by using data from the UK's Family and Children Survey (FACS) for 1999 to 2005. This survey orginally tracked only lone parents with children or households with children with limited incomes, then expanded to be a representative sample of all families with children. As in many of the other studies, its main purpose was not related to debt and health, but was to evaluate the effectivens of government work incentive measures. Nonetheless, it does gather data on financial hardship, credit and borrowing arrangements and health. Across all years and samples, there is a positive correlation between those reporting financial difficulties and depression which is statistically significant at

the 5% level. When lagged analysis is done, looking at those who currently report no debt problems, but reported debt problems in the past, 6% report depression as compared to 2% of those reporting no debt problems. The incidence of those concurrently reporting debt problems and depression is much higher: 17% in the 2005 survey. While establishing a correlation, no causality is established via this analysis.

To try to establish causality, Bridges and Disney design a latent variable model with the left hand side the latent propensity of being depressed at time i and the right hand side containing a vector of exogenous variables plus a measure of self-reported financial difficulties and an error term. Socioeconomic variables and current health are controlled for. "Positive responses to the questions concerning 'debt problems'/'financial stress' raise the incidence of depression by just over a percentage point." (Bridges & Disney, 2010) (p.393) Ill-health also has a positive and significant effect on the probablity of reporting depression. However, when the authors look at the relationship between objective measures of indebtedness and depression, the link weakens considerably. Having a savings account lowers the propensity to report depression, yet the number of outstanding debts is indiviudally insignifcant and only arrears in excess of £2000 are significant (and positively associated with depression.) The authors take their analysis one step further after these unexpected results and find that self-reported measures of financial difficulties are related to objecitve measures of the same, so that objecitve measures affect depression indirectly by affecting self-reported financial difficulties which do have a statistically significant effect on the probablity of reporting depression.

In "Health and Financial Strain: Evidence from the Survey of Consumer Finances," Lyons and Yilmazer (2005) look at household financial strain and self-reported health of the household

head. Cross sectional data from the Survey of Consumer Finances is employed in a 2-stage probit for health status of household head. Financial strain is identified by being either 1) delinquent on loan payment, 2) total debt > total assets, or 3) liquid assets/income < .25. The authors find causality from health to financial strain but not the reverse, then use negative shock to income to ensure identification of financial strain equation. 32.4 % of delinquent households have heads in poor health compared to 23.8% of non-delinquent. Over 27% of delinquent households had negative shocks. For the two-stage probit of the health equation, results are not significantly different from zero for the effect of financial strain variables on health, age, black, receiving welfare and smoking. When marginal effects are computed, being delinquent is positive and significant on poor health for those with high school education or less.

C. Foreclosure and Health: United States

Though not empirical, the essay entitled "Will the Public's Health Fall Vicitim to the Home Foreclosure Epidemic?" sets out the reasons why mortgage problems might strain mental health: the process is long and has numerous stages. On a rating scale that ranks the stressfulness of 43 life events, foreclosure has moved from number 21 to number 11 in the thirty years from 1967 to 1997. The article does state that "home sale proceeds are wholly retained by US banks," which is an inaccurate statement. (Bennett, Scharoun-Lee, & Tucker-Seeley (2000))

Pollack and Lynch's (2009) "Health Status of People Undergoing Foreclosure in the Philadelphia Region," is perhaps most relevant in looking at how the practices of the subprime mortgage industry in the United States affect public health. Participants undergoing foreclosure were recruited by a mortgage counseling agency and their health was compared to a community sample for the 2008 Southeastern Pennsylvania Household Health Survey. A single Likert-scale

item was used to assess self-rated health. (Self-rated health has been found to be reliable in other studies. (Idler, 1997))

The effect of foreclosure on health was measured via estimation of weighted multivariate logistic regression models. Foreclosure was the primary independent variable and health indicators were the dependent variables. Age, gender, race/ethnicity and socioeconomic indicators were included. The experimental group had more unemployed, more individuals below the poverty level, fewer college graduates than the control group. When socioeconomic characteristics were taken into account, the foreclosed population no longer had worse overall health than the control group. The foreclosed were significantly more likely to have hypertension and heart diseases and to have a clinically diagnosed psychiatric condition, with 36.7% meeting the screening criteria for major depression. The foreclosed reported smoking more and drinking more in the past month. Cost related medical non-adherence was quite high and more than half of the sample reported skipping or delaying a meal because of cost. Some of the participants reported health as the reason they were in foreclosure, but it was not the most commonly reported reason for foreclosure. It seems reasonable that causation flowed both ways, with health causing some foreclosures, but the stress of foreclosure and the inability to pay for medical care while going through foreclosure also having a detrimental effect on health.

In a later work, Pollack et al.(2010) use propensity score methods to compare individuals who reported living in unaffordable housing situations to similar individuals living in affordable housing. Respondents were asked how difficult it was for them to afford housing in the last year, with response choices of: very difficult, somewhat difficult, not very difficult, not difficult at all. The first two responses were grouped toegether as unaffordable housing, while the latter

two were considered affordable housing. Similarly, on the dependent variable side, self-rated health was grouped into fair or poor versus excellent or good. The propensity score method should make the results more generalizable to other populations. Housing unaffordability was significantly related to increased odds of poor self-rated health, hypertension, arthritis and cost-related healthcare and prescription nonadherence. Interestingly, the effects were greater for renters than homeowners, with the strongest effect for cost-related outcomes.

D. Foreclosure and Health: UK

A number of studies from the U.K. examine "The Psychological Costs of Unsustainable Housing Commitments," as Taylor et al. (2006) do in their paper so titled using data from the British Household Panel Survey (BHPS) from 1991 to 2003. They first point out that household sector mortgage debt rose from 25% of disposable income in 1980 to 75% in 1992, that there have been one million evictions and five hundred thousand repossessions in the U.K. since 1991. "Results from multivariate analysis indicate that for men arrears and housing payment problems incur significant psychological costs," even after controlling for financial hardship and financial shocks and other time-invariant individual characteristics. Arrears have a larger impact than payment problems, and mental well-being decreases further if the threat of eviction or repossession is imminent. "For women, it is persistent exposure to unsustainable housing commitments that incur psychological costs. [Additionally], the psychological costs of arrears are larger among homeowners than tenants."

The strength of this paper lies in the richness of the panel dataset. Since individuals are followed over time, those who changed address could be asked if it were due to eviction or

repossession. The detailed questions allow the degree of financial hardship to be ascertained: households are asked whether they could afford heat, meat, vacations, furniture, clothing… Mental well being is measured using the GHQ12 score, which is dervied from the General Health Questionnaire, the most widely used self-reported mental health measurement in the U.K. (Taylor, Pevalin, & Todd, 2006)

In this earlier 1998 work on the subject of repossession and heath, Nettleton and Burrows delve into specific social characteristics which make indebtedness problems currently more likely by using the Survey of English Housing, which is a secondary analysis of British Household Panel Survey (BHPS) and consists of households headed by younger people, single parents, single male parents, divorced and separated, divorced and inactive. They state that "Mortgages…are premised on the assumption of stable employment over a long period of time. There is an increasingly clear disjuncture emerging between the supposed need for flexible labour markets and the ability of people to sustain mortgage costs over long periods." (p.735) To examine this change over time they look at two transitions: 1991 to 1992 and 1994 to 1995. In the first, the housing recession was at its deepest; by the second, the recession was beginning to end. A weighted sample was constructed of individuals who had a mortgage but reported having no problems paying it in the first year. For the first transition, 15% of the 3,700 sampled were having trouble by second year. In the second transition, 10% of 3,500 were in trouble. GHQ12 scores, ranging from zero for excellent to 36 for very poor, were used to measure mental wellbeing. The authors looked at both the change in the score, and the percentage of the sample who scored better versus the percentage who scored worse. The GHQ12 score change was analyzed with a multivariate regression while a logistic regression tested the dichotomy. The

control variables included income and income change, physical health problems and changes in physical health problems, employment and changes in employment. Two models were run for each dependent variable: one with all variables and the other with best fitting; males and females were run separately. For men, mortgage problems led to a 1.64 increase in GHQ12; for women it led to a 2.51 increase. An inverse relationship was discovered between the original score and its change: higher scores were less likely to change. For both sexes, each health problem in 1991 led to a .75 change in the GHQ12 score. A decrease in the number of household members employed led to a 1.2 unit increase in the GHQ12 score. The best fitted model explained 22% of the change in the GHQ12 score.

The logistic regression found women with mortgage problems having a higher chance of suffering a decrease in wellbeing, compared to women who did not, by a factor of 3.24 while men's odds increased by a factor of 1.81. The relationship is weak for the second transition for the multiple regression but similar for the logistic, with the factor for men being 1.5 and for women 1.95. The study also looked at number of visits to GP after onset of mortgage problems: it was only statistically significant for men in the first transition, but did increase the likelihood that they would visit their general practitioners.

Nettleton and Burrows also perform two qualitative studies which bring a new perspective to the debate over the relation between health and home repossession. In both studies they follow thirty families who have gone through the foreclosure process in the U.K. They provide a thorough description of what the process entails. In the first study they make what I feel is a valid point about the importance of psycho-social mechanisms in determining people's well being: "it is *relative* rather than *absolute* poverty that is critical to overall health status."

(Nettleton & Burrows, (2000), p.463). Through interviews with 44 adults and 17 children they show that home ownership, which "for too long health policy analysts have implicitly regarded … as the domain of the contented middle classes," (Nettleton & Burrows (2000), p.478), can have significant emotional costs which can affect health. In their second paper they strive to show that these families were not passive through the process, but that the institutions they negotiate with can be impersonal and inflexible, leading to feelings of helplessness, frustration and anger. Their works definitely lend credence to the argument that foreclosure has negative psycho-social results.

Foreclosures are also thought to harm children: studies have shown that uprooted children "tend to suffer emotionally, socially and academically." (El Boghdady, 2010) This harm to family members is perhaps a good segue into spillovers outside the household.

IV. Spillover Effects

By increasing foreclosure rates, subprime lending has a number of spillover effects on the neighborhoods in which the foreclosures take place. Perhaps the most detrimental is that they lead to more foreclosures by depressing property values. Modeling by Lin et al. (2009) clearly sets out the effect of foreclosures on surrounding house values, weighting their data points by time and distance, using 2003 as a boom year and 2006 as a bust. The worst effect is an 8.7% decline in house values per event. Seasonal and zip code dummies control for seasonal and neighborhood fixed effects. Foreclosures have also been shown to increase violent crime rates, which can be a public health concern since it causes injury, and in the most extreme case of murder, mortality. In "Assessing the Impact of Home Foreclosures in Charlotte

Neighborhoods," Michael Bess (2008) found that from 2003 to 2006, "violent crime rose consistently…in high-foreclosure neighborhoods, but remained significantly lower in the low-foreclosure neighborhoods, except in 2004."

V. Conclusion

Most of the research to date has been cross sectional; the few longitudinal are generally short term. Further research is needed to establish causality. HRS data can be used to explore how increases in debt affect health. The Case Schiller index or Freddie Mac home price index can pinpoint areas hardest hit versus least hit by property value declines; a quasi discontinuity design of health of owner occupiers in the two communities, pre and post the decline in property values, could be done. The challenge will be to control for other economic variables and heteroskedasticity among the samples employed.

Chapter Three

The Effect of Mortgage Debt on Health

co-authored with Leigh Ann Leung

Abstract

This study examines the effect of mortgage debt on health among homeowners using six waves of the Health and Retirement Survey (HRS) from 1998 to 2008. Health status is measured by overall wellbeing, incidence of high blood pressure, obesity, and depressive symptoms. Since homeownership in the United States is promoted through subsidized home financing, our findings have important policy implications and also highlight the need to improve financial literacy.

1 Introduction

Owner-occupied housing is a major asset on U.S. households' balance sheets, accounting for over a third of total assets (Poterba and Samwick (2001)). A number of social benefits are associated with homeownership. Homeownership lengthens housing tenure by increasing the cost of relocating and reducing household mobility. Longer housing tenure promotes family stability and better child outcomes. Longer housing tenure is also associated with better self-reported health (Dietz and Haurin (2003), Pollack et al. (2004)). Homeowners have an incentive to improve housing structures and participate in political and social activities. Though homeowners bear the cost of capital reinvestments and community engagement, neighboring homeowners benefit as well through higher home valuations[4] (Dietz and Haurin (2003), Glaeser and Shapiro (2003)).

Since home purchases require a great deal more capital than households typically have on hand, most home sales are financed. While homes constitute a large share of household assets, home mortgages constitute a large share of household liabilities. U.S. policy encourages homeownership but little is understood about the ramifications of the concomitant debt. In fact, the government's subsidy of mortgage financing[5] encourages leverage over equity in home purchases and greater consumption of housing than households would have chosen if these subsidies did not exist (Glaeser and Shapiro (2003)). In 2008, 93 percent of homes purchased

[4]The externality works in the opposite direction since a foreclosure lowers neighboring home values.

[5] The cost of borrowing is subsidized by allowing interest paid on mortgages to be deducted from income (Rosen (1985)) and through government guarantees which reduce the credit risk of mortgage loans, essentially lowering the interest rate.

involved financing, though in 2010, this declined to 91 percent (Hale (2009, 2010)). The prevalence of house financing is also affected by the interaction between policy and economic conditions. During periods of mortgage credit expansion, riskier homebuyers can also qualify for mortgages, thereby increasing the prevalence of mortgage finance in home sales (Mian and Su (2009), Keys et al. (2010)).

While homeownership leads to positive social outcomes, mortgage indebtedness potentially leads to negative health outcomes. We use Grossman's (1972) model of health as a stock variable, which depreciates over time but can be augmented by combining time, income, and medical care, to illustrate the potential negative impact of mortgage indebtedness on health. We hypothesize a direct and an indirect path through which mortgage indebtedness leads to poor health. First, higher mortgage indebtedness increases financial stress. Epidemiological studies have found that stress plays a role in cardiovascular disease (Dorian and Taylor (1984)). Previous studies have also found that stress affects both the contraction of and progression of certain diseases (Calcagni and Elenkov (2006), Contrada and Baum (2009)), and in particular stress can increase the probability of catching a cold (Takkouche et al. (2001)). Financial stress can also lead to unhealthy behaviors such as drinking, smoking, or substance abuse, or may cause sleep problems and eating disorders (Neil Schneiderman (2008)). Second, since higher mortgage indebtedness corresponds to a negative wealth effect, it can lead to fewer health investments, particularly preventative care investments.

Mortgage indebtedness can be measured as the ratio of mortgage loan to home value (LTV). A high LTV means that homeowners have little or no equity in the home value. In the model, a

decline in home prices affects homeowners differently depending on their level of home quity[6].

Among homeowners with little or no equity, a decline in home prices increases LTV, and leads to financial stress and fewer health investments[7]. Among homeowners with sizable equity cushions, a decline in home prices increases LTV, but may not necessarily lead to financial stress or changes in health investments.

Given the potential negative relationship between debt and health, policies that promote homeownership through financing may have unintended health consequences, especially when home prices decline sharply. Prior studies on debt and health consider individuals near or at foreclosure. However, the share of homeowners that default is small compared to the share of homeowners with mortgage debt outstanding and the negative impact of debt on health may affect homeowners not in foreclosure. Furthermore, most existing studies use data that are limited to a specific state or set of states in the U.S. To our knowledge, this is the only study to use household mortgage loan to home value to estimate the effect of the mortgage indebtedness on mental and physical health among a nationally representative sample of adults over the age of 50 in the U.S.

We show that high mortgage indebtedness is associated with a greater likelihood of poor health,

[6] The level of home equity is related to housing tenure. New homeowners are more likely to have less equity compared to seasoned homeowners given the amortizing structure of mortgage loans.

[7] Empirical evidence for the indirect effect is mixed. Keese and Schmitz (2010) using longitudinal data for Germany found that individuals with debt are more likely to visit a doctor. Since Germany has universal healthcare, the indirect effect of debt on health is likely smaller. Currie and Tekin (2011) using foreclosure data for four states in the U.S. found that a higher number of foreclosures is associated with more hospital visits and fewer preventive medical visits.

a decline in well-being, obesity, high blood pressure, and presence of a depressive symptom. However, if mortgage indebtedness and health are endogenous, then OLS estimates are biased. The endogeneity may be due to reverse causality or that debt and health are simultaneous determined by an unobserved omitted variable, e.g. ability, health or wealth endowments, risk tolerance, or time preference. We argue that the recent housing decline serves as a natural experiment by shifting the level of mortgage indebtedness across metropolitan statistical areas (MSA) over time. We use home prices as an instrument for the mortgage loan to home value (LTV) ratio in an Instrumental Variable (IV) framework to identify the causal effect of mortgage debt on health. Among mortgagors, we found that a 10 percent increase in the probability of high LTV increases the likelihood of a decline in well-being by 4 percent and the likelihood of a depressive symptom by 3 percent. We examined whether the results are robust to changes in the estimation sample, redefinition of the variable of interest (LTV), and the estimation model. Following Currie and Tekin (2011), we also used the incidence of cancer as a falsification test.

2 Literature Review

Defaulting on mortgage debt is a disruptive life event that may negatively affect health. In the U.S., the rise in foreclosures since 2008 has prompted research on the impact of foreclosures on health. Pollack and Lynch (2009) compared the health of individuals, recruited through a mortgage counseling agency, undergoing foreclosure with that of a community sample from the 2008 Southeastern Pennsylvania Household Health Survey. They found that the foreclosed sample were significantly more likely to have hypertension, heart disease, and a clinically diagnosed psychiatric condition than the control group. The foreclosed also reported greater consumption of smoking and drinking in the past month. In a broader study covering four states

(Arizona, California, Florida, and New Jersey), Currie and Tekin (2011) found that zipcodes with a greater number of foreclosures also experienced a greater rise in Emergency Room visits and hospitalizations for stress related conditions, controlling for county-specific, time-varying factors such as labor market conditions. Furthermore, the effect was greater among younger individuals and for conditions that are typically avoidable with preventative care.

Prior to default, borrowers who have missed two or more consecutive payments on the mortgage loan are considered delinquent. Previous studies have examined the effect of mortgage debt delinquency on health. For the U.S., Alley et al. (2011), using the 2006 and 2008 waves of the Health and Retirement Survey (HRS), compared the health outcomes of mortgagors who had been more than two months delinquent on their mortgage payments in the past two years to those who are current on their mortgage payments. They found that delinquent respondents were significantly more likely to have depressive symptoms and to have less access to health relevant resources. These results are qualitatively consistent with similar studies in the U.K. Taylor et al. (2006), using the British Household Panel Survey (BHPS) from 1991 to 2003, a period that covers the recession in the early nineties, found that being past due on mortgage debt is associated with a negative psychological effect among men, controlling for financial conditions and other personal traits. Nettleton and Burrows (1998), using the Survey of English Housing[8] from 1991-1992 and 1994-1995, found that difficulty meeting mortgage payments is associated with a decline in mental well-being.

Previous studies have also examined the effect of unsecured debt on health. Drentea and

[8] The Survey of English Housing is a supplemental survey to the British Household Panel Survey (BHPS) consisting of households headed by younger individuals, single parents, single male parents, divorced and separated, divorced and inactive.

Lavrakas (2000), using a sample of adults in Ohio, found that greater credit card debt-to-income is associated with a greater likelihood of physical health impairment. In a follow up study, Drentea (2000) found that greater credit card debt-to-income is associated with a greater likelihood of having mental anxiety. Similarly, Brown et al. (2005), using the 1995 and 2000 waves of the British Household Panel Survey (BHPS), found that greater unsecured household debt is associated with the likelihood of having poor mental health. Keese and Schmitz (2010), using the German Socioeconomic Panel (GSOEP) from 1999-2009, found that greater debt is associated with worse mental health and a higher incidence of obesity. They also estimated a fixed effects model to control for individual-specific, time-invariant factors that may be endogenous to health and debt. Fixed effects estimates show that greater indebtedness leads to poor mental health and lower health satisfaction with mortgage debt having a large effect on mental health. Though, loan amounts of unsecured debt are typically less than that of mortgage, these findings suggest that even unsecured debt has a negative effect on health.

Finally, a number of studies have examined the effect of self-reported financial stress on health. Bridges and Disney (2010) and Skapinakis et al. (2006) found that individuals experiencing financial difficulties were more likely to exhibit depression. O'Neill et al. (2005) and Lyons and Yilmazer (2005) found a positive correlation between self-reported financial stress and poor self-reported health. While these studies show a negative relationship between financial stress and health, the particular type of debt leading to financial stress was not identified.

The literature on the health effects of debt has primarily focused the household's ability to make debt repayments, that is, whether the household is liquidity constrained. Another measure of a household's financial condition is the debt to asset ratio, an indicator of balance sheet leverage. In contrast to prior studies, this study focuses on households with high mortgage debt to assets

but not necessarily delinquent or in default. We argue that households with a high mortgage loan to home value (LTV) also experience financial stress given that debt secured by the primary residence comprise the largest share of household balance sheets. Since the number of homeowners that have experienced a decline in home equity is larger than the number in delinquency or foreclosure, we argue that the potential effect of having high LTV on health is relevant to a broader segment of the population[9].

3 Data

Individual level data on health, housing, financial situation, and other socioeconomic factors were obtained from the University of Michigan Health and Retirement Survey (HRS). The HRS is a nationally representative survey of adults over the age of 50 conducted every two years. Since young adults are more likely to borrow to finance a home purchase, excluding these individuals is a limitation of the data. On the other hand, older adults are more likely to be homeowners and less likely to transition in or out of homeownership[10]. For our analysis, we subdivide the respondents into homeowners, which includes all who responded that they owned a home and includes both those with mortgages on their homes (mortgagors) and those who own their homes outright, free of debt. The mortgagor category is therefore a subset of homeowners.

Six waves of the HRS from 1998 to 2008 were chosen to overlap with the housing boom and bust cycle and allow for panel estimation. Individuals living in a multifamily home, nursing

[9] For example, Alley et al. (2011), using only the HRS 2008 participants eligible to be asked mortgage-delinquency questions, reported a mortgage delinquency rate of 3 percent whereas, using complete HRS 2008 wave, 13 percent of mortgagors have high LTV.
[10] The participation rate of homeownership stabilizes at around 70 percent after age 45 (Poterba and Samwick (2001)).

home, farm, or ranch were excluded. For the OLS and IV estimations, each wave was treated as a cross-section to create a pooled dataset with slightly over 80,000 observations. For the fixed effects estimation, the same dataset, excluding individuals who died between 1998 and 2008, was treated as an unbalanced panel with a little over 19,000 observations. The HRS housing module contains extensive information on housing-related items such as homeownership, housing structure, home purchase price, current house price, and housing debt outstanding. The HRS dataset was merged to an index of house prices by metropolitan statistical area (MSA). Home price index data was obtained from Freddie Mac[11] which publishes the Freddie Mac House Price Index (FMHPI).

The FMHPI is constructed using repeat transactions on single-family detached or townhome properties which serve as collateral for mortgage loans purchased by either Freddie Mac or Fannie Mae. The FMHPI closely tracks other constant-quality home prices indices such as Standard and Poor's Case-Shiller and the Federal Housing Finance Agency.

3.1 Variable definitions

Health conditions related to financial stress include self-reported overall well-being, negative change in overall well-being, obesity, high blood pressure, and presence of a depressive symptom. HRS measures overall well-being as a categorical variable where 1 indicates excellent health, 2 indicates very good health, 3 indicates good health, 4 indicates fair health, and 5 indicates poor health. Poor overall health was constructed as a dichotomous variable where 1 indicates fair or poor overall health. Decline in health was constructed as a dichotomous variable

[11] Freddie Mac is a former government sponsored entity now under a conservatorship directed by the Federal Housing Finance Agency (FHFA).

where 1 indicates an increase in the self-reported overall well-being categorical variable. Obesity was constructed as a dichotomous variable where 1 indicates a body-mass index of 30 or greater. High blood pressure is a self-reported dichotomous variable where 1 indicates presence of high blood pressure. The HRS measures mental health with a modified version of the Center for Epidemiologic Studies Depression (CESD) scale. The CESD score is the sum of six indicators for the presence of depressive symptoms (depression, everything is an effort, sleep is restless, felt alone, felt sad, and could not get going) minus the sum of two indicators for the presence of non-depressive symptoms (felt happy and enjoyed life). CESD scores range from 1 to 8, with 8 representing those exhibiting the most depressive symptoms.

We converted this measure of depression into a dichotomous variable with 1 indicating the presence of any depressive symptom. Cancer is a self-reported dichotomous variable where 1 indicates presence of cancer.

Households experience financial stress when the burden of mortgage indebtedness becomes excessive. To measure excessive mortgage indebtedness, we use the loan to value (LTV) ratio defined as the amount of mortgage loan outstanding divided by the self-reported home value[12]. LTV measures the degree of leverage used to finance the primary residence, which, all else equal, declines over time given the amortizing nature of mortgage loans. If housing values decline, then home equity is reduced and may even be negative. As well, homeowners with a high LTV cannot reduce housing consumption accordingly and even if they manage to sell the

[12] The Rand version of HRS home value and mortgage debt variables were used instead of the raw HRS variable since it had fewer missing values. All housing variables refer to the respondent's primary residence. A small number of respondents had a LTV that far exceeded average values. LTV was top-coded at their respective 99 percentile values. An indicator variable was included to adjust for LTV top-coding.

home, they are more likely to incur a financial loss due to lower equity and transaction fees. Therefore, we hypothesize that high LTV, through financial stress, leads to a greater likelihood of a negative health outcome.

4 Estimation Model

The reduced form model for health as a function of mortgage indebtedness and socioeconomic factors is given by

$$H_{it} = \alpha + \lambda_{LTV} + T_t + \delta_{msa} + \gamma_{msa} \times t + X_{it}\theta + \varepsilon_{it} \quad (1)$$

where H_{it} is a dichotomous indicator for presence of each health condition, $_{LTV}$ is a dichotomous indicator for LTV greater than 0.8, $_t$ is an indicator for each wave, $_{msa}$ is an indicator for each MSA, $_{msa}$ t is a MSA-specific linear time trend, X_{it} is a vector of socioeconomic variables which includes total non-housing assets, household income, gender, age, education, race/ethnicity, marital status, labor force status, employment status, blue-collar worker, and health insurance status for individual i in wave t, and is a vector of parameters. The cut-off of 0.8 for high LTV was chosen based on the loan requirement at purchase for a conventional mortgage. Though loan requirements vary with macroeconomic conditions, typically mortgage lenders require homebuyers to pay at least 20 percent of the appraised home value at closing. Therefore, if LTV rises above 80 percent, then the mortgagor experiences a decline in equity, which we hypothesize is a source of financial stress.

Since LTV relates to the value of the primary residence, it is likely correlated with the individual's non-housing assets (Flavin and Yamashita (2002)). Total non-housing assets and

household income control for differences due to household portfolio choice[13]. In addition, MSA and year fixed effects control for time-invariant differences across MSAs and year-specific differences in health conditions, respectively. Finally, to ensure that our instrument more likely reflects exogenous deviations from long-run trends in home prices by MSA, we also include MSA-specific linear time trends.

Equation 1 was estimated in an IV framework to identify the causal effect of LTV on health using the Freddie Mac House Price Index (FMHPI) as the instrument. The FMHPI is a valid instrument because home prices are strongly correlated with LTV, given that self-reported home value is the denominator of the LTV ratio, but should not directly affect health except through LTV, which proxies the individual's level of financial stress[14]. Equation 1 was estimated in an exactly identified model with the first stage given by:

$$\lambda_{LTV} = B + FMHPI^{-1}_{msa;t} + T_t + \delta_{msa} + \gamma_{msa} \times t + X_{it}\theta + \eta_{it} \qquad (2)$$

where $FMHPI^{-1}_{msa;t}$ is the inverse of the FMHPI normalized to 1 in year 2000.

The effect of high LTV on health was estimated for the sample population, homeowners, and mortgagors. Since the sample population contains both renters and homeowners, an indicator variable for homeowners was included when estimating equations 1 and 2 using the sample population. Including an indicator variable for homeowners adjusts for selection between

[13] Income and non-housing assets are in units of dollars per thousand.
[14] Engelhardt (2003) used home price indices to correct for measurement error in self-reported with lower prevalence of depressive symptoms, high blood pressure, and cancer. This could be home values. They found that self-reported home values are generally overestimated in the range of 10%.

homeowners and renters and ensures that the parameter on high LTV is only identified using homeowners' LTV.

4.1 Summary statistics

Table 1 shows the sample-weighted means for the socioeconomic, health, and housing finance variables for the sample population, homeowners, and mortgagors. Since the HRS represents an older sample of the U.S. population, the share of homeowners is larger than that for overall U.S. population, 78 percent compared to 67.5 percent as of 2008 (Current Population Survey/Housing Vacancy Survey (2011)). On average, mortgagors tend to be healthier than the sample population because mortgagors also tend to be younger, 61 versus 65 years. In contrast, the prevalence of obesity is higher among mortgagors. Table 2 shows the housing finance variables for the sample population, homeowners, and mortgagors for each wave from 1998 to 2008. Table 3 shows health conditions for the sample population, homeowners, and mortgagors for each wave from 1998 to 2008. Among mortgagors, the prevalence of obesity and high blood pressure has increased over this period while the prevalence of poor health, negative changes in health and cancer remained relatively stable. Depressive symptoms declined slightly.

5 Results

5.1 Effect of high LTV on health among mortgagors

Table 4 shows the estimation results among mortgagors using OLS for each of the five health conditions. Errors were adjusted for heteroskedasticity and clustered by MSA. Estimates show

that a high LTV is significantly correlated with a greater likelihood of fair/poor well-being, negative change in well-being, obesity, presence high blood pressure, and presence of a depressive symptom. The significance and sign of estimates for the remaining socioeconomic factors vary depending on the health condition. For all five conditions, more years of schooling, being in the labor force, and greater non-housing assets are associated with a lower likelihood of poor health conditions.

Table 5 shows the estimation results among mortgagors using IV for each of the five health conditions. The IV estimates are positive but magnitudes are roughly larger by a factor of 10. Only the estimate on likelihood of a negative change in well-being remains statistically significant at the 90 percent level. IV and OLS estimates for a negative change in well-being are 0.402 and 0.0282, respectively. This implies that OLS estimates are biased towards zero.

We consider several potential omitted variables. Individuals who are less patient, more risk loving, or have a low health endowment are more likely to have a high LTV. However, these individuals are also more likely to be in poor health suggesting that OLS estimates will be biased away from zero. For OLS estimates to be biased towards zero, the omitted variable should be positively correlated with high LTV and negatively correlated with poor health or vice versa. We hypothesize that the omitted variable could be ability or wealth endowment. Individuals who have a high ability or a high wealth endowment are less likely to be credit constrained, more likely to qualify for a high LTV, and less likely to be in poor health. This could explain why OLS estimates are biased towards zero. An alternate explanation could be attenuation bias due to measurement error. Engelhardt (2003) found self-reported home values to be overstated in the range of 10%.

5.2 Robustness Checks

We examine whether the results are robust to changes in the estimation sample, redefinition of the variable of interest (LTV), and the estimation model. The estimation sample was increased to include homeowners with no mortgages and renters, both groups with LTV equal to zero. As well, the sample was reduced to exclude individuals age 65 and above to ensure that the results are not driven by this age group. We also estimated the effect of low LTV on the same health conditions expecting that the estimated effect would be either insignificant or negative. Following Currie and Tekin (2011), we used the incidence of cancer as a falsification test. Finally, we considered an alternative estimation model with an unobserved, individual specific, time-invariant omitted variable.

5.2.1 Effect of high LTV on health by homeownership-status

Although the main finding relates to mortgagors, it is also of interest to examine the effect among the sample population and homeowners. And since previous studies have found that debt affects mental health in particular, the eight symptoms that comprise the CESD measure were separately examined as outcome variables. Table 6 shows the effect of high LTV on the five health conditions among the sample population, homeowners, and mortgagors. (Effects on the eight depressive symptoms are available upon request.)

Among mortgagors, the OLS and IV estimates are positive for each of the depressive symptoms and significant at the 95 percent level for restless sleep, did not enjoy life, and hard to get going. In the sample of homeowners, homeowners with no mortgages are added to the sample of mortgagors. This more than doubles the sample size and should increase the power of the t-test.

However, the adjusted errors among homeowners are roughly the same as that for mortgagors. This suggests that the heterogeneity of renters and homeowners with no mortgages contributes to the error term and does not improve the power. In the sample population, renters are added to the sample of homeowners increasing the sample by over 20,000 observations. The IV estimates for presence of depressive symptom and felt alone are significant at the 95 percent level.

The R squared from the first stage of the IV estimation supports the validity of the instrument. (More specifics available upon request.)

5.2.2 Effect of low LTV on health

We estimated the effect of low LTV, defined as an LTV of 40 percent or less, on the likelihood of each health condition. Mortgagors with low LTV should not experience financial stress as these homeowners have sizable home equity. Table 7 shows that the estimated effect of low LTV is negative and significant for outcomes using OLS. Among mortgagors, the estimated effect of low LTV is negative and significant for a decline in well-being, not enjoying life, and difficulty getting going.

5.2.3 Fixed Effects

We consider an estimation model with an unobserved, individual specific, time-invariant omitted variable. The fixed effects model is given by

$$H_{it} = \alpha + \lambda_{LTV} + \varpi_i + \tau_t + X_{it}\,\theta + \varepsilon_{it} \qquad (3)$$

where ϖ_i is a dichotomous indicator for each individual, X_{it} is a vector of time-varying socioeconomic variables which includes total non-housing assets, household income, age,

marital status, labor force status, employment status, blue-collar worker, and health insurance status for individual i in wave t, and is a vector of parameters.

Table 8 shows the effect of high LTV on the likelihood of each condition using fixed effects estimation. A 10 percent increase in the likelihood of having high LTV increases the likelihood of being in fair/poor health and having a negative change in health by 15 and 19 percent among the sample population and homeowners, respectively. Among mortgagors, the estimate is not significant but since the adjusted error is roughly the same as for the other two groups, this lack of significance is likely due to lack of power. Interestingly, while the IV estimates suggest that high LTV affects health through mental stress, fixed effects estimates do not show a significant effect on incidence of depressive symptoms.

5.2.4 Cancer as a control outcome

Following Currie and Tekin (2011), we used cancer as a “control" outcome. Assuming that financial stress does not cause cancer, then high LTV should have no effect on presence of cancer. Table 9 shows that high LTV does not have a significant effect on the likelihood of cancer neither among mortgagors, homeowners, nor the sample population.

5.2.5 Sub-sample by age

Finally, the effect of high LTV was estimated on a restricted sample of individuals less than 65 years old to ensure that our results are not driven by individuals age 65 and over. The sample of mortgagors is reduced to 17,131 from 18,222 observations. The sample population is reduced to 27,705 from 61,607 and the sample of homeowners is reduced to 34,560 from 80,036. The

results for the sample restricted by age are qualitatively consistent with the unrestricted sample.

6 Discussion

High LTV is significantly correlated with poor self-reported well-being, a decline in well-being, obesity, high blood pressure, and presence of a depressive symptom. High LTV is not significantly correlated with cancer, suggesting that these findings are not an artifact of the data. Though the estimates of IV are larger in magnitude relative to OLS, the adjusted errors are also larger, such that only decline in well-being and presence of a depressive symptoms such as restless sleep, did not enjoy life, and hard to get going remain statistically significant. Our IV specification allows the price effect to fall in absolute value as prices rise; preliminary evidence indicated this type of non-linearity. Additionally, previous research which has IVed for wealth have not found significant effects of increases in wealth on health Meer et al. (2003) Kington (1997).

While overall results are not as significant when we move from OLS to IV and fixed effects, we still feel these results support our hypothesis that higher leverage has a negative effect on health. Examination of the movements of the FMHPI in Table 2 show that, though the Index fell from 2006 to 2008, home prices on average were still considerably higher than in the first three waves we are using. Therefore, only mortgagors who bought their homes after 2002 or took equity out of their homes after 2002 should be experiencing real distress. Further studies using post 2008 price declines should add strength to our results, as would research using zipcode level price declines rather than MSA level.

Fixed effect results for non-experimental studies cannot be expected to be strong because there

will not be much variability within people over time. In our case, we are looking for variability in indicator variables, which further limits the amount of power to be expected. Table 2 demonstrates that there is little movement over time. The fact that a 10 percent increase in the likelihood of having high LTV increases the likelihood of homeowners being in fair/poor health and having a negative change in health by 19 percent is supportive of our hypothesis.

We compared the effect of high LTV with that of mortgage delinquencies from Alley et al. (2011) and foreclosures from Currie and Tekin (2011) on health in the U.S. Although, Alley et al. (2011) used the same dataset, they used a subsample of homeowners who responded to an internet-based questionnaire which specifically asked mortgage delinquency status. Alley et al. (2011) estimated the log odds of a major decline in self-reported health to be 1.17 and of a depressive symptom to be 7.86. Converting from odds ratios and assuming a probability of delinquency of 3 percent[15], the predicted probabilities for a decline in health and depressive symptom is 1.67 and 2.73 percent, respectively.

Currie and Tekin (2011) estimated the effect of foreclosure on the number of hospitalization and ER visits related to hypertension and anxiety to be 0.0055 and 0.025, respectively, among those age 50-64. The average number of foreclosures per zip code between 2005 and 2009 was 84. This corresponds to a 7.39 percent increase in the number of hospitalization and ER visits related to hypertension and a 15.85 percent increase in visits related to anxiety.

According to Table 2, between 2006 - 2008, the prevalence of high LTV increased by 30

[15] Alley et al. (2011) did not report the weighted-mean prevalence of mortgage delinquency in the sample, only the number of observations. We calculated the delinquency rate based on the reported number of observations.

percent. This corresponds to an estimated increase of 6.33 percent in the likelihood of high blood pressure and 9.6 percent in the likelihood of a depressive symptom among mortgagors.

A limitation of this study is that HRS data only surveys people over 50 years of age. Since Currie and Tekin (2011) found the most pronounced effects on those between 20 and 49 years of age, the effect of high LTV could be larger for a younger cohort. On the other hand, since younger homeowners have more time to recoup losses in home equity, the effect on health may be smaller. An area for further research would be to use a dataset with younger homeowners.

From a policy perspective, our results highlight the unintended health consequences of promoting financing for home purchases, especially when home prices are subject to volatility. Innovations in the mortgage loan market have allowed high leverage and frequent refinancing. At the same time labor markets are characterized by less stability, with shorter tenures at the same firm and more frequent unemployment spells. Policymakers should consider whether the benefits of homeownership outweigh the negative health effects of high mortgage indebtedness. Additionally, improvements in financial literacy should increase homeowners' awareness of the pitfalls of high leverage. This is of high importance in areas of the country where decent rental housing is in scant supply.

Table 1: Summary statistics (HRS 1998-2008 pooled)
Sample weighted means

	All	Homeowners	Mortgagors
homeowner	0.78	1.00	1.00
mortgagor	0.36	0.46	1.00
female	0.55	0.53	0.50
age	65.89	65.26	60.89
years of schooling	12.79	13.15	13.67
black	0.10	0.08	0.09
hispanic	0.07	0.06	0.06
other	0.04	0.04	0.05
married	0.64	0.73	0.78
in labor force	0.44	0.48	0.66
unemployed	0.01	0.01	0.01
has health insurance	0.84	0.84	0.79
blue collar	0.50	0.45	0.38
household income	70,757.51	79,868.59	95,344.69
non-housing assets	325,975.64	393,406.98	316,221.91
hamort	35,975.02	46,153.61	100,458.58
hahous	188,206.94	239,472.00	274,344.97
LTV	0.16	0.21	0.45
high LTV	0.04	0.05	0.11
low LTV	0.81	0.76	0.47
poor health	0.26	0.22	0.19
negative change in health	0.25	0.23	0.21
obesity	0.26	0.25	0.29
high blood pressure	0.50	0.48	0.45
depressive symptoms	0.55	0.51	0.49
cancer	0.13	0.13	0.10
observations	80,088	61,638	26,233

Table 2: Homeownership and mortgage indebtedness time trends, 1998-2008.

	1998	2000	2002	2004	2006	2008
	All					
LTV	0.16	0.15	0.14	0.17	0.17	0.17
high LTV	0.04	0.04	0.03	0.04	0.04	0.05
low LTV	0.81	0.82	0.83	0.79	0.81	0.81
Freddie Mac Home Price Index	87.75	100.00	116.57	143.01	160.93	133.44
homeowners	0.78	0.78	0.78	0.78	0.78	0.78
mortgagors	0.34	0.35	0.32	0.38	0.38	0.36
	Homeowners					
LTV	0.20	0.20	0.18	0.22	0.21	0.21
high LTV	0.05	0.04	0.04	0.05	0.05	0.06
low LTV	0.76	0.76	0.78	0.73	0.76	0.76
Freddie Mac Home Price Index	87.88	100.00	116.25	142.08	159.49	132.41
	Mortgagors					
LTV	0.46	0.45	0.45	0.46	0.44	0.46
high LTV	0.11	0.10	0.10	0.10	0.10	0.13
low LTV	0.46	0.47	0.46	0.46	0.50	0.48
Freddie Mac Home Price Index	87.23	100.00	117.44	145.06	163.79	132.70
observations	14,764	13,668	12,698	14,264	12,684	12,010

Sample-weighted shares except for LTV and Freddie Mac Home Price Index which are sample-weighted means.

Table 3: Health conditions time trends, 1998-2008

	1998	2000	2002	2004	2006	2008
	All					
poor health	0.27	0.24	0.25	0.26	0.26	0.27
negative change in health	0.26	0.24	0.26	0.27	0.25	0.26
Obesity	0.22	0.23	0.24	0.26	0.29	0.30
high blood pressure	0.44	0.47	0.51	0.49	0.53	0.57
depressive symptoms	0.59	0.58	0.54	0.53	0.54	0.52
cancer	0.11	0.12	0.14	0.12	0.14	0.15
	Homeowners					
poor health	0.23	0.20	0.21	0.21	0.21	0.22
Negative change in health	0.24	0.21	0.24	0.24	0.23	0.23
obesity	0.22	0.23	0.24	0.25	0.28	0.29
high blood pressure	0.42	0.45	0.50	0.47	0.51	0.55
depressive symptoms	0.56	0.55	0.51	0.49	0.51	0.48
cancer	0.11	0.12	0.14	0.12	0.13	0.15
	Mortgagors					
poor health	0.20	0.17	0.19	0.18	0.18	0.20
negative change in health	0.21	0.18	0.22	0.23	0.20	0.21
obesity	0.25	0.26	0.29	0.28	0.32	0.34
high blood press	0.38	0.42	0.47	0.43	0.47	0.52
depressive symptoms	0.53	0.52	0.48	0.48	0.49	0.46
cancer	0.09	0.10	0.12	0.09	0.10	0.12
observations	14,764	13,668	12,698	14,264	12,684	12,010

Sample-weighted means. Obesity:BMI>30; Depressive symptoms: CESD>0

.

Table 4: OLS: Effect of high LTV on likelihood of each condition: mortgagors

	Mortgagors				
	poor health	neg chg in health	obesity	high blood pressure	depressive symptoms
high LTV	0.0514***	0.0282***	0.0524***	0.0263**	0.0653***
	(0.00894)	(0.0100)	(0.0129)	(0.0111)	(0.0125)
female	-0.0266***	-0.00100	-0.0277***	-0.0315***	0.0365***
	(0.00808)	(0.00692)	(0.00874)	(0.0109)	(0.00788)
age	-0.00292	-0.0132***	0.00963**	0.0371***	-0.00988*
	(0.00398)	(0.00397)	(0.00450)	(0.00470)	(0.00555)
age squared/100	0.00266	0.0121***	-0.0120***	-0.0220***	0.00637
	(0.00333)	(0.00326)	(0.00339)	(0.00358)	(0.00442)
yrs schooling	-0.0206***	-0.00523***	-0.00898***	-0.00504***	-0.0164
	(0.00149)	(0.00143)	(0.00175)	(0.00191)	(0.00207)
black	0.0495***	-0.0344***	0.105***	0.161***	0.0452***
	(0.0112)	(0.00926)	(0.0148)	(0.0163)	(0.0128)
hispanic	0.0524***	-0.00842	0.0137	-0.0225	0.00425
	(0.0139)	(0.0179)	(0.0190)	(0.0164)	(0.0258)
other	0.0329	-0.00237	-0.0409	0.0284	0.0537**
	(0.0179)	(0.0175)	(0.0271)	(0.0183)	(0.0216)
married	-0.0249**	0.000529	-0.0224*	0.000299	-0.0914***
	(0.0102)	(0.00755)	(0.0133)	(0.0130)	(0.0107)
labor	-0.177	-0.114	-0.0290	-0.0614	-0.114
	(0.00946)	(0.00846)	(0.0104)	(0.00902)	(0.00940)
unemployed	0.0738***	0.0585	0.0308	0.0701**	0.168***
	(0.0219)	(0.0355)	(0.0315)	(0.0289)	(0.0329)
insured	0.0210	0.0167	0.0119	0.0278	0.00959
	(0.00739)	(0.00651)	(0.0101)	(0.0114)	(0.00966)
blue collar	0.0322	0.00510	-0.00565	-0.00768	0.0537
	(0.00839)	(0.00832)	(0.0109)	(0.0124)	(0.0109)
income/1000	-0.0000513	0.00000812	-0.0000518	-0.0000584**	-0.0000677**
	(0.0000347)	(0.0000266)	(0.0000457)	(0.0000292)	(0.0000352)
non-housing assets/1000	-0.0000094***	-0.00000606*	-0.0000118***	-0.0000150***	0.0000127***
	(0.00000290)	(0.00000351)	(0.00000325)	(0.00000421)	(0.00000350)
Observations	26222	23105	25857	26218	24487
$_R2$	0.149	0.059	0.069	0.115	0.091

All specifications include year indicators, MSA indicators, and MSA-specific linear trends. Robust errors clustered by MSA in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01 High LTV defined as LTV > 0.80.

Table 5: IV: Effect of high LTV on the likelihood of each condition among mortgagors.

	Mortgagors				
	poor health	neg chg in health	obesity	high blood pressure	depressive symptoms
high LTV	0.306	0.402*	0.131	0.211	0.320
	(0.207)	(0.231)	(0.239)	(0.215)	(0.244)
female	-0.0256***	0.000650	-0.0273***	-0.0309***	0.0373***
	(0.00805)	(0.00685)	(0.00880)	(0.0106)	(0.00786)
age	-0.000316	-0.00890***	0.0105**	0.0390***	-0.00708
	(0.00430)	(0.00420)	(0.00527)	(0.00500)	(0.00621)
age squared/100	0.00106	0.00936***	-0.0125***	-0.0232***	0.00459
	(0.00338)	(0.00318)	(0.00376)	(0.00371)	(0.00476)
years of schooling	-0.0194***	-0.00330*	-0.00861***	-0.00416**	-0.0150***
	(0.00180)	(0.00180)	(0.00218)	(0.00201)	(0.00236)
unemployed	0.0688***	0.0559	0.0289	0.0665**	0.163***
	(0.0228)	(0.0368)	(0.0316)	(0.0296)	(0.0350)
insured	0.0223***	0.0188***	0.0123	0.0287***	0.0105
	(0.00729)	(0.00697)	(0.0105)	(0.0110)	(0.00970)
blue collar	0.0275***	-0.00181	-0.00716	-0.0111	0.0486***
	(0.00857)	(0.0104)	(0.0111)	(0.0130)	(0.0116)
income/1000	-0.0000451	0.0000175	-0.0000499	-0.0000540*	-0.0000630**
	(0.0000305)	(0.0000214)	(0.0000450)	(0.0000280)	(0.0000317)
non-housing assets/1000	-0.00000698**	-0.00000278	-0.0000111***	-0.0000133***	-0.0000102***
	(0.00000342)	(0.00000397)	(0.00000359)	(0.00000445)	(0.00000388)
Observations	26222	23105	25857	26218	24487
R^2	0.114	.	0.067	0.103	0.067
First-stage F-stat	22.42	14.78	21.35	22.30	21.03

All specifications include year indicators, MSA indicators, and MSA-specific linear trends. Robust errors clustered by MSA in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ High LTV defined as LTV > 0.80.

Table 6: Effect of high LTV on the likelihood of health conditions

.	All		Homeowners		Mortgagors	
	OLS	IV	OLS	IV	OLS	IV
poor health	0.0559***	0.1319	0.0594***	0.0428	0.0514***	0.3056
	(0.00837)	(0.25173)	(0.00839)	(0.25975)	(0.00894)	(0.20684)
neg chg in health	0.0345***	0.2327	0.0361***	0.1425	0.0282**	0.4021*
	(0.00968)	(0.38378)	(0.00998)	(0.32797)	(0.01002)	(0.23114)
obesity	0.0710***	-0.0395	0.0696***	-0.1594	0.0524***	0.1310
	(0.01308)	(0.25744)	(0.01348)	(0.24223)	(0.01289)	(0.23924)
high blood pressure	0.0396***	0.4738	0.0400***	0.3367	0.0263**	0.2106
	(0.01094)	(0.32306)	(0.01131)	(0.26898)	(0.01113)	(0.21470)
depressive symptoms	0.0677***	0.8575*	0.0726***	0.1402	0.0653***	0.3202
	(0.01229)	(0.49481)	(0.01199)	(0.35587)	(0.01247)	(0.24377)
depressed	0.0368***	0.2341	0.0404***	0.0671	0.0315***	0.1298
	(0.00963)	(0.28668)	(0.00975)	(0.23741)	(0.00972)	(0.18049)

Robust errors clustered by MSA in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ High LTV defined as LTV > 0.80.
All specifications include controls for gender, age, age-squared/100, education, race/ethnicity, marital status, labor force status, income/1000, non-housing assets/1000, and health insurance status. All specifications include year indicators, MSA indicators, and MSA-specific linear trends

Table 7: Effect of low LTV on the likelihood of each condition

	All		Homeowners		Mortgagors	
	OLS	IV	OLS	IV	OLS	IV
poor health	-0.0290***	-0.0926	-0.0331***	-0.0294	-0.0235***	-0.2013
	(0.00532)	(0.17046)	(0.00525)	(0.17667)	(0.00681)	(0.12563)
neg chg in health	-0.0267***	-0.1511	-0.0286***	-0.0898	-0.0224***	-0.2328*
	(0.00490)	(0.24639)	(0.00502)	(0.21021)	(0.00669)	(0.14100)
obesity	-0.0528***	0.0274	-0.0542***	0.1095	-0.0421***	-0.0836
	(0.00850)	(0.17959)	(0.00882)	(0.17498)	(0.00940)	(0.14506)
high blood pressure	-0.0409***	-0.3313*	-0.0439***	-0.2305	-0.0376***	-0.1378
	(0.00764)	(0.20099)	(0.00813)	(0.17080)	(0.00849)	(0.13177)
depressive symptoms	-0.0257***	-0.5936*	-0.0320***	-0.0950	-0.0254***	-0.2046
	(0.00701)	(0.32360)	(0.00657)	(0.23617)	(0.00858)	(0.15990)
depressed	-0.0239***	-0.1592	-0.0270***	-0.0449	-0.0197***	-0.0827
	(0.00439)	(0.18732)	(0.00472)	(0.15780)	(0.00562)	(0.11531

All specifications include controls for gender, age, age-squared/100, education, race/ethnicity, marital status, labor force status, income/1000, non-housing assets/1000, and health insurance status. All specifications include year indicators, MSA indicators, and MSA-specific linear trends.
Robust errors clustered by MSA in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ Low LTV defined as LTV <= 0.4.

Table 8: Fixed Effects: Effect of high LTV on the likelihood of each condition

	All	Homeowners	Mortgagors
poor health	0.0151*	0.0188**	0.0127
	(0.00803)	(0.00834)	(0.00885)
neg chg in health	0.0086	0.0099	0.0070
	(0.01068)	(0.01127)	(0.01212)
obesity	-0.0032	-0.0048	-0.0049
	(0.00670)	(0.00712)	(0.00752)
high blood pressure	-0.0070	-0.0066	-0.0057
	(0.00686)	(0.00724)	(0.00756)
depressive symptoms	0.0129	0.0077	-0.0016
	(0.01041)	(0.01102)	(0.01167)
depressed	-0.0023	-0.0018	-0.0050
	(0.00819)	(0.00862)	(0.00911)

All specifications include controls for age, marital status, labor force status, income/1000, non-housing assets/1000, and health insurance status.
All specifications include year indicators.
Robust errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ High LTV defined as LTV > 0.80.

Table 9: Effect of high LTV on the likelihood of cancer

	All		Homeowners		Mortgagors	
	OLS	IV	OLS	IV	OLS	IV
high LTV	-0.00978	0.239	-0.00609	0.149	-0.00658	0.0817
	(0.00731)	(0.196)	(0.00708)	(0.151)	(0.00682)	(0.115)
homeowner	0.00223	-0.0107				
	(0.00582)	(0.0110)				
female	-0.00989*	-0.00921*	-0.0104*	-0.00952	0.00718	0.00753
	(0.00535)	(0.00520)	(0.00607)	(0.00586)	(0.00622)	(0.00613)
age	0.00750***	0.00937***	0.00883***	0.0102***	0.00403	0.00493
	(0.00176)	(0.00214)	(0.00224)	(0.00266)	(0.00334)	(0.00331)
age squared/100	-0.00283**	-0.00392***	-0.00342**	-0.00419**	0.000180	-0.000381
	(0.00132)	(0.00148)	(0.00169)	(0.00187)	(0.00275)	(0.00272)
years of schooling	0.00234***	0.00257***	0.00170	0.00191	0.000673	0.00110
	(0.00107)	(0.00110)	(0.00125)	(0.00129)	(0.00179)	(0.00174)
married	-0.00192	-0.000593	-0.000632	0.000563	-0.00268	-0.000725
	(0.00538)	(0.00525)	(0.00627)	(0.00619)	(0.00930)	(0.00971)
Observations	80051	80051	61610	61610	26227	26227
R^2	0.045	0.027	0.049	0.040	0.065	0.058
First-stage F-stat		27.44		24.32		22.51

All specifications include year indicators, MSA indicators, and MSA-specific linear trends.
Robust errors clustered by MSA in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
High LTV defined as LTV > 0.80.

Table 10: Effect of high LTV on the likelihood of each condition among individuals less than 65 years old

	All		Homeowners		Mortgagors	
	OLS	IV	OLS	IV	OLS	IV
poor health	0.0556***	0.0469	0.0549***	-0.1496	0.0496***	0.0972
	(0.00977)	(0.27352)	(0.00990)	(0.26300)	(0.01089)	(0.22943)
neg chg health	0.0395***	0.2261	0.0390***	0.0353	0.0361**	0.3383
	(0.01324)	(0.34926)	(0.01324)	(0.31675)	(0.01409)	(0.21206)
obesity	0.0808***	0.1364	0.0781***	0.2038	0.0654***	0.1459
	(0.01522)	(0.24515)	(0.01530)	(0.22509)	(0.01552)	(0.26114)
high bl press	0.0507***	0.2566	0.0484***	0.0422	0.0410**	0.0285
	(0.01582)	(0.32845)	(0.01602)	(0.27576)	(0.01529)	(0.24329)
depress symp	0.0659***	0.4691	0.0673***	-0.0287	0.0651***	0.4106
	(0.01481)	(0.37198)	(0.01485)	(0.29952)	(0.01456)	(0.27315)
depressed	0.0295**	0.2082	0.0297**	0.1298	0.0268**	0.2456
	(0.01129)	(0.25056)	(0.01136)	(0.19139)	(0.01156)	(0.20168)
all an effort	0.0476***	0.6391*	0.0497***	0.2885	0.0549***	0.3477
	(0.01303)	(0.35051)	(0.01292)	(0.29413)	(0.01262)	(0.28883)
restless sleep	0.0481***	0.0102	0.0482***	-0.0793	0.0428***	0.3284
	(0.01335)	(0.31820)	(0.01351)	(0.28177)	(0.01305)	(0.26531)
felt unhappy	0.0332***	0.1121	0.0335***	-0.0185	0.0296***	0.2551
	(0.00957)	(0.25009)	(0.00962)	(0.20634)	(0.00916)	(0.19306)
felt alone	0.0182**	0.3645	0.0191**	0.1971	0.0155*	0.1933
	(0.00841)	(0.30866)	(0.00850)	(0.22752)	(0.00859)	(0.18694)
not enjoy life	0.0176**	0.3695*	0.0161*	0.3317*	0.0168**	0.3558*
	(0.00778)	(0.20148)	(0.00769)	(0.18352)	(0.00751)	(0.19104)
felt sad	0.0467***	-0.0843	0.0464***	-0.1307	0.0430***	-0.0990
	(0.01133)	(0.33987)	(0.01146)	(0.30199)	(0.01241)	(0.26768)
hard get going	0.0309***	0.2253	0.0303***	0.1149	0.0272**	0.5121**
	(0.00928)	(0.26897)	(0.00933)	(0.21609)	(0.00977)	(0.22528)

All specifications include controls for gender, age, age-squared/100, education, marital status, race/ethnicity, labor force status, income/1000, non-housing assets/1000, and health insurance status. All specifications include year indicators, MSA indicators, and MSA-specific linear trends.
Robust errors clustered by MSA in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Chapter Four

Mortgage Debt, Unemployment, and Health

co-authored with Leigh Ann Leung

Abstract

We look at the effect of high mortgage leverage interacted with unemployment on health, using the NLSY79, a national sample of over 12,000 men and women who were 14-22 years old when they were first surveyed in 1979. Results show that high mortgage loan to house value when interacted with unemployment is positively and significantly correlated with poor health. Temporal ordering estimation is employed to test whether past periods of unemployment and high LTV are also significantly correlated with poor health.

JEL Classification: G

Keywords: Homeownership, mortgage debt, unemployment, health, temporal ordering

1 Introduction

Previous studies have found that unemployment leads to poor health and higher mortality. Different hypotheses have been proposed to explain this relationship. One hypothesis is that unemployment leads to a decline in social status which negatively affects health. Another hypothesis suggests that unemployment affects health directly through increased stress. An indirect path attributes the decline in health to lower lifetime income by reducing investment in medical care. This study examines the effect through financial stress. We hypothesize that if unemployment affects health through stress, the effect will be particularly acute for homeowners with mortgages. To our knowledge, this is the first study to examine the effect the health consequences of the interaction of unemployment and mortgage indebtedness.

We focus on mortgage debt for two main reasons. Firstly, home mortgages constitute a large share of household liabilities, since home purchases require a great deal more capital than households typically have on hand, necessitating financing of the majority of home sales. Secondly, U.S. policy encourages homeownership but little is understood about the ramifications of the concomitant debt. In fact, the government's subsidy of mortgage financing[16] encourages leverage over equity in home purchases and greater consumption of housing than households would have chosen if these subsidies did not exist (Glaeser and Shapiro (2003)). In 2008, 93 percent of homes purchased involved financing, though in 2010, this declined to 91 percent (Hale (2009, 2010)). The degree of house financing is also affected by the interaction between

[16] The cost of borrowing is subsidized by allowing interest paid on mortgages to be deducted from income (Rosen (1985)) and through government guarantees which reduce the credit risk of mortgage loans, essentially lowering the interest rate.

policy and economic conditions. During periods of mortgage credit expansion, riskier homebuyers can also qualify for mortgages, thereby increasing the prevalence of mortgage finance in home sales (Mian and Su (2009), Keys et al. (2010)). Since capital gains on homes are not subject to taxes if invested in a more expensive home, sellers in rising price markets are encouraged to invest all their profit back into real estate, distorting demand for expensive homes.

While homeownership in general leads to positive social outcomes, mortgage indebtedness potentially leads to negative health outcomes. We use Grossman's (1972) model of health as a stock variable, which depreciates over time but can be augmented by combining time, income, and medical care, to illustrate the potential negative impact of mortgage indebtedness on health. We hypothesize a direct and an indirect path through which mortgage indebtedness leads to poor health. First, higher mortgage indebtedness increases financial stress. Epidemiological studies have found that stress plays a role in cardiovascular disease (Dorian and Taylor (1984)). Previous studies have also found that stress affects both the contraction of and progression of certain diseases (Calcagni and Elenkov (2006), Contrada and Baum (2009)), and in particular stress can increase the probability of catching a cold (Takkouche et al. (2001)). Financial stress can also lead to unhealthy behaviors such as drinking, smoking, or substance abuse, or may cause sleep problems and eating disorders (Neil Schneiderman (2008)). Second, since higher mortgage indebtedness corresponds to a negative wealth effect, it can lead to fewer health investments, particularly preventative care investments.

Mortgage indebtedness can be measured as the ratio of mortgage loan to home value (LTV). A high LTV means that homeowners have little to no equity in their home[17]. High LTV may lead to

[17] The level of home equity is related to housing tenure. New homeowners are more likely to

financial stress and fewer health investments[18]. Among homeowners with sizable equity cushions, a decline in home prices increases LTV, but may not necessarily lead to nancial stress or changes in health investments.

Given the potential negative relationship between debt and health, policies that promote homeownership through financing may have unintended health consequences, especially in times of readily available credit, when little to no equity may be required. Prior studies on debt and health consider individuals near or at foreclosure. However, the share of homeowners that default is small compared to the share of homeowners with mortgage debt outstanding and the negative impact of debt on health may affect homeowners not in foreclosure. Furthermore, most existing studies use data that are limited to a specific state or set of states in the U.S. To our knowledge, this is the only study to use household mortgage loan to home value to estimate the effect of the mortgage indebtedness on mental and physical health among a nationally representative sample of adults.

The form of housing debt most prevalent in the United States is the 30-year xed rate mortgage, which was designed in a period when average job tenure was longer. Average job tenure for men in the 45 to 54 age group, which corresponds to the age group of this study, declined from 10.1% to 8.1% in the decade from 1996 to 2006 (Economic News Release (2012)). We feel that periods

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have less equity compared to seasoned homeowners given the amortizing structure of mortgage loans.

[18] Empirical evidence for the indirect effect is mixed. Keese and Schmitz (2010) using longitudinal data for Germany found that individuals with debt are more likely to visit a doctor. Since Germany has universal healthcare, the indirect e ect of debt on health is likely smaller. Currie and Tekin (2011) using foreclosure data for four states in the U.S. found that a higher number of foreclosures is associated with more hospital visits and fewer preventive medical visits.

of unemployment combined with high mortgage debt can be stressful and negatively affect health.

The contribution of this paper compared to our study using HRS is that we can estimate the effect of mortgage debt on a cohort that is more likely to rely on wage income, less likely to rely on retirement income, and also have lower net worth. A younger cohort will also allow us to examine whether having stable income can mitigate the financial stress associated with mortgage indebtedness. We are testing dual hypotheses: 1) that those with more stable income should experience less stress; and 2) that those with high mortgage debt who are involuntarily unemployed experience even greater stress. Previous studies have shown that unemployment increases mortality. We will review and summarize the literature on this topic and examine the effect of the interaction between unemployment and mortgage debt on health outcomes. We expect that unemployment also compounds the negative health effect of mortgage debt. To our knowledge, this paper is the first to recognize that neither unemployment nor debt alone may have a significant adverse impact on health, but rather the presence of the two variables simultaneously leads to stress and worse health outcomes.

2 Literature Review

Defaulting on mortgage debt is a disruptive life event that may negatively affect health. In the U.S., the rise in foreclosures since 2008 has prompted research on the impact of foreclosures on health. Pollack and Lynch (2009) compared the health of individuals, recruited through a mortgage counseling agency, undergoing foreclosure with that of a community sample from the 2008 Southeastern Pennsylvania Household Health Survey. They found that the foreclosed sample were significantly more likely to have hypertension, heart disease, and a clinically

diagnosed psychiatric condition than the control group. The foreclosed also reported greater consumption of smoking and drinking in the past month. In a broader study covering four states (Arizona, California, Florida, and New Jersey), (Currie and Tekin (2011) found that zipcodes with a greater number of foreclosures also experienced a greater rise in Emergency Room visits and hospitalizations for stress related conditions, controlling for county-specific, time-varying factors such as labor market conditions. Furthermore, the effect was greater among younger individuals and for conditions that are typically avoidable with preventative care.

Prior to default, borrowers who have missed two or more consecutive payments on a mort-gage loan are considered delinquent. Previous studies have examined the effect of mortgage debt delinquency on health. For the U.S., Alley et al. (2011), using the 2006 and 2008 waves of the Health and Retirement Survey (HRS), compared the health outcomes of mortgagors who had been more than two months delinquent on their mortgage payments in the past two years to those who are current on their mortgage payments. They found that delinquent respondents were significantly more likely to have depressive symptoms and to have less access to health relevant resources. These results are qualitatively consistent with similar studies in the U.K. Taylor et al. (2006), using the British Household Panel Survey (BHPS) from 1991 to 2003, a period that covers the recession in the early nineties, found that being past due on mortgage debt is associated with a negative psychological effect among men, controlling for financial conditions and other personal traits. Nettleton and Burrows (1998), using the Survey of English Housing[19] from 1991-1992 and 1994-1995, found that difficulty meeting mortgage payments is associated

[19] The Survey of English Housing is a supplemental survey to the British Household Panel Survey (BHPS) consisting of households headed by younger individuals, single parents, single male parents, divorced and separated, divorced and inactive.

with a decline in mental well-being.

Previous studies have also examined the effect of unsecured debt on health. Drentea and Lavrakas (2000), using a sample of adults in Ohio, found that greater credit card debt-to-income is associated with a greater likelihood of physical health impairment. In a follow up study, Drentea (2000) found that greater credit card debt-to-income is associated with a greater likelihood of having mental anxiety. Similarly, Brown et al. (2005), using the 1995 and 2000 waves of the British Household Panel Survey (BHPS), found that greater unsecured household debt is associated with the likelihood of having poor mental health. Keese and Schmitz (2010), using the German Socioeconomic Panel (GSOEP) from 1999-2009, found that greater debt is associated with worse mental health and a higher incidence of obesity. They also estimated a fixed effects model to control for individual-specific, time-invariant factors that may be endogenous to health and debt. Fixed effects estimates show that greater indebtedness leads to poor mental health and lower health satisfaction with mortgage debt having a large effect on mental health. Though loan amounts of unsecured debt are typically smaller than that of mortgage debt, these findings suggest that even unsecured debt has a negative effect on health.

Finally, a number of studies have examined the effect of self-reported financial stress on health. Bridges and Disney (2010) and Skapinakis et al. (2006) found that individuals experiencing financial difficulties were more likely to exhibit depression. O'Neill et al. (2005) and Lyons and Yilmazer (2005) found a positive correlation between self-reported financial stress and poor self-reported health. While these studies show a negative relationship between financial stress and health, the particular type of debt leading to financial stress was not identified.

The literature on the health effects of debt has primarily focused the household's ability to make

debt repayments, that is, whether the household is liquidity constrained. Another measure of a household's financial condition is the debt to asset ratio, an indicator of balance sheet leverage. In contrast to prior studies, this study focuses on households with high mort-gage debt to assets but not necessarily delinquent or in default. We argue that households with a high mortgage loan to home value (LTV) also experience financial stress given that debt secured by the primary residence comprise the largest share of household balance sheets. Since the number of homeowners with high leverage is larger than the number in delinquency or foreclosure, we argue that the potential effect of having high LTV on health is relevant to a broader segment of the population[20].

In this paper we examine the effect of housing leverage in conjunction with unemployment. Previous studies have found unemployment is associated with an increase in mortality. Sullivan and von Wachter (2009) found that, on average, unemployment increases mortality hazard by 10 to 15%, implying a decrease in life expectancy of 1 to 1. 5 years for workers displaced in middle age. The effect is strongest immediately after a layoff but persists twenty years after displacement and is largest for those less than 45 years of age. S. A. Burgand and House (2007) used two large population-based longitudinal samples to examine the effect of layoffs on self-reported health. They found a negative correlation between unemployment and health even after carefully controlling for selection bias.

[20] For example, Alley et al. (2011), using only the HRS 2008 participants eligible to be asked mortgage-delinquency questions, reported a mortgage delinquency rate of 3 percent whereas, using the complete NLSY 2008 wave, 13 percent of mortgagors have high LTV.

3 Data

Individual level data on health, housing, financial situation, and other socioeconomic factors were obtained from the National Longitudinal Survey of Youth 1979 (NLSY79), part of the National Longitudinal Surveys (NLS) program. These respondents were between 45 and 53 years of age at their 2008 interview. The NLSY79 is composed of three independent subsamples. The first consists of a cross-sectional sample (6,111) of people living in the United States in 1979 and born between January 1, 1957, and December 31, 1964 (inclusive); the second (5,295), over samples Hispanic, Latino, black, and economically disadvantaged persons, also living in the United States and born in the same period as the cross sectional sample, while the third (1,280) is limited to persons born between January 1, 1957, through December 31, 1961 (inclusive), serving in the military as of September 30, 1978. Since our interest in this paper is to extend our results as broadly as possible, we eliminate the military segment.

3.1 Variable definitions

The NLSY administers an extended health module once a respondent turns forty years of age. The SF-12, which stands for short-form 12-question, is a brief inventory of self-reported mental and physical health. This scale was administered to respondents who had turned 40 since their last interview as part of the age 40+ health module, included in the 1998, 2000, 2002, 2004, and 2006 surveys.

As part of this module, respondents are asked to self-rate their health, on a scale of 1 to 5. We convert this to a dichotomous variable, with one representing those with poor to fair overall health. This is our main dependent variable of interest. Additionally, we look at the effect on

other health measures, including obesity, hypertension, frequency of colds, symptoms of depression, and trouble sleeping.

Households experience financial stress when the burden of mortgage indebtedness becomes excessive. To measure excessive mortgage indebtedness, we use the loan to value (LTV) ratio defined as the amount of mortgage loan outstanding plus any other amount owed on home divided by the self-reported home value. LTV measures the degree of leverage used to finance the primary residence, which, all else equal, declines over time given the amortizing nature of mortgage loans. However, if homeowners take out equity and/or housing values decline, then home equity is reduced and may even become negative. As well, homeowners with a high LTV cannot reduce housing consumption accordingly and even if they manage to sell the home, they are more likely to incur a financial loss due to lower equity and transaction fees. Therefore, we hypothesize that high LTV, through financial stress, leads to a greater likelihood of a negative health outcome.

We control for age, education, race, employment, marital status and gender at the time the 40+ health module was administered. We follow (Thompson (2011)), and use both the mean of each respondent's annual household income and the standard deviation of income as independent variables. Income data was inflated to 2006 dollars using the CPI-U-RS. This is done in recognition of health being a stock variable (Grossman (1972)) and thus affected by past investments, which are related to income. We include the standard deviation of earnings to control for volatility; fluctuations in income as well as low income may have effects on health. Since our primary research interest concerns the effect of hosing leverage, we match income data to years of homeownership. Since health also has genetic characteristics we control for early

mortality of respondents' parents by creating an indicator variable which is zero if the parent died at age 60 or older, and one if the parent died before 60 years of age. We also interact unemployment with LTV, hypothesizing that the effect of the two on health may not be purely additive.

4 Estimation Model

Our main estimation of the effect of LTV on health is as follows:

$$H_{i40} = B_0 + B_1 D_i + B_2 \text{WksUnemp}_i + X_i \theta + \varepsilon_I \quad (1)$$

where H_{i40} is a health condition measured at the time of the 40+ health module, D_i is an indicator variable for high mortgage loan to self-reported home value (measured as greater than 0.8), WksUnemp_i is the number of weeks the respondent has been unemployed in the past year, and X_i is a vector of variables for respondent's socioeconomic characteristics including highest grade completed, wage (dollars/1000), gender, number of weeks the respondent has been out of the labor force in the past year, race/ethnicity, marital status, whether the respondent has health insurance, lives in an MSA, and the respondent's parents' characteristics such as mother's highest grade completed, father's highest grade completed, whether mother's age at death was less than 60, and whether father's age at death was less than 60.

4.0.1 Interaction of Unemployment and High Loan-to-Value: Effect on Health

The following equation highlights our specification which interacts involuntary unemployment and high loan-to-value:

$$H_{i40} = B_0 + B_1 D_i + B_2 \text{WksUnemp}_i + B_3 D_i \text{ x } \text{WksUnemp}_i + X_{i\theta} + \varepsilon_i \quad (2)$$

4.0.2 Effect of LTV on investment in healthcare

We test our sub-hypothesis that the effect of housing leverage on health may be indirect; as leverage increases, respondents may be less likely or less able to invest in healthcare. Our estimation model for the effect of high loan to value on use of healthcare pools the data from the 2002 survey through the 2008 survey. We measure the effect of high LTV on the likelihood of failing to have an annual physical as follows:

$$\text{LastPhysical} > 1\text{Y } r_{it} = B_0 + B_1 D_{it} + B_2 \text{WksUnemp}_{it} + X_{it}\theta + \varepsilon_1 \quad (3)$$

This first specification regresses mortgage, home value, unemployment and a host of socioeconomic variables on not having had a physical in the last year. Then we run high LTV and the socioeconomic variables on the same independent variable, and perform a third specification where we interact unemployment and high LTV, in keeping with our main model. The interaction equation is provided below.

$$\text{LastPhysical} > 1\text{Y } r_{it} = B_0 + B_1 D_{it} + B_2 \text{WksUnemp}_{it} + B_3 D_{it} \text{ x WksUnemp}_{it} + X_{i\theta} + \varepsilon_1 \quad (4)$$

4.0.3 Temporal Ordering

Since the 40+ health module is administered to NLSY79 respondents only once, generally in the interview immediately following their turning 40 years of age, fixed effects estimation cannot be done with this data. Additionally, our examination of the trends in health outcomes both in this data set and the HRS shows very little movement of these dichotomous variables over time, indicating that they do not lend themselves to fixed effects estimation, which relies on variation around the mean for identification of the effect being studied. We therefore decided to follow

other researchers who used the NLSY79, primarily Thompson (2011), and employ temporal ordering, whereby independent variables are measured over prior time periods (t-1), and the dependent variable measured at time t. The temporal ordering model for health as a function of mortgage indebtedness and socioeconomic factors is given by

$$H_{i40} = B_0 + B_1 D_{it} + B_2 WksUnemp_{it} + B_2 D_{it} \times WksUnemp_{it}$$

$$+ B_4 D_{it-1} + B_5 WksUnemp_{it-1} + B_6 D_{it-1} \times WksUnemp_{it-1} + X_i\theta + \varepsilon_i \quad (5)$$

where H_{i40} is overall health as self-reported at the time of the 40+ health module, D_{it} is an indicator for high LTV, $WksUnemp_{it}$ is the number of weeks unemployed in the last year, D_{it} times $WksUnemp_{it}$ is the interaction of weeks unemployment and high LTV, X_i is a vector of socioeconomic variables which includes gender, age, education, race/ethnicity, and marital status for individual i at the time they answered the 40+ health module, and θ is a vector of parameters.

4.1 Summary statistics

Table 1 shows the sample-weighted means for the socioeconomic, health, and housing finance variables for mortgagors in the NLSY79 who responded to the 40 and older health module. The average mortgage value is just over $108,000, while home values average $215,000.

Fifteen percent of the sample fall into the high loan-to-value category, i.e., loan-to-value is greater than 80%. (We chose 80% as a threshold since 20% equity has traditionally been required by mortgage providers and for Fannie/Freddie eligibility. Our results are robust to alterations to this threshold, however). The mean leverage is just under sixty percent. Both the absolute leverage and amount of the sample falling into the high LTV category are higher than the same

measures for the HRS sample, which were 45% and 11%, respectively. This is as expected, since equity generally builds with housing tenure, which is positively correlated with age. Only 7% of the mortgagors in the NLSY79 self-report fair to poor health, but over 50% are obese, 23% suffer from hypertension, 25% from depressive symptoms.

5 Results

OLS cross sectional results are reported in Table 2. Evaluated independently, larger mortgages, more expensive homes, are negatively correlated with poor health outcomes, though only home value's effect on obesity and hypertension are statistically significant (the former at the 10% level, the latter at the 5% level). The lack of significance for most of the outcomes is most likely due to multicollinearity: we are regressing home value, mortgage value, wages, on our health outcomes, all of which we expect to be correlated. The signs on the other socioeconomic variables are as expected, with education strongly correlated with better health, married respondents, respondents in the labor force and females healthier than their counterparts.

Table 3 show the effect of high mortgage loan to home value on the likelihood or each of the health outcomes. The likelihood of being obese is 5.24% greater for mortgagors with loan-to-values greater than eighty percent; this result is significant at the 10% level. Both weeks unemployed and weeks out of the labor force are significantly correlated with reporting worse overall health, being depressed, and having trouble sleeping. Since health has a genetic component, we control for the age of death of parents, and we account for early childhood factors by controlling for parents' education.

As expected, when we interact high loan-to-value with weeks of involuntary unemployment, Table 4, our results increase in significance: the likelihood of being in poor health or having

frequent colds is significant at the 5% level; the effect on hypertension is significant at the 10% level.

Since higher mortgage indebtedness corresponds to a negative wealth effect, it can lead to fewer health investments, particularly preventative care. We therefore perform a third estimation where we look at whether high LTV has a negative effect on respondents' propensity to have an annual physical exam. The results in Table 5 suggest that any effect high LTV has on getting a routine physical is insignificant, but that involuntary unemployment can lead respondents' to skip physicals. That this is most likely tied to a lack of insurance for the unemployed is supported by the highly (1% level), significant impact the presence of health insurance has on the likelihood of getting an annual physical, in all three specifications. Insured respondents were 20% less likely to go more than a year without a physical than the overall sample of mortgagors. Interestingly, when we interact weeks of unemployment with high LTV, the sign on the coefficient switches: respondents with high mortgage loans to house values and more weeks of involuntary unemployment are more likely to get an annual physical than respondents with similar weeks of unemployment but less highly leveraged. This may support our argument that high LTV harms health and therefore makes the respondent feel more in need of a physical exam, but this is only conjecture. There may be other factors at play.

Table 6 gives strong support to our hypothesis that for this sample, health will be negatively affected by involuntary unemployment contemporaneous with high LTV. We see that past high LTV interacted with past weeks of unemployment have the greatest effect on poor health, so long as we look back only one period (the time between surveys), with significance at the 1% level. The effect loses significance if further in the past, possibly pointing to the resiliency of the

population. Unemployment in a prior period has a significant effect on poor health in all specifications, whereas the effect of high LTV is only significant if current high LTV and unemployment are omitted from the regression. (Results of averaging LTV and income over the tenure of homeownership, then regressing these averages and the standard deviation of income against health outcomes were insignificant, and are therefore not reported here. We expected the standard deviation of income to have an effect, since income volatility is generally viewed negatively, but since this is a relatively young sample in a mostly robust economy, we feel that there were probably few negative shocks, and it is negative shocks which are likely to have adverse health effects.)

6 Discussion

As in our previous research, we find that when viewed separately, neither having a large mortgage nor an expensive home has a significant effect on overall health or the prevalence of depressive symptoms. However, for mortgagors in the NLSY79, high LTV has a significant effect on the likelihood of being obese only, amongst the five health outcomes we measure. For the HRS sample, results of the effect of high LTV are highly significant on all health outcomes. When high LTV is interacted with weeks of unemployment, the probability of reporting fair to poor health increases by almost 1 percentage point, which is significant at the 5% level. Additionally, the interaction of these two variables causes significant increases in hypertension and frequency of colds for mortgagors. These results support both our hypothesis that high LTV is less stressful for younger people who are more likely to have earned income which can be used to reduce leverage, and time to build equity before retirement, and our second hypothesis that unemployment coupled with high LTV will have a negative impact on health.

We do not find that those with high loan-to-value neglect basic preventative care, which we measure as whether or not respondents had an annual physical exam, but the number of weeks of unemployment is positively correlated with not having an annual physical.

The Obtaining Needed Medical Care/Early Release of Selected Estimates Based on Data From the January - June 2011 National Health Interview Survey (2011) reports a national increase in the percentage of persons in the United States who failed to obtain needed medical care in the past twelve years, from 4.3% in 1999 to 6.8% in the first six months of 2011. Currie and Tekin (2011) estimated the effect of foreclosure on the number of hospitalization and ER visits related to hypertension and anxiety to be 0.0055 and 0.025, respectively, among those age 50-64. The average number of foreclosures per zip code between 2005 and 2009 was 84. This corresponds to a 7.39 percent increase in the number of hospitalization and ER visits related to hypertension and a 15.85 percent increase in visits related to anxiety.

We employ temporal ordering to support causality running from debt and unemployment to worse health. The OLS results might be a result of reverse causality, with poor health leading to higher debt. We cannot rule out reverse causality given that poor health has a significant and larger effect on the likelihood of high LTV in two years in Table 7.

From a policy perspective, our results highlight the unintended health consequences of promoting financing for home purchases when labor markets are characterized by less stability, with shorter tenures at the same firm and more frequent unemployment spells. Policy-makers should consider whether the benefits of homeownership outweigh the negative health effects of high mortgage indebtedness for persons who will experience spells of unemployment. Additionally, improvements in financial literacy should increase homeowners' awareness of the

pitfalls of high leverage. This is of high importance in areas of the country where decent rental housing is in scant supply, and some leverage is likely required to have a desirable home.

Table 1: Summary statistics (NLSY79 40 and older health module)

	Mortgagors
mortgage loan (dollars/1000)	108.17
home value (dollars/1000)	214.90
mortgage loan-to-home value	0.59
high LTV	0.15
weeks unemployed (past year)	0.87
weeks out of labor force (past year)	4.01
wage (dollars/1000)	47.00
total family income (dollars/1000)	85.24
female	0.49
hispanic	0.05
black	0.06
married	0.80
age	40.25
insured	0.93
lives in MSA	0.16
highest grade completed	14.11
mother highest grad completed	12.02
father's highest grade completed	12.26
mother's age at death < 60	0.07
father's age at death < 60	0.12
poor health	0.07
physical health	53.47
obesity	53.65
hypertension	0.23
frequent colds	0.14
mental health	0.25
trouble sleeping	0.13
cancer	0.02
observations	3,197

Table 2: Effect of mortgage loan and home value on various health conditions

	poor health	obesity	hypertens	freq colds	cesd>5
mortgage loan (dollars/1000)	-0.0000261	-0.000118	-0.0000901	-0.000108	-0.0000521
	(0.0000576)	(0.000118)	(0.0000768)	(0.000136)	(0.000133)
home value (dollars/1000)	-0.0000460	-0.000104*	-0.0000729**	-0.0000474	-0.0000314
	(0.0000294)	(0.0000552)	(0.0000305)	(0.0000569)	(0.0000534)
weeks unemployed (past year)	0.00279**	-0.00213	0.000172	0.0000644	0.00266*
	(0.00135)	(0.00148)	(0.00118)	(0.00146)	(0.00151)
weeks out of labor force (past year)	0.00141***	-0.000950	0.000561	0.000682	0.00196***
	(0.000499)	(0.000719)	(0.000558)	(0.000677)	(0.000662)
wage (dollars/1000)	-0.000113	-0.000196	-0.0000299	-0.000147	-0.000145
	(0.000101)	(0.000243)	(0.000176)	(0.000229)	(0.000155)
female	-0.00632	-0.0406**	-0.0439***	0.0759	0.0607***
	(0.0100)	(0.0189)	(0.0139)	(0.0166)	(0.0138)
hispanic	-0.0125	0.0514*	-0.0371**	-0.0432*	0.0105
	(0.0147)	(0.0280)	(0.0177)	(0.0238)	(0.0202)
black	0.00189	0.126***	0.0740***	-0.0615***	0.0117
	(0.0139)	(0.0271)	(0.0209)	(0.0214)	(0.0193)
married	-0.0239*	0.0351*	0.00652	-0.0282	-0.0547***
	(0.0125)	(0.0208)	(0.0160)	(0.0190)	(0.0170)
insured	-0.0453***	-0.0365	-0.0449*	-0.0117	-0.0447
	(0.0227)	(0.0354)	(0.0259)	(0.0289)	(0.0277)
lives in MSA	0.0112	0.0171	0.0200	0.0434	0.00921
	(0.0118)	(0.0226)	(0.0165)	(0.0198)	(0.0163)
highest grade completed	-0.00834***	-0.0157***	-0.00231	0.0114***	-0.00970***
	(0.00210)	(0.00387)	(0.00280)	(0.00354)	(0.00291)
mother's highest grade comp	-0.00299	-0.00115	0.00515*	-0.00209	0.000839
	(0.00203)	(0.00405)	(0.00279)	(0.00354)	(0.00290)
father's highest grade comp	0.000304	-0.000283	-0.00286	0.00324	0.00277
	(0.00166)	(0.00312)	(0.00217)	(0.00277)	(0.00228)
mother's age at death < 60	0.0168	0.0294	0.0137	-0.0144	0.0184
	(0.0186)	(0.0333)	(0.0245)	(0.0273)	(0.0245)
father's age at death < 60	0.0130	-0.0255	0.0426	0.00854	-0.0214
	(0.0146)	(0.0255)	(0.0204)	(0.0227)	(0.0183)
Observations	3194	2535	3195	3195	3179
R^2	0.038	0.050	0.033	0.025	0.035

Robust errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

All specifications include age and year indicator variables

Table 3: OLS: Effect of mortgage loan-to-home value on the likelihood of each health condition

	poor health	obesity	Hyper-tension	freq colds	cesd>5	trouble sleeping
high LTV	0.0185	0.0524**	-0.00400	-0.00393	0.0000196	0.00943
	(0.0138)	(0.0251)	(0.0174)	(0.0204)	(0.0176)	(0.0163)
weeks unemployed (past year)	0.00272	-0.00232	0.00000589	-0.0000708	0.00257*	0.00390**
	(0.00136)	(0.00146)	(0.00118)	(0.00148)	(0.00153)	(0.00156)
weeks out of labor force (past year)	0.00128***	-0.00131*	0.000301	0.000469	0.00185***	0.00262***
	(0.000489)	(0.000710)	(0.000552)	(0.000669)	(0.000652)	(0.000632)
wage (dollars/1000)	-0.000211**	-0.000463**	-0.000242	-.000325	-.000239*	-0.000328**
	(0.0000919)	(0.000231)	(0.000167)	(0.000203)	(0.000143)	(0.000138)
female	-0.00760	-0.0435**	-0.0464***	0.0740***	0.0594***	0.0225*
	(0.00999)	(0.0188)	(0.0139)	(0.0165)	(0.0137)	(0.0124)
hispanic	-0.0152	0.0426	-0.0413**	-0.0472**	0.00871	-0.0319*
	(0.0146)	(0.0279)	(0.0177)	(0.0236)	(0.0200)	(0.0181)
black	0.00245	0.129***	0.0795***	-0.0568***	0.0126	-0.0253
	(0.0140)	(0.0272)	(0.0209)	(0.0215)	(0.0194)	(0.0173)
married	-0.0245*	0.0345*	0.00396	-0.0302	-0.0562***	-0.0514***
	(0.0126)	(0.0209)	(0.0160)	(0.0189)	(0.0170)	(0.0158)
insured	-0.0478**	-0.0459	-0.0503*	-0.0167	-0.0452	-0.0350
	(0.0226)	(0.0352)	(0.0259)	(0.0289)	(0.0277)	(0.0257)
lives in MSA	0.0117	0.0194	0.0220	0.0454**	0.00895	0.0224
	(0.0118)	(0.0225)	(0.0165)	(0.0198)	(0.0163)	(0.0152)
highest grade completed	-0.00895***	-0.0176***	-0.00358	0.0103***	-0.0104***	-0.00346
	(0.00207)	(0.00384)	(0.00278)	(0.00352)	(0.00286)	(0.00264)
mother's highest grade completed	-0.00320	-0.00174	0.00470*	-0.00251	0.000732	-0.00121
	(0.00203)	(0.00403)	(0.00280)	(0.00355)	(0.00290)	(0.00254)
father's highest grade completed	0.000224	-0.000537	-0.00315	0.00299	0.00265	0.00105
	(0.00166)	(0.00312)	(0.00217)	(0.00276)	(0.00228)	(0.00196)
mother's age at death < 60	0.0156	0.0240	0.0123	-0.0154	0.0178	0.000692
	(0.0186)	(0.0333)	(0.0246)	(0.0273)	(0.0246)	(0.0221)
father's age at death < 60	0.0120	-0.0302	0.0418**	0.00759	-0.0207	-0.0297*
	(0.0146)	(0.0256)	(0.0205)	(0.0227)	(0.0183)	(0.0161)
Observations	3194	2535	3195	3195	3179	3195
R^2	0.037	0.047	0.030	0.024	0.035	0.038

Robust errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01
All specifications include age and year indicator variables

Table 4: OLS: Effect of mortgage loan-to-home value interacted with unemployment on the likelihood of each health condition

	poor health	obesity	Hyper-tension	freq colds	cesd>5	trouble sleeping
high LTV	0.0111	0.0560**	-0.0111	-0.0124	-0.00347	0.00769
	(0.0135)	(0.0255)	(0.0174)	(0.0206)	(0.0177)	(0.0164)
weeks unemployed (past year)	0.00154	-0.00178	-0.00113	-0.00142	0.00201	0.00362**
	(0.00131)	(0.00160)	(0.00116)	(0.00145)	(0.00157)	(0.00167)
High LTV x weeks unemployed	0.00949**	-0.00428	0.00911*	0.0109**	0.00444	0.00223
	(0.00475)	(0.00339)	(0.00486)	(0.00456)	(0.00483)	(0.00462)
weeks out of labor force (past year)	0.00127***	-0.00130*	0.000293	0.000460	0.00185***	0.00262***
	(0.000489)	(0.000710)	(0.000552)	(0.000669)	(0.000652)	(0.000632)
wage (dollars/1000)	-0.000219**	-0.000459**	-0.000250	-0.000335*	-0.000243*	-0.000330**
	(0.0000915)	(0.000231)	(0.000167)	(0.000203)	(0.000143)	(0.000138)
female	-0.00803	-0.0432**	-0.0468***	0.0735***	0.0592***	0.0224*
	(0.00995)	(0.0188)	(0.0139)	(0.0165)	(0.0137)	(0.0124)
hispanic	-0.0166	0.0436	-0.0427**	-0.0489**	0.00801	-0.0322*
	(0.0146)	(0.0279)	(0.0177)	(0.0236)	(0.0200)	(0.0181)
black	0.00285	0.129***	0.0799***	-0.0563***	0.0128	-0.0252
	(0.0140)	(0.0272)	(0.0209)	(0.0215)	(0.0194)	(0.0173)
married	-0.0240*	0.0344*	0.00441	-0.0296	-0.0560***	-0.0513***
	(0.0126)	(0.0208)	(0.0160)	(0.0189)	(0.0170)	(0.0158)
insured	-0.0466***	-0.0467	-0.0492*	-0.0153	-0.0446	-0.0347
	(0.0225)	(0.0352)	(0.0257)	(0.0287)	(0.0277)	(0.0258)
lives in MSA	0.0115	0.0197	0.0217	0.0451**	0.00882	0.0224
	(0.0118)	(0.0225)	(0.0165)	(0.0198)	(0.0163)	(0.0152)
highest grade completed	-0.00899***	-0.0176***	-0.00361	0.0102***	-0.0104***	-0.00347
	(0.00207)	(0.00384)	(0.00278)	(0.00352)	(0.00286)	(0.00264)
mother's highest grade completed	-0.00307	-0.00180	0.00482*	-0.00236	0.000793	-0.00118
	(0.00203)	(0.00403)	(0.00280)	(0.00354)	(0.00290)	(0.00255)
father's highest grade completed	0.000187	-0.000516	-0.00318	0.00295	0.00263	0.00104
	(0.00164)	(0.00312)	(0.00218)	(0.00276)	(0.00227)	(0.00196)
mother's age at death < 60	0.0144	0.0244	0.0111	-0.0168	0.0172	0.000406
	(0.0188)	(0.0333)	(0.0244)	(0.0273)	(0.0246)	(0.0221)
father's age at death < 60	0.0133	-0.0309	0.0431**	0.00908	-0.0201	-0.0294*
	(0.0146)	(0.0256)	(0.0204)	(0.0227)	(0.0183)	(0.0161)
Observations	3194	2535	3195	3195	3179	3195
R^2	0.041	0.048	0.031	0.026	0.036	0.038

Robust errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

All specifications include age and year indicator variables

Table 5: OLS: Effect of housing leverage on whether it has been more than a year since last physical exam (NLSY79 Pooled 2002-2008)

	>1 year since last physical	>1 year since last physical	>1 year since last physical
mortgage loan (dollars/1000)	0.0000412		
	(0.0000486)		
home value (dollars/1000)	0.00000481		
	(0.0000222)		
high LTV		-0.00470	-0.000800
		(0.0125)	(0.0127)
weeks unemployed (past year)	0.00188**	0.00192**	0.00258***
	(0.000860)	(0.000859)	(0.000950)
high LTV x weeks unemployed			-0.00381*
			(0.00203)
weeks out of labor force (past year)	-0.000343	-0.000291	-0.000291
	(0.000328)	(0.000326)	(0.000326)
wage (dollars/1000)	-0.000110	-0.0000675	-0.0000668
	(0.000117)	(0.000113)	(0.000113)
female	-0.152***	-0.152***	-0.152***
	(0.0108)	(0.0108)	(0.0108)
hispanic	-0.0263	-0.0244	-0.0242
	(0.0164)	(0.0164)	(0.0163)
black	-0.164***	-0.165***	-0.165***
	(0.0131)	(0.0131)	(0.0131)
married	-0.0314***	-0.0308***	-0.0306***
	(0.0116)	(0.0115)	(0.0115)
insured	-0.203***	-0.202***	-0.203***
	(0.0182)	(0.0182)	(0.0182)
lives in MSA	-0.00970	-0.00990	-0.00970
	(0.0116)	(0.0116)	(0.0116)
highest grade completed	-0.000445	-0.0000838	-0.0000286
	(0.00234)	(0.00232)	(0.00232)
mother's highest grade completed	0.00240	0.00252	0.00248
	(0.00234)	(0.00234)	(0.00234)
father's highest grade completed	-0.000117	-0.0000209	-0.00000124
	(0.00184)	(0.00184)	(0.00184)
mother's age at death < 60	-0.00211	-0.00211	-0.00213
	(0.0185)	(0.0185)	(0.0184)
father's age at death < 60	-0.0229	-0.0223	-0.0226
	(0.0148)	(0.0148)	(0.0148)
Observations	13049	13049	13049
R^2	0.069	0.069	0.069

Robust errors clustered on individuals in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01
All specifications include age and year indicator variables

Table 6: OLS: Effect of current and lagged mortgage loan-to-home value interacted with current and lagged unemployment on the likelihood of poor health

	poor health	poor health	poor health	poor health
high LTV	0.0115	0.00860	0.00989	
	(0.0133)	(0.0176)	(0.0210)	
weeks unemployed	0.00154	0.000890	0.000767	
	(0.00131)	(0.00124)	(0.00126)	
high LTV x weeks unemployed	0.00950**	0.0123**	0.0104*	
	(0.00473)	(0.00488)	(0.00568)	
1-lag high LTV		0.00342	0.0213	0.0311*
		(0.0152)	(0.0203)	(0.0174)
1-lags weeks unemployed		0.00361*	0.00405**	0.00416**
		(0.00198)	(0.00198)	(0.00204)
1-lag high LTV x weeks unemployed		0.00965**	0.0127***	0.0121**
		(0.00492)	(0.00469)	(0.00473)
2-lags high LTV			0.00151	0.0000780
			(0.0136)	(0.0138)
2-lags weeks unemployed			0.00111	0.00109
			(0.00209)	(0.00208)
2-lags high LTV x weeks unemployed			-0.00365	-0.00369
			(0.00256)	(0.00255)
Observations	3194	2625	2238	2238
$_R2$	0.041	0.048	0.051	0.045

Robust errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01

All specifications include full set of control variables

Table 7: OLS: Effect of poor health on the likelihood of high LTV in 2 years

	high LTV in 2 years
poor health	0.0538**
	(0.0236)
high LTV	0.527***
	(0.0228)
weeks unemployed (past year)	0.000627
	(0.000886)
high LTV x weeks unemployed	0.00474
	(0.00441)
weeks out of labor force (past year)	0.000554
	(0.000449)
wage (dollars/1000)	0.00000443
	(0.000109)
female	0.000684
	(0.0115)
hispanic	0.000330
	(0.0174)
black	0.0191
	(0.0179)
married	-0.0279**
	(0.0141)
insured	-0.0607***
	(0.0226)
lives in MSA	-0.000896
	(0.0137)
highest grade completed	0.000807
	(0.00256)
mother's highest grade completed	0.00273
	(0.00262)
father's highest grade completed	-0.00122
	(0.00195)
mother's age at death < 60	0.0101
	(0.0204)
father's age at death < 60	0.0117
	(0.0168)
Observations	2856
R^2	0.362

Robust errors in parentheses; * p < 0.1, ** p < 0.05, *** p < 0.01
All specifications include age and year indicator variables

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