Essays in Household Savings and Portfolio Choice

by

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Contents

List of Figures

List of Tables

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Declaration

I submit this thesis to the University of Warwick in accordance with the requirements for the degree of Doctor of Philosphy. I declare that this thesis is my own work and that any material contained in it has not been submitted for a degree at another university.

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Abstract

The first part of this thesis presents a decomposition of household savings. One of the explanations for the wealth gap is that households with the same income level and demographic characteristics present differences in saving rates. This issue has been studied for African American versus Whites, but has not been directly addressed for Hispanics. Using pre-retirement data from the Health and Retirement Study, I compute saving rates as the ratio of wealth change to income over the years 1992-1998 and 1998-2004. In a regression framework I find that Mexican Americans, but not other Hispanics, have lower saving rates than Whites, even after controlling for income and socio-demographic factors. The inclusion of Social Security (S.S.) and pension wealth widens the gap further, which reflects the lack of pensions' coverage among Mexican Americans. In contrast, the difference between African Americans and Whites is only significant when retirement assets are not added to total wealth, consistent with the equalizing effect of S.S.. Then I conduct a regression decomposition for the mean gap in saving rates and find that: i) the component of the Mexican American-White differential not explained by observable characteristics becomes significant when S.S. and pensions are included; ii) with or without retirement assets the unexplained racial gap disappears; and iii) income and education are the main predictors of the savings gaps.

The second and third parts investigate the effect of bankruptcy protection on households' portfolio choice. The debtor protection provided by the U.S. personal bankruptcy law reduces exposure to uninsurable risks: it allows defaulters to discharge unsecured debt and to protect a certain amount of home equity. A reduction in background risk - for example, resulting from labor or entrepreneurial income - can affect the demand for risky financial assets. Thus, the bankruptcy protection can affect ex ante households' willingness to tilt the financial portfolio towards those assets. On the one hand the implicit consumption insurance may lead to higher risk-taking by increasing the consumption floor if there is a negative wealth shock ("risk-taking channel"). On the other hand, more generous bankruptcy provisions will lead to a reduction in the demand for stock via: i) a higher probability of bankruptcy, since stocks are lost in bankruptcy because they are not protected ("protection channel"); or ii) worse credit market conditions -less access to credit at a higher price-, since higher bankruptcy protection implies a reduction of the collateral ("credit market channel").

In the context of a portfolio choice model, in the second chapter I illustrate how the bankruptcy protection can affect risk-taking through the "risk-taking channel" and the "protection channel". In the third part, I examine empirically the relationship between bankruptcy protection and stock market participation by exploiting the variation in that protection across states and over time. I find that doubling the amount of home equity that can be protected reduces stock ownership by 2 p.p. at intermediate protection levels ($22,000 to $90,000). This decline is restricted to high-asset and high-income households, which are more likely to participate in the stock market. Since poor rather than rich households are affected by worse credit market conditions when bankruptcy becomes more generous, the "credit market channel" is not a plausible mechanism. I do not find any effect of higher protection on the share of stocks in liquid assets, which suggests that the bankruptcy protection does not affect households' risk appetite. My findings are consistent with unprotected rather than risky assets becoming less attractive as the level of protection increases, as predicted by the "protection channel".

Abbreviations

AIC	Akaike's Information Criterion
BAPCPA	Bankrupcty Abuse Prevention and Consumer Protection Act
CDs	Certificate of Deposits
CMS	Center for Medicare & Medicaid Services
DB	Defined-benefit
DC	Defined-contribution
HRS	Health and Retirement Study
IMR	Inverse Mills ratio
IRAs	Individual Retirement Accounts
NIPA	National Income and Product Accounts Tables
PSID	Panel Study of Income Dynamics
SCF	Survey of Consumer Finances
S.S.	Social Security
SIPP	Survey of Income and Program Participation

Chapter 1

Ethnic and Racial Disparities in Saving Behavior

1.1 Introduction

In recent decades, the U.S. has witnessed the demographic growth of ethnic and racial minority groups, especially Hispanics. According to the estimates from the U.S. Census Bureau, in 1990 Blacks and Hispanics represented the 12.3% and 9% of the total population.[1] By 2010, these figures increased by 0.3p.p. and 7.3p.p. respectively. The 2014 projections for 2060 anticipate that Blacks will represent the 14.3%, whereas the fraction of Hispanics will almost double and reach the 28.6%. These groups are particularly disadvantaged, not only in terms of income and labor market opportunities, but also in terms of wealth and readiness for retirement. After the financial crisis of 2007-2008, the wealth gap between minorities and Whites has climbed to a record level, reaching in 2009 the highest peak of the last 25 years at least.[2] Whereas the consequences of these disparities are well known, their causes and the instruments to reduce them still need to be better understood. The goal of this study is to examine the differences in savings behavior of Whites and Hispanics - distinguishing Mexican Americans from Other Hispanics - and

[1] In most US surveys Hispanics are considered as an ethnic group, which is a classification determined by culture or origin and independent of race. Hispanics self-identify mainly as white, mestizo or mulatto descendants, or black. However, most are viewed as of multiracial origin in the US. In this study I refer to 'non-Hispanic Whites' simply as 'Whites' and to 'non-Hispanic Blacks' as 'Blacks'.

[2] "Wealth Gaps Rise to Record Highs Between Whites, Blacks and Hispanics", Pew Research Center, July 2011.

their determinants. These differences are compared with the more studied ones between African Americans and Whites.

A natural explanation for wealth disparities across families are differences in income. However, a number of studies have shown that the Black-White gap persist even within groups with the same permanent income level. Moreover, the ethnic and racial gaps in wealth levels are larger than the corresponding gaps in income. This gave rise to a variety of explanations to account for wealth differences that cannot be explained solely by income (Blau and Graham, 1990, Wolff, 1992, Oliver and Shapiro, 1995, Menchik and Jianakoplos, 1997, Hurst et al., 2010, Barsky et al., 2002, Altonji and Doraszelski, 2005). The main sources of inequality beyond permanent income, derived from the the standard life-cycle model [Modigliani and Brumberg, 1954], are differences in saving rates, in inheritances or inter-generational transfers and in ex-post rates of return to capital.[3] However, saving rates not only differ within but also across income levels. Families with lower permanent income have lower saving rates [Dynan et al., 2004].[4] Thus, the relevant question is whether there are differences in the saving rates of Hispanics and Whites, conditioning on income. If there are differences in savings which cannot be explained by income and demographics, then it remains to see what other factors can account for that differential.

In that context, the contributions of this study are, first, to compute the gap in saving rates between Hispanics and Whites, which so far has only been analyzed as an explanation for the racial wealth gap [Gittleman and Wolff, 2004, Altonji and Doraszelski, 2005]. The available data allows to distinguish differentials in saving rates arising from active savings decisions made by the households (exclusive of capital gains) versus those resulting from differences in the evolution of asset prices (passive savings). Second, I document the ethnic differences in saving rates including Social Security (S.S.) and pensions. To the best of my knowledge, no comprehensive study on the racial savings gap has included these

[3]Inheritances may affect relative wealth positions if Hispanics and Blacks inherit from their parents smaller amounts than Whites. Juster et al. [1999] dismiss the importance of bequests since very few American households have received financial inheritances. On the other hand, the fact that Hispanics and Blacks have a different portfolio composition than Whites (for example, they are much less likely to hold financial assets) can result in lower ex-post rates of return on their savings. This can also happen if there are differences in asset-specific rates of return, i.e. conditional on holding specific assets (on housing or the stock market, for instance), minorities face systematically lower rates of return.

[4]In the simplest version of the life-cycle model savings are proportional to permanent income. However, saving rates are expected to differ with income in more extended versions of the model that introduce heterogeneity in time preference rates and in interest rates across households, and non-homothetic preferences.

assets either, despite that they represent a substantial fraction of household's portfolio before retirement. Finally, I study the ethnic differences in savings using a regression decomposition approach (Oaxaca-Blinder). A previous study on ethnic differences, Cobb-Clark and Hildebrand [2006], has done it for wealth in levels only, and no study has done it yet for savings. Cobb-Clark and Hildebrand [2006] state that most of the wealth gap between Mexican Americans and Whites stems from differences in current income levels and, more importantly, from background characteristics of households: Mexican American families have younger heads, more children and lower educational attainment than non-Hispanic families.

However, there are reasons to suspect that Hispanics have different patterns of wealth accumulation than Whites that are not purely explained by income and socio-demographic characteristics. Although still open to debate, the hypothesis of cultural effects as an explanation for saving differentials has been proposed by Bosworth [1993]: people from different countries have different intrinsic tastes for saving.[5] Thus, cultural predispositions to take care of aging parents may explain why Hispanics save less for retirement than other groups, as the following quotation from *The Wall Street Journal* illustrates:

> Not only do many Latinos work in low-wage industries, but the idea of accumulating funds for one's elder years doesn't always mesh with a culture that emphasizes individuals taking care of one another. "Retirement is a foreign concept for many Hispanic workers," [...]. "The focus is on providing for the extended family, and they expect their family to take care of them when they're no longer working." ...Even at the highest income level counted in the Ariel/Hewitt survey—a salary of $120,000 or above—Hispanics had the least amount saved for retirement: an average of $150,000, compared with $155,000 for African Americans, $161,000 for whites and $223,000 for Asians. [Pessin, 2011].

Remittances associated to strong family support networks may crowd-out savings in

[5]Carroll et al. [1999] compare saving patterns of immigrants to U.S. and find significant differences on savings across country of origin. However, they argue that cultural differences may not explain the differences in savings observed across countries because immigrants from countries with high saving rates do not necessarily save more. Haliassos et al. [2015] find that household financial behavior differs across european culture groups. These differences diminish but do not disappear completely with exposure to common institutions not arising from the original culture.

the host country. And Mexico is the largest recipient of remittances originating in the US: In 2014, remittances sent to Mexico amount to US$24,396m followed by those to China (US$16,329m) and India (US$11,177m).[6] In addition, institutional barriers such as those associated with legal status, place of birth and language skills may disproportionally limit Hispanics' access to financial and insurance markets (Osili and Paulson, 2009; Rutledge and McLaughlin, 2008). Lower access to financial markets results in lower levels of financial literacy due to lack of experience, and therefore correlates with poor financial behavior [Lusardi, 2005]. Rutledge and McLaughlin, 2008 argue that Hispanics, particularly those of Mexican origin, are less likely to seek, or be able to find, health insurance coverage than Whites. As a result, medical expenses should be paid out-of-pocket, reducing their ability to save for retirement. Other factors that could lead to lower savings also apply to African Americans. For example, Charles et al. [2009] present evidence that Hispanics and Blacks spend relatively more on conspicuous goods than Whites, as a way to signal status. Moav and Neeman [2012] show that such behavior leads to an equilibrium where the saving rate is increasing in income, resulting in a poverty trap. Finally, minority households have significantly shorter planning horizons than other groups [Scholz and Levine, 2003]. Differences in rates of time preference, risk aversion, liquidity constraints and other factors related to preferences, such as time inconsistency, may also have an independent role to explain differences in savings.

To examine the savings gap across ethnic and racial groups, I compute total saving rates as the change in wealth divided by income using data from the Health and Retirement Study (HRS) for the periods 1992-1998 and 1998-2004. Active savings are constructed using specific questions on investment in asset categories for which capital gains are more important, including housing, real estate, business, retirement assets and stocks. Passive savings, measuring capital gains or savings due to the change in the price of the asset, are obtained as the difference between total savings minus active savings. I first regress saving rates on dummies for each group and other controls.[7] Conditioning on income

[6] World Bank, Bilateral remittance estimates using migrant stocks, destination country incomes, and source country incomes, 2014.

[7] Something to consider is that the models of wealth accumulation suffer from higher measurement errors in the dependent variable and lower explanatory power (as measured by the adjusted R^2) than the models in wealth levels. This requires being more cautious in the interpretation of their results, including those from the decompositions.

and socio-demographic factors, Mexican Americans save 6.3p.p. less than Whites at the mean, and 3.6p.p. less at the median. The size of the gaps are considerable since they represent a two-thirds decline in the mean and median saving rates of 10.3% and 5.5%. The racial gaps are smaller, 3.3p.p. at the mean and 2.2p.p. at the median. I do not find significant differences in savings between Other Hispanics and Whites. Whereas the mean gap in savings reflects the effects of asset prices and capital gains for African Americans, the median differences can be attributed to the direct effects of accumulation decisions, both for Mexican and African Americans. Including S.S. and pensions, the gap in savings increases substantially up to 14.5p.p. at the mean and 11p.p. at the median for Mexican Americans and is more precisely estimated, but disappears for Black households. This may reflect the lower access to pensions among Mexican Americans, given that S.S. has a more universal coverage and equalizes saving rates. Indeed, they are less likely to work for employers who sponsor pension schemes and, even if they are eligible for employer-sponsored retirement savings programs, they are less likely to participate [Richman et al., 2012].[8]

Next, I conduct an Oaxaca-Blinder decomposition, less restrictive than the regression approach since not only the intercept but also the slope of the savings function with respect to all the controls varies across groups. This approach divides the mean saving differential in a part explained by group differences in observable characteristics ("explained"), and another resulting from differences in unobserved predictors ("unexplained"). The most remarkable finding is that the unexplained component of the Mexican Americans' savings gap is significant only after including S.S. and pensions and amount to 63%. This is consistent with lack of pensions' coverage as responsible for their low saving rates relative to White households, even to those with the same income level and demographic characteristics. Income, but especially education, are the main contributors to the remaining explained fraction of 36%. Demographic characteristics and region of residence have a negative but insignificant contribution to the gap in saving rates, but almost null to the gap in wealth levels.[9] The results from the decompositions also show that the

[8] According to Richman et al. [2012] the low pension savings among Mexican Americans responds to the collectivist culture that makes people savings more vulnerable to the needs of the family members, who in turn can provide support at old ages.

[9] In contrast, Cobb-Clark and Hildebrand [2006] find that not only income and education but also age and the number of children matter to explain the ethnic wealth gap at the median. Future research on

unexplained difference in saving rates between African Americans and Whites disappears, whereas observable characteristics significantly account for at least 60% of the racial gap.

Given that income and demographics explain most of the wealth gap between Mexican Americans and Whites, as noted by Cobb-Clark and Hildebrand's (2006), this would imply that ethnic differences in the patterns of wealth accumulation do not matter to explain the gap in wealth levels. However, the differences in saving rates can eventually affect the wealth gap as they accumulate over time. Moreover, the presence of unexplained group differences in saving rates could help to make conjectures about the optimality/adequacy of such behavior. The existence of such gap in savings may be a first -although not conclusive- indicator that Mexican Americans are not saving optimally for retirement.[10] If Mexican Americans do not have preferences about inter-generational transfers, saving too little may be inefficient since their lifetime utility can be increased by reallocating consumption across time. And if the generosity of S.S. is reduced in the future, then it becomes crucial to understand if their savings behavior on the remaining assets is indeed optimal.

1.2 Related Literature

The study of the differential in Hispanics and Whites' saving rates relates to the broad economic literature on racial and ethnic inequality. This literature has focused mainly on income; the bulk of studies on wealth differences are much more recent. Whereas income inequality is a good indicator of discrimination in the labor market, wealth inequality provides a more complete measure of the relative economic position of minority families. Moreover, the empirical evidence indicates that the racial gap in wealth is considerably larger than the gap in income. And among the studies on wealth, most of them seek to explain the gap in wealth levels; just a few look at the rate of wealth accumulation or savings rate. By looking at the dynamics of the wealth accumulation process it is possible to gain a deeper understanding of the reasons behind wealth disparities.

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decompositions at the median can help to better compare my results with the ones in that study.

[10] It is not clear either that the typical (White) American household is saving optimally [Scholz et al., 2006]. To determine the optimality of households' savings one needs to make assumptions about future consumption and preferences. And to assess the adequacy of savings one needs to make value judgments relating to needs at older ages.

Most of the initial literature on wealth inequality has focused on the factors that explain the gap between Black and Whites (see Terrell, 1971, Sobol, 1979, Blau and Graham, 1990, Wolff, 1992, Oliver and Shapiro, 1995, Menchik and Jianakoplos, 1997, Hurst et al., 2010).[11] In their seminal study, Blau and Graham [1990] conduct a means-coefficient analysis, also known as Blinder-Oaxaca decomposition, that breaks down the differences in wealth into two components: one explained by differences in household characteristics, such as income, and another that is unexplained. They find that income is the most important factor to explain wealth differentials. However, even after accounting for income and other socio-demographic factors, they find that a substantial portion of the gap remains unexplained. They attempt to resolve the puzzle by evaluating the arguments taken from the standard life cycle model [Modigliani and Brumberg, 1954], which attributes the racial differences in wealth to: i) inheritances or inter-generational transfers, ii) rates of return, and iii) savings rates. They conclude that racial differences in inheritances are the most likely of the three to account for most of the wealth gap.

More recent studies, like Altonji and Doraszelski [2005] and Barsky et al. [2002], have risen concerns about the adequacy of the regression decomposition approach. Barsky et al. [2002] claim that such decompositions incorrectly assume linearity in the relation between wealth and income. Moreover, the estimates based on such functional form are used to extrapolate outside the range of the Black income distribution, which is shifted to the left relative to the White distribution. Thus, they propose a nonparametric method to perform the decomposition and find that two-thirds of the mean differences in wealth can be attributed to earnings. They do not consider other factors, but acknowledge that it is fruitful to explore racial differences in preferences for wealth accumulation as a possible cause of the wealth gap. In comparison with previous studies, Altonji and Doraszelski [2005] can explain a larger fraction of the racial disparity in wealth holdings with income and demographic variables, but only if they estimate the wealth model in a sample of Whites. If they use a sample of Blacks, then they can only explain a small portion. They suggest that this discrepancy in the sensitivity of wealth holdings to observable characteristics is as important as the differences in income and demographics to understand the racial wealth gap. They conclude that the discrepancy is not caused by extrapolation

[11] For a survey of the literature on racial differences in wealth see Scholz and Levine [2003].

out of sample nor by differences in inter vivos transfers and inheritances, but instead they suspect that it is explained by differences in savings behavior. This could be the case since, for example, a smaller proportion of Blacks has access to financial institutions.

Despite the speculations that differences in wealth accumulation can contribute to the racial wealth gap, the topic has received little direct attention in the literature. One exception is Gittleman and Wolff [2004], the study more similar in its approach to this. They divide the change in the value of each asset into capital gains and gross savings, which are the additional funds invested in that asset. Their measure of savings (gross savings minus inflows from inheritances) is closely related to what in the literature is referred as active savings.[12] A wealth accounting framework is built to decompose the changes in wealth into savings, capital gains and inheritances or transfers. They find that racial differences in savings rates are not significant after controlling for income, and that the rate of return to capital is not greater for Whites than for Blacks, although they acknowledge that the latter may be period-specific. In counterfactual experiments following Oaxaca and Ransom [1994], they compute the fraction of the wealth gap that will be reduced if Blacks and Whites had comparable levels of income, had equalized the unconditional saving rates, had similar portfolio composition, or had inherited similar amounts. Although the equalization of savings rates would have also increased the wealth ratio, it is remarkable that they did not find a racial difference in savings behavior after controlling for income.

By the mid-nineties, studies looking at Hispanic wealth were almost nonexistent; the literature rising in subsequent years include Smith [1995], Even and Macpherson [2003] and Cobb-Clark and Hildebrand [2006]. They reach to different conclusions about the extent to which observable characteristics are able to explain the ethnic wealth gap. In a multivariate model, Smith [1995] finds that income and, to a smaller extent, current health are important predictors of racial and ethnic wealth disparities. Even when a significant amount of the wealth differences can be explained by these and other variables emphasized

[12] In contrast to the measure of active savings used by Hurst et al. [2010] and Juster et al. [1999] among others (including this study), Gittleman and Wolff [2004] do not attribute the entire change in net equity of the home (less the value of home improvements) to capital gains. Instead, they divide it into saving (the change in mortgage principal) and capital gains (the change in the value of the house). Second, for other assets for which there are not specific questions about inflows, the active saving approach allocates the entire change in net value to saving. In contrast, Gittleman and Wolff [2004] allocates a fraction to capital gains by applying a rate of return.

in models of asset accumulation, the magnitudes of the differentials remain large. Then he includes pension and S.S. into his definition of wealth and finds that it has a big impact on reducing racial and ethnic disparities. This is not surprising, since private pensions and S.S. represent a big fraction of household wealth and S.S. has an equalizing effect, since it differs very little across race and ethnicity. However, he notes that racial and ethnic wealth disparities are still larger than what seems justified by differences in permanent income alone, and concludes that the puzzle of why income minorities save so little remains unresolved.

In contrast, Even and Macpherson [2003] and Cobb-Clark and Hildebrand [2006] arrive to the conclusion that most of the wealth ethnic gap stems from differences in current income levels and background characteristics of households, rather than on the way in which households have accumulated wealth in the past (conditional on their income and characteristics). In a multivariate framework, Even and Macpherson [2003] find that differences in earnings, education and socio-demographic characteristics account for most of the racial and ethnic differences in wealth. This result holds independently of whether pension wealth is included or not in the measure of total wealth (although pension savings do not affect the wealth differentials at the mean, they do have an effect at the lower tail of the distribution since poorer households hold a larger fraction of wealth in pensions). Cobb-Clark and Hildebrand [2006] analyze the wealth gap using a semi-parametric decomposition and find that although income differences are important, the main factor explaining the inequality in wealth are demographic characteristics: Mexican American families have more children and heads that are younger. Low educational attainment explains part of the wealth gap, even after accounting for differences in income. Note that the results of these two studies contrast to the explanations given in the literature for the gap in wealth between Blacks and Whites that originates in the way in which –conditional on their characteristics- wealth is accumulated.

Finally, note that the differential saving rates across races can also be viewed through the 'chance' versus 'choice' framework proposed by Venti and Wise [1998]. Their purpose is to understand how much of that wealth dispersion can be attributed to 'chance' events, such as inheritances, poor health or other shocks to wealth, and how much to the conscious 'choice' of saving out of available resources. In that context, Gustman and Steinmeier [2004] estimate a joint structural model of retirement and wealth for groups defined by

race, ethnicity, gender and marital status. They decompose differences in outcomes into differences resulting from parameters of the preference function and differences resulting from circumstances (i.e. the opportunity set and factors determining the disutility of work such as health status). Their findings suggest that differences in outcomes among White, Black and Hispanic males are explained by differences in time preferences and in circumstances rather than by differences in preferences for leisure and consumption.

1.3 Data

In this study I use household data from the HRS. It has several advantages over other household surveys collecting wealth data. First, it provides assets and income data of high quality, with a relatively low rate of item non-response and abnormally high retention rates compared to other aging studies [Banks et al., 2010]. In particular, it provides the best household survey data available to calculate pension wealth. Since pension wealth is typically the largest asset on the household balance sheet, its importance for the study of savings is paramount. Second, the HRS oversamples Blacks and Hispanics at the rate 2:1 relative to Whites, which guarantees a reasonable sample size for the analysis of racial and ethnic differences.[13] Third, this data set collects information on households with at least one individual over 50 years old, which allows focusing on savings adequacy for retirement. In fact, the HRS is not appropriate to study savings for the entire age distribution. But the sample selected is the most adequate for this study because as people get older and approach retirement, they hold more types of assets, own more wealth and save faster.

The measure of net worth used here can be grouped into real wealth (main home equity, other real estate, vehicles and business), and financial wealth (Individual Retirement Accounts, stocks, mutual funds, checking and savings accounts, certificate of deposits, savings bonds, treasury bills, bonds, and other assets, less other debts). Note that this measure excludes private pension wealth, social security wealth, and future earnings. Thus, to account for them I use a set of cross-wave data constructed with information derived from the HRS: the Prospective Social Security Wealth Measures of Pre-Retirees[14], the Imputa-

[13]Residents of the State of Florida were the other group oversampled, because it is an area with high density and number of older populations.

[14]The version 4.0 of the data was prepared by Kandice Kapinos with Charlie Brown, Michael Nolte, Helena Stolyarova, and David Weir. Survey Research Center, Institute for Social Research, University of

tions for Pension Wealth 1992 and 1998[15], and the Imputations for Employer-Sponsored Pension Wealth from Current Jobs in 2004.[16]

The measure of income corresponds to the last calendar year and is the sum of respondent and spouse earnings, pensions and annuities, government transfers, household capital income, and other income and lump sums from insurance, pension, and inheritance. To compute saving rates including S.S. and pensions, it is necessary to adjust the measure of total income and account for employer contributions. Thus, I adjust total household income by adding the fraction of the respondent and spouse earnings that correspond to employer contributions to Defined Benefit (DB) and Defined Contribution (DC) plans and to S.S.. This is measured as the cost to employers for DB and DC plans and for S.S. as percentages of total compensation. The data is taken from the Employer Costs for Employee Compensation, produced by the Bureau of Labor Statistics. More details of how wealth and income measures are constructed can be found in Appendix B.

I use household weights for descriptive statistics but not in the regressions. The use of sample weights in regression analysis is typically required when there is endogenous stratification. In that case, the survey over-samples a particular population and the oversampling criteria are related to the dependent variable, so the usual estimators are inconsistent if weights are not used.[17] For this study there is purely exogenous stratification because the HRS stratifies on the regressors only (i.e. race and ethnicity) and not on the savings rate, and so the usual estimators are still consistent even if the HRS were indirectly oversampling people with low savings.[18]

The sample used for this study is restricted to sub-households with the same head and spouse over the relevant period (1992-1998 or 1998-2004), a common requirement adopted in the literature. By restricting the sample to stable households, one can ensure that wealth changes are not mainly explained by changes in family composition. I further drop observations for sub-households that were in the sample but were not interviewed

Michigan, November 2010. See at: http://hrsonline.isr.umich.edu/index.php?p=avail.

[15] Final version 2.0, December 2006. See at: http://hrsonline.isr.umich.edu/index.php?p=avail.

[16] Version 1, July 2009. See at: http://hrsonline.isr.umich.edu/index.php?p=avail.

[17] Hill [1992] explains this in the context of the PSID, which over-samples low-income households. Thus, in that case, the regressions that use income as the dependent variable need to be weighted.

[18] Under exogenous stratification one may use weights for a descriptive approach, where the estimated relations do not necessarily imply causality and attempt to describe characteristics of the whole population and not of a particular sample. But there is no need to use sample weights for a structural or analytical approach. Cameron and Trivedi [2005] give a good insight into this issue.

in a particular wave, and for those that have either income or wealth missing. Then I drop households where the head was below 50 or above 70 years old in 1998 and in 2004 and where the head reports to be retired, where retirement status is defined through self-reports.[19] Also, I exclude households where the spouses are of a different race or ethnicity.

1.3.1 Measurement error

There are three main sources of concern related to the presence of measurement error in saving rates. The first comes from estimates of specific assets such as pension and S.S. wealth. Smith [1995] notes that estimates of aggregate net worth are more reliable than those of individual assets. Even when pension data is the better collected to date in a survey; still it suffers from serious measurement errors [Venti and Wise, 1998]. The respondents' lack of knowledge about the characteristics of their pension plans implies that they have trouble classifying them as DB or DC. And if they classify their DC pension plan as DB, then the corresponding balance is zero for that wave. Measurement error in S.S. data may come from imputations for respondents that could not be matched to S.S. earnings data. Thus, the slightly negative average saving rates in S.S. wealth observed in 1992-1998 may partly reflect measurement errors. Indeed, a higher fraction of imputations corresponds to changes in S.S. that are negative than to positive changes.

Second, as in most household surveys, the wealth of very rich families is not accurately captured. It is hard to define the sample frame, and even when families are interviewed, it could be that they are reluctant to report very large amounts of stock holdings. Also, it is particularly hard to calculate the net value of certain assets with complex financial structures, such as business, where the complexity increases with the value of the asset. Unless special sampling frames are designed to represent high-wealth households, as in the Survey of Consumer Finances (SCF), the full range of the wealth distribution is not readily captured. Moreover, there is evidence that wealthier households are more reluctant to report and therefore missing data is not random (Smith, 1995, Banks et al., 2010).

The third source of measurement error relates to the approach used to compute savings as the difference in net worth between two time periods. The quality of data on assets and

[19] See Appendix C for a discussion of how self-selection into retirement may affect this sample.

income is lower when they are used in their longitudinal dimension. Indeed, misreporting of asset balances and the absence of longitudinal imputations imply that the use of successive waves of wealth can confound some analyses. Venti and Wise [1998] points out that "these potential misreports create 'spurious' wave-to-wave changes in assets that are common and typically much larger than 'legitimate' wave-to-wave changes.". If measurement error is not perfectly correlated across survey waves, changes in wealth may carry significant amounts of measurement error. Since both realized and active savings are measured with error, the problem becomes even bigger for capital gains obtained as the difference between realized and active savings.

Measurement error in the dependent variable of the models of savings results in lower explanatory power (as measured by the adjusted R^2) than the models in wealth levels. OLS estimates will be still consistent, although not as precise as with perfect data. In general, measurement error in the dependent variable is more innocuous than in the regressors. I still implement several procedures to alleviate its impact. First, given the potentially larger error in the measurement of specific assets, I restrict the analysis to total wealth and a few aggregate components. Second, I trim the sample by excluding households with wealth levels and saving rates at the top and bottom 2 per cent of the distribution.[20] In this way, I not only exclude the extremely wealthy from the analysis, whose savings behavior is more difficult to model, but I also get rid of outliers originated in measurement errors. Third, I estimate the regressions at the median of the dependent variable since they are less sensitive to the presence of outliers than mean regressions. Finally, in terms of imputation, the HRS has benefited from the use of bracket questions that allow determining a range in which the values lie and mitigates the problem of random non-response. However, the imputations of missing values do not rely on cross-wave information; the HRS public release files only use information from the wave corresponding to the missing data. Thus, I rely on the RAND HRS 2008 Income and Wealth Imputations that use an imputation method consistent across waves.[21]

[20] This procedure has been applied, among others, by Gittleman and Wolff [2004] to the Panel Study of Income Dynamics (PSID) data.

[21] March 2011. See at: http://hrsonline.isr.umich.edu/index.php?p=avail.

1.3.2 Saving rates

The saving rate is defined as the ratio between savings and the income earned during the relevant period. The conceptually most appropriate measure of savings is the one given by the difference between disposable personal income and consumer expenditures, where both measures are obtained directly. By defining real income for household i, Y_{is}, as the sum of the return on non-human wealth between $s-1$ and s ($r_{is-1}W_{is-1}$), after-tax earnings (E_{is}), and transfers from the government (TR_{is}), household savings can be expressed as:

$$Y_{is} - C_{is} = r_{is-1}W_{is-1} + E_{is} + TR_{is} - C_{is} \tag{1.1}$$

where C_{is} is total consumption and r_{is-1} is the real after-tax rate of return on non-human wealth between $s-1$ and s.

However, there are practical difficulties to implement such approach using survey data. In particular, measuring consumption is a very time-consuming process and so it is not typically available in most surveys. Thus, the approach that I follow here is the one feasible with HRS data and the most common in the empirical literature.[22] It consists on computing savings as the difference in net worth between two time periods ($W_{is} - W_{is-1}$), which is referred as realized savings. Wealth at the end of period s is defined as:

$$W_{is} = W_{is-1}(1 + r_{is-1}) + TR_{is} + E_{is} - C_{is} \tag{1.2}$$

where $W_{is-1}(1 + r_{is-1})$ is net worth (exclusive of human wealth) at the beginning of period s. The equivalence of the two definitions of savings is verified since capital gains are added to income to the extent that they are included in r. As explained before, the main disadvantage of this approach is that the first difference of wealth will inherit, and most likely exacerbate, the measurement error that may be already present in the measured net wealth.

An advantage of the HRS is that it allows distinguishing the change in the value of an asset due to: i) 'active savings', or current income that households do not spend but save, and ii) 'passive savings', reflecting the change in the price of the asset or capital gains

[22] See Juster et al. [1999] for a detailed description of these approaches.

that households do not realize and spend. Realized savings –i.e. changes in household wealth-, can differ sharply from active savings. Eventually, the choice of the most relevant concept of savings depends on the question of interest. The active saving measure, which intends to measure flows of money into and out of different assets, is the more similar to the traditional saving measure of income minus consumption. It is more appropriate to analyze the supply of loanable funds for new investment and therefore is useful to study the effect of a redistribution of income on economic growth [Dynan et al., 2004]. On the other hand, a measure of total savings that includes capital gains is the more appropriate concept to study the ex-post adequacy of saving for retirement. In the present study I focus in both measures given that their decomposition can shed light into different aspects of the wealth accumulation process across ethnic and racial groups.

The survey contains specific questions about active savings precisely for those components were capital gains are more important, such as housing, investment in real estate other than the primary residence, business, IRAs, and stocks. For those assets, capital gains are obtained as a residual –it is the difference between realized and active savings. In the particular case of housing, active saving is computed as in Juster et al. [2005]. For households living in the same house between two waves, it equals the cost of home improvements plus the change in the mortgage and other home loans if a family owned a house, and zero otherwise. When a family moves, active saving in housing is computed as the change in home equity. This implies that when a family does not move the change in house value is imputed to capital gains. And for families that move between surveys all saving in housing -including the change in house value- is imputed to active saving. In addition, note that since both realized and active savings are measured with error, the problem becomes even bigger for capital gains, and this renders more difficult the estimation of behavioral functions.

Finally, these measures of savings needs to account for net transfers into the households, such as inheritances and gifts from family and friends, and changes in assets resulting from household members moving out or into the family. Since the form of these transfers and changes in assets resulting from changes in family composition is not known, it is not possible to allocate them to particular assets nor to decompose them between active savings and capital gains. Thus, the net transfers can only be considered when computing aggregate savings.

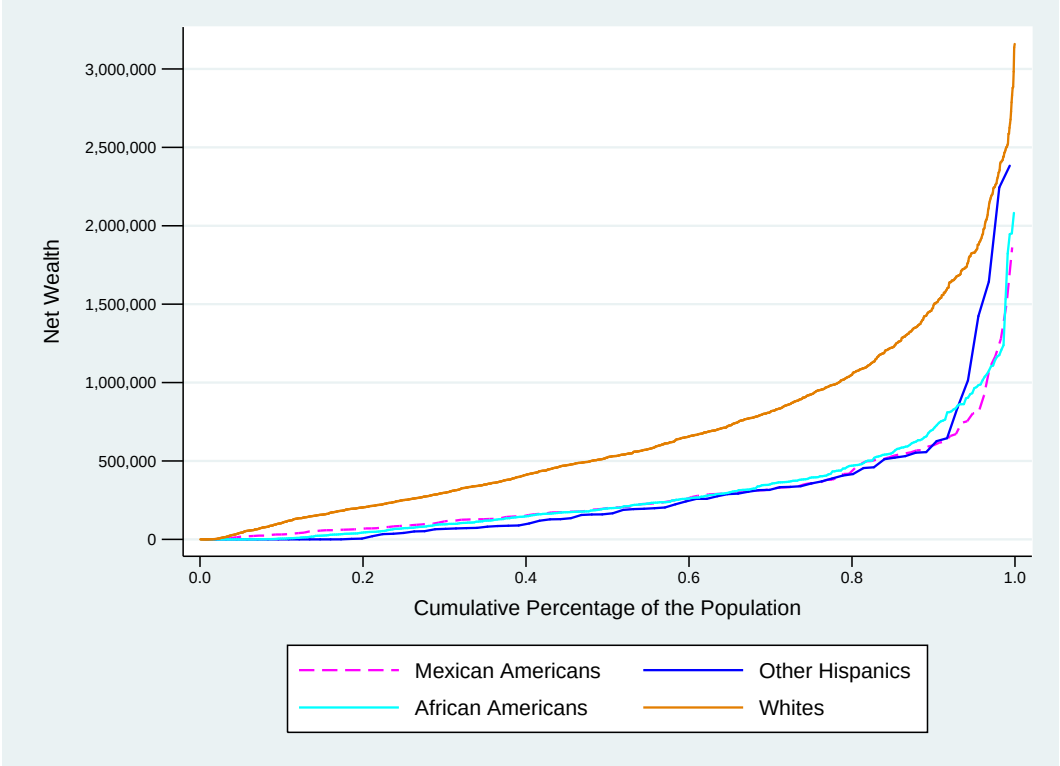
1.4 Ethnic Differences in Saving Rates

1.4.1 Descriptive Analysis

Differences in Wealth Levels and in Portfolio Composition

There is a wide gap in wealth levels between Hispanics and Whites, similar to the gap between African Americans and Whites. This can be seen in Figure 1.1, where I plot the inverse cumulative distribution function (or quantile function) of net wealth for each group, distinguishing between Mexican Americans and the rest of Hispanics. The figure shows that the three minority groups present a cumulative distribution of wealth that looks much more similar than the one corresponding to Whites. The Mexican Americans' median wealth of $200 thousand corresponds to the 20th percentile of the White distribution for 2004. Similarly, the median wealth of Other Hispanics ($163 thousand) corresponds approximately to the 16th percentile of the White distribution. However, the graphic also shows that Other Hispanics are relatively more represented than other minority groups at high wealth levels, revealing the higher inequality among Hispanics of non-Mexican origin.

Figure 1.1: **Quantile function of net wealth by ethnic group, 2004**



Note: The plot represents the empirical quantile function of households' net wealth. Sample consists of HRS households whose head was the same between 1998 and 2004 and was not retired during those years. The top and bottom 2 percent of total wealth in 2004 was dropped.

Before looking at the patterns of wealth changes, I discuss the distribution of wealth in levels by household characteristics at one point in time. In Table 1.1 I present summary statistics for both mean and median net worth holdings. The gap with Whites in wealth levels is larger for African Americans than for Mexican Americans and they are similar to those found by Cobb-Clark and Hildebrand [2006] and Gittleman and Wolff [2004]. Other Hispanics present the smallest gap in means but the widest gap in medians of the three groups, consistent with their extreme positive distribution. Including retirement assets, the gaps of the three groups with Whites narrow, especially at the median, reflecting the equalizing effect of S.S. wealth. Thus, after adding S.S. and pensions, Mexican Americans' wealth increases from \$52 to \$243 thousand, which closes the gap from 26% to 43% of the White median wealth (\$196 thousand and \$569 thousand with retirement assets). In turn, the median gaps for Other Hispanics goes from 8% to 35% and for African Americans goes from 15% to 24% after accounting for retirement assets.

Even when income explains more of the ethnic than of the racial wealth gap, it is not the whole story, at least for Mexican Americans. The Black gap in wealth levels becomes wider at the lowest income quartile (in medians) and narrows down only slightly at higher income levels.[23] The Mexican American gap becomes smaller after controlling for income but, except at the bottom income quartile (and only in medians), it does not disappear. Thus, the persistence of wealth differences within income groups suggests that income classes alone have little explanatory power and that the gaps cannot be fully attributed to the fact that African Americans and Mexican Americans are less represented at high income levels. Among Other Hispanics, the gap with Whites is large at the bottom income quartile. But at higher income levels the gap closes completely and they even surpass Whites at the top of the income distribution - although the sample size of Hispanics is much smaller in that range. Thus, income can account for most of the gap between Whites and Other Hispanics, except among poorer families.

Education has also more explanatory power for Hispanics than for Blacks, but wealth differences still remain after controlling for education. The ratio of Black to White wealth at each educational level is similar than the ratio for all families, both in means and in medians. For Hispanics the ratio becomes somewhat larger among high school graduates,

[23] I do not present the results for the 50th to 75th quartile separated from the upper quartile due to the

Table 1.1: **Mean and median net worth by household characteristics, 2004**

	Mean values				Median values			
	Mexican Americans	Other Hispanics	African Americans	Whites	Mexican Americans	Other Hispanics	African Americans	Whites
All non-retired households	130.2	214.0	81.2	341.1	51.5	15.0	30.0	196.0
incl. S.S. & Pensions	351.2	398.2	307.3	702.9	242.6	198.9	191.9	569.3
Income quartile								
< 25th	52.5	14.6	26.2	100.9	30.5	0.1	0.5	26.4
25th - 50th	157.6	200.0	85.3	185.3	73.0	131.2	54.0	116.8
> 50th	308.5	865.1	205.0	485.2	253.8	752.2	107.3	344.5
Education of head								
No high school diploma	73.8	108.9	58.7	182.7	33.0	0.1	11.1	58.0
High school graduate	212.9	166.3	60.9	261.8	115.0	43.0	21.5	154.0
College/postcollege grad.	NA	NA	193.7	521.8	NA	NA	101.5	394.0
Age of head								
50 - 60 years old	154.5	231.7	76.8	324.0	65.0	60.0	16.1	188.0
61 - 70 years old	105.1	198.5	86.9	361.6	33.0	9.0	37.0	210.2
Number of children								
2 or less	157.3	289.7	69.3	368.0	90.0	34.0	21.0	230.0
3 or more	117.8	163.0	88.8	312.3	42.0	6.0	32.4	168.0
Marital status of head								
Married	160.8	109.4	134.8	417.0	62.0	43.0	64.0	266.0
Single	76.7	274.5	56.8	191.0	24.0	9.0	5.0	92.8
Birthplace of head								
US born	123.6	583.8	72.9	335.4	50.0	117.5	25.0	190.0
Foreign born	142.1	135.9	186.0	498.2	52.1	9.0	118.0	292.0
Years in US since immigration								
30 years or less	112.2	50.1	83.6	687.1	40.0	15.0	0.0	301.0
more than 30	131.9	284.7	81.1	337.1	52.1	11.8	30.5	193.0

Note: Wealth values are in thousands of 2004 dollars and exclude S.S. and pensions except when indicated. Sample consists of HRS households whose head and spouse were the same between 1998 and 2004, the head was not retired during those years and was between 50 and 70 years old in 2004. Households with mixed-ethnicity couples are excluded. The top and bottom 2 percent of total wealth in 2004 was dropped to compute mean values. All data are weighted using HRS household weights for 2004.

with Mexican Americans' median wealth representing a 75% of Whites' wealth and Other Hispanics' wealth representing a 28% (the corresponding ratios for all families are 26% and 8% respectively).[24]

The means and medians by age of the household head show that wealth levels are higher for Hispanics aged between 50 and 60 years old than for those aged between 61 and 70, whereas the opposite is true for African Americans and Whites. As a result, the ethnic gap is wider among older households, whereas the racial gap does not change with age. Given the age window of this study, the pattern described is more likely to reflect the ability of households to accumulate wealth out of their income, which may the overshadow the role of inheritances and inter vivos gifts. Intergenerational transfers should be more important to explain the wealth gap of younger households.

The remaining characteristics included in Table 1.1 also have little explanatory power; the ethnic and racial gaps result from differences within categories defined by such characteristics. The ratio of Hispanic to White wealth is smaller for families with 3 or more children than for those with up to 2 children, whereas the opposite is true for Black families. That gap is similar among married and single households, at least for those of Mexican origin. Note that African American households where the head is single are relatively more disadvantaged relative to Whites. The wealth gap of Mexican Americans that were born in the US is smaller than the one of those born abroad, which is consistent with the findings in Cobb-Clark and Hildebrand [2006], whereas the opposite is true for the racial gap. Among the foreign-born, the more recent Hispanic and Black immigrants exhibit a much larger wealth gap than those that spent at least 30 years in the US.

Not only there are differences in wealth levels between Whites and minority groups, but also there are wide disparities in the types of assets in which wealth is invested. This can be seen in Figures 1.2 and 1.3, which show how groups differ in terms of access to individual assets and of the importance that each asset has in total net wealth, conditional on ownership.

The fraction of Mexican Americans that owns a house in 2004 is relatively high (77%), just a bit smaller than the fraction of Whites (86%).

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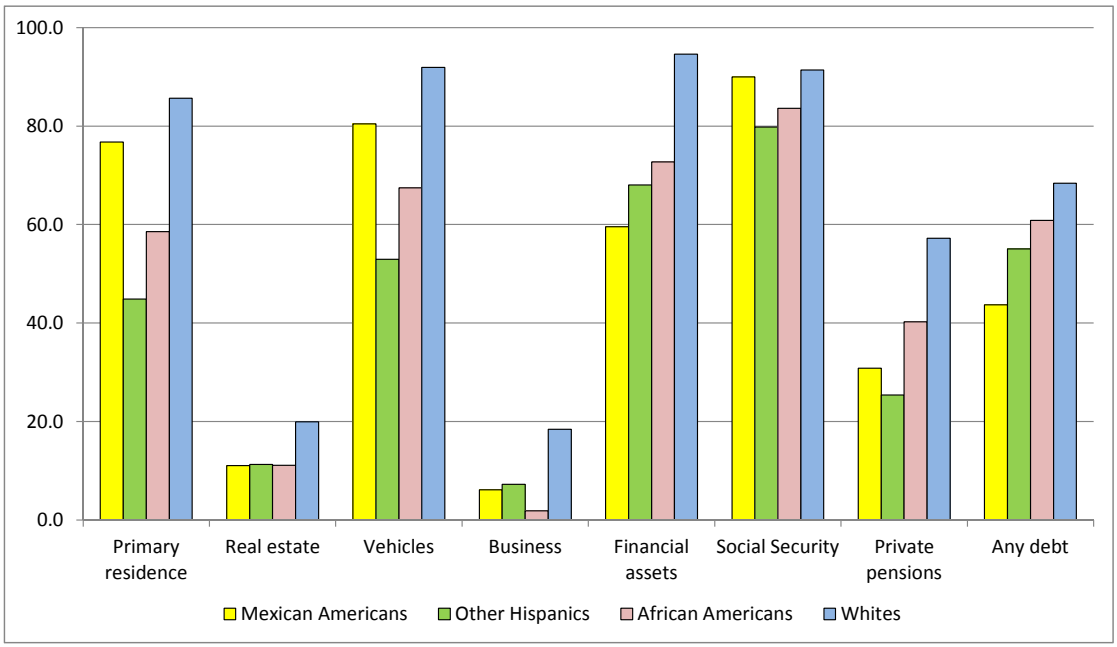
small number of observations for Hispanics in that range.

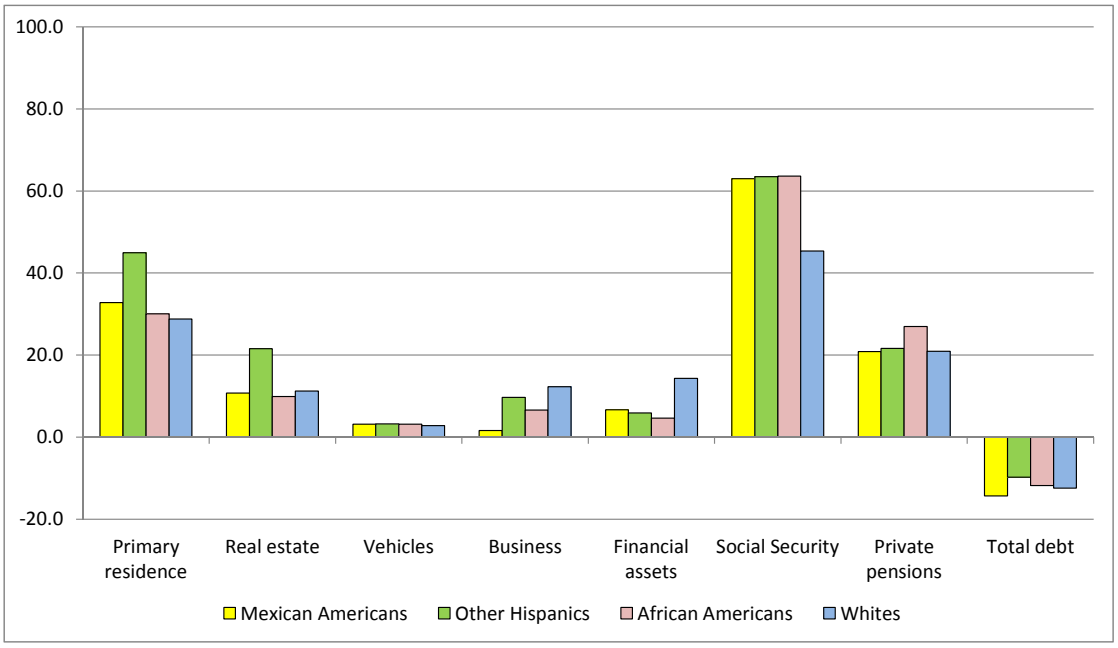
[24] There are insufficient observations to estimate the ethnic gap among college graduates.

Figure 1.2: **Percentage of households holding each type of asset, 2004**



Note: Sample consists of HRS households whose head and spouse were the same between 1998 and 2004, the head was not retired during those years and was between 50 and 70 years old in 2004. Households with mixed-ethnicity couples are excluded. Net financial assets include IRA/Keogh accounts, stocks, checking and saving accounts, CDs, government bonds, Treasury bills and bonds. All data are weighted using the HRS household weights for 2004.

Figure 1.3: **Percentage of total household wealth, 2004**



Note: See notes to Figure 1.2. In addition, the top and bottom 2 percent of each component's share in total wealth in 1998-2004 are dropped. The asset shares are conditional on ownership.

Other Hispanics and African Americans are less likely to own a home: average ownership is 45 and 59% respectively. Average ownership of the remaining real assets, i.e. other real estate, vehicles and business, is also smaller for minorities than for Whites. Conditional on ownership, the average wealth share of the value of the primary residence and of other real assets is similar across all groups; only Other Hispanics exhibit a higher share.

Whereas most Whites hold financial assets of some form, the proportion of Hispanics and Blacks with such assets is lower (60% Mexican Americans, 68% Other Hispanics and 73% Blacks). Moreover, most of the financial wealth held by Hispanics consists on checking and savings accounts, since very few have stocks, bonds and other savings accounts such as IRAs or Keoghs. Among those that have some type of financial asset, its value represents only 6-7% of Hispanics' total wealth, around a half of the fraction for Whites. In terms of liabilities, Hispanics are less likely to hold any type of debt - on average 68% of Whites, 44% of Mexican Americans and 55% of Other Hispanics hold some debt. Conditional on having any debt, its share in total wealth does not differ significantly across groups and varies between 10 and 14%.

The smallest gap in wealth holdings is found in S.S.. Around 90% of Mexicans and Whites and 80% of Other Hispanics and Blacks have S.S. in 2004. Moreover, S.S. represents a much higher fraction of total wealth for Hispanics (63%) and Blacks (64%) than for Whites (45%). This can be attributed to the fact that many households from minority groups only hold very few assets and highlights their dependence on S.S. to complement their savings. Private pensions are less widespread; only around 57% of the Whites and between 25 and 31% of the Hispanics have a pension. Its share in total wealth is similar across groups, oscillating between 24 and 30%.

Summarizing, the evidence on the portfolio composition suggests that the more remarkable gaps are in terms of asset ownership. In particular, Mexican Americans are less likely than Whites to have a business, to hold financial assets, a private pension and any form of debt, whereas the gap in holdings of assets is comparatively smaller. With a few exceptions, the gaps in participation for African Americans are smaller than for Hispanics. Conditional on ownership, the four groups make a similar allocation of wealth across different assets.

Differences in Wealth Accumulation

In Table 1.2 I compare the unconditional savings and saving rates of Hispanics and African Americans with those of Whites for 1992-1998 and 1998-2004. Between 1992 and 1998 the average total savings of Mexican Americans decline by $12.3m, whereas they increase for Other Hispanics and Blacks by $3.2m and $10.3, and especially for Whites by $60.6m. Given that the median Hispanic and Black households have zero savings, the median gap with Whites is of $16.9m across the three groups. The lower Mexican savings at the mean than at the median reflects the importance of the lower tail of the distribution. The next row shows changes in wealth as a percentage of household income. Following the standard practice, mean rates are computed as the ratio between average savings and average income accumulated over the six years. The 25th, 50th and 75th percentiles are obtained for the ratio of savings over income. The largest mean gap is for Mexican Americans, who save on average -7.8%, whereas Whites save 15.5% of their income, Other Hispanics 1.6% and African Americans 5%. The gaps with Whites in total savings and total saving rates is significant for the three minority groups.

To examine the sources of these differences, next I show a breakdown of total saving rates by type of asset, distinguishing between real and financial assets. Even when all groups - including Whites - have low saving rates on real assets in this period, they are particularly low for Mexican Americans (-10.5%) and this is explaining the decline in their total average saving rate. Given minorities' limited access to financial markets, their saving rates on financial assets are smaller than the 11.9% of Whites, with gaps at the mean driven by the 75th percentile.

I also look at the decomposition between active and passive saving rates to determine whether differences in the aggregate are due to money invested into new assets or to the effects of asset prices and capital gains. For Hispanics, especially Mexican Americans, negative passive saving rates are the main explanation for the low average total rates observed over this period. In contrast, the evolution of asset prices is more favorable for Blacks and Whites on average. In terms of active savings, the median household of the three minority groups have close to zero investments into new assets, whereas the Whites' rate is 3%. At the mean, only Mexican Americans and Blacks present a gap.

Table 1.2: **Saving rates by ethnicity and race, 1992-1998 and 1998-2004**

	Mexican Americans					Other Hispanics					African Americans					Whites				
		Percentile					Percentile					Percentile					Percentile			
	Mean	25th	50th	75th		Mean	25th	50th	75th		Mean	25th	50th	75th		Mean	25th	50th	75th	
1992-98																				
Wealth change	−12.3	−27.8	0.0	19.0	***	3.2	−5.8	0.0	8.0	***	10.3	−13.4	0.0	27.4	***	60.6	−23.0	16.9	103.5	
Total sav. rate	−7.8	−25.4	0.0	14.2	***	1.6	−5.0	0.0	6.8	***	5.0	−8.6	0.0	15.7	***	15.5	−8.9	6.5	28.5	
Real assets	−10.5	−17.9	0.0	8.9	***	0.6	−2.1	0.0	6.2		2.1	−7.2	0.0	7.9	**	3.6	−7.1	1.8	12.7	
Financ. assets	2.7	−1.5	0.0	2.6	***	1.0	−1.6	0.0	2.3	***	2.9	−1.6	0.0	3.3	***	11.9	−2.5	2.1	14.8	
Active	−0.4	−7.9	0.0	12.1	***	4.7	−6.6	0.0	11.3	**	1.4	−4.3	0.4	10.0	***	4.7	−6.1	3.0	14.1	
Passive	−7.4	−19.8	0.0	12.8	***	−3.1	−12.8	0.0	10.0	***	3.6	−10.4	0.0	11.2	***	10.7	−10.0	2.6	24.2	
Total+SS+Pens	−7.7	−48.9	0.5	34.7	***	13.1	−14.1	7.0	26.3		7.8	−27.7	5.4	34.9	***	17.9	−20.0	13.4	45.1	
Social Security	−1.3	−5.0	3.3	16.5		1.8	−0.9	1.9	10.5		−1.4	−3.3	3.8	10.2	*	−1.1	−1.3	3.0	7.4	
Pensions	−1.1	0.0	0.0	0.0	*	8.3	0.0	0.0	3.4		2.2	0.0	0.0	2.3	***	3.5	−0.4	0.0	9.0	
Nr. of obs.	164		177			98		107			550		587			1,952		2,077		
1998-2004																				
Wealth change	32.9	−14.3	3.3	48.3	***	57.0	0.0	1.7	69.9		12.5	−11.3	0.0	24.1	***	103.4	−17.1	31.0	165.5	
Total sav. rate	17.4	−12.1	3.4	40.1		27.3	0.0	3.0	29.7		5.7	−8.7	0.1	14.4	***	22.9	−6.6	9.2	36.7	
Real assets	14.4	−9.4	2.1	26.0		22.7	0.0	0.0	21.7		5.6	−2.8	0.0	10.2	***	15.0	−3.5	5.5	22.4	
Financ. assets	3.0	−1.3	0.0	2.7	**	4.6	−0.4	0.0	6.2		0.1	−3.0	0.0	3.2	***	8.0	−4.7	1.5	13.9	
Active	−5.0	−18.1	0.0	7.9	***	5.5	−3.3	0.0	7.3	*	−4.4	−6.6	0.0	7.8	***	4.8	−7.1	3.6	15.7	
Passive	22.4	−8.9	6.9	44.4		21.8	0.0	0.0	31.4		10.1	−7.8	0.0	16.3	***	18.1	−6.7	5.9	30.4	
Total+SS+Pens	25.5	−38.5	16.5	74.3		54.0	0.0	30.5	72.8		24.1	−19.0	16.0	53.7		30.3	−14.8	21.3	58.1	
Social Security	2.2	−33.5	11.1	30.3		7.4	0.0	9.5	24.9		8.2	0.0	13.0	25.9	**	5.1	0.0	10.2	18.4	
Pensions	−0.2	0.0	0.0	0.0	***	13.3	0.0	0.0	0.0		12.3	0.0	0.0	2.3		4.7	−1.7	0.0	6.9	
Nr. of obs.	141		153			72		78			395		413			1,535		1,654		

Note: The change in wealth is in millions of 2004 dollars and excludes S.S. and pensions. Mean saving rates for each group equal the ratio of mean saving over six times average annual income during the same period. Percentile saving rates are computed for the ratio of saving over six times income during the same period. Real assets comprise main home equity, real estate, vehicles and business. Financial assets include IRA/Keogh accounts, stocks, checking and saving accounts, CDs, government bonds, Treasury bills, bonds, and other savings minus debt. Active saving is the sum of net flows of money saved in individual assets. Passive saving is the difference between total change in wealth and active savings. Social Security wealth is computed assuming claiming at age 70. Pension wealth includes Defined Benefit values at expected age of retirement and Defined Contribution/Combination account balances. The HRS sample consists on households whose head and spouse were the same and the head was not retired in 1992-1998 (1998-2004) and was between 50 and 70 years old in 1998 (2004). Households with mixed-ethnicity couples are excluded. The samples are trimmed only for mean rates by dropping the top and bottom 2 percent of total saving over 1992-1998 (1998-2004) and of average income over 1993-1997 (1999-2003).
*, **, *** difference in the distribution with Whites significant at 10, 5 and 1 percent level (based on the Mann-Whitney two-sample statistic).

When S.S. and pensions are included in the measure of wealth, the mean and median saving rates increase for all groups and the differences with Whites remain significant, except for Other Hispanics.[25] This reflects that saving rates on S.S. are positive at the median, even for Hispanics and Blacks, and their distribution is not significantly different than the one of Whites.[26]In contrast, the median saving rate on pensions is zero for all groups, even for Whites, as a result of the low ownership rates.

Between 1998 and 2004, total saving rates increase on average, especially for Mexican Americans (17.4%) and Other Hispanics (27.3%). As a result, the ethnic gap in saving rates becomes insignificant, whereas the racial gap remains. The pattern in the second period is partly due to Hispanics living in areas where the boom in house prices was more pronounced. The sharp increase in housing prices that started in the mid-90s and lasted until their collapse in 2007 has been steepest in California, Arizona, Nevada and Florida, where there is a higher proportion of Hispanics. Thus, average saving rates on real assets increased substantially for Hispanics with respect to the previous period and approached the 15% rate of Whites. In turn, the fall in stock prices from 2000 to 2002 would have contributed to deteriorate the saving rates of Whites versus Hispanics since the former have a higher fraction of their wealth in stocks. As a result of the evolution of house and stock prices, some of the Hispanics' passive saving rates surpass those of Whites in the second period. In contrast, the persistence of the racial gap in passive savings suggests that Blacks were not affected by the evolution of the housing market prices as much as Hispanics. This differs from the findings in Gittleman and Wolff [2004], who compute

[25]The mean saving rate including S.S. and pensions does not equal the sum of the individual components displayed in Table 1.2 given the different trimming used for the saving rate excluding those assets.

[26]The negative S.S. saving rates at the bottom of the distribution may partly reflect measurement errors derived from the imputations for respondents that could not be matched to S.S. earnings data. Indeed, a higher fraction of imputations correspond to changes in S.S. that are negative than to positive changes.

higher average rates of return to capital for African Americans than for Whites during 1984-1994, but acknowledge that they must be period-specific.

Aside from those factors that are beyond a households' control, in 1998-2004 minority groups still do not have active savings at the median, where the ethnic and racial gaps persist and amount to 3.6p.p.. And the entire distributions of Mexican Americans and Blacks' active rates remain significantly different than the one of Whites at the 1% level. This indicates that the main changes in saving rates between the two periods are explained by asset prices and capital gains rather than by households' decisions to accumulate a different fraction of their income. After accounting for S.S. and pensions, the total saving rates of all groups increase but the differences with Whites remain non-significant for Hispanics and become insignificant for Blacks. Relative to the first period, in the second the Mexican Americans' gap in pension savings becomes significant at the 1% rather than at the 10% level, whereas the racial gap disappears. This confirms the presumption that Mexican Americans are less likely than other groups to plan for retirement, relying more on S.S..

The results of Table 1.2 show the gaps in aggregate saving rates that are significant at the 1% level in both periods: the White-Black gap (excluding retirement assets) and the White-Mexican Americans gap (only in active savings). In the next section I will pull the saving rates of the two periods and turn to multivariate analysis to see if the gaps with Whites remain after controlling for income and other household characteristics.

1.4.2 Multivariate Analysis

Saving rates depend upon differences in lifetime income. But even among those households with the same income, saving rates may vary due to differences in risk aversion, rates of time preference, or liquidity constraints. Thus, to examine ethnic and racial differences in savings in the pre-retirement HRS sample, the regression that I estimate is:

$$\begin{aligned}\text{Saving Rate}_i = \beta_0 + \beta_1(\text{Mexican American})_i + \beta_2(\text{Other Hispanic})_i + \\ + \beta_3(\text{African American})_i + \gamma\text{Income}_i + \delta X_i + \varepsilon_i\end{aligned} \tag{1.3}$$

where Mexican American$_i$, Other Hispanic$_i$ and African American$_i$ are indicator variables denoting the ethnicity or race of the household head; Income$_i$ is the household's total income; and X_i is a vector of demographic controls. This vector includes a linear and a

quadratic term for the age of the household head, the number of children in the household, dummies for the head's educational attainment, marital status and birthplace (U.S. or foreign born), and region dummies. Since I am estimating OLS models where I pool saving rates from two periods, I also include in the set of controls a dummy that takes value one in the period 1998-2004 and zero in 1992-2004.

An advantage of the HRS is that it provides very good measures of household income for multiple years. This allows me to control for average family income over 1994, 1996 and 1998 and over 2000, 2002 and 2004 for the models for saving rates in 1992-1998 and in 1998-2004 respectively. The main concern is that a spurious negative correlation between saving rates and income may arise if measured income differs from lifetime income since income also enters as a denominator in the saving rate. This could be the case if measured income contains transitory components and suffers from measurement error. However, Dynan et al. [2004] has found in a model similar to this that a simple average of current income eliminates much of the transitory effects of income and thus could be a good proxy for permanent income. They come to this conclusion by adopting an IV approach consisting on instrumenting measured, current income with proxies for permanent income (these instruments are expected to be highly correlated with the permanent component of current income, but not with its transitory component and the measurement error). Using consumption, future and lagged earnings and education as instruments they find similar results to those obtained without instrumenting, the approach adopted here.

The estimation of equation (1.3) presents a particular challenge derived from the skewness of the distribution of saving rates. I deal with this issue in two ways, which also are robust to the presence of extreme outliers, as noted in section 1.3.1. First, I trim the top and bottom 2 percent of the distribution of the dependent variable for the OLS regressions to remove the impact of heavy tails.[27] Second, I estimate quantile regressions that are more robust than OLS when the empirical distribution is not normal and can be used on the full samples, without trimmings. They allow to estimate differences in savings at the medians rather than at the means.

[27] I trim (remove outlier values) rather than winsorize the data (convert the outlier values to the closer data point that is not an outlier) since the latter puts more weight on the extremes of the distribution. As a consequence, it amplifies the influence of the values in the tails, and thus, it is a more adequate approach when the data is normally distributed rather than highly skewed.

For the OLS regressions only, I estimate the standard errors using clusters at the family level. In the Appendix Table D.1 I check the robustness of the standard errors to different correction methods. I compare the clustered standard errors estimated in an OLS model with those obtained from a non-clustered OLS model to gain further evidence that the clustered and non-clustered estimates are not substantially different. The same is done for the median regressions, by comparing the conventional with the bootstrapped standard errors.

Endogeneity issues

Following the literature on racial and ethnic wealth gap in US, I assume that race and ethnicity are fixed and exogenous. However, this may not be a valid assumption given that to some extent ethnicity and race can be a choice made by individuals. Nix and Qian [2015] find that race change in US was a widespread phenomenon between 1880 and 1940, responding to strong social, economic and political incentives for blacks to 'pass' for whites. Looking at the 2000 and 2010 Censuses, Liebler et al. [2014] find that 1 percent of Blacks changed to White and 5 percent changed from Hispanic to non-Hispanic. The presence of endogeneity in race and ethnicity raises some considerations noted by Nix and Qian [2015]. First, if the purpose of this study were to evaluate the causal effect of being Black or Hispanic on savings behaviour, then the design of the identification strategy would require a better understanding of the determinants of changes in ethnicity and race. Second, the effect of the endogeneity of race and ethnicity depends on whether people who change their identity behave more like Whites or like Hispanics/Blacks. If Hispanics who do not identify as such behave more like non-Hispanic Whites, then the interpretation of the effect of ethnicity on savings behaviour remains the same. However, if they save like Hispanics, then the estimated relationships will be biased. Finally, if the interest were in studying the effect of enslavement, discrimination, language barriers or cultural background on saving decisions, then it is important to understand the behaviour of those who change their ethnic/racial identity. In contrast, my results capture the effect of self-identity on savings, an interpretation that is not substantially altered by the fact that individuals may change their ethnicity.

Among the covariates used to explain the gaps in saving rates, the more likely to pose identification problems are income, education and the number of children. However, it

is beyond its scope to enter the controversy about the cause of the relationship between those regressors and saving rates. The purpose of this study is in determining whether there are differential saving rates by ethnicity and race that are not explained by income, education and demographic composition related to the stage of the lifecycle. Moreover, the direction of causality in the case of those variables is clearer than in the case of other factors strongly correlated with wealth and ethnicity/race and not included in the analysis, such as health status. Even when in principle omitted variables could confound the effect of permanent income on saving rates, it is less likely to suffer from reverse causality, except in the case of capital income. Education is typically constant over time, especially in the HRS sample, where the household head is 50 years old or older. The number of children also presents little variation among households in later stages of the life cycle relative to younger ones.

Results

The first set of results are presented in Table 1.3 for total savings rates excluding retirement assets. Columns 1 and 4 show that the unconditional mean and median gaps between Mexican and African Americans with Whites are large and significant at the 1% level. After controlling for income the gaps become slightly smaller, and after adding the full set of controls they become significant only at the 10% level. Columns 3 and 6 indicate that the Mexican American gap in means amounts to 6.3p.p., and in medians to 3.6 p.p., which represents almost a two-third decline in the mean (10.3%) and median (5.5%) saving rates. The racial gap is smaller and equals 3.3p.p. at the mean and 2.2.p.p. at the median, approximately a one-third reduction in the average and median saving rates. There is no gap in savings between Other Hispanics and Whites: the former present significantly lower savings only at the median when no controls are included. The dummy for the second period indicates that saving rates are higher in 1998-2004 than in 1992-1998, which is consistent with the housing boom in the second period.

Next, I examine the composition of the gap in total savings by looking separately at differences in the accumulation of real and financial assets. The results from Table 1.4 indicate that Mexican Americans present a lower rate of accumulation in both asset categories than Whites, but the coefficients are only significant before controlling for income.

Table 1.3: **Total saving rates, 1992-1998 and 1998-2004**

	(1) OLS	(2) OLS	(3) OLS	(4) Median	(5) Median	(6) Median
Mexican Americans	-.103***	-.065**	-.063*	-.075***	-.036**	-.036*
	(.030)	(.031)	(.037)	(.016)	(.018)	(.021)
Other Hispanics	-.027	.004	-.011	-.075***	-.028	-.037
	(.031)	(.031)	(.041)	(.022)	(.024)	(.027)
African Americans	-.079***	-.047***	-.033*	-.075***	-.031***	-.022*
	(.015)	(.016)	(.017)	(.010)	(.011)	(.011)
98-04'	.071***	.065***	.068***	.018**	.009	.017*
	(.015)	(.015)	(.015)	(.008)	(.008)	(.009)
Constant	.095***	.039***	-2.122	.075***	.022***	-.555
	(.010)	(.013)	(1.363)	(.006)	(.007)	(.760)
Other controls	No	Income	Income + others	No	Income	Income + others
Mean dependent variable	.103	.103	.103			
Median dependent variable				.055	.055	.055
Adj. R-Square	.011	.024	.027			
Pseudo R-Square				.007	.015	.017
Observations	4,183	4,183	4,183	4,351	4,351	4,351

Notes. The table reports the coefficients from OLS and median regressions of the total saving rate on ethnicity and race dummies and other controls. Saving rates are defined as the ratio of saving over six times income during the same period. The observations for the two periods are pooled and only fixed-effects for the second period are included. All specifications that control for income, also control for its square. In addition, specifications in columns (3) and (6) control for age of the head and its square, the number of children in the household, the education of the head and the head's spouse, dummies indicating if the household head is married, born in U.S., and for each of the nine regional divisions used by the US Census Bureau. Robust standard errors (clustered at the family level) and trimmed samples are used for OLS regressions only. Household data is from the HRS for the period 1992-2004.

However, if the coefficients are estimated separately for each period, the gap in real assets remains significant in the first period, even after adding all the controls, but not in the second period when Hispanics have benefited from the housing boom. Even with the full set of controls, African Americans also have lower savings in real assets, significant at the median, and in financial assets, significant at the mean. These results reflect mainly the dynamics during the second period, when the fall in stock prices has been more detrimental for Whites' savings.

In Table 1.5 I look at the decomposition of total saving rates in active and passive, to understand what is driving the differentials with Whites from a different perspective. Columns 1 and 7 show that the passive component is the main source of the unconditional mean gap in total saving rates for Mexican and African Americans, as noted in section 4.1. After controlling for income and socio-demographic characteristics (column 9), the

Table 1.4: **Saving rates in real and financial assets, 1992-1998 and 1998-2004**

	Real assets						Financial assets					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	Median	Median	Median	OLS	OLS	OLS	Median	Median	Median
Mexican Americans	-.057**	-.042	-.045	-.026***	-.015	-.017	-.052***	-.031***	-.004	-.022***	-.005	-.004
	(.026)	(.026)	(.029)	(.009)	(.009)	(.011)	(.010)	(.011)	(.015)	(.006)	(.007)	(.009)
Other Hispanics	.014	.026	.006	-.025**	-.011	-.017	-.032***	-.014	.010	-.022***	-.003	-.000
	(.025)	(.025)	(.031)	(.012)	(.012)	(.014)	(.012)	(.012)	(.016)	(.008)	(.009)	(.011)
African Americans	-.026**	-.014	-.016	-.025***	-.012**	-.010*	-.051***	-.033***	-.019**	-.022***	-.006	-.006
	(.011)	(.012)	(.012)	(.005)	(.006)	(.006)	(.007)	(.007)	(.008)	(.004)	(.004)	(.005)
98-04'	.094***	.092***	.097***	.025***	.018***	.022***	-.019***	-.022***	-.024***	.000	-.003	-.005
	(.011)	(.011)	(.011)	(.004)	(.004)	(.004)	(.007)	(.007)	(.008)	(.003)	(.003)	(.003)
Constant	.021***	-.001	-1.323	.025***	.007**	-.365	.072***	.041***	-.615	.022***	.003	.055
	(.007)	(.009)	(.902)	(.003)	(.004)	(.386)	(.005)	(.007)	(.654)	(.002)	(.003)	(.304)
Other controls	No	Income	Income + others	No	Income	Income + others	No	Income	Income + others	No	Income	Income + others
Mean dependent variable	.053	.053	.053				.050	.050	.050			
Median dependent variable				.021	.021	.021				.010	.010	.010
Adj. R-Square	.022	.025	.027				.010	.028	.032			
Pseudo R-Square				.005	.007	.009				.005	.011	.013
Observations	4,174	4,174	4,174	4,351	4,351	4,351	4,190	4,190	4,190	4,351	4,351	4,351

Notes. The table reports the coefficients from OLS and median regressions of the saving rates in real and financial assets on ethnicity and race dummies and other controls. Saving rates are defined as the ratio of saving over six times income during the same period. Real assets comprise main home equity, real estate, vehicles and business. Financial assets include IRA/Keogh accounts, stocks, checking and saving accounts, CDs, government bonds, Treasury bills, bonds, and other savings minus debt. The controls included are the same as the ones in Table 1.3. Robust standard errors (clustered at the family level) and trimmed samples are used for OLS regressions only. Household data is from the HRS for the period 1992-2004.

Table 1.5: **Active and passive saving rates, 1992-1998 and 1998-2004**

	Active saving rates						Passive saving rates					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	OLS	Median	Median	Median	OLS	OLS	OLS	Median	Median	Median
Mexican Americans	-.030*	-.020	-.026	-.035***	-.018**	-.019*	-.076**	-.052*	-.043	-.034**	-.003	.002
	(.016)	(.016)	(.020)	(.009)	(.009)	(.011)	(.030)	(.030)	(.036)	(.016)	(.014)	(.017)
Other Hispanics	-.027	-.019	-.038*	-.036***	-.019*	-.024*	.002	.022	.001	-.034	-.002	.010
	(.019)	(.019)	(.022)	(.013)	(.012)	(.014)	(.037)	(.038)	(.045)	(.021)	(.019)	(.022)
African Americans	-.027***	-.018**	-.016	-.032***	-.018***	-.011*	-.057***	-.037**	-.034**	-.034***	-.012	-.007
	(.009)	(.009)	(.010)	(.006)	(.005)	(.006)	(.015)	(.016)	(.017)	(.009)	(.008)	(.009)
98-04'	-.003	-.005	-.005	.003	.001	.001	.079***	.075***	.078***	.020***	.015**	.019***
	(.008)	(.008)	(.008)	(.004)	(.004)	(.004)	(.014)	(.014)	(.015)	(.007)	(.006)	(.007)
Constant	.038***	.023***	-.682	.035***	.016***	-.374	.061***	.026**	-.438	.034***	-.002	-.283
	(.005)	(.007)	(.680)	(.003)	(.004)	(.383)	(.010)	(.013)	(1.306)	(.005)	(.006)	(.616)
Other controls	No	Income	Income + others	No	Income	Income + others	No	Income	Income + others	No	Income	Income + others
Mean dependent variable	.029	.029	.029				.079	.079	.079			
Median dependent variable				.025	.025	.025				.023	.023	.023
Adj. R-Square	.002	.005	.005				.011	.016	.016			
Pseudo R-Square				.004	.007	.008				.003	.007	.008
Observations	4,191	4,191	4,191	4,351	4,351	4,351	4,174	4,174	4,174	4,351	4,351	4,351

Notes. The table reports the coefficients from OLS and median regressions of the active and passive saving rates on ethnicity and race dummies and other controls. Saving rates are defined as the ratio of saving over six times income during the same period. Active saving is the sum of net flows of money saved in individual assets. Passive saving is the difference between total change in wealth and active savings. The controls included are the same as the ones in Table 1.3. Robust standard errors (clustered at the family level) and trimmed samples are used for OLS regressions only. Household data is from the HRS for the period 1992-2004.

coefficients for African Americans, but not for Mexican Americans, remain significant at the 5% level and reveal a gap in passive savings of 3.4p.p.. The mean gaps in active savings for both groups are insignificant after adding the full set of controls (column 3), in line with the findings of Gittleman and Wolff [2004] for Blacks. Thus, capital gains rather than the decisions to invest money into a new asset explain the mean gap in total saving rates between African Americans and Whites. Whereas the same pattern is observed for Mexican Americans, the estimates are not significant.

In terms of medians, columns 4 and 10 of Table 1.5 show that Mexican and African Americans present a similar gap in active and in passive savings. However, in this case the differences in passive savings become considerably smaller and not precisely estimated after controlling for income. In contrast, the differences in active savings remain significant at the 10% level for both groups, even after adding the socio-demographic controls. These results depart from those in Gittleman and Wolff [2004], who only find a gap between Blacks and Whites before controlling for income. Columns 6 and 12 indicate that Mexican Americans save 2p.p.m less than Whites, and African Americans 1p.p. less, which represent a 76% and a 44% reduction relative to the overall median active rate of 2.5%. Thus, in contrast to the pattern described at the mean, the ethnic and racial gaps in total savings at the median result from the decision to consume more out of income than Whites, rather than from the path of prices followed by the assets in which they choose to save.

Table 1.6 shows the same regressions as Table 1.3 but the measure of savings rates includes S.S. and pensions. Before and after controlling for income, the differences between Mexican Americans and Whites are significantly negative, both in means and in medians. When all the controls are included, Mexican Americans save 14.5p.p. less than Whites at the mean, and 11p.p. less at the median, and these figures represent at least a 100% decline relative to the overall saving rates. Thus, including retirement assets, the gap in saving rates between Whites and Mexican Americans is considerable larger than when those assets are excluded. This may reflect the fact that the lack of access to private pensions among Mexican Americans more than compensates the equalizing effect of S.S.. For African Americans the size of the gap with Whites is smaller than for Mexican Americans and disappears after the inclusion of additional controls. Other Hispanics exhibit actually higher saving rates than Whites, but these differences are only significant at the mean

before including the full set of controls.

Table 1.6: **Total saving rates including Social Security and pensions, 1992-1998 and 1998-2004**

	(1) OLS	(2) OLS	(3) OLS	(4) Median	(5) Median	(6) Median
Mexican Americans	-.174***	-.137***	-.145**	-.133***	-.081**	-.110**
	(.051)	(.051)	(.059)	(.037)	(.035)	(.046)
Other Hispanics	.092*	.123**	.097	.007	.030	.004
	(.056)	(.056)	(.066)	(.051)	(.048)	(.059)
African Americans	-.085***	-.053*	-.041	-.081***	-.039*	-.010
	(.027)	(.028)	(.030)	(.022)	(.022)	(.025)
98-04'	.180***	.174***	.228***	.111***	.098***	.142***
	(.022)	(.022)	(.022)	(.018)	(.017)	(.018)
Constant	.095***	.039**	-6.786***	.133***	.073***	-5.878***
	(.015)	(.019)	(1.991)	(.013)	(.015)	(1.635)
Other controls	No	Income	Income + others	No	Income	Income + others
Mean dependent variable	.147	.147	.147			
Median dependent variable				.156	.156	.156
Adj. R-Square	.022	.027	.051			
Pseudo R-Square				.006	.010	.022
Observations	4,178	4,178	4,178	4,351	4,351	4,351

Notes. The table reports the coefficients from OLS and median regressions of the saving rates, including S.S. and pensions, on ethnicity and race dummies and other controls. Saving rates are defined as the ratio of saving over six times income during the same period. The controls included are the same as the ones in Table 1.3 but household income is adjusted for earnings corresponding to employer contributions to DB and DC plans and to S.S.. Robust standard errors (clustered at the family level) and trimmed samples are used for OLS regressions only. Household data is from the HRS for the period 1992-2004.

1.4.3 Oaxaca-Blinder decomposition

The main disadvantage of the regression approach just presented is that it is too restrictive. It implies that the slope of the savings function with respect to all the controls (income, age, education, etc.) is the same for all ethnic groups, and only the intercept of the function varies. A typical solution to this problem is to use a regression decomposition approach, such as the Oaxaca-Blinder decomposition, that allows to decompose differences in mean saving rates across two groups.

More formally, let's consider the decomposition for an outcome variable S (wealth or saving rates). The model for savings is linear and separable in observable and unobservable characteristics:

$$S_{ig} = X_{ig}\beta_g + \nu_{ig} \qquad for\ g = H, W \tag{1.4}$$

where $E[\nu_{ig}|X_{ig}] = 0$ and the subindex g represents the two groups, Hispanics (H) and Whites (W). Let's denote by $D_{iW} = 1$ the indicator for Whites. The mean outcome difference, taking the expectations over X, can be expressed as:

$$E[S_{iW}|D_{iW} = 1] - E[S_{iH}|D_{iW} = 0] = E(X_W|D_{iW} = 1)\beta_W - E(X_H|D_{iW} = 0)\beta_H \tag{1.5}$$

How much of the wealth/saving difference can be accounted for by group differences in predictors, X_g? Using the White coefficients as the reference coefficients and rearranging (1.5) in a part explained and a part unexplained by the predictors, I compute the decomposition as:

$$\begin{aligned} &E[S_{iW}|D_{iW} = 1] - E[S_{iH}|D_{iW} = 0] = \\ &= \{E(X_W|D_{iW} = 1) - E(X_H|D_{iW} = 0)\}\beta_W + E(X_H|D_{iW} = 0)(\beta_W - \beta_H) \end{aligned} \tag{1.6}$$

Equation (1.6) divides the wealth/saving differential between two groups: a part that is explained by group differences in observable characteristics, and another (typically referred as unexplained) resulting from differences in unobserved predictors. Also, I can use this framework to look at the individual contributions of the set of predictors, such as income or education, to the differential.

Results

Table 1.7 reports the decompositions between Mexican Americans and Whites using the coefficients estimates for Whites, as in equation (1.6).[28] I first present the decompositions for wealth in levels to facilitate comparison with previous studies. The results indicate that 92% of the mean gap in wealth levels (USD231) is explained. Even when they are for the mean rather than for the median, these results are in line with those from Cobb-Clark and Hildebrand's (2006) semi-parametric decomposition. Examining native- and foreign-born Mexicans separately, they find that around 11-12% of the median gap remains unexplained

[28] A recurrent issue in the literature decomposing the racial wealth gap is that more is explained if coefficients from Whites are used to predict wealth for Blacks than the other way around. For example, Altonji and Doraszelski [2005] account for 79% of the wealth gap when they use the White regression model, but only 25% when they use the Black model. This reflects the fact that wealth differences among Blacks are less sensitive to income and demographics than wealth differences among Whites. I find a similar pattern for the models of wealth levels if I use Mexican of African Americans rather than Whites as the reference groups, whereas for the models of saving rates the explained fractions become negative in most cases.

after controlling for a similar set of regressors. The next columns show that only half of the 10.2p.p. gap in total savings is explained by observable characteristics. I also include the decomposition for active saving rates, more likely to reflect households' "choices" rather than "chance". In this case, the 3p.p. mean gap is significant at the 10% level only and even a smaller fraction of that gap (43%) is explained by households' characteristics.

After including S.S. and pensions, the wealth gap goes up by USD156 thousands and the one in total saving rates by 6.9p.p.. This increase could be reflecting the lower pension savings among Mexican Americans. Differences in characteristics ("endowments") between the two groups account for 90% of the wealth gap but for only 36% of the savings gap. Moreover, the remaining 63% of the unexplained savings gap is significant at the 10% level. The equalizing effect of S.S. may be the reason why a smaller fraction of the gap in savings is explained by observable characteristics when retirement assets are included.

When one looks at the contributions of single set of predictors, income and education are in general the only significant in the decompositions from Table 1.7. Income is more important than education to explain the gaps in wealth levels, whereas education is more relevant to account for differences in saving rates. Demographic characteristics and region of residence's contributions to the wealth gap are close to null and to the saving rates gap are negative but insignificant - i.e. they contribute to close that gap.

Table 1.8 presents the results for African Americans. In this case, the explained fractions of the gap in wealth levels (USD246 thousands) and in total saving rates (8.1p.p.) are similar and amount to 70% and 74% respectively. Altonji and Doraszelski [2005] find a similar size of the estimated savings gap (8.3p.p.) but income and demographics explain a larger fraction of the gap in wealth levels (above 80%) and in savings (84%). As noted for Mexican Americans, the explained fraction of the gap in active savings (59%) is smaller than of the gap in total savings. The inclusion of retirement assets implies a smaller increase in the wealth and savings gaps (by USD119 thousands and 0.8p.p.) than the ones observed for Mexican Americans. With the inclusion of S.S. and pensions, the explained fraction of the savings gaps declines from 74% to 63% but still it is almost twice as large as for Hispanics and the unexplained fraction is not significant. Most of the predictors have a positive and significant contribution to explain the racial gap in wealth levels. For the gap in saving rates, income and education are the main significant contributors.

Three issues stand out from the results of the decompositions. First, only the unex-

Table 1.7: **Mean regression decompositions of the Mexican Americans to Whites gap in wealth and saving rates (1992-1998 and 1998-2004)**

							Including S.S. and Pensions			
	Level of wealth		Total saving rate		Active saving rate		Level of wealth		Total saving rate	
Total gap	230,858***		0.102***		0.030*		386,390***		0.171***	
	(13,702)		(0.031)		(0.016)		(20,077)		(0.052)	
Explained gap	213,328***	(92%)	0.051*	(50%)	0.013	(43%)	347,266***	(90%)	0.062	(36%)
	(25,208)		(0.030)		(0.015)		(31,884)		(0.041)	
Unexplained gap	17,530	(8%)	0.050	(49%)	0.017	(57%)	39,124	(10%)	0.108*	(63%)
	(24,581)		(0.042)		(0.022)		(28,507)		(0.065)	
Contributions to the explained gap by component										
Income	144,017***	(62%)	0.030***	(29%)	0.010***	(33%)	193,512***	(50%)	0.029***	(17%)
	(11,767)		(0.006)		(0.003)		(14,961)		(0.009)	
Education	69,392***	(30%)	0.041***	(40%)	0.016**	(53%)	132,258***	(34%)	0.051**	(30%)
	(10,524)		(0.014)		(0.008)		(13,108)		(0.020)	
Demographic characteristics	882	(0%)	-0.012	(−12%)	−0.009	(−30%)	15,909	(4%)	−0.001	(−1%)
	(17,880)		(0.020)		(0.010)		(20,369)		(0.026)	
Region of residence	344	(0%)	-0.006	(−6%)	-0.003	(−10%)	9,335	(2%)	−0.013	(−8%)
	(948)		(0.002)		(0.008)		(14,269)		(0.022)	
1998-2004	−1,306	(−1%)	-0.001	(−1%)	0.000	(0%)	−3,748	(−1%)	−0.004	(−2%)
	(948)		(0.002)		(0.000)		(2,366)		(0.005)	

Notes. The table reports the Oaxaca-Blinder decompositions of the mean differences in wealth levels and saving rates between Mexican Americans and Whites, using the White coefficients as reference. Income includes household income and its square (as of 1998 and 2004 for the wealth models and as of 1994-1998 and 2000-2004 for the saving rates models), education are dummies for the head and the head's spouse education level (no high school diploma, high school graduate and college/postcollege graduate), demographic characteristics are age, age-squared, number of children, and dummies for head's marital status and birthplace (U.S. or foreign born), region of residence are dummies for each of the nine regional divisions used by the US Census Bureau. Robust standard errors (clustered at the family level) and trimmed samples are used in all specifications. Household data is from the HRS for the period 1992-2004. Percent of total variation in parentheses, next to the estimated output. * p<0.10, **p<0.05, *** p<0.01

Table 1.8: **Mean regression decompositions of the African-Americans to Whites gap in wealth (1992-1998 and 1998-2004)**

							Including S.S. and Pensions			
	Level of wealth		Total saving rate		Active saving rate		Level of wealth		Total saving rate	
Total gap	245,602***		0.081***		0.027***		364,124***		0.089***	
	(10, 130)		(0.015)		(0.009)		(16, 134)		(.027)	
Explained gap	172,621***	(70%)	0.060***	(74%)	0.016***	(59%)	295,591***	(81%)	0.056***	(63%)
	(11, 214)		(0.010)		(0.005)		(16, 727)		(.033)	
Unexplained gap	72,981***	(30%)	0.021	(26%)	0.011	(41%)	68,533***	(19%)	0.031	(37%)
	(9, 092)		(0.018)		(0.010)		(11, 687)		(0.065)	
Contributions to the explained gap by component										
Income	121,106***	(49%)	0.025***	(31%)	0.008***	(30%)	161,192***	(44%)	0.025***	(28%)
	(9, 910)		(0.005)		(0.003)		(12, 477)		(0.008)	
Education	21,350***	(9%)	0.015*	(19%)	0.012**	(44%)	81,935***	(23%)	0.023*	(26%)
	(7, 840)		(0.009)		(0.005)		(9, 142)		(0.012)	
Demographic characteristics	22,255**	(9%)	0.010	(12%)	−0.003	(−11%)	42,296***	(12%)	0.000	(0%)
	(9, 650)		(0.010)		(0.005)		(7, 407)		(0.014)	
Region of residence	7,075*	(3%)	0.008*	(10%)	-0.002	(−7%)	8,246*	(2%)	0.004	(4%)
	(3, 655)		(0.005)		(0.002)		(4, 327)		(0.006)	
1998-2004	836	(0%)	0.002	(2%)	0.000	(0%)	1, 922	(1%)	0.005	(6%)
	(614)		(0.001)		(0.000)		(1, 513)		(0.003)	

Notes. The table reports the Oaxaca-Blinder decompositions of the mean differences in wealth levels and saving rates between African Americans and Whites, using the White coefficients as reference. The predictors included are the same as the ones in Table 1.7. Robust standard errors (clustered at the family level) and trimmed samples are used in all specifications. Household data is from the HRS for the period 1992-2004. Percent of total variation in parentheses, next to the estimated output. * p<0.10, **p<0.05, *** p<0.01

plained gap in saving rates including S.S. and pensions remains significant, which could reflect Mexican Americans' lack of savings in private pensions, given that S.S. has an equalizing effect.[29] When retirement assets are not included, the mean (unexplained) gaps in savings between Mexican Americans and Whites, marginally significant in the regression approach, become insignificant in the decompositions. In turn, consistent with the findings in Gittleman and Wolff [2004], no unexplained gap in saving rates between African Americans and Whites remain significant.[30]

Second, my results imply that Hispanic households would have 90-92% of the wealth that White households hold if they had the same income and demographics as Whites, but their saving rates at most will increase by 50% based on the measure of total saving rates. In contrast, the overall explained fraction of the racial wealth gap is more similar to the explained fraction of the savings gap. This reflects the fact that demographic characteristics and region of residence: i) have a negative - but insignificant - contribution to the gap in savings for Mexican Americans but a positive or less negative one among African Americans; and ii) do not contribute to the ethnic wealth gap. Also it reflects that income contributes less to the savings than to the wealth gap.

Finally, note that my data corroborate Cobb-Clark and Hildebrand's (2006) findings that a substantial fraction of the mean ethnic gap in wealth levels would disappear if Mexican Americans and Whites had the same distribution of income and demographic variables and the White wealth equation held for Mexicans. This would imply that ethnic differences in the accumulation of wealth are not crucial to explain the gap in wealth levels, which can be entirely attributed to the ethnic gap in income and demographics. However, it could be that the significant differences in saving rates observed for Mexican Americans build up, becoming a predictor of growing wealth disparities that eventually will become significant.

[29] Another way to interpret the "unexplained component" is as the average effect of ethnicity on Mexican Americans' saving rates [Sloczynski, 2014].

[30] In contrast, both the explained and unexplained fractions of the racial wealth gap are significant and the explained fraction is smaller than in Altonji and Doraszelski [2005]. The use of a more restricted set of regressors that facilitate comparison with studies on the ethnic wealth gap [Cobb-Clark and Hildebrand, 2006] and on the racial savings gap [Gittleman and Wolff, 2004] could be the reason that I explain a smaller fraction. Moreover, the regressors I include are less likely to raise endogeneity concerns than others used by those authors such as health status.

1.5 Conclusion

While there is a broad literature looking at the reasons for the differences in wealth between Black and White families, less is known about the differences between Hispanics and Whites. This study attempts to fill this gap by documenting the ethnic differences in saving rates for families with the same level of income, one possible explanation for the gap in wealth levels.

Controlling for income and other demographic characteristics, in a regression framework I find that total saving rates for Mexican and African Americans are lower than for Whites both at the mean and at the median. Moreover, the gaps at the median are due to the direct decision of investing less money into new assets (active savings) rather than to capital gains (passive savings). Including S.S. and pensions, the gap in total saving rates becomes larger both at the mean (14.5p.p.) and at the median (11p.p.) for Mexican Americans, but disappears for Blacks. This could be attributed to the fact that many households of Mexican origin have lower savings in private pensions than Whites, which may offset the equalizing effect of S.S.. A regression decomposition allows me to decompose the mean savings gaps into a component explained by observable characteristics and an unexplained component. The results indicate that the fraction of the Mexican American-White gap in saving rates not explained by observable characteristics is large and significant only when retirement assets are included. There is not unexplained racial gap in savings, in line with Gittleman and Wolff [2004]. The decompositions also reveal that education has an important role to explain the gap in saving rates. This is not surprising since education is typically seen as a proxy for permanent income, may be correlated with tastes toward savings and may affect the ability to plan for retirement. Income also matters to explain that gap, but other demographic characteristics such as age, marital status, number of children or being foreign born are not significant.

Further research is needed to shed light into these findings with alternative decompositions. By using different comparison groups (Cotton, 1988; Fortin, 2008) I can address one problem of this methodology, in particular, that the portion of the savings gap explained by differences between Hispanics and Whites is not invariant to whether the Hispanic or White saving structure is chosen as the reference saving structure. By using decompositions at the median (DiNardo et al., 1996; Firpo et al., 2009), I can address the skewness

of the saving distribution. In addition, larger samples of longitudinal data on wealth and collection of direct measures of savings for minority groups would be useful to obtain more precise estimates.

This paper provides a better understanding of the ethnic and racial differences in the patterns of wealth accumulation, which is necessary to guide policies promoting savings among the poor. The advocates of this approach argue that it is a promising avenue for fighting against poverty, complementary to traditional approaches centered on income, consumption and education. Even if income and demographics fully explain ethnic and racial differences in wealth levels, current differences in savings may contribute either to deepen or to close the wealth gap in the future as they build up over time. Moreover, there are several ways in which encouraging savings can enhance the well-being of low-income minority groups: i) wealth accumulation makes affordable certain lumpy investments such as a house that contribute substantially to increase living standards; ii) it helps to cope with unexpected events such as a job loss or a temporary illness; iii) the habit of accumulating a fraction of personal income for the future makes people more forward looking and extend their planning horizon; iv) S.S. offers a higher replacement rate to low-income people and so they may not see the need to save individually for retirement, which leaves them more vulnerable if the generosity of public funds diminishes. The present findings indicate that Mexican Americans are especially vulnerable given their low participation in pension schemes and this needs to be taken into account by policy interventions. In addition, my results imply that policies reducing disparities in earnings and, more importantly, improving educational opportunities for minorities should be effective ways to foster their total and active saving rates.

Appendix

A Additional tables

Table A.1: **Regressions of total saving rate excluding Social Security and pensions - Robustness of standard errors**

	Mexican Americans	Other Hispanics	African Americans
Mean regressions	−0.065	0.004	−0.047
No correction	(0.031)**	(0.031)	(0.016)***
Cluster at household level (main)	(0.032)**	(0.031)	(0.016)***
Clustered-bootstrap	(0.018)**	(0.024)	(0.011)***
Observations	4,183	4,183	4,183
Median regressions	-0.036	-0.028	-0.031
No correction (main)	(0.012)***	(0.009) ∗ ∗∗	(0.009)***
Bootstrapped	(0.009)***	(0.008)***	(0.007)***
Observations	4,351	4,351	4,351

Note: All regressions control for income and its square, and a dummy for years 1998-2004. * p<0.10, **p<0.05, *** p<0.01

B Data description

I use household data from the Health and Retirement Study (HRS) for 1992-2004. In this appendix I describe in detail the construction of the variables used for the analysis.

1) Sample selection: Most of the data are taken from the 1992, 1998 and 2004 HRS waves, but I also rely on some data from intermediate waves to compute permanent income and active savings. Respondents in the HRS are defined as the age-eligible individuals (in 1992 the selected birth cohort aged 51-61) and the spouse, regardless of age, when the respondent is married. Spouses are included because retirement decisions are often taken jointly by the couple. Thus, at least two observations are present in households with married or partnered respondents: one for the primary respondent, the individual with more knowledge about assets, debts and retirement planning, and other for the secondary respondent, i.e. his/her spouse. Following the standard practice, I will treat the male in the couple, rather than the primary respondent, as the household head. The reason is that this facilitates comparison with other studies, and also there are more differences in characteristics affecting earnings behavior between men and women than between the primary and secondary respondent [Moon and Juster, 1995].

Each individual defined as the household head constitutes one observation. The sample selection follows the typical restrictions adopted in the empirical literature on savings. Thus, I restrict the sample to sub-households with the same head over the relevant period (1992-1998 or 1998-2004) and to those where the head's spouse was the same, in case the head has a partner. This leaves 10,283 observations in 1992-1998 and 11,767 in 1998-2004. The purpose is to restrict the sample to stable households, where wealth changes are not explained mostly by changes in family composition. I also drop observations for sub-households that were in the sample but were not interviewed in a particular wave. This leaves a total of 5,548 observations for the analysis in 1992-1998 and 9,147 observations for 1998-2004. Sub-households that have either income or wealth missing were also dropped (only 10 households were dropped in 1998-2004). Next, I drop households where the head was below 50 or above 70 years old in 1998 and in 2004 (5,243 observations remaining for 1992-1998 and 4,618 for 1998-2004). Then I drop households where the head reports to be retired either in the first or in the last year of each period, which leaves 3,113

and 2,424 observations for 1992-1998 and for 1998-2004 respectively.[31] Finally, I exclude households where the spouses are of a different race or ethnicity and so the total number of observations falls to 2,953 in 1992-1998 and to 2,302 in 1998-2004. Finally, the sample was trimmed when necessary by dropping households in the top and bottom 2 percent of the corresponding distribution (details are given in each table's notes).

2) Weights: All summary statistics for 1992-1998 were obtained using the household level weights provided by the HRS for 1998. Results for 1998-2004 use the weights for 2004.

3) Constructed variables:

A. Total Saving: It is obtained as the difference between real net wealth in 1998 (2004) minus real net wealth in 1992 (1998). That measure can be decomposed into two components: active and passive savings. The measures of wealth levels (total and individual components) are taken from the RAND HRS 2008 Income and Wealth Imputations. Total net wealth comprises main home equity (the value of main house minus all mortgages in the primary residence and other home loans), real estate other than home equity, vehicles, business, Individual Retirement Accounts (IRAs), stocks, mutual funds, checking and savings accounts, CDs, savings bonds, treasury bills, bonds, and other assets (money owed by others, valuable collections, rights in a trust or estate) less other debts (credit card balances, medical debts, life insurance policy loans, loans from relatives). This measure of total wealth excludes pension and Social Security (S.S.), which are not directly reported in the survey. These variables were constructed ex-post using information collected in the 1992, 1998 and 2004 waves and it is possible to access to some of them through the HRS website. Here I use the pension and S.S. wealth measures that are publicly available and I add them to the measure of wealth in order to compute total wealth.

- Pension wealth: The procedure to construct this variable for 1992 and 1998 is described in the HRS document 'Imputations for Pension Wealth 1992 and 1998', and for 2004 in the document 'Imputations for Employer-Sponsored Pension Wealth from Current Jobs in 2004'. Pension wealth is estimated for current jobs from both self-reported and

[31] Note that retirement status can vary if instead of using self-reports one uses an objective measure such as "no current job". Gustman et al. [1995] show that self-reports result in significantly lower number of retirees than the use of objective measures. Thus, as a robustness check one can also define retired households as those where the head has no current job. They also note that the HRS allows capturing the flows from labor force to retirement and the other way around, resulting from the fact that retirement is not an absorbing state.

employer data. Using the respondent's self-reported pension plan type, it is possible to determine which method of wealth estimation to use.

i) If the respondent is covered by at least one DC plan on his current job at the time of the survey (1992, 1998 or 2004), DC wealth is computed from the self-reported account balance. Note that multiple accounts can be reported from the same job and in that case total DC wealth is the sum of each account balance from current job.

ii) If the respondent is covered by at least one DB plan at the time of the survey, the HRS Pension Estimation Program is used to compute wealth for each DB plan. This is done by combining self-reported data and pension plan rules obtained from the Summary Plan Description. SPDs were obtained by different means such as by contacting the employers of HRS respondents, by conducting an employer pension provider survey, by respondents' requests to their employers, by Internet searches and use of commercial databases. DB values were calculated at seven different ages: the expected age of retirement, early age of retirement, normal age of retirement, ages 60, 62, 65 and, only for 2004, age 70. The calculations of the present values from DB plans use the intermediate future real interest rate (2.9%) and the inflation rate (2.8%) forecast by the Social Security Administration (SSA). The present values are then discounted back to the survey year, which allows comparison between DB and DC amounts.

iii) If the respondent is covered by DB and DC plans or a Combination plan, both DB and DC wealth values are calculated.

Thus, total pension wealth is calculated by adding DB values at a given age of retirement (expected, early, normal, 60, 62, 65 or 70) and the total value of all the DC/Combination account balances in the corresponding survey year. Different imputations methods were used when the data needed for these estimates were missing. Since in 1992 and 1998 DB wealth is discounted back to the survey year only for the expected age of retirement, this is the only DB value I can use for 2004 as well.

- Social Security wealth: The methodology to construct this variable is described in the HRS document 'Prospective Social Security Wealth Measures of Pre-Retirees'. S.S. wealth is calculated for 'pre-retirement' respondents (i.e. those who are not claiming S.S. benefits as of the wave date) in 1992, 1998 and 2004.[32] First, this involves computing

[32]This is the information in the files publicly available as of August 2012. Access to the S.S. wealth

the Average Indexed Monthly Earning (AIME) and Primary Insurance Amount (PIA) for each respondent using the ANYPIA program (Office of the Actuary, v 2008.1). That program determines S.S. eligibility and coverage for each individual based on his/her earnings record. AIME is the average of the individual's highest indexed earnings over the appropriate number of 'computation years'. The PIA is the amount payable to the worker at the projected claim date in claim year dollars and it is a function of AIME and 'bend points'. Annual PIAs are calculated as of three claim ages: age 62, full retirement age (FRA) and age 70. To calculate survival probabilities, they use the SSA life tables by year of birth and sex. And the interest rates and the inflation rates are taken from the SSA Trustee Reports.

S.S. wealth is calculated on three monthly benefits: i) *retirement insurance benefits* (or old-age insurance benefits) are based on lifetime earnings, and are paid to retired workers age 62 or over who are fully insured ii) *incremental auxiliary spouse benefits*, is based on the spouse's life-time earnings and iii) *incremental survivor benefit*, is based on the deceased insured worker's lifetime earnings. Thus, wealth is computed by assuming that the monthly S.S. benefit comprises i) and ii) if both spouses are alive, whereas it comprises i) and iii) if one worker is deceased. By definition, ii) and iii) are zero for the higher earner. Adjustments are made on each period for early or late claiming, and these three components of S.S. wealth are weighted by the survival probabilities. The resulting wealth values are made comparable across individuals by reporting them in wave date dollars. Note that benefits are calculated assuming claiming ages that the respondent has not yet attained by the survey date (age 62, FRA, and age 70). If a respondent is older than a particular age claim or if he has started claiming benefits, missing values are assigned. Thus, for example, S.S. wealth at FRA is only calculated for individuals that are 67 or younger.

Thus, the variable measuring household total S.S. wealth, assuming both respondent and spouse claim at their respective FRA, is the sum of respondent's retirement insurance wealth, respondent's incremental auxiliary spouse benefit wealth, respondent's incremental survivor benefit wealth, spouse's incremental retirement insurance benefit wealth, spouse's incremental auxiliary spouse benefit wealth, and spouse's incremental survivor benefit

measures for current retirees has restricted access.

wealth. As in the case of other wealth components, missing values were imputed when possible.

Ideally, to compute total wealth one would like to add S.S. and pension wealth assuming claiming at age 62 or at FRA (also called normal retirement age), which are the assumptions used to compute both pension and SS wealth for all the three waves. However, I can only use pension wealth at expected age of retirement for the reasons explained above. Thus, I decided to use S.S. wealth assuming claiming at age 70, since in that way I can have pension measures for people at older ages (recall that S.S. wealth take value zero when people has already reached the assumed claiming age, thus if I were using SS assuming claiming at 62 or FRA I will be underestimating S.S. wealth at older ages).

B. Active Saving: The specific measures of active savings are taken from the 'Assets and Income' and 'Asset change' modules, using the corresponding HRS imputations. Active savings using the HRS data can be defined as the sum of the following components:

. Active savings =

+ change in the value of housing*
+ net amount invested in real estate (excluding main home)*
+ change in the net value of vehicles
+ net amount invested in business*
+ net amount put into IRA or Keogh accounts*
+ net investment into stocks*
+ change in the value of cash assets
+ change in the net value of other assets
− change in the value of other debt

Some of the active savings components were measured by the HRS using explicit questions, such as the cost of home improvements, investment in real estate other than the primary residence, business, IRAs, and stocks.[33] Those questions were added in every wave, and so I added the values reported for each two-year period in order to get the total active

[33]The components for which there are specific questions about active savings in the HRS are the ones marked with an asterisk.

savings between 1992 and 1998 and between 1998 and 2004. The remaining components were obtained as the difference in wealth between the six-years period, and so for them active savings are identical to total savings. Among the assets with no specific questions on active savings are S.S. and pensions, despite that capital gains may be significant especially in DC pension plans. Thus, in this case I opted for not distinguishing between active and passive savings to avoid overestimating the former. To my knowledge, this distinction for retirement assets has not been done in other studies of savings either, although one may be willing to distinguish between the change in wealth resulting from net new money put into these accounts and the change in wealth resulting from capital gains.

Active saving in housing is computed separately for households living in the same house and households moving between two consecutive waves, as in Juster et al. [2005]. For the first group, active saving equals the cost of home improvements plus the change in the mortgage and other home loans if a family owned a house, and zero otherwise. When a family moves between two waves, active saving in housing is computed as the change in home equity. Thus, when a family does not move, the change in house value is imputed to capital gains, whereas for families that move between surveys all saving in housing -including the change in house value- is imputed to active saving.

Finally, note that the HRS also includes questions about net transfers into the household consisting on inflows and outflows resulting from changes in family composition and inheritances and gifts. In particular, 'assets and debts brought in' and 'assets and debts moved out' capture the fact that, as individuals join the family, they may bring assets and debts with them and, as they leave, they may take assets and debts as well. In addition, active savings include inheritances and gifts from family and friends that are not savings out of income as in the traditional definition of savings. Since in general we don't know the type of assets associated to these flows, i.e. whether the household receives a car or a stock as a result of an inheritance or a new member join in, we cannot impute them correctly to active or passive savings. Following Juster et al. [2005], I do not include these net wealth transfers as part of either active nor passive savings.

C. **Passive Saving**: It only accounts for the capital gains of the assets for which the HRS has specific questions about active savings. Here I compute the aggregate measure of passive savings as the difference between the change in total net wealth during 1992-1998 (1998-2004) minus total active savings over the same period. Since both total and active

saving are deflated as described in point 4) below, passive saving obtained as a residual are also in 2004 dollars.

D. **Income**: Income variables are taken from the same source as the wealth measures, that is, the RAND HRS 2008 Income and Wealth Imputations. The measure of total income computed from the HRS corresponds to the last calendar year and is the sum of respondent and spouse earnings, pensions and annuities, Supplemental Security Income and Social Security disability, Social Security retirement, unemployment and workers compensation and other government transfers, household capital income (includes business or farm income, self-employment earnings, gross rent, dividend and interest income, and other asset income), and other income and lump sums from insurance, pension, and inheritance. It was not possible to compute disposable income by subtracting taxes paid by the household members because the HRS does not collect information on taxes (with a few exceptions, such as taxes on real estate). Income is calculated for 1993-1997 by averaging data from the 1994, 1996 and 1998 waves, and for 1999-2003 by taking the mean of the following three waves (2000, 2002 and 2004).

In addition, to compute saving rates, it is necessary to adjust the measure of total income and account for employer contributions to pensions and S.S.. As Dynan et al. [2004] point out, these contributions are part of pension and SS saving but they are not included in the measure of total income described above. The HRS only asks about the employer contributions to DC plans but not about contributions to DB plans nor to SS. In addition, self-reports on employer contributions are known to be typically measured with error, due mainly to the lack of knowledge of the respondent. Thus, I opted for using the Employer Costs for Employee Compensation (ECEC), produced by the Bureau of Labor Statistics. The ECEC measures the average cost to employers for wages, salaries and benefits, per employee hour worked. In particular, it provides the cost for DB and DC plans and for S.S. as percentages of total compensation. I use the average for the period 1992-2006 of these measures, computed separately for state and local government workers on the one hand, and private industry workers on the other. The percentages of total compensation are 6.2% for DB, 0.6% for DC, and 3.6% for SS in the case of workers in the public sector, and 1.5%, 1.6% and 4.8% respectively for the private sector. Thus, I adjust total household income by adding the fraction of the respondent and spouse earnings that correspond to employer contributions to DB and DC plans and to S.S..

E. Saving Rates: I compute total, active and passive saving rates as the ratio between the corresponding saving measure over 1992-1998 (1998-2004) and six times the average of total adjusted income over 1993-1997 (1999-2003).

F. Other variables:

- Age: Age is one of the key eligibility criteria for a household to be part of the HRS sample and so the unit of observation is the age-eligible respondent. Age of the household head is measured in 1995 for the period 1992-1998 and in 2001 for the period 1998-2004.

- Education: Education dummies were built by considering the highest degree of education of the household head. The dummies created are "no high school diploma" if the individual has no degree or a General Equivalence Degree (GED), "high school graduate" if the individual has a high school diploma and "college/postcollege graduate" if the individual has at least a two-year college degree.

4) Deflators: All variables are deflated using the NIPA implicit price deflator for personal consumption expenditures, with the base year adjusted to be 2004. The stock variables such as total wealth and its components and permanent income are deflated by dividing the correspondent balance by the price index for that year. Thus, the change in wealth is simply the difference of those variables in real terms. The flow variables used to compute active savings are deflated using the 2-year harmonic mean of the NIPA implicit price deflator for personal consumption. Then the real components over each 2-year period are added to obtain the 6-year active saving measure (for 1992-1998 and 1998-2004 separately).

C Self-selection into retirement

Figure C1 shows that the fraction of non-retired people decrease monotonically with age for Blacks and Whites. The proportion of Hispanics who are still working at each age and ethnic group is higher than the proportion of Whites. Moreover, the pattern of decline is less monotonic than the pattern observed among Blacks and Whites. The density estimates of working people's age declines smoothly for whites after 55 years old in 1995 and after 60 years old in 2001. In contrast, the decline is less smooth for Mexican Americans and Other Hispanics in both periods. This reveals that there is some self-selection into retirement among Hispanics. They are more likely to continue working at older ages than Whites.

Figure C.1: **Proportion of non-retired households**

Panel A. Period 1992-1998 by age in 1998

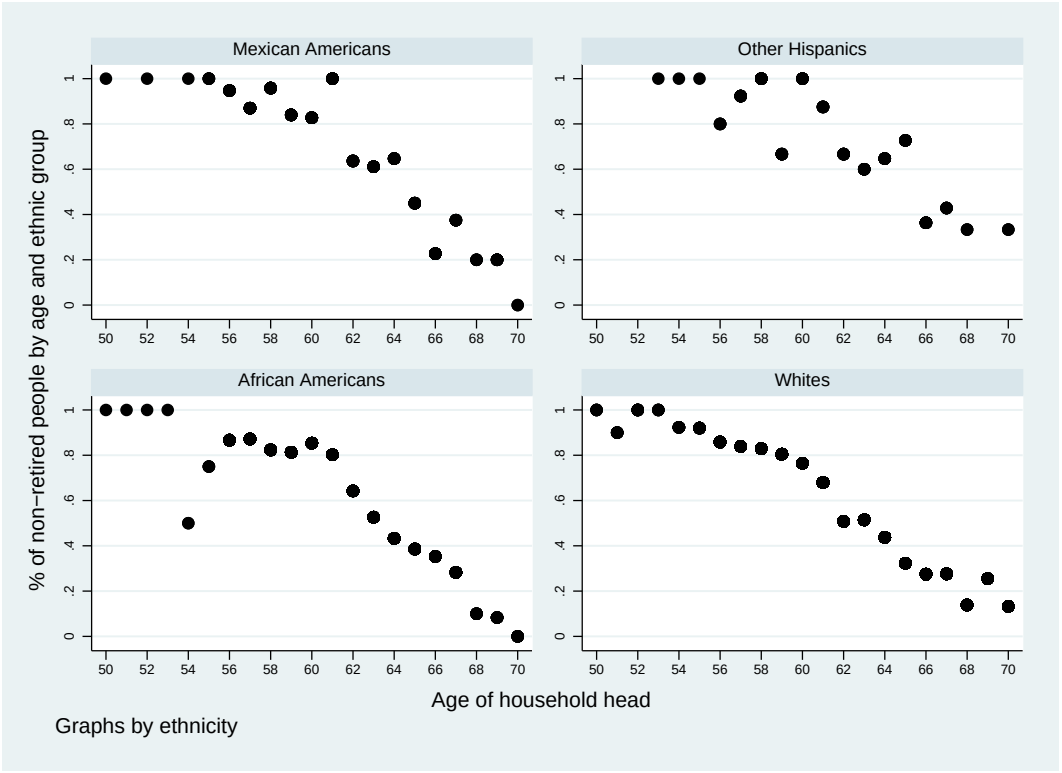
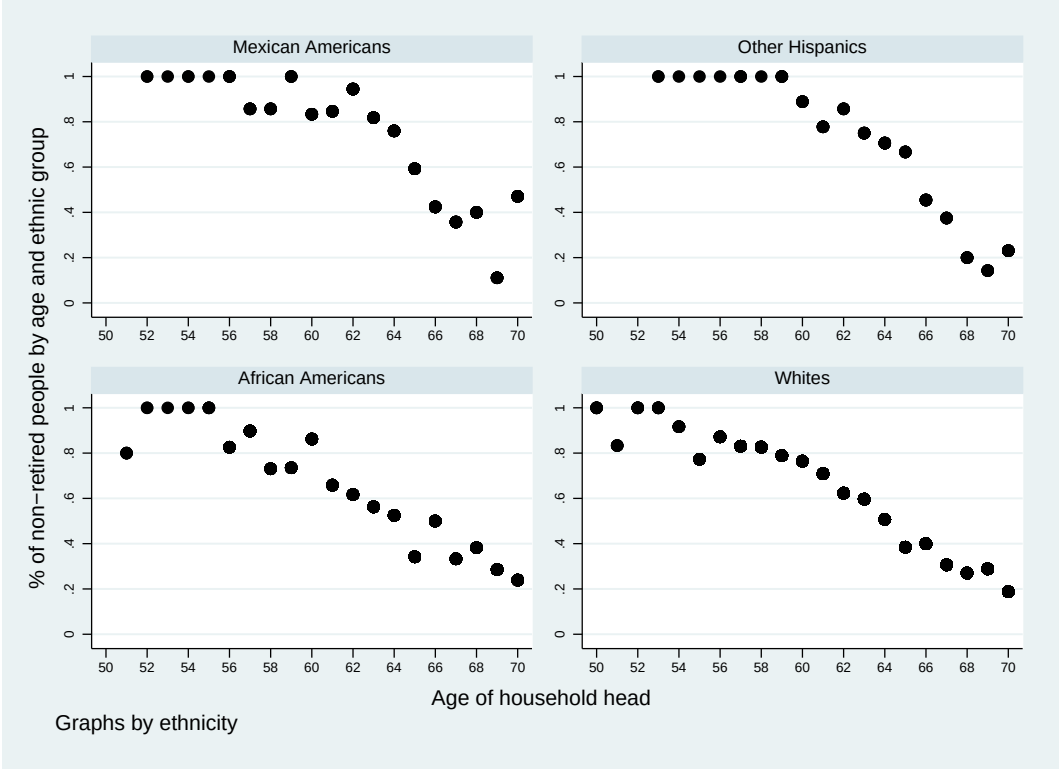


Figure C.1: **Proportion of non-retired households**

Panel B. Period 1998-2004 by age in 2004



Note: Age corresponds to the age of the household head. Proportions are taken over the total number of individuals in the corresponding age and ethnic group. Sample consists of HRS households whose head and spouse were the same between 1998 and 2004 (Panel A) and between 1989 and 2004 (Panel B), the head was not retired during those years and was between 50 and 70 years old in 1998 (2004). Households with mixed-ethnicity couples are excluded. Non-retired households are those where the head does not report to be retired in both years.

Figure C.2: **Density estimates of age by ethnicity and race**

Panel A. 1998

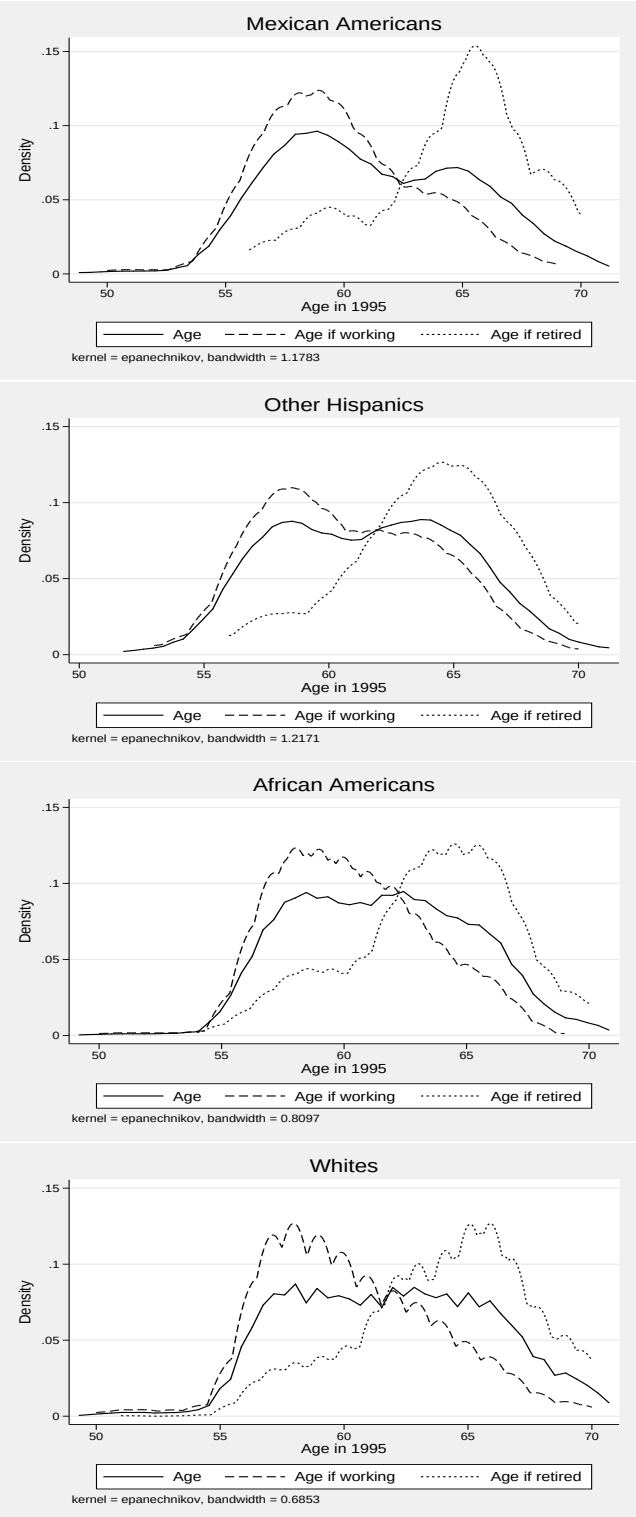
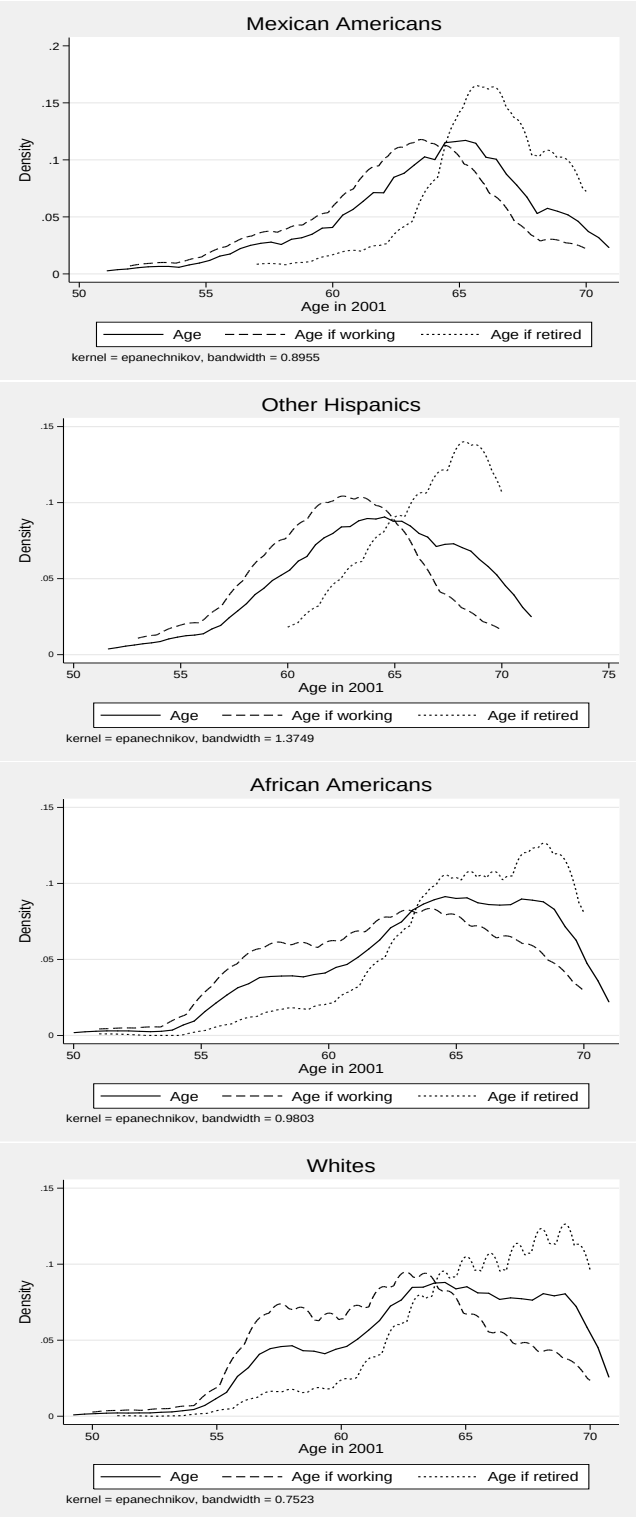


Figure C.2: **Density estimates of age by ethnicity and race**

Panel B. 2004



Note: Age corresponds to the age of the household head. Sample consists of HRS households whose head and spouse were the same between 1998 and 2004 (Panel A) and between 1989 and 2004 (Panel B), the head was not retired during those years and was between 50 and 70 years old in 1998 (2004). Households with mixed-ethnicity couples are excluded. Non-retired households are those where the head does not report to be retired in both years. Retired households are those where the head reports to be retired in at least one of those two years.

Chapter 2

The Effect of Bankruptcy Protection on Portfolio Choice

2.1 Introduction

A long-standing question in finance, important for asset pricing and investment theory, is what determines portfolio choice. The decision to invest in risky assets not only depends on the volatility of the returns but also on other sources of risk. In a world with incomplete markets, government-supplied consumption insurance can affect portfolio decisions by decreasing exposure to some uninsurable risks. However, there is little empirical evidence on such effects. Many U.S. households are exposed to financial risks resulting from labor and entrepreneurial income volatility and medical expenses. These risks can ex-ante affect households' willingness to invest in risky financial assets and, if they materialize, they can trigger household bankruptcy [Cohen-Cole, 2009]. In this context, the U.S. bankruptcy law is one of the largest social programs in the country, providing debtors with insurance against the consequences of negative shocks. It is more generous towards debtors than the corresponding laws from other countries; even after the 2005 "Bankruptcy Abuse Prevention and Consumer Protection Act" (BAPCPA) made it less pro-debtor to prevent speculative behavior. Here I examine empirically its ex-ante effects on households' participation on the stock market. There could be welfare gains from this insurance if it encourages stock market participation among risk-averse households.

When a household files for Chapter 7 bankruptcy it can retain some assets up to the exemption level, plus the human capital, and can discharge some debts. Since the

home is typically the most important asset in households' net worth, I focus on homestead exemptions.[1] These exemptions determine the maximum amount of equity in owner-occupied homes that the household can retain after declaring bankruptcy. Different states set different levels of exemptions at different times, making the U.S. bankruptcy law a unique lab to evaluate their effects empirically. Moreover, the benefits of filing have not been ignored, given that on average five per thousand individuals have commenced a personal bankruptcy case between 1999 and 2009.

The existing empirical literature has focused mostly on the effects of this insurance on risk-taking in the form of entrepreneurship and much less on financial risk-taking.[2] To fill that gap, I ask two questions: (1) Is there an effect of homestead exemptions on stock market participation? and if so (2) What are the main channels that can explain this effect? I find that doubling exemptions reduces stock ownership by 2p.p. when exemptions are between $22,000 and $90,000 approximately. Given that on average 20% of the households in the Panel Study of Income Dynamics (PSID) own stocks outside retirement accounts, this represents a 10% decline. I interpret this result as reflecting a lower preference for unprotected assets when the bankruptcy system becomes more lenient.

The first important contribution from this study is the finding that a higher level of bankruptcy protection reduces stock market participation, which at first seems surprising. It is widely accepted in the literature that risk-taking is higher in the presence of a guaranteed minimum wealth or limited liability, because it gives investors the equivalent of a put free option [Gollier et al., 1997, Gormley et al., 2010].[3] Recent studies on medical expenditure risk and portfolio choice conclude that the availability of health insurance increases risky asset holdings (Atella et al., 2012; Goldman and Maestas, 2013; Christelis et al., 2014). The empirical literature on the effect of bankruptcy protection on entrepreneurship finds positive effects in general.[4] To the best of my knowledge, Persad [2005] is the

[1] Other assets that are typically protected are vehicles, retirement assets (IRA and Keogh accounts), and in some states, a small amount of bank deposits.

[2] White [2007b] surveys the theoretical and empirical literature on the economic effects of the corporate and personal bankruptcy law.

[3] Further, Gollier et al. [1997] show that "betting for resurrection" may arise when there is a critical level of initial wealth, close enough to bankruptcy, under which risk-averse investors with limited liability choose maximal risk exposure.

[4] The relation between bankruptcy protection and entrepreneurship has been studied by Fan and White [2003], Armour and Cumming [2008], Cerqueiro and Penas [2011], Mankart and Rodano [2012], Fossen [2014].

only study to look at the effect of bankruptcy exemptions on households' demand for risky assets. Based on a real option model he predicts that the consumption floor in bankruptcy should increase people's willingness to increase the risky portfolio share. I claim that this prediction holds only if the risk of default is uncorrelated or positively correlated with the portfolio risk. Persad examines changes in exemptions for different states separately using a difference-in-difference approach. The use of fixed-effect estimates that pool several states in a single regression allows me to obtain more precise and robust estimates.

The second main contribution is an analysis of the channels through which increases in exemptions may reduce stock market participation. A first that I call "protection channel" reflects the fact that higher protection makes unprotected assets less attractive. Filing under Chapter 7 requires surrendering all unprotected assets, including stocks, to a trustee, who will sell them to pay debts. A second "risk channel" reflects the effect of exemptions on the preference for risky assets. Having higher home equity protection may reduce the demand for stocks if the portfolio risk and the risk of default are negatively correlated. Assets that pay more in the bad state are less attractive when bankruptcy becomes more generous.[5] A third is the "credit market channel". Higher protection reduces the collateral value of assets because only assets above the exemption level can be seized. Thus, when the protection increases, lenders will increase the cost of borrowing and/or reduce the availability of credit. Higher interest rates would make future borrowing less attractive if households need liquidity to compensate for a bad return realization, reducing the current demand for stocks. Conditional on holding debt, its higher interest rate reduces the perceived expected excess return to investing in the risky asset because households earn less on each dollar invested in stocks [Becker and Shabani, 2010]. Credit rationing can also reduce participation. If households "borrow to save", lower availability of credit directly affects the ability to save in stocks. But even if that is not the case, being denied a loan may require drawing down liquid assets from the buffer of stocks for consumption purposes.

The evidence seems to support the first channel, though I cannot rule out completely the other two: An increase in exemptions reduces the willingness to invest in assets that

[5]Evidence that households hedge other risks, such as human capital risk, in the stock market is given by Guiso et al. [1996]; Vissing-Jorgensen [2002] and Betermier et al. [2012].

can be lost in bankruptcy, reducing stock market participation. First, I find that the effects are limited to high-asset and high-income households that are the more likely to trade in the stock market. Poorer households may be less likely to respond either by reducing stock market entry or by increasing exit when the probability of bankruptcy increases. Notice that high-asset households also file for bankruptcy [White, 2007a, Miller, 2012]. Even after the 2005 reform, they can still plan strategically and reduce pre-bankruptcy income to become eligible for Chapter 7.[6] The reduction in stockholdings among high-asset and high-income households is less consistent with the credit market channel. In particular, when looking for evidence of credit rationing, I find that higher exemptions only reduce the debt holdings of poorer households. Previous literature has found that exemptions may even increase the availability of credit among the rich [von Lilienfeld-Toal and Mookherjee, 2008]. The stronger credit market constraints are imposed on the poor because their ex ante probability of default increases more with exemptions (Gropp et al., 1997; Severino et al., 2014).

Second, the stronger decline on stockholdings found for entrepreneurs, defined as self-employed or business owners, is consistent with the protection but not with the risk channel. The risk channel predicts an increase rather than a decrease in stock market participation as a result of higher exemptions among self-employed, with income positively correlated with stock returns [Heaton and Lucas, 2000]. In that case, households can consume more when income is high by investing in stocks, and when income is low and stocks pay less, they can resort to the bankruptcy insurance. In contrast, the protection channel predicts that as exemptions increase, and therefore the probability of bankruptcy, entrepreneurs may be less willing to hold assets that are lost if they file for Chapter 7. The stronger effects may simply reflect the fact that they are more likely to be aware of the bankruptcy law.

Third, exemptions do not affect the share of stocks in liquid assets, even among households with higher income volatility such as self-employed. This can happen if the decline in stock market participation is driven by the lower preference for unprotected

[6] The BAPCPA introduced a "means test" that requires that only households with average income below the state median income in the six months before filing can be eligible for Chapter 7. Those that don't pass the test can still qualify if their disposable income -the average income minus allowances for living expenses- is sufficiently low. Selling unprotected assets, such as stocks, may be one strategy to reduce capital income.

rather than risky assets. In that case, households will reduce the demand for any non-exempt asset when exemptions increase, including safe assets. My data confirms that higher exemptions lead to a decline in the ownership of safe liquid assets. In contrast, the risk channel should affect the risky portfolio share, not just the participation decision, given that it affects the preference for risky versus safe assets. Finally, one would expect that the lower demand for unprotected assets also leads to more investment in assets that are protected from bankruptcy, such as home equity and retirement accounts, and/or more consumption. Unlike Corradin et al. [2013] and Greenhalgh-Stanley and Rohlin [2013], I find that higher exemptions do not lead to more investment in housing, and instead I find some evidence that they increase investment in annuities and IRAs at the intensive margin. The lack of data on consumption does not allow me to test for this explanation, however, a response in the form of higher consumption cannot be ruled out.

This Chapter presents the theoretical framework that illustrates the main mechanism driving the results in Chapter 3. The baseline model follows Gormley et al. [2010] and shows how exposure to a large, negative wealth shock affects household savings and investments in risky assets. Then I depart from those authors, who focus on the role of insurance purchased by the household, to study the effects of introducing an implicit insurance as the one from Chapter 7 bankruptcy. For simplicity, I restrict the model to the demand-side and I do not incorporate the general equilibrium effects that would arise when accounting for the response of the lending sector. Thus, the model only illustrates the protection channel, which receives more support from the data, and the risk channel when the background risk and portfolio risk are uncorrelated.

This research addresses an important policy question: How do public insurance programs affect risk-taking generally? Higher bankruptcy insurance can have positive spillover effects on financial markets mainly when the portfolio risk and the risk of default are uncorrelated or positively correlated. Assuming that this is the case at least for some households, my findings suggest that the bankruptcy system does not encourage financial risk-taking. The dominant effect is a decline in participation among high-income and high-asset households. If households reduce investment in unprotected assets to invest more in protected assets such as retirement accounts, then exemptions are actually a desirable device to increase retirement savings, which can in turn be invested in stocks. However, if households increase consumption in exchange for the lower investment in risky assets,

then the side effects of this policy are less beneficial. Even if that is the case, the costs of exemptions in terms of social welfare will also depend on whether wealthy households benefit more or less from holding stocks than other households.

2.2 Related Literature

The relationship between bankruptcy protection and households' financial portfolios has received little attention in the empirical literature. One exception is Persad [2005], who examines whether the wealth insurance induces a smaller portfolio share of safe assets. His theoretical framework, based on real option theory, predicts that bankruptcy exemptions increase the beneficial effects of risk-taking leading agents to increase the share of risky assets in their portfolios. In contrast, I note that the effects on risk-taking resulting from the additional insurance are ambiguous rather than positive and depend on how the portfolio risk correlates with the risk of default. Persad [2005] relies on a difference-in-difference approach to evaluate separately the rise in the homestead exemptions for different states over the period 1988-1996.[7] The estimates by home equity quintiles with data from the Consumer Expenditure Survey result in small cell sizes in several cases, whereas in others he finds both positive and negative effects. Using a fixed-effect estimator, I can pool all the states in a single regression, which produces more precise and robust results than the difference-in-difference strategy.

The effect of bankruptcy on portfolio reallocation has been explored by Lehnert and Maki [2002]. They find that high asset exemptions encourage households to simultaneously hold low-return liquid assets and high-interest unsecured debt, what they refer to as the "borrowing to save" effect (also noted by Lopes, 2008 and Mankart, 2014). However, they do not find any effect of bankruptcy law on assets and debts measured separately. Although I do not test for the strategic behavior, and leaving risk considerations aside, it is even more plausible that people would borrow to save in high-return assets when the generosity of bankruptcy increases.

The question addressed by this paper is complementary to the literature on the ex-ante effects of bankruptcy on household asset accumulation, pioneered by Repetto [1998]. Using

[7] In particular, he considers the increase in exemptions in California (1990), Colorado (1991), the federal exemption (1994) and the 1993 decline in the Minnesota exemption.

PSID data, she finds that bankruptcy exemptions crowd out total wealth accumulation. But whereas homestead exemptions are positively correlated with home equity, the relation between exemptions on other personal property and financial wealth is negative. The resulting decline in financial wealth is consistent with my findings for stock ownership and safe liquid assets. The effect of homestead exemptions on housing has been explored using a reduced-form approach by Corradin et al. [2013] and Greenhalgh-Stanley and Rohlin [2013]. These studies conclude that the wealth insurance effect outweighs the supply-side constraints.[8] Corradin et al. [2013] find that households in high exemption states allocate approximately 20% more of their average wealth to home equity than households in low exemption states. The evidence for a positive relation between exemptions and homeownership is weaker. They conclude that the homestead exemption may bias household portfolios by increasing the home equity share in net worth for home owners. My paper complements these findings by showing another distortion induced by the exemptions in the form of lower holdings of non-exempt assets.

This paper relates to previous studies that have looked at the effect of bankruptcy exemptions on risk-taking in the form of entrepreneurship. The household's decision to own a business has been examined by Fan and White [2003] and by Greenhalgh-Stanley and Rohlin [2013] for the elderly. Georgellis and Wall [2006], Armour and Cumming [2008] and Fossen [2014] explore the link between bankruptcy and self-employment. The limited evidence on this subject supports a positive association in general.[9] The demand effects on entrepreneurship are expected to be positive because personal bankruptcy directly reduces exposure to entrepreneurial risk. In contrast, the demand effects on stockholdings are ambiguous because -at least theoretically- bankruptcy protects from background risk and this mediates the final effect on stockholdings. The protection channel can also lead to a negative effect on financial risk-taking but not on entrepreneurship. On the other hand, to the extent that stocks can be used for risk-sharing, i.e. for hedging other risks, this paper also relates to Mahoney [2012]. He shows that the implicit insurance from

[8] A recent branch of this literature looks at the effect of bankruptcy laws on debt and aggregate savings in the context of a life-cycle model, including Livshits et al. [2007], Pavan [2008], Athreya [2008], Lopes [2008], and Mankart [2014]. Only Pavan [2008] distinguishes accumulation of durable (home equity and vehicles) and financial wealth (farms or business, land, other real estate and all the remaining risky and safe financial assets). This literature relies on quantitative models of the credit market and lacks empirical evidence on the effects of bankruptcy protection.

[9] More details of this literature are given in section 6.6.

bankruptcy crowds-out the adoption of formal health insurance. In contrast, my results do not suggest that the bankruptcy insurance crowds-out the demand for risky assets in their role of risk-sharing devices, since it also reduces the demand for liquid assets in general.

This paper also relates to two branches of the literature attempting to explain the determinants of participation in equity markets and portfolio allocation. On the one hand, it relates to the strand looking at the effects of uninsurable risks such as medical expense risk or income risk on stock market participation. In particular, health insurance may mediate the negative effect of health risk on stockholdings, as originally postulated by Rosen and Wu [2004] and later examined by several studies, including Atella et al. [2012], Goldman and Maestas [2013] and Christelis et al. [2014]. More in general, Gormley et al. [2010] show that access to any form of insurance is positively correlated with higher participation rates. This contrasts with my results since bankruptcy is only an implicit insurance that by protecting certain asset categories can distort portfolio allocations beyond its impact on risk-taking behavior.[10] On the other hand, the importance of entrepreneurs' income risk for portfolio choice has been noted by Heaton and Lucas [2000]. The income of the self-employed is more volatile and positively correlated with stock returns, which may lead to lower stockholdings. In that context, my findings do not confirm the implication that entrepreneurs will respond to the bankruptcy insurance by increasing stockholdings because, even if it reduces exposure to income risk, the protection channel dominates.

This study also draws on the literature on the effect of bankruptcy protection on credit supply, another mechanism potentially driving the results. The evidence on access to credit is mixed, whereas there is consensus that protection increases interest rates, especially for poor borrowers. The cross-sectional evidence from these studies suggests that low-income households and small firms are more exposed to credit rationing. Gropp et al. [1997] find that the effects of an increase in exemptions on the availability and amount of credit and on the interest rates of automobile loans impose higher constraints on low-asset households. Lin and White [2001] find that higher exemptions increase the probability of borrowers being denied mortgage loans. The literature addressing firms' access to credit finds a similar pattern. Small firms experience more negative credit conditions when

[10] Although not reported here, no significant effects were found for people in bad health.

they are located in states with unlimited rather than low exemptions [Berkowitz and White, 2004]. Furthermore, the reduction of credit is larger for unlimited liability small businesses than for corporations [Berger et al., 2011]. In contrast, using firm-fixed effects, Cerqueiro and Penas [2011] find that small corporations but not unlimited liability business experience a reduction in available financing, slower growth and higher failure rates. On the other hand, using county fixed effects, Severino et al. [2014] find that bankruptcy protection increases the holdings of credit card debt and the corresponding interest rates, especially in low-income regions. Based on a similar empirical strategy and controlling for individual fixed effects, I find negative effects of exemptions on total debt, mainly for low-income households. This indicates the presence of credit rationing resulting from higher exemptions, although ultimately this does not seem to be the mechanism driving the results.

Finally, this paper relates to the literature exploring the effect of debt holdings on household portfolio choice. Becker and Shabani [2010] show that the benefits to equity market participation among households with high-interest-rate debt are smaller. They estimate that households with mortgage debt are 10% less likely to own stocks, and claim that similar effects may result from holding other types of high-interest rate debt such as credit card debt. Davis et al. [2006] extend the life cycle model to account for a cost of borrowing in excess of the risk-free asset return and this delivers lower equity market participation. Although the empirical evidence does not support this hypothesis, I build on this literature to predict how changes in the cost of borrowing arising from higher exemptions may affect stockholdings.

2.3 U.S. Bankruptcy Law

Main functions

There are two main underlying functions of the bankruptcy law. One is to act as a consumption insurance. Individuals smooth consumption over the lifecycle by taking loans. However, there is uncertainty over future income and future expenses, and if income turns out to be low or expenses high, individuals would have to reduce their consumption dramatically or will not be able to meet their financial obligations. The bankruptcy insurance allows discharging unsecured debt in exchange for assets above the exemption

level (Chapter 7) or for payments out of disposable income (Chapter 13). Since the possibility of default is higher in the presence of this consumption insurance, lenders charge a "premium" in the form of higher interest rates. However, the bankruptcy insurance cannot be so high that induces moral hazard from debtors and leads to inefficiencies resulting from the excessive borrowing costs.

The other main function of the bankruptcy law, in conflict with the previous one, is to punish debtors who cannot pay their obligations. The goal is to reduce moral hazard: Households are discouraged to borrow without considering if they are solvent and to reduce their ability to repay by working less. These behaviors can lead to default, followed by credit rationing and higher interest rates, which is detrimental for future borrowers. On the other hand, the punishment cannot be so high that it induces moral hazard from the lenders. A high punishment makes more attractive to lend to risky borrowers and to charge high ex-post interest rates. The punishment imposed by the US bankruptcy law involves future exclusion from credit markets, bankrupts' names are made public, bankruptcy filings appear on credit records for 10 years, and defaulters are not allowed to file again for several years.

These costs could imply that households do not widely see bankruptcy as an insurance. However, the frequency of the bankruptcy episodes, even after the 2005 reform, suggests that debtors do not refrain from ultimately relying on this mechanism.

Chapter 7 versus Chapter 13

When a household files for bankruptcy, it can discharge most unsecured debt, including credit card debt, installment loans and medical bills. Debts that are not dischargeable include tax obligations, student loans, alimony, child support obligations, debts incurred by fraud, credit card debt incurred just before filing, and some secured debt such as mortgages and car loans.[11] There are two repayment options: Chapter 7 and Chapter 13. Under Chapter 7 households discharge unsecured debt and, in return, creditors can seize assets

[11] Even after filing for Chapter 7 the borrower has to continue making mortgage payments, or otherwise the lender can foreclose the house. But Chapter 7 eliminates the personal liability for mortgage loans. This means that the borrower cannot be liable for a deficiency judgment, which occurs when the house is sold through foreclosure but the sale proceeds are lower than the mortgage balance. In that case, Chapter 7 prevents the lender to go after the borrower's personal assets to collect the mortgage deficiency. This is one of the reasons why in practice homeowners who default on their mortgages also file for bankruptcy.

above exemption levels according to state laws. On the other hand, under Chapter 13 households discharge debt in exchange for payments out of post-bankruptcy income over the following three to five years, but they can keep their assets.

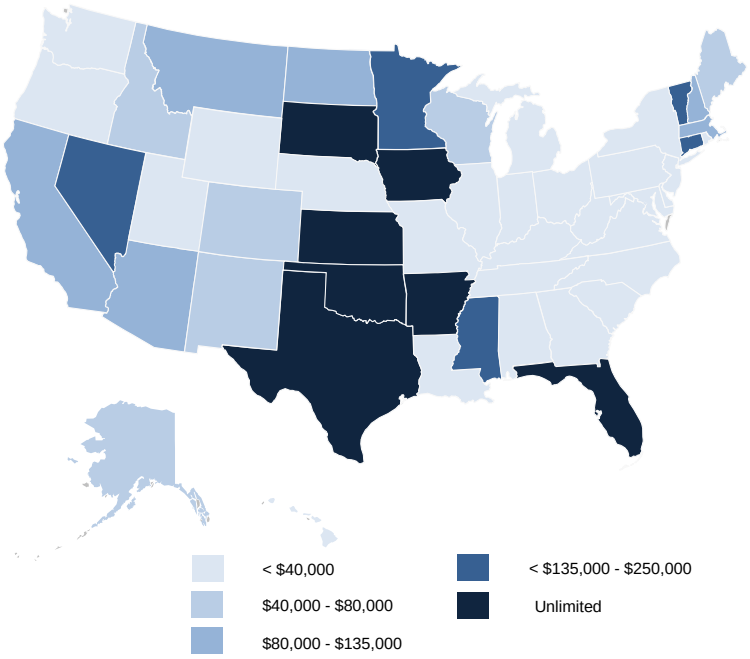
The effect of Chapter 7 asset exemptions is to provide extra insurance to households by emerging from bankruptcy with positive net worth. They appeared in U.S. towards the end of the 18th century, when some states in the South wanted to protect landowners from their creditors in the North, and have spread over the following century in part as an incentive to attract migrants. The asset categories that typically have some level of protection under Chapter 7 are equity in owner-occupied homes, vehicles, retirement assets (IRA and Keogh accounts), and bank deposits. In addition, there are "wildcard exemptions" that can be used for assets in excess of the exemption in other asset categories. The asset exemptions vary by state and by the marital status of the individual, and in occasions also by age (65 or over) and disability status. Some states give the option to file using the level of exemptions set by the federal law. Before 2005 Chapter 13 filers were able to propose their own repayment plans and typically proposed to repay an amount equal to the value of their non-exempt assets: They were not allowed to repay less and since they had the option to choose Chapter 7, they had no incentives to repay more [White, 2007a]. This means that even for those who decided to file under Chapter 13, Chapter 7 exemptions would still affect the repayment amount and therefore the probability of bankruptcy.

Table 2.1 shows the average exemption level for couples by year. The average protection to home equity increased from $57,000 in 1999 to over $100,000 in 2009 and was $75,000 over the period 1999-2009. In Figures 2.1 and 2.2 I summarize how that level varied across states and across time. In 1999 homestead exemptions went from zero in Delaware and Maryland to unlimited in seven states (Arkansas, Florida, Iowa, Kansas, Oklahoma, South Dakota and Texas). The larger increases in exemptions during the 10-year period were in Delaware, South Carolina, Rhode Island, New York and Massachusetts, whereas DC was the only state that ever changed from the level of exemptions set by the federal law to unlimited. Some states give the option to file using the level of exemptions set by the federal law. The federal exemption level has only increased to compensate for the inflation, as can be seen in Figure 2.2 for Hawaii, New Jersey and Pennsylvania. In turn, the exemptions from some states exhibit no variation in nominal values and therefore experience a decline in real values, including Alabama, Connecticut, Kentucky, Mississippi,

Vermont, Virginia and Wyoming.

Figure 2.1: **Bankruptcy exemption levels by state; values in real 2004 USD**

Panel A. Homestead plus wildcard exemption levels for couples, 1999.



Panel B. Homestead plus wildcard exemption levels for couples, 2009.

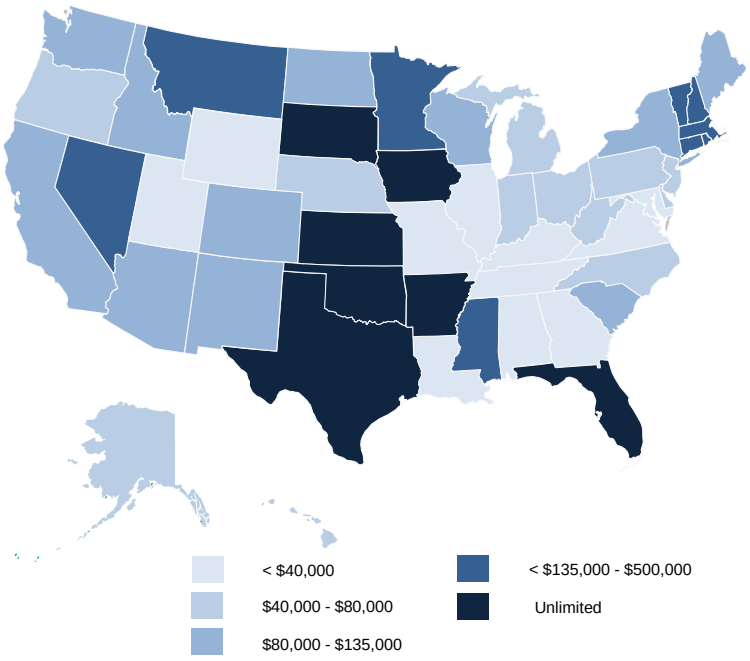


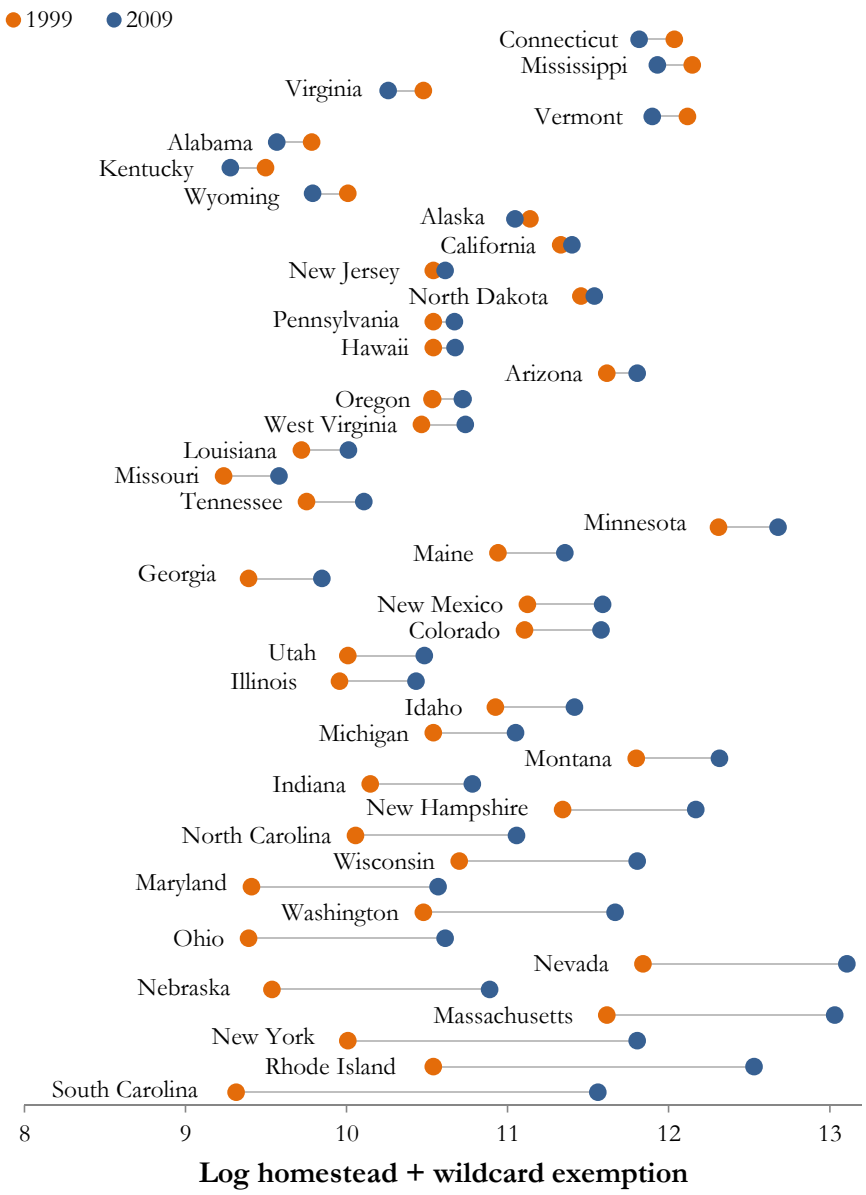
Table 2.1: **Summary statistics for bankruptcy exemptions**

Average exemption levels for couples, 1999-2009

		All the sample	**Exemptions < $22,000**		**Exemptions > $22,000 & < $90,000**		**Exemptions > $90,000**		
		Average exemption ($)	**Average exemption ($)**	**Number of states**	**Average exemption ($)**	**Number of states**	**Average exemption ($)**	**Number of states**	
								Finite	**Unlimited**
1999	Homestead + wildcard	57,209	13,146	12	43,953	23	149,833	9	7
	Total asset exemptions	61,602	13,858	11	46,859	23	148,032	10	
2001	Homestead + wildcard	58,210	13,692	13	46,391	20	139,724	10	8
	Total asset exemptions	63,274	13,577	10	47,570	22	139,861	11	
2003	Homestead + wildcard	63,659	14,963	15	50,012	18	161,268	10	8
	Total asset exemptions	69,562	14,546	11	49,427	21	163,019	11	
2005	Homestead + wildcard	74,812	15,329	15	49,785	18	209,083	10	8
	Total asset exemptions	80,999	15,712	11	48,445	21	208,436	11	
2007	Homestead + wildcard	96,694	15,391	8	46,337	19	197,144	16	8
	Total asset exemptions	103,361	16,317	6	49,861	21	206,221	16	
2009	Homestead + wildcard	104,050	15,227	5	48,705	20	190,218	18	8
	Total asset exemptions	112,526	16,409	3	47,841	20	191,628	20	
1999-2009	Homestead + wildcard	75,701	14,550		47,370		178,459		
	Total asset exemptions	81,809	14,772		48,309		180,214		

Notes. This table shows the average exemption levels for couples split among states with low (<$22,000), medium (>$22,000 and <$90,000) and high (>$90,000) exemptions in real 2004 dollars. The thresholds are defined based on the sum of the homestead and wildcard exemptions. Total asset exemptions include vehicles and bank deposits in addition to homestead and wildcard exemptions.

Figure 2.2: **Log state exemption levels for couples, 1999-2009 (2004 USD)**



Notes. Excludes states with unlimited exemptions (Arkansas, Florida, Iowa, Kansas, Oklahoma, South Dakota, Texas and District of Columbia) and Delaware that was an outlier for the first years of the sample.

Before 2005 debtors could choose under which Chapter they wanted to file and the most common choice was Chapter 7. Under that Chapter, debtors have to surrender all their non-exempt assets but can retain their future income. Under Chapter 13 borrowers are forced to repay from post-bankruptcy income, a less attractive alternative. Chapter 7 implied that even if defaulters had a very high income, it was not committed to future repayments. This system encouraged strategic behavior and became beneficial for

individuals with high income and wealth.

The 2005 bankruptcy reform

In 2005 there was a reform in the bankruptcy law, known as the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA), to reduce the distortions which had lead to historically high levels of bankruptcy. The reform included the removal of the debtor's right of choosing between Chapters 7 and 13, aimed at preventing high-income debtors to file for bankruptcy under Chapter 7. In order to qualify for Chapter 7, debtors' family income in the six months before filing must be smaller than the median income in their state. Sometimes debtors are allowed to file under Chapter 7, even if they don't pass the 'means test', as long as their monthly disposable income is below a certain threshold.[12] In addition, the mean test doesn't apply for people whose debts come primarily from the operation of a business (self-employed).

Other changes implemented by the BAPCPA included the increase in the costs of filing. After the reform, average total filing costs increased from \$900 to \$1,500 under Chapter 7 and from \$3,700 to \$5,700 under Chapter 13 (United States Government Accountability Office, 2008). In addition, the minimum time that debtors must wait before filing again also increased from six to eight years for Chapter 7, from six months to two years for Chapter 13, and from no minimum to four years for a Chapter 7 followed by a Chapter 13 filing. Finally, debtors could no longer propose their own repayment plans under Chapter 13 and have to use all their disposable income to make repayments over the next 5 years after filing.

The BAPCPA imposed three measures that restricted the speculative behavior under Chapter 7. First, for debtors moving between states before filing the exemptions that apply are those of the state with the lower levels within the last two years. Second, the homestead exemption cannot exceed \$125,000 if the house was purchased within the $2^1/_2$ years prior to filing. Third, the fraction of the home equity accumulated by paying down mortgage within the 3 years and 4 months before filing is not protected. In addition to these restrictions, the only modification to Chapter 7 exemptions was a new exemption

[12] "Disposable income" is defined as the difference between debtors' average monthly family income during the six months prior to filing and a new income exemption. The income exemption determines for each debtor an allowance for living expenses.

for tax-protected individual retirement accounts (up to $2 million for couples and half of that amount for singles).

The reform reduced the number of Chapter 7 filings from a peak of around 2 million per year in 2005 to 600,000 a year later [White, 2008]. In subsequent years, they increased again and reached a level of around 1 million by 2009. Hence, despite the BAPCPA, the filings under Chapter 7 are still important (they represented around 60% of total filings in 2006 and 2007 versus 80% in 2005). The bankruptcy law became more pro-creditor, but it still allows debtors to gain financially by filing for bankruptcy [White, 2007a]. High-income debtors can plan strategically and file under Chapter 7. In consequence, the reform did not reduce filings under that Chapter from high-income borrowers more than it did from other borrowers either because they could pass the mean test or because they are self-employed [White, 2008].

2.4 A model of portfolio choice with bankruptcy

Saving and investment without bankruptcy

First I consider a two-period model of household savings and portfolio choice as in Gormley et al. [2010]. The household starts the first period with initial wealth W_0. Consumption today and consumption in the next period are denoted by C_0 and C_1 respectively. In the second period the household receives a wealth endowment $\widetilde{W}_1$. This endowment equals the present value of future income, $W_1 \geq 0$, with probability $1-\epsilon$ and the negative wealth shock, $-D < 0$, with probability ϵ. In the first period, the household can consume, save (for example, in home equity) or invest in a risky asset such as a stock. The risky asset has a random gross return given by $\widetilde{R}_1$ that equals $u > 1$ with probability $p > 0$ and $d < 1$ with probability $1 - p$. For simplicity, I assume that the stock returns and the income process are uncorrelated and that the interest rate on savings equals zero.

The household's problem in the first period is to choose consumption C_0, savings H, and stock investment α to solve:

$$\max_{C_0,H,\alpha} U(C_0) + \delta E[U(C_1)] \tag{2.1}$$

subject to:

$$H = W_0 - C_0 - \alpha \tag{2.2}$$

$$C_1 = H + \alpha \widetilde{R}_1 + \widetilde{W}_1 \tag{2.3}$$

where:

$$U(C) = \begin{cases} u(C) & \text{if } C \geq \underline{C} \\ -\infty & \text{otherwise} \end{cases} \tag{2.4}$$

and $u(C)$ is strictly increasing and strictly concave for $C \geq \underline{C}$, δ is the subjective time discount rate and $\underline{C}$ is the subsistence level of consumption.

Without loss of generality, as in Gormley et al. [2010] I make the assumption that the magnitude of the negative wealth shock is given by $D = W_0 - 2\underline{C} > 0$. Such a large negative wealth shock can occur if there is an unexpected illness that implies a substantial increase in medical expenses and a large loss of future income. It can also occur if there is a prolonged period of unemployment leading to a reduction in income that exceeds current wealth.

Proposition 1. *Given a negative wealth shock of size D that has a positive probability of occurrence, the household does not participate in the stock market, i.e. $\alpha^* = 0$. In addition, household consumption is set at the minimum, $C_0^* = \underline{C}$, and the remaining wealth is allocated to savings, $H^* = W_0 - \underline{C}$.*

Proof of Proposition 1:

The household's problem can be written as:

$$\begin{aligned} \max_{C_0,\alpha} U(C_0) + \delta [p(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha u + W_1) + \\ + (1-p)(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha d + W_1) + \\ + p\epsilon U(W_0 - C_0 - \alpha + \alpha u - D) + (1-p)\epsilon U(W_0 - C_0 - \alpha + \alpha d - D)] \end{aligned} \tag{2.5}$$

Suppose $\alpha > 0$, then it can be shown that if $C_0 \geq \underline{C}$, C_1 is smaller than the subsistence

level in the bad state of the world:

$$\begin{aligned} W_0 - C_0 - \alpha + \alpha d - D &= W_0 - C_0 - \alpha + \alpha d - (W_0 - 2\underline{C}) \\ &\leq \underline{C} + \alpha (d - 1) \\ &< \underline{C} \end{aligned}$$

If $C_1 < \underline{C}$ then the fifth term in equation (2.5) is $-\infty$. Thus, at the optimum it must be $\alpha^* = 0$ because when $\alpha > 0$ any loss in the stock market would induce an infinite utility loss if the negative wealth shock occurs.

Given $\alpha^* = 0$, let's suppose that $C_0 > \underline{C}$:

$$\begin{aligned} W_0 - C_0 - D &= W_0 - C_0 - (W_0 - 2\underline{C}) \\ &< \underline{C} \end{aligned}$$

Since $U(C) = -\infty$ for any $C < \underline{C}$, we must have $C_0^* = \underline{C}$. Given that $\alpha^* = 0$, from period-zero budget constraint this implies that $H^* = W_0 - \underline{C}$. $\otimes$

Proposition 1 says that if a large wealth shock is expected with a positive probability, the household does not participate in the stock market. This result holds even if the probability of the shock is very small and independently of how high are the expected stock return and household's wealth in good states. Since any loss in the stock investment would lead to an infinite utility loss if the wealth shock is bad enough, the optimal strategy for the household is not to participate in the stock market. In addition, the household consumes only at the subsistence level and saves as much as possible.

Bankruptcy insurance

I now study how the possibility of declaring bankruptcy affects investment, consumption and saving decisions. To that end I modify the baseline specification and assume that in the bad states of the world it is possible for households not to repay their loans - so that second-period wealth is zero rather than $-D < 0$. In exchange they lose all the investment in risky assets, whereas their savings are protected up to a certain amount. In particular, under the bankruptcy law the individual can guarantee a minimum level of consumption given by H, up to a maximum of X. I will further assume that the bankruptcy protection

guarantees consumption at least equal to the subsistence level, i.e. $X \geq \underline{C}$.

Since the household only lives two periods, I ignore the option value of bankruptcy that needs to be studied in a dynamic setting.[13] Thus, the problem of the household remains the same as in (2.1):

$$\max_{C_0,H,\alpha} U(C_0) + \delta E[U(C_1)] \tag{2.6}$$

whereas the budget constraints become:

$$\begin{aligned} H &= W_0 - C_0 - \alpha && (2.7)\\ C_1 &= \max\left(C_1^{NB}, C_1^{B}\right) && (2.8)\\ C_1^{NB} &= H + \alpha\widetilde{R}_1 + \widetilde{W}_1 && (2.9)\\ C_1^{B} &= \min(H, X) && (2.10)\\ & X \geq \underline{C};\ \alpha \geq 0 && (2.11) \end{aligned}$$

where C_1^{NB} and C_1^{B} denote consumption in the non-bankruptcy and bankruptcy states. Equation (2.8) captures the fact that when the stock return and wealth are high it is optimal to repay the loan, but when they are sufficiently low the optimal strategy is to file for bankruptcy. By assuming $\alpha \geq 0$ I am constraining short sales positions. There is no need to impose a borrowing constraint $H \geq 0$ because the household will optimally never want to have negative consumption in bankruptcy.

In Proposition 2 I state the implications of the model given by (2.6) to (2.11) in terms of participation, savings and consumption.

Proposition 2. *There are two cases to consider. (i) There exists $\underline{\epsilon}$ such that, $\forall \epsilon < \underline{\epsilon}$, the household saves an amount at least equal to the subsistence level of consumption, $H^* \geq \underline{C}$. In addition, the household optimally participates in the stock market, $\alpha^* > 0$, as long as the risk premium is positive and C_0^* is at least equal to the subsistence level. (ii) There exists*

[13] In this two period model the only cost of bankruptcy is the loss of seizable assets. Thus, it does not account for the fact that households value the option to declare bankruptcy at some future time and the uninterrupted access to unsecured credit. This needs to be studied in a multi-period model, in which households are willing to trade the immediate benefit of filing in exchange for keeping their option [Lehnert and Maki, 2002].

$\bar{\epsilon}$ such that, $\forall \epsilon > \bar{\epsilon}$, the household does not participate in the stock market, i.e. $\alpha^* = 0$, even if the risk premium is positive, saves $H^* \in [\underline{C}, X]$ and consumes $C_0^* \in [\underline{C}, W_0 - \underline{C}]$.

Proof of Proposition 2.

In the presence of bankruptcy protection, the household problem can be written as:

$$\begin{aligned}\max_{C_0,H,\alpha} U(C_0) + \delta \{ & p(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha u + W_1) + \\ & + (1-p)(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha d + W_1) + \\ & + p\epsilon U(\max[W_0 - C_0 - \alpha + \alpha u - D, \min(W_0 - C_0 - \alpha, X)]) + \\ & + (1-p)\epsilon U(\min(W_0 - C_0 - \alpha, X))\} \quad (2.12)\end{aligned}$$

The expression in (2.12) captures the fact that if the household experiences both negative shocks files for bankruptcy, but if the stock return in the good state is sufficiently high, then C_1^{NB} could be higher than C_1^B. At the optimum, the household chooses $C_0^* \geq \underline{C}$ and $H^* \geq \underline{C}$ so that the utility floor in every period is given by $U(\underline{C})$. From the time-zero budget constraint in (2.7), the condition $H^* \geq \underline{C}$ implies $C_0^* \leq W_0 - \underline{C} - \alpha$.

If $\alpha^* = 0$, then $C_1^{NB} < C_1^B$ when there is a negative wealth shock, even if the stock return is high. Thus, when $H^* < X$, the first-order conditions of (2.12) with respect to α evaluated at $\alpha^* = 0$ are:

$$[pu + (1-p)d - 1](1-\epsilon) U'(W_0 - C_0 + W_1) - \epsilon U'(W_0 - C_0) \quad (2.13)$$

As ϵ approaches 0, if the risk premium $(pu + (1-p)d - 1) > (<) 0$, the expression in (2.13) is positive (negative) for any $C_0 = C_0^*$ given that the utility function is strictly increasing. Therefore, when the risk premium is nonzero the first-order conditions are zero if $\alpha^* \neq 0$. Given the constraint $\alpha \geq 0$, this implies that $\alpha^* > 0$. When $H^* \geq X$, the second term in (2.13) drops, so the same implications for α^* hold. This completes the proof of *(i)*.

As ϵ approaches 1, savings are set at a level that guarantees a subsistence level of consumption but not larger than the amount that can be protect in the event of bankruptcy, i.e. $H^* \in [\underline{C}, X]$. Thus, from the first-period budget constraint in (2.7) consumption at $t = 0$ is given by $C_0^* \in [\underline{C}, W_0 - \underline{C}]$. In addition, for ϵ sufficiently large the expression in (2.13) is negative for any $C_0 = C_0^*$. Thus, when $H^* \leq X$ the first-order conditions are

negative if $\alpha^* = 0$ and the household would like to choose $\alpha^* < 0$. In the presence of short sales constraints, the optimal strategy for the household is to set $\alpha^* = 0$. This completes the proof of *(ii)*. $\otimes$

The probability of a negative wealth shock identifies two regions in the parameter space. The solution will be in the region where $\alpha^* > 0$ when the probability of a negative wealth shock is sufficiently low. In that case, savings can be lower and consumption can be higher than in the absence of bankruptcy, but both at least should be equal to the subsistence level of consumption. This sets a consumption floor in the bad states of the world, which in turn implies that the household is willing to participate in the stock market if the risk premium is positive. Even if there is a low stock realization combined with a large negative wealth shock, by declaring bankruptcy the household can avoid an infinitely negative utility loss. Thus, for households facing a sufficiently low probability of a wealth shock, the presence of bankruptcy protection implies lower savings, higher consumption and a positive investment in the risky asset.

The solution will be in the region where $\alpha^* = 0$ when the probability of occurrence of a very large negative wealth shock is sufficiently high. In that case, the household saves an amount at least equal to the subsistence level to guarantee a finite utility in bankruptcy, but not more than the protection level given that this is the maximum than can keep in the second period. It does not invest in risky assets because they are lost in bankruptcy, so the wealth that is not saved in the first period is consumed. Thus, when the probability of a negative wealth shock is sufficiently high, the bankruptcy protection also implies that households save less and may consume more than in the absence of bankruptcy, but do not participate in the stock market.

The next proposition states that increases in exemptions will have different effects on participation depending on the probability of a negative wealth shock. The prediction is that an increase in exemptions will discourage investment in the risky asset when the probability of a negative wealth shock is sufficiently low and savings are not fully protected, but otherwise it will have no effect on the demand for stocks.

Proposition 3. *(i) There exists* $\underline{\epsilon}$ *and* $\widetilde{X}$ *such that* $\forall \epsilon < \underline{\epsilon}$*, when* $H^* \geq X$*, an increase in the exemption level from* $X < \widetilde{X}$ *to* $X' > \widetilde{X}$ *leads to lower investment in the risky asset, increases consumption and has no effect on savings. (ii) There exists* $\bar{\epsilon}$ *such that* $\forall \epsilon > \bar{\epsilon}$*,*

when $H^* = X$, an increase in X leads to higher savings, lower consumption and has no effect on the demand for the risky asset.

Proof of Proposition 3.

When ϵ is sufficiently small and $H^* \geq X$ the expected utility is given by:

$$\max_{C_0,H,\alpha} U(C_0) + \delta \{p(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha u + W_1) + \\ + (1-p)(1-\epsilon) U(W_0 - C_0 - \alpha + \alpha d + W_1) + p\epsilon U(\max[W_0 - C_0 - \alpha + \alpha u - D, X]) + \\ + (1-p)\epsilon U(X)\} \quad (2.14)$$

Let's define a threshold exemption level $\widetilde{X}$ below which $C_1^{NB} \geq C_1^B$ in the case of a negative wealth shock and a high stock return. Thus, for $X \leq \widetilde{X}$ the first-order conditions with respect to α are:

$$p(1-\epsilon)(u-1) U'(W_0 - C_0 - \alpha + \alpha u + W_1) + \\ + (1-p)(1-\epsilon)(d-1) U'(W_0 - C_0 - \alpha + \alpha d + W_1) + \\ + p\epsilon(u-1) U'(W_0 - C_0 - \alpha + \alpha u - D) \quad (2.15)$$

For $X > \widetilde{X}$, $C_1^{NB} < C_1^B$ and so the third term in (2.15) drops. Since that term is positive, first-order conditions and therefore α^* are also smaller when $X > \widetilde{X}$ than when $X \leq \widetilde{X}$. Thus, when $H^* \geq X$, an increase in X implies lower investment in the risky asset, savings do not change (they are already larger than X at the optimum) and C_0^* increases. If $H^* < X$, changes in X have no effect on the optimal investment, savings or consumption decisions. Since savings are already fully protected, increases in exemptions do not increase the consumption floor in bankruptcy. This completes the proof of *(i)*.

As ϵ becomes sufficiently large and if $H^* = X$, an increase in exemptions from X to X' increases savings from H^* to $H^{*'}$, which in turn leads to a higher C_1^B. This reduces even further the willingness to hold stocks, but these are already zero at the optimum, as stated in part *ii.* of Proposition 2. As a result of the higher savings, C_0 becomes smaller. If $H^* < X$, an increase in exemptions does not affect savings or investment decisions because exemptions are not binding. This completes the proof of *(ii)*. $\otimes$

Proposition 3 builds on the results presented in Proposition 2. In the region in which the probability of a negative wealth shock is low, Proposition 2.i. states that the household invests in risky assets in the presence of bankruptcy. On the one hand, when savings are not yet fully protected, the increase in protection implies a higher consumption in bankruptcy. By making bankruptcy more attractive, Proposition 3 anticipates that the higher protection reduces the willingness to invest in the risky asset. Savings do not change because they are already higher than the protection level at the optimum. As a result of the decline in stockholdings, the household consumes more in the first period. On the other hand, when savings are fully protected at the optimum, exemptions are not binding and therefore additional increases do not have any effect on investment decisions nor on savings.

As the probability of a negative wealth shock becomes sufficiently high, Proposition 2 predicts that the optimal decision for the household is not to participate in the stock market. An increase in the protection level makes bankruptcy more generous. Thus, if optimal savings were set at the exemption level, when the protection increases the household wants to save more in protected assets and less in assets that are lost in bankruptcy. As a result, Proposition 3 states that we should observe an increase in savings but no effect on participation, given that optimal stockholdings are already zero in this region and there are short sales constraints. The higher savings imply a decline in first-period consumption. However, if optimal savings were below the protection level, then no effects are expected on household portfolios given that exemptions are not binding.

2.5 Conclusion

In this chapter I have shown the main channels through which the home equity protection in bankruptcy can affect stockholdings using a two-period portfolio choice model. In the baseline model, households facing a positive probability of a large wealth shock are not willing to invest in stocks since a low return realization may imply an infinite utility loss. On the one hand, bankruptcy protection implies a consumption floor in the bad state of the world, which increases the desire to invest in stocks when the probability of that shock is sufficiently low. On the other hand, when the probability of a shock and the protection level are sufficiently low, an increase in that protection leads to a higher probability of

bankruptcy: the household can consume more in that state. This has a negative effect on the demand for stocks, which are lost in bankruptcy. Note that to keep the model tractable I am abstracting from the effects through the lending sector, which receives less support from the data. Lenders may also discourage investment in risky assets by increasing interest rates on unsecured debt and reducing the availability of credit. Thus, modeling that channel would require endogeneizing debt holdings and interest rates. The resulting net effect of higher exemptions on households' stockholdings is therefore an empirical question. The rest of this thesis is devoted to an empirical exploration of households' stockholdings responses to the presence of additional bankruptcy insurance.

Chapter 3

Bankruptcy Protection And Household Risk-Taking: Empirical Evidence

3.1 Introduction

To evaluate the causal effect of exemptions on stock ownership and in the share of stocks in liquid wealth I use data from the PSID for the period 1999 to 2009. Identifying the effect of exemptions on stockholdings needs to account for the fact that the exemption level can be correlated with state unobservable characteristics. For example, if wealthier states have higher levels of bankruptcy protection, relying only on cross-section variation may be misleading. Thus, I exploit the variation in exemptions across states and over time. In this way, I rule out that state-level heterogeneity is driving the results. For the allocation regressions, I use the inverse Mills ratio to account for endogenous selection into stock market participation. Following Chiappori and Paiella [2011] and Fagereng et al. [2013], the log of total wealth lagged one period is the regressor used in the exclusion restriction. However, the evidence is less conclusive at the intensive margin since the amount invested in stocks based on survey data has high measurement and reporting error [Fagereng et al., 2013].

The empirical strategy is based on two identification assumptions.[1] First, after con-

[1] These assumptions are made by Severino et al. [2014] to study the effect of exemptions on unsecured

trolling for individual and state characteristics and linear state trends, changes in the state exemption level only affect those households living in the treated state. To test this assumption, I reestimate my main results by imputing the state where each household was living at the time of joining the sample for the whole sample period to rule out that results are driven by households moving across states. I also use a dynamic specification that includes leads of exemptions to capture pre-existing trends that could be driving the results. The second assumption is that the change in exemptions is an exogenous shock to households' stockholdings: the timing of changes in exemptions is orthogonal to the determinants of stock market participation. I test it by exploring the correlation between state exemptions and possible determinants of exemption changes that could also affect portfolio decisions.

My empirical approach has two merits. First, I show that relying on pure cross-section variation or state fixed-effects as in Gropp et al. [1997], Berger et al. [2011] and Greenhalgh-Stanley and Rohlin [2013] may result in biased estimates of the effects of exemptions. The availability of longitudinal data allows me to compare the same household from a particular state over time by using both individual and state fixed-effects. This is also important if, as in the PSID sample, it is not infrequent that households move states over time. My empirical strategy is thus closer to the ones pursued by Cerqueiro and Penas [2011] and Severino et al. [2014] that account for firm and county fixed-effects respectively.

Second, I relax the linearity assumption and allow the marginal effects to vary along the exemption distribution. Imposing a linearity restriction in the estimated coefficients is not the most natural simplification. On the one hand, an increase in exemptions should only lead to changes in the portfolio for households with home equity in excess of the exemption, ruling out effects at very high exemption levels. On the other hand, at low exemption levels the effect of increases in exemptions on the probability of bankruptcy and on portfolio choice is expected to be small. As a result, the effects of exemptions are predicted to occur at intermediate levels. Among the reduced-form studies that account for nonlinearities are Berkowitz and White [2004], Georgellis and Wall [2006] and Greenhalgh-Stanley and Rohlin [2013]. This study is the first to use restricted cubic splines, which are less sensitive to anomalies within the data than polynomials. I also estimate piecewise

debt.

linear splines that provide a better trade-off between flexibility and interpretability of the estimated coefficients. Although the negative results are robust to the use of cubic polynomial transformations, their poor behaviors in the tails result in large positive effects driven by outliers.

3.2 Data and sample definition

My main data source is the Panel Study of Income Dynamics (PSID), which provides the best panel data for my analysis since it has detailed data on portfolio composition, publicly available state identifiers and socio-demographic characteristics of households that are tracked over an extended period of time. The variables necessary for my analysis are contained in the wealth survey, conducted in 1984, 1989, 1994, and every other year from 1999 onwards. I restrict my analysis to the period 1999-2009, since starting from 1999 there were some changes in the definition of the stock and liquid wealth measures.[2]

The measure of risky assets includes stocks invested in publicly held corporations, mutual funds or investment trusts. I exclude from this measure the fraction of individual retirement accounts (IRAs) that is invested in stocks, because after 2005 IRA accounts are protected from bankruptcy up to $2 million. Therefore, stocks invested into retirement accounts also become exemptible.[3] In addition, stocks outside retirement accounts can be freely reallocated toward other assets without the penalties from early retirement and can be used as a saving vehicle without the restrictions in terms of how much can be deposited.

Safe assets include money in checking or savings accounts, money market funds, certificates of deposit, government savings bonds or treasury bills, bond funds and other assets. I also exclude assets in employer-based pensions or IRAs. The sum of stocks and safe assets is the measure of liquid assets. The risky portfolio share is defined as the ratio of stocks over total liquid assets. One caveat with the regressions using the risky share as the dependent variable is that this measure does not distinguish between active and passive savings in stocks. As a result, passive variations in the value of stocks can be

[2] Until 1994, the PSID's measure of stocks and other liquid assets includes those invested into retirement accounts.

[3] The effect of IRA's exemptions on stocks invested into those accounts cannot be identified to the extent that there is no cross-state variation and only little cross-time variation in the corresponding exemption levels.

concealing active rebalancing decisions made by the households [Calvet et al., 2009]. The PSID includes questions that allow elucidating active savings in stocks, defined as the changes in the risky share not resulting from passive realized returns but from portfolio rebalancing decisions. However, I do not use them because survey measures of active savings are prone to suffer from measurement and reporting error [Chen and Stafford, 2014]. To some extent this is also true for the risky share [Fagereng et al., 2013], implying that the estimated effects of exemptions at the intensive margin should only be taken as suggestive.

I also estimate models for other outcomes including home equity, retirement accounts, total and non-mortgage debt, self-employment and business ownership. Home equity is constructed as the value of the home minus mortgage debt. Retirement accounts includes money in private annuities or IRAs. Non-mortgage debt includes all debts except for mortgages and vehicle loans, such as credit card balances, student loans, medical or legal debts, or loans from relatives. Thus, this measure may slightly overestimate the level of unsecured debt since it includes debts that are not dischargeable, such as student loans. I use two definitions of entrepreneurship, following Hurst et al. [2010]. One is based on self-employment status of the household head and the other is based on ownership of a business or a farm by any family member. For self-employment status I distinguish between unincorporated and incorporated, and restrict to heads that report being "self-employed only". Business ownership is an indicator for whether anyone in the family own all or part of a farm or business. I deflate all dollar values by the US NIPA implicit price deflator for personal consumption expenditures ($2004\,q1 = 100$).

The level of exemptions from each state and year was extracted from bankruptcy filing manual books.[4] In my baseline analysis, I only include homestead plus wildcard exemptions since the house is typically the most important asset in a household's total net worth. Other categories added for robustness checks are vehicles, business wealth and other real estate. For states with unlimited homestead exemptions, I set the corresponding value to $550,000, which is the maximum dollar amount of those exemptions across all states in 2009. The state level variables used as controls are taken from the Bureau of Labor

[4] "How to File for Chapter 7 Bankruptcy", Albin Renauer J.D., Stephen Elias Attorney, and Robert Leonard J.D., Nolo, several editions.

Statistics (unemployment rate), the Bureau of Economic Analysis (proprietor employment, per capita personal income, real GDP), Freddie Mac (the house price index), CMS[5] (per capita medical expenses) and the Statistics Division of the Administrative Office of the U.S. Courts (non-business bankruptcy filings).

I restrict the sample to households where the head is 65 years old or younger in every year, which reduces the original sample to 41,366 observations. The life-cycle model and the empirical evidence indicate that households hold more conservative portfolios as they age, and therefore, older households may be less willing to increase their stockholdings in response to the changes in bankruptcy protection. In addition, they are relatively less likely to file for bankruptcy, although the most recent years have been characterized by an upsurge in filings among older households [Pottow, 2012]. I also exclude 2,695 observations where some of the control variables are missing (self-employment, unemployment and retirement status, years of education and state of residence), 1,212 observations where some of the relevant wealth components are missing (home equity, mortgage, other debt and business equity) and 43 observations with negative income. This results in 37,416 observations corresponding to 50 states plus Washington, D.C.

Table 3.1 reports descriptive statistics on households' stockholdings and their determinants.[6] Only 23% of the households own stocks at all, whereas 70% own safe liquid assets. Stock market entry and exit relative to the previous wave are on average 7 and 9%. The average amount invested in protected assets is $68,000 for home equity and $24,000 for retirement accounts, whereas ownership is 61% and 31% respectively. When looking at households' liabilities, the average outstanding debt is $62,000 and excluding mortgages reduces to $8,000. Lower values at the median than at the mean are consistent with the fact that the assets and debts' distributions are positively skewed. Only 12% of the heads in the sample are self-employed and most of them own unincorporated rather than incorporated firms (65% versus 35%).

When the sample is restricted to stockholders, the average share of stocks in liquid wealth amounts to 62%.

[5] Centers for Medicare & Medicaid Services (2011). Health Expenditures by State of Provider. Retrieved 26 June 2014 at http://www.cms.gov/NationalHealthExpendData/downloads/provider-state2009.zip.

[6] See D.1 in the Appendix for definitions of all the variables. Note that the totals do not add up to the final sample size because I use the PSID weights.

Table 3.1: **Summary statistics for selected data, 1999-2009**

	Mean	Std. Dev.	Median	N
All households				
Stock market participation (%)	23.34	42.30	0	36,869
Stock market entry (%)	6.88	25.31	0	36,869
Stock market exit (%)	9.36	29.13	0	36,869
Ownership of safe liquid assets (%)	69.66	45.97	100	36,869
Safe liquid assets ($)	19,759	54,987	1,841	36,869
Total liquid assets ($)	44,902	129,421	2,653	36,869
Income ($)	42,468	44,113	32,139	36,869
House ownership (%)	61.01	48.77	100	36,869
Home equity ($)	67,814	117,182	17,820	36,869
Retirement account ownership (%)	31.45	46.43	0	36,869
Retirement account ($)	23,777	69,821	0	36,869
Non-mortgage debt ownership (%)	56.35	49.60	100	36,869
Non-mortgage debt ($)	7,848	16,520	923	36,869
Any debt ownership (%)	74.33	43.68	100	36,869
Total debt ($)	62,230	90,385	20,493	36,869
Business equity ownership (%)	12.86	33.48	0	36,869
Self-employed (% of household heads)	11.58	31.99	0	36,869
Unincorporated firm (% of self-employed)	64.52	47.85	100	3,738
Incorporated firm (% of self-employed)	35.38	47.82	0	3,738
Age of the head	43.05	12.04	44	36,869
Male (% of pop)	73.29	44.25	100	36,869
Married (% of pop)	55.46	49.70	100	36,869
Years of education	13.43	2.50	13	36,869
Number of children	0.73	1.09	0	36,869
Minority (% of pop)	17.51	38.01	0	36,869
Stock market participants				
Stocks (% liquid assets)	62.42	33.12	69.67	6,557
Other debt ownership (%)	53.14	49.91	100	6,557
Self-employed (% of household heads)	17.06	37.62	0	6,557
Unincorporated firm (% of self-employed)	51.33	50.01	100	1,073
Incorporated firm (% of self-employed)	48.58	50.00	0	1,073
Age of the head	46.39	11.13	47	6,557
Male (% of pop)	83.66	36.97	100	6,557
Married (% of pop)	69.77	45.93	100	6,557
Years of education	14.85	1.97	16	6,557
Number of children	0.63	0.97	0	6,557
Minority (% of pop)	3.71	18.89	0	6,557
State-level variables				
House price index	126.60	28.31	123.33	306
Unemployment rate (%)	5.40	1.86	4.98	306
Nr. of non-business bankruptcy filings	4.85	2.06	4.63	306
Per capita medical expenses ($)	5,510	1,421	5,402	306

Notes. Household-level data includes the descriptive statistics for the household heads in the 1999, 2001, 2003, 2005, 2007 and 2009 PSID panels, who are 65 years old or younger. I weight observations using the PSID core/immigrant family longitudinal weights. State-level data are annual averages for the same years. All monetary values are in real 2004 dollars and winsorized at the 1st and 99th percentile. All variables are described in Appendix D.1.

Stock market participants are 5p.p. more likely to be self-employed than the entire sample and conditional on being self-employed, they are more likely to be incorporated (49%). This reflects the correlation between stockholdings and wealth, given that incorporated self-employed typically own larger firms. In addition, the fraction of heads that are male, married and especially non-Hispanic whites is larger among stock market participants. In the last rows I include the summary statistics for the state-level variables that might be correlated with the exemptions. The number of personal bankruptcy fillings amounts on average to 5 per thousand inhabitants, revealing that these episodes are not extremely infrequent in the US.

3.3 Empirical Analysis

3.3.1 Empirical predictions

In this section I first describe the main channels through which the bankruptcy protection can affect stock market participation. Some of these channels affect the demand of stocks whereas other affect stockholdings via the supply-side of the credit market. After summarizing the empirical predictions, I describe how I distinguish between the different channels by exploring heterogeneous effects.

- **Risk channel:** The bankruptcy protection affects the demand for risky assets by providing insurance against other risks that can trigger bankruptcy. Examples of such uninsurable risks, typically referred as 'background risk', are the risk on human capital, in the form of shocks on labor income, and the risk of out-of-pocket medical expenses. Therefore, the effect on the demand for risky assets will depend on how the portfolio risk correlates with those other risks.

If stock returns are *not correlated* with the non-financial income risk (or health risk), so that the latter is defined as pure background risk, the bankruptcy insurance should lead to higher investment in risky assets. Background risk reduces risk-taking under certain assumptions [Pratt and Zeckhauser, 1987, Kimball, 1993, Gollier and Pratt, 1996] and lowers investment in risky assets [Elmendorf and Kimball, 2000, Guiso et al., 1996]. The intuition is that the variance of non-financial income generates a crowding-out effect on stockholdings. In that context, by providing insurance against income risk the bankruptcy system reduces the gap in consumption between the good and the bad states (i.e., between

the states with high and low income). This reduction in downside risk will make stocks more attractive, increasing the willingness to take more risks in the financial portfolio.

If stock returns are *positively correlated* with non-financial income risk, higher bankruptcy insurance should also lead to higher demand for stocks. When the portfolio and the background risks are substitutes, stocks are less attractive since they increase the gap in consumption between high- and low-income states. Thus, an increase in bankruptcy insurance that increases the consumption floor in the bad state will make investors more willing to invest in stocks. When income is high the household also benefits from higher stock returns, whereas in low-income states there is the option to declare bankruptcy.

If stock returns are *negatively correlated* with the non-financial income risk, the bankruptcy protection should reduce the demand for stocks. When the risk of the portfolio and the background risk are complements, stocks are an attractive investment because they reduce the gap in consumption between the good and the bad state. In that sense, stocks provide an implicit insurance. Therefore, an increase in insurance from bankruptcy reduces the demand for insurance through the stock market. In other words, the marginal benefit of investing in stocks, which pay more in the bankruptcy state, decreases when bankruptcy becomes more generous.

- **Protection channel:** An increase in home equity protection makes bankruptcy more generous and this leads to a lower demand for stocks. By increasing the probability of bankruptcy, higher exemptions reduce the marginal benefit of holding assets that are lost in bankruptcy relative to assets that are protected. Stocks held outside retirement accounts are not protected, so they become less attractive.

- **Credit market channel:** Higher exemptions lead to worse credit market conditions that in turn may reduce the demand for stocks. When exemptions increase, the value of the collateral declines and this reduces lenders' expected repayment. Lenders may respond to the reduction in collateral increasing the interest rates or rationing the access to credit. The increase in interest rates reduces the expected excess return of the risky asset relative to the safe asset - the unsecured debt in this case -, and as a result investing in stocks becomes less attractive. Credit rationing also may reduce participation in the stock market if households have to liquidate stocks to compensate for the lack of bank financing. Among non-participants, credit rationing will reduce the probability of entry in the stock market

if they are liquidity constrained and want to "borrow to save".[7]

Given the multiple channels leading to opposite effects, the theoretical prediction of an increase in exemptions is ambiguous. Next I state the main predictions that will guide the empirical tests.

- H1. For households with home equity above the state exemption level, we should observe an increase in stock market participation resulting from higher exemptions if the risk channel dominates and: i) the portfolio risk is uncorrelated with background risk, or ii) the portfolio risk and the background risk are positively correlated.

- H2. For households with home equity above the exemption level, we should observe a decrease in stock market participation resulting from higher exemptions if: i) the risk channel dominates and risks are negatively correlated; ii) the protection channel dominates; and/or iii) the credit market channel dominates.

Stronger effects on participation through any channel are expected among home owners, since they are the only able to exploit the implicit insurance from bankruptcy. Therefore, increases in exemptions should not affect renters' stockholdings. Also, note that the demand effects are only expected among households with home equity above the exemption level, which means that no response may be observed if exemptions are sufficiently high. When the home is fully protected, further increases in protection do not provide additional insurance.

The plausibility of the risk channel can be tested by exploring the effects of exemptions on the share of stocks in liquid assets. The effects on the risky portfolio share will reveal a shift in preferences for risky versus safe assets, either towards more or less risk-taking depending on how risks are correlated. In addition, the risk channel should have stronger effects on the stockholdings of households with more volatile income, such as self-employed and business owners. Heaton and Lucas [2000] show that entrepreneurial income is positively correlated with stock returns, which implies that the bankruptcy insurance should increase their stock market participation. The response should come from the owners of unincorporated firms, who benefit more from the bankruptcy provisions.

[7] Even when households typically borrow to consume rather than to invest, in the period 2003-2007 some households were increasing leverage to invest in the stock market. Also, in those years households with a mortgage were more likely to open a stock market account to build a buffer of liquid assets, possibly because stock returns were seen as stochastically dominant and uncorrelated with labor or housing market risk [Chen and Stafford, 2014].

Corporations already have limited liability and therefore their owners are less likely to rely on this risk-sharing mechanism.

The effects from the protection channel should be stronger among high-income and high-asset households. These are the ones more likely to participate in the stock market and as a result will have incentives to liquidate stocks when the bankruptcy insurance becomes more generous. In addition, the protection channel should lead to a decline in other unprotected assets, such as safe liquid assets. As a result, this channel may have a negative effect on the participation decision but it should not necessarily affect the share of liquid assets invested in stocks.

According to the credit market channel, an increase in the cost of borrowing and credit rationing should have a stronger effect among low-income households. Ex ante, higher exemptions increase more the probability of default for poor than for wealthy households, and so the former are likely to experience more constraints in the availability of credit [Gropp et al., 1997, von Lilienfeld-Toal and Mookherjee, 2008].

3.3.2 Empirical strategy

My empirical analysis focuses on the effect of bankruptcy protection on decisions made by households of holding stocks at the intensive and extensive margins. There are some drawbacks of identifying the effect of exemption levels on stockholdings using purely cross-state variation. State-level heterogeneity may confound the results if the asset exemption levels are correlated with unobservable state characteristics. To circumvent this identification challenge, I investigate to which extent the demand for stocks is influenced by the degree of bankruptcy protection exploiting both state and time variation in the dollar amount of the asset exemptions. This is possible since different states have changed the levels of exemptions by different amounts at different times.

A second empirical challenge is to deal with the plausibly non-linear effects of changes in the bankruptcy protection. On the one hand, the bankruptcy protection only increases with exemptions for households that have home equity in excess of the exemption level. Otherwise, when the exemption is sufficiently high, increases in exemptions do not provide additional insurance for a given level of home equity. On the other hand, when exemptions are sufficiently low, the additional insurance provided by increases in exemptions is small. Therefore such increases only have a small effect on the probability of bankruptcy. Thus,

the treatment effect is expected to be non-linear on the level of exemptions; in particular, it is more likely to occur at intermediate exemption levels.

If the marginal effects can take different values at different points of the exemption distribution, then imposing a linearity restriction may not be appropriate. Loken et al. [2012] show that linear fixed-effect estimates may be misleading in the presence of nonlinearities, since the FE estimator depends on how the marginal effects are weighted. These weights consist on two components: the proportion of households with a change in the exemption of size "Z" and the proportion of households at each exemption level given that they experience a within-state exemption change of size "Z". Thus, marginal effects corresponding to states that experience little within-state variation receive a lower weight in the linear FE estimand, and these weights can even become negative. This could be problematic when the underlying relationship is nonlinear since the FE estimator can yield a negative or zero estimate even if all the marginal effects are strictly positive, or vice versa. In this case, the linear FE estimator, which assumes that the marginal effects are the same for all exemption levels, will not be representative of any particular marginal effect.

To capture nonlinearities requires using some flexible functional form that does not impose the same sign to the relationship of interest for all exemption levels. Hence, I use restricted cubic splines, which represent the curve by a different cubic function on each interval between data points (knots).[8] In Appendix A.2 I justify the choice for the placement and number of knots. Since polynomials are the most common approach in the economics literature to allow for bends in the curve fitting the data, in the robustness analysis I also perform estimations with stock ownership specified as a quadratic and cubic function of log exemptions.

The four-knot restricted cubic spline for household i, living in state s, at time t is estimated using the following panel specification:

$$Y^*_{ist} = \beta_0 + \beta_t + \beta_s + \beta_s \times t + \beta_i + \beta_1 X_{1,st} + \beta_2 X_{2,st} + \beta_3 X_{3,st} + \beta_4 Q_{ist} + \beta_5 R_{st} + \varepsilon_{ist} \quad (3.1)$$

[8] Cubic is the most commonly used degree for splines since the resulting fitting curve is continuous both in the first and second derivatives, even at the interpolating nodes. Although its popularity in the economics literature is still limited, the use of a spline approach for regression discontinuity designs and regression kink designs, which typically rely on local linear or quadratic regressions, has been advocated by Rau [2011], Ganong and Jager [2014] and Gelman [2014]. In turn, Gelman and Imbens [2014] argue that high-order polynomial regressions (cubic or higher) can be misleading in that context for reasons that may apply to this study as well.

where the dependent variable, Y_{ist}, is an indicator for holding positive amounts of risky assets, i.e. we observe $Y_{ist} = 1$ if $Y^*_{ist} > 0$. In the allocation regressions, the latent variable $Y^*_{ist} > 0$ represents the desired portfolio share, and the observed stock share in liquid wealth lies between zero and one, i.e. $Y_{ist} = \max\{0, \min\{Y^*_{ist}, 1\}\}$. The parameters specific to the restricted cubic spline are:

$$X_{1,st} = X_{st}$$

$$X_{2,st} = \frac{(X_{st} - k_1)^3 - (k_4 - k_3)^{-1}\left\{(X_{st} - k_3)^3 (k_4 - k_1) - (X_{st} - k_4)^3 (k_3 - k_1)\right\}}{(k_4 - k_1)^2}$$

$$X_{3,st} = \frac{(X_{st} - k_2)^3 - (k_4 - k_3)^{-1}\left\{(X_{st} - k_3)^3 (k_4 - k_2) - (X_{st} - k_4)^3 (k_3 - k_2)\right\}}{(k_4 - k_1)^2}$$

where:

$$(X_{st} - k_i) = \begin{cases} X_{st} - k_i & \text{if } X_{st} - k_i > 0 \\ 0 & \text{if } X_{st} - k_i \leq 0 \end{cases} \qquad i = 1, 2, 3, 4$$

and k_1, k_2, k_3, k_4, denote the knot values, X_{st} is the log of homestead plus wildcard exemptions and $X_{1,st}$, $X_{2,st}$, and $X_{3,st}$ are the variables created to estimate the cubic spline. Note that restricted cubic splines use a linear function before the first knot and after the last knot to guarantee that the curve does not behave poorly in the tails. The specification in (3.1) allows conducting a test of linearity in X_{st} by testing the null hypothesis that the coefficients of the nonlinear terms are zero, i.e.: $H_0 = \beta_2 = \beta_3 = 0$.

In equation (3.1) I also include a constant measuring aggregate financial parameters (such as the risky asset premium), β_0, and a time dummy capturing changes in these aggregate parameters that affect the entire cross-section of individuals in any given year, β_t. The inclusion of the time dummy responds to a common identifying assumption in this literature that there are age and time effects in portfolio choice but no cohort effects. β_s is a state dummy that controls for all state-specific factors - whether observable or unobservable - that are constant over time and can affect outcomes. I also account for differential state-specific linear trends in all variables that capture unobserved state characteristics changing over time, $\beta_s \times t$, and for individual-level fixed-effects, β_i, and ε_{it} is an idiosyncratic error. Since only one state (D.C.) ever changed from a finite exemption

to unlimited, I cannot identify the effect of unlimited exemptions with this approach. Note that it is possible that the 2007-08 financial crisis has a large influence in the state-specific trends since it is included in the last years of the sample. This would happen because the crisis had different effects across states, which can make difficult to separate the longer term trends in stock investment from the effects of the business cycle, resulting in misleading evidence.[9] Thus, following Neumark et al. [2014], I also control for state-specific quadratic time trends, which should be more appropriate to capture the variations induced by the crisis.

I follow the recent literature in the choice of the control variables, by including regressors with a demonstrated effect on participation and asset allocation (see D.1 in the Appendix for definitions). In Q_{ist} I control for socio-economic and demographic variables, such as labor income, to rule out that the results are driven by income shocks. I also include dummies for whether the head is married, unemployed and looking for work or retired, and measures for age of the head, years of education, dummies for being Hispanic or black, the number of children in the household and the total number of persons in the family unit. In R_{st} I control for state-level variables reflecting economic conditions, including state house price levels and the unemployment rate.

To estimate the effects of exemptions on stock ownership I use OLS and logit models.[10] For the risky portfolio share I rely on a Heckman selection model, using lagged log wealth as the exclusion restriction as in Chiappori and Paiella [2011] and Fagereng et al. [2013]. The need for this approach arises from the fact that stockholders may not be randomly selected from the population and this results in selection bias. Thus, I rely on a two-step estimation method to account for any possible dependence between the decision to hold stocks and the fraction of the portfolio invested into those assets. In the first stage, households decide on stock ownership and in the second stockholders decide how much to invest in stocks. I estimate the effects of homestead exemptions on the stock share of

[9] The sharp increase in housing prices that started in the mid-90s has been stronger in California, Arizona, Nevada and Florida. These states also were among the most affected by the house price collapse in 2007.

[10] In the specifications with the full set of fixed-effects I only estimate OLS models, even when they involve a limited dependent variable, given the computational problems clustering the standard errors and to compute the marginal effects for the logit fixed-effect model. However, in the specification in which both OLS and logit models were estimated we can see that the corresponding marginal effects are very similar.

stockholders by including the inverse Mills ratio (IMR), which accounts for the endogenous selection into stockmarket participation and for the fact that bankruptcy exemptions may also affect participation.

Since exemptions vary at the state level but the dependent variable is observed at the individual level, the effect of changes in exemptions is likely to be correlated within a state. Thus, I cluster the standard errors at the state level. This allows for correlation of the error term in equation (3.1) for households from a given state at a particular point in time, since the error may include a state-year shock in addition to the idiosyncratic individual component. Also, it allows for any time series correlation of these state-year shocks.

As it is the case with most nonlinear models, this estimation strategy does not render a straightforward interpretation of the individual coefficients. Thus, I also obtain point estimates from piecewise linear regressions that provide a good balance between flexibility and interpretation. By relying on a linear function, the resulting curve has first-order discontinuities ("elbows") and provides a poorer fit, but it is useful to get point estimates of the relationship between exemptions and stock ownership.

The piecewise linear regression with two knots is estimated based on the following latent model:

$$Y^*_{ist} = \beta_0 + \beta_t + \beta_s + \beta_s \times t + \beta_i + \beta_1 X_{1,st} + \beta_2 X_{2,st} + \beta_3 X_{3,st} + \beta_4 Q_{ist} + \beta_5 R_{st} + \varepsilon_{ist} \quad (3.2)$$

where:

$$X_{1,st} = \min\left(X_{st}, 10\right)$$
$$X_{2,st} = \max\left\{\min\left(X_{st}, 11.4\right), 10\right\} - 10$$
$$X_{3,st} = \max\left\{\min\left(X_{st}, 13.3\right), 11.4\right\} - 11.4$$

X_{st} is the log exemption level, 13.3 is the maximum value taken by X_{st} in the dataset and 10 and 11.4 are the two knots (see Appendix A.2 for the choice of the number and placement of the knots). As a result, β_1 represents the slope of log exemptions when they are below 10, β_2 is the slope of log exemptions when $X_{st} \geq 10$ and $X_{st} < 11.4$, and β_3 is the slope when $X_{st} \geq 11.4$.

The empirical strategy used in the previous models (3.1) and (3.2) relies on two

identifying assumptions.[11] First, after controlling for observed individual and state time-varying characteristics, linear state trends, and time-invariant state characteristics, exogenous changes in the state exemption level will only affect households living in the state where the change took place. Second, the timing of the changes in exemptions is orthogonal to the determinants of the demand for risky assets. If this assumption is valid, the change in exemptions should be an exogenous shock to households' demand for risky assets.

The first assumption can be assessed by ruling out that identification is driven by people moving across states. A household may chose to move to a state that has just increased exemptions. If this household was already participating in the stock market, we will observe an increase in stock holdings in the receiving state. Around 5-7% of the households in the sample moved states across waves, and these moves may lead to biases in the estimated effects of exemptions. Considering that the average stock market entry and exit are relatively low (7% and 9% for the entire period), the effects of changes in the sample composition may be non-negligible. By controlling for household fixed-effects I ensure that I am comparing the same individual over time within the same state, since each individual serves as its own control group.[12] In addition, I reestimate my results using the state where the individual was living at the time of the first interview for the whole period. If the results are robust to this specification, then there is more evidence that self-selection bias is not a big concern.

Accounting for household fixed-effects in addition to the set of controls described above, the first assumption implies that the differences in stockholdings across states are purely determined by exogenous changes in the exemption level. This can be tested by ruling out the presence of other factors that could drive the results, such as state-level pre-existing trends that are not captured by the state linear trends included in the model.

[11] These assumptions were originally stated by Severino et al. [2014] to examine the effect of bankruptcy exemptions on household debt. In this section, part of the analysis to test their validity follows a similar approach.

[12] Controlling for individual fixed-effects but not for state fixed-effects would also result in a bias. For example, if a household doesn't change its stock market participation but moves to a state with a lower exemption level, the resulting within-individual variation in exemptions will be negative. This will result a larger bias than in the specification with only state fixed-effects because each individual has a small weight in the state average. Using a within-state variation, we may observe a decline or an increase in the effect of exemptions depending on the stockholdings of the mover relative to the average stockholdings in the states of origin and destination.

This could occur, for instance, if states that increased exemptions were experiencing an economic downturn before the policy change. Thus, I look at the dynamic effects of exemptions by including a lead of the exemption level. This can be interpreted as a placebo test: If the coefficient associated with the lead is not significant, I can rule out the presence of pre-existing trends or anticipatory effects biasing the results. In addition, by including one lag of the exemption level, I can explore the presence of short-term effects, which could arise if the response to the changes occurs with some delay or if it is persistent over time.

The second assumption can be tested by exploring the correlation between the state exemption level and possible determinants of the exemptions that may also affect portfolio decisions. According to Cerqueiro and Penas [2011], the level of protection was typically changed to keep up with increasing home prices and rising medical costs. Another reason is the purpose to match higher exemptions in neighboring states that attracted "deadbeat" filers, who would also transfer their exemptible assets. Thus, I regress the state exemption level on the contemporaneous and lagged values of a set of state-level variables that are potentially correlated both with increases in asset exemptions and with entry or exit from the stock market.

To confirm that the main results are driven by home owners, I also estimate equations (3.1) and (3.2) for the subsample of renters and homeowners separately. I restrict the sample to households that rent (own) a house in the first wave in which they entered into the sample and in the current wave (or in 1999 for those entering before). With this restriction I avoid that the results get contaminated by sample selection, since home ownership itself may be affected by the treatment.

To elucidate how the effects change with asset holdings, I split the sample by terciles of the within-state home equity distribution. The terciles are defined state-by-state, for singles and couples separately, based on the average home equity level from all the years that the household was interviewed. I also explore heterogeneous effects by income level, by splitting the sample among households with average income above or below the median of the state for the whole period.

I test for heterogeneous effects among entrepreneurs defined alternatively as self-employed or business owners. The estimates will be biased if the treatment also affects the decision to enter or to exit entrepreneurship. To deal with this selection problem, and

based on some exploratory analysis, I restrict the group of entrepreneurs to those that have already that status in the first year in which they enter into the sample and exclude individuals eventually changing status since they could lead to a mitigation bias.

As supporting evidence for the protection channel, I also look at the effects of exemptions on other protected and unprotected assets. In particular, I estimate the same model for the intensive and extensive margins of safe liquid assets, which are lost in bankruptcy, and of housing and retirement accounts, which are protected. In all the estimates at the intensive margin I need to deal with the selection problem derived from the fact that ownership of each asset category is not random. Therefore, I follow the practice in the literature (Corradin et al., 2013; Greenhalgh-Stanley and Rohlin, 2013) and use the IMR to control for endogenous selection into ownership of safe liquid assets, housing and retirement assets. As in the case of the risky portfolio share, I use lagged log wealth as the selection variable.

As a robustness analysis, I address possible differences in the treatment intensity in the pre-reform period by restricting the sample to the years 1999-2005. The purpose is to isolate the effects before the 2005 reform, although it should be noted that most of the changes in exemptions have taken place after that year. In other robustness checks I re-estimate the models with a broader measure of asset protection (including vehicles and bank deposits in addition to home equity), using the PSID longitudinal sample weights and dropping from the sample outliers that correspond to observations with very low exemption levels (Delaware for the period 1999-2005). Finally, I look at the effect on entrepreneurship. By understanding how people react to the bankruptcy insurance on this dimension, I can get further insight into the channel driving the results.

3.4 Results

3.4.1 Risky asset ownership

In Panel A of Table 3.2 I present the estimated coefficients from the linear spline model from equation (3.1). The knots are placed at log exemptions equal to 10 and 11.4 (i.e. exemptions equal to \$22,000 and \$90,000 approximately), based on the analysis from Appendix A.2. In columns 1 and 2 the estimates from the pooled cross section are negative and significant at high exemptions (above \$90,000).

Table 3.2: **Regressions of stock market participation**

Panel A. Piecewise-linear splines

	OLS	Logit	OLS	Logit	OLS	OLS	OLS	OLS	OLS
								Renters	Home owners
Coefficients									
Low exemptions	.010	.072	.021***	.163***	.010	.008	.017*	.003	.013
	(.011)	(.105)	(.007)	(.062)	(.008)	(.011)	(.009)	(.015)	(.021)
Middle exemptions	.012	.057	.000	-.031	-.019***	-.031***	-.028***	-.000	-.048***
	(.013)	(.084)	(.007)	(.056)	(.007)	(.009)	(.010)	(.014)	(.012)
High exemptions	-.019**	-.119**	-.022	.043	.008	.012	.013	-.014	.034**
	(.007)	(.053)	(.025)	(.102)	(.016)	(.017)	(.020)	(.020)	(.015)
Marginal effects									
Low exemptions		.007		.016**					
		(.010)		(.006)					
Middle exemptions		.006		-.003					
		(.009)		(.006)					
High exemptions		-.013*		.006					
		(.007)		(.015)					
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE			Y	Y	Y	Y	Y	Y	Y
Individual FE					Y	Y	Y	Y	Y
State x time trend						Linear	Quadratic	Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mean dependent variable	.178	.178	.178	.178	.178	.178	.178	.053	.293
Akaike's information criterion	27,147	27,563	26,752	27,250	-6,429	-6,551	-6,619	-13,045	2,615
No. of Obs.	37,416	37,416	37,416	37,416	37,416	37,416	37,416	10,571	15,292
No. of Clusters	51	51	51	51	51	51	51	50	51
R-Squared	.17		.18		.01	.01	.01	.03	.02
Pseudo R-Squared		.21		.22					

Notes. This table shows OLS and Logit estimates using two-knots linear splines. The dependent variable is a dummy indicating stock ownership. The coefficients on Low, Middle and High exemptions correspond to log exemptions smaller than 10, between 10 and 11.4 and greater than 11.4. Marginal effects are estimated for the logit models at log exemptions equal 10, 11.4 and at 13.3 and at the sample means of the remaining covariates. Column 8 (11) is restricted to households that do not own (own) a house in the first wave that appeared in the sample and in the current wave. The demographic controls include the log of household income, head's age, race/ethnicity and number of years of education, dummies for whether the head is male, married, unemployed or retired, and measures for the numbers of members in the family unit and the number of children. State-level controls include home price and unemployment rate. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

However, OLS and Logit estimates could be biased in the presence of fixed unobserved state characteristics correlated with the exemption level and with stockholdings, such as the state business climate. Thus, in columns 3 and 4 I use a within-state transformation that eliminates the unobserved state-level component of the error term. I find a positive effect when log exemptions are below 10 whereas the negative effects at high exemption levels become insignificant. Notice the similarity of the marginal effects estimated with OLS and Logit models, both in the cross-sectional and panel regressions.

Next, I eliminate both the unobserved state- and individual-level error components by adding individual-level fixed-effects. In this way, the effects of exemptions on an individual who lived for two waves in state A and for four waves in state B are considered separately. When individual fixed-effects are included, significant but negative effects are found at intermediate levels whereas the positive effects at low levels become insignificant. The degree of risk aversion is one plausible time-invariant unobserved individual characteristic that could bias the estimates in columns 1 to 4, which do not rely on a within-individual transformation. The introduction in columns 6 and 7 of state-specific time trends, linear and quadratic, does not substantially alter the estimated coefficients. This suggests that the crisis at the end of the sample is not confounding the results. The estimates from column 6 indicate that when exemptions double stockholdings decrease by 2.1p.p. at exemption levels between $22,000 and $90,000. Finally, in columns 8 and 9 I use my preferred specification to estimate the effects on renters and home owners separately. I find that the response to higher exemptions is restricted to home owners, as expected. For this group, doubling exemptions leads to a decrease in stock ownership of 3.3p.p. at intermediate exemption levels and to an increase of 2.6p.p. at higher levels.

In Panel B of Table 3.2 I estimate OLS regressions using a smoother restricted cubic spline model and the same specifications as in Panel A. The linear term is positive but insignificant in general across the different specifications. The two nonlinear terms are

Table 3.2: **Regressions of stock market participation**

Panel B. Restricted cubic splines

	OLS	OLS	OLS	OLS	OLS	OLS	OLS
						Renters	Home owners
Log exemptions	.006	.023***	.015	.016	.027**	-.000	.029
	(.013)	(.008)	(.010)	(.014)	(.011)	(.017)	(.026)
Log exemptions'	.045	-.076	-.135**	-.202**	-.237***	.023	-.341***
	(.093)	(.050)	(.061)	(.081)	(.074)	(.106)	(.120)
Log exemptions"	-.155	.118	.319**	.500**	.575***	-.086	.867***
	(.217)	(.125)	(.152)	(.194)	(.187)	(.237)	(.270)
Demographic controls	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y
State FE		Y	Y	Y	Y	Y	Y
Individual FE			Y	Y	Y	Y	Y
State x time trend				Linear	Quadratic	Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y
Mean dependent variable	.178	.178	.178	.178	.178	.053	.293
Akaike's information criterion	27,147	26,754	-6,429	-6,553	-6,624	-13,045	2,613
Test of nonlinearity	2.988*	2.091	2.552*	3.341**	5.199***	.302	7.682***
No. of Obs.	37,416	37,416	37,416	37,416	37,416	10,571	15,292
No. of Clusters	51	51	51	51	51	50	51
R-Squared	.17	.18	.01	.01	.01	.03	.02

Notes. This table shows OLS estimates using restricted cubic splines with four knots placed at the 5th, 35th, 65th, and 95th percentiles of the log exemption distribution. The dependent variable is a dummy indicating stock ownership. The coefficient on "Log exemptions" corresponds to the linear term, and the ones on "Log exemption"' and "Log exemption"" capture nonlinearities. The "Test of nonlinearity" is a test of H_0 : Log exemptions' = Log exemptions" = 0. Column 6 (7) is restricted to households that do not own (own) a house in the first wave that appeared in the sample and in the current wave. The demographic controls include the log of household income, head's age, race/ethnicity and number of years of education, dummies for whether the head is male, married, unemployed or retired, and measures for the numbers of members in the family unit and the number of children. State-level controls include home price and unemployment rate. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

significant at the 5% level after controlling for state and individual fixed-effects, although their interpretation is not straightforward. The test of nonlinearity based on the F-statistic supports the non-linear specification. The null hypothesis for the tests of nonlinearity is that the nonlinear coefficients (Log exemptions' and Log exemptions") are zero. For the model with state-specific linear time trends the corresponding test statistic is $F(2, 50) = 3.341$ and significant at the 5% level, supporting the nonlinear specification.

Given the difficulty interpreting the individual coefficients estimated with the restricted cubic splines, I plot in Figure 3.1 the corresponding marginal effects based on the model with state-specific linear time trends (columns 4, 6 and 7 in Table 3.2, Panel B). The curve with the marginal effects represents the change in the probability of stock ownership when exemptions increase, that is, the derivative of the probability with respect to exemptions at different exemption levels. Panel A shows that exemptions have a significantly negative effect on stockholdings when the log is between 10 and 11.3 approximately, which corresponds to exemptions between $22,000 and $80,000. Notice that the unconditional average home equity in the sample, $68,000, falls within this interval and the median value, $18,000, is close to the lower bound. In Panel B I confirm that there are no effects among households that were always renters, whereas the negative effects among those that were always home owners are larger relative to the whole sample and become positive at high exemption levels.

Figure 3.1: **Regressions of stock market participation using restricted cubic splines: Marginal effects at various exemption levels**

Panel A. All the sample

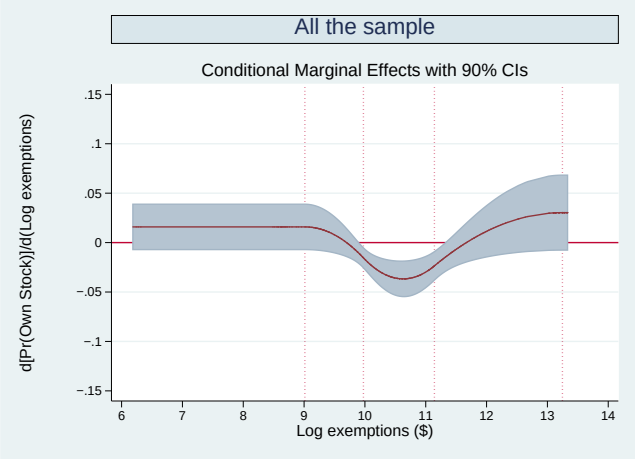
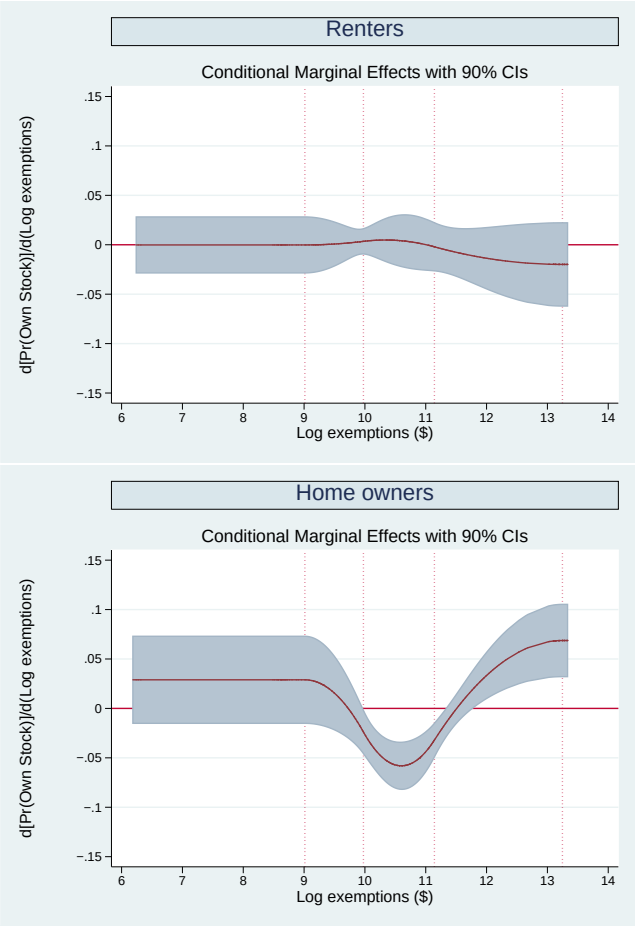


Figure 3.1: **Regressions of stock market participation using restricted cubic splines: Marginal effects at various exemption levels**

Panel B. Renters and home owners



Notes. The figures show the marginal effects of exemptions on stock ownership estimated using restricted cubic splines as in columns 4, 6 and 7 of Table 3.2, Panel B. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009 and in Panel B the sample is restricted to households that were always renters and home owners. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. The vertical dotted lines represent each of the four knots placed at the 5th, 35th, 65th, and 95th percentiles. These are equally spaced percentiles of the exemption's marginal distribution recommended by Harrell (2001) when the number of knots is four. 90% confidence intervals are obtained by clustering the standard errors at the state level.

Sample selection. To test for the validity of the first identifying assumption, in 3.3 I address the possibility that the effects are contaminated by individuals moving endogenously into states with higher bankruptcy protection. Thus, I re-estimate my main effects using the same state where the household was living at the time of joining the sample for the whole sample period. If self-selection bias is not a big concern, the results should be robust to this specification. I confirm that the signs and the magnitude of the coefficients for intermediate exemption levels remain similar as in Table 3.2, Panels A and B, although

they are less precisely estimated in the specifications without state-specific linear trends. Overall, individuals moving across states do not seem to affect substantially the estimated effects of exemptions.

Table 3.3: **Sample selection: Effect of exemptions from the state of residence in the year that the household joined the sample**

	Piecewise linear splines			Restricted cubic splines		
			Home owners			Home owners
Low exemptions	.004	.003	.002			
	(.008)	(.010)	(.016)			
Middle exemptions	-.014	-.035***	-.060***			
	(.009)	(.011)	(.014)			
High exemptions	.016	.031	.072***			
	(.019)	(.019)	(.019)			
Log exemptions				.008	.013	.020
				(.010)	(.013)	(.020)
Log exemptions'				-.094	-.221**	-.383***
				(.071)	(.092)	(.110)
Log exemptions"				.246	.586**	1.059***
				(.181)	(.224)	(.268)
Demographic controls	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Linear		Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y
Mean dependent variable	.178	.178	.293	.178	.178	.293
No. of Obs.	37,416	37,416	15,292	37,416	37,416	15,292
No. of Clusters	51	51	51	51	51	51
R-Squared	.00	.01	.01	.00	.01	.01

Notes. This table shows the results of estimating panel models using piecewise linear spline regressions with two knots at log exemptions equal to 10 and 11.4 (col. 1 to 3) and restricted cubic splines with four knots placed at the 5th, 35th, 65th, and 95th percentiles of the log exemption distribution (col. 4 to 6). Each household is assigned the state reported at the time of joining the sample. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009. In columns 3 and 6 the sample is restricted to households that were always home owners. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Dynamic effects. In Table 3.4 I look at the dynamic evidence on the timing of exemption changes by adding one lag and one lead to the main specification to capture the effect of the treatment two years after and two years before.[13] The results presented in Table 3.4 indicate that the empirical model passes the falsification test for pre-existing trends

[13]I only include one lag because the loss of degrees of freedom resulting from the addition of each lag is large for models with piecewise-linear splines, since each lag requires the estimation of three additional parameters. In addition, note that the results in Table 3.4 correspond to the period 1999-2007, since the last year of the sample is dropped to estimate the effects of the leads.

or anticipatory effects, especially in the specifications including state-specific trends. Indeed, the associated coefficient is non-significant, which gives convincing evidence that the contemporaneous effects are not biased. The coefficients for the lagged variables are significant for home owners at intermediate levels, suggesting that the estimated effects remain two years after the policy change. Relative to the baseline specification, the magnitude of the contemporaneous effect at intermediate exemption levels is not substantially altered after the inclusion of the lag and the lead. The difference becomes larger, however, in the specifications with state-specific quadratic time trends (-0.064 in column 3 of Table 3.4 versus -0.28 in column 7 of Table 3.2, Panel A).

Table 3.4: **Dynamic effects of exemptions on stock ownership**

	Piecewise linear splines					
				Home owners		
Low exemptions (t+1)	-.004	-.016	-.028	-.036	-.034	-.070
	(.012)	(.014)	(.018)	(.030)	(.034)	(.043)
Middle exemptions (t+1)	.008	-.003	-.012	.023	.010	-.021
	(.011)	(.013)	(.016)	(.016)	(.022)	(.030)
High exemptions (t+1)	-.017	-.018	-.052	-.068**	-.041	-.078
	(.022)	(.019)	(.033)	(.026)	(.025)	(.063)
Low exemptions (t)	.022*	.021	-.000	.014	.024	-.021
	(.012)	(.014)	(.025)	(.032)	(.037)	(.050)
Middle exemptions (t)	-.029***	-.033***	-.064***	-.025*	-.035**	-.097**
	(.009)	(.010)	(.022)	(.014)	(.015)	(.038)
High exemptions (t)	.036**	.034*	.051***	.041*	.053	.075**
	(.015)	(.018)	(.014)	(.024)	(.039)	(.033)
Low exemptions (t-1)	-.014	.008	.023	-.019	.005	.083*
	(.011)	(.012)	(.022)	(.020)	(.025)	(.043)
Middle exemptions' (t-1)	-.018	-.014	-.001	-.075**	-.089**	-.055
	(.016)	(.021)	(.026)	(.034)	(.044)	(.049)
High exemptions (t-1)	-.019	-.007	-.006	-.023	.008	.040
	(.013)	(.009)	(.020)	(.024)	(.019)	(.029)
Demographic controls	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Quadratic		Linear	Quadratic
Year FE	Y	Y	Y	Y	Y	Y
No. of Obs.	30,222	30,222	30,222	12,683	12,683	12,683
No. of Clusters	51	51	51	51	51	51
R-Squared	.01	.01	.01	.01	.02	.02

Notes. This table shows the results of estimating panel models using piecewise-linear spline regressions with two knots for the lead, the contemporaneous and the lagged value of log exemptions. The dependent variable is a dummy indicating stock ownership. Household data is from the PSID for the period 1999-2007. In columns 4 to 6 the sample is restricted to households that were always home owners. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Thus, the preferred specification is the one including state-specific linear time trends, since it passes the falsification tests and the estimated coefficients for the contemporaneous effects remain similar after including a lag and a lead.

Effect of state background variables on exemptions. The assumption that the timing of exemption changes is exogenous can be threatened if the determinants of exemption changes are also driving stock market participation. In 3.5, I explore the correlation between the log of homestead (plus wildcard) exemptions and possible determinants of changes in exemptions, including state house prices, unemployment rate, proprietor employment, per capita personal income, GDP, medical expenditures and the number of bankruptcy filings per capita. All columns are estimated using OLS regressions where I cluster the standard errors at the state level. The dummy for couples is always positive and significant since couples can double the exemption level in selected states. When I control for state and year fixed-effects, I find that exemption levels are positively correlated with house price, the state unemployment rate and the number of filings. These results confirm the need to control for house price and unemployment rate in the regressions for stock ownership.[14] Thus, conditional on state home prices, unemployment rates, other individual-level controls and the full set of fixed-effects, exemption changes are plausibly exogenous to the demand for risky assets.

3.4.1.1 Heterogeneous effects by asset and income levels and by entrepreneurial status

In Table 3.6 I explore the presence of heterogeneous effects at different asset and income levels using the preferred specification with state-specific linear time trends. If the stronger response is observed among richer households, my main findings may be explained by the protection channel. If instead poorer households are the ones responding to the additional insurance, then the risk or credit market channels may be a more plausible explanation. In columns 1 to 3 I find that households at the top tercile of the home equity distribution, for which the average stock ownership is around 33%, are the only responding to changes in the bankruptcy protection.

[14] Since the number of bankruptcy filings is endogenous, adding it as a control can lead to a bias. However, my results for the effects of exemptions on stock market participation are robust to its inclusion in the set of controls.

Table 3.5: **Effects of state background variables on bankruptcy exemption levels**

	Homestead + wildcard exemption			
House price (t)	-.247	1.258***	-1.323	.940*
	(1.015)	(.406)	(.949)	(.546)
House price (t-1)			.012	.010
			(.008)	(.008)
Unemployment rate (t)	-.235	.165**	-.111	.126**
	(.164)	(.067)	(.131)	(.054)
Unemployment rate (t-1)			-.136	-.003
			(.149)	(.067)
Proprietor employment (t)	.533***	-.038	.794*	.008
	(.142)	(.092)	(.419)	(.081)
Proprietor employment (t-1)			-.281	-.072
			(.458)	(.103)
Per capita personal income (t)	-.016	1.499	9.337	1.711
	(5.180)	(7.093)	(10.834)	(10.440)
Per capita personal income (t-1)			-10.960	-5.018
			(12.575)	(7.744)
State GDP (t)	-1.162***	-.120	-.134	-.370
	(.318)	(.264)	(.588)	(.340)
State GDP (t-1)			-1.078	.196
			(.696)	(.242)
Per capita medical expenses (t)	65.520**	33.817	-74.028	-14.311
	(25.630)	(55.705)	(69.554)	(73.493)
Per capita medical expenses (t-1)			158.835**	47.458
			(75.255)	(47.246)
Non-business filings (t)	-.036	.085**	-.038	.061**
	(.143)	(.035)	(.086)	(.029)
Non-business filings (t-1)			-.033	.049
			(.097)	(.056)
Couples	.115***	.151***	.117**	.152***
	(.042)	(.033)	(.044)	(.033)
Year FE	Y	Y	Y	Y
State FE		Y		Y
No. of Obs.	596	596	596	596
R-Squared	.19	.94	.22	.95

Notes. The dependent variable is the log of homestead plus wildcard exemptions (set to $550,000 for households in states with unlimited homestead exemptions). The sample period is 1999-2009 and only years surveyed in the PSID wealth questionnaires are included. All non-categorical regressors are in logs. The house price index is from Freddie Mac, the unemployment rate is from the Bureau of Labor Statistics, and proprietor employment, per capita personal income and real GDP are from the Bureau of Economic Analysis. Per capita medical expenses are from the Centers for Medicare & Medicaid Services. The total per capita number of non-business bankruptcy filings (in 1,000's) is from the Statistics Division of the Administrative Office of the United States Courts. Couples is a dummy taking value one for exemption levels corresponding to couples. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Doubling exemptions increases stock ownership by over 3.5p.p. when log exemptions are low and decreases stock ownership by 4.6p.p. at intermediate exemption levels. For those at the bottom and at the middle of the home equity distribution, with average stock ownership of 7% and 17%, the effects are insignificant.

Table 3.6: **Panel regressions of stock market participation: Piecewise-linear splines**

Heterogeneous effects by home equity and income levels and by entrepreneurial status

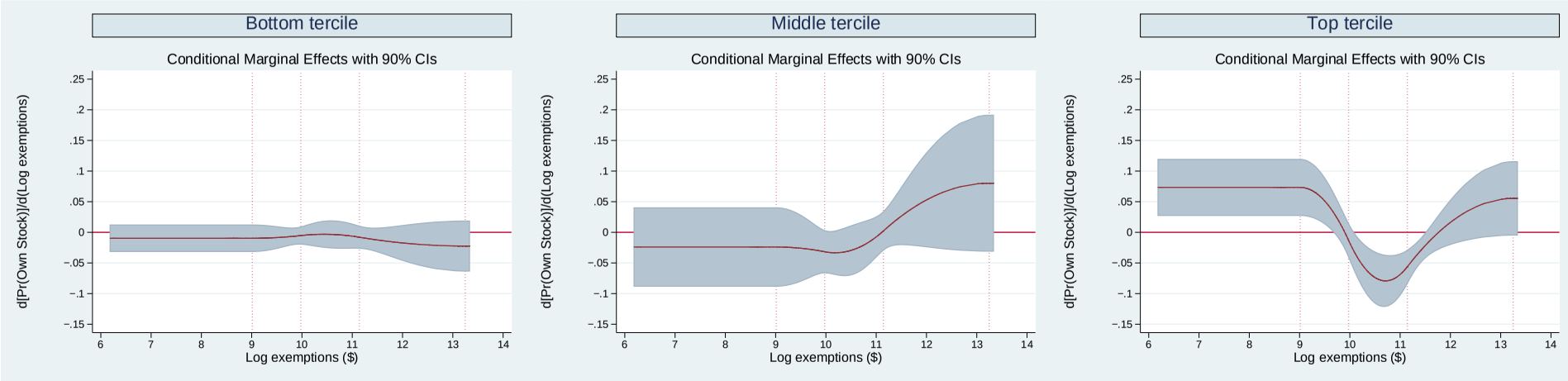
	By home equity level			By income level		By entrepreneurial status		
	Bottom	Middle	Top	Low	High			
Low exemptions	-.009	-.022	.051**	-.008	.026	.013	.013	.008
	(.011)	(.038)	(.021)	(.007)	(.022)	(.010)	(.010)	(.009)
Middle exemptions	.000	-.027	-.066***	-.002	-.052***	-.029***	-.030***	-.027***
	(.012)	(.022)	(.023)	(.014)	(.015)	(.010)	(.009)	(.009)
High exemptions	-.027	.062	.019	.011	.018	.010	.011	.022
	(.019)	(.050)	(.023)	(.017)	(.029)	(.013)	(.013)	(.020)
Low exemptions x Self-employed						.093		
						(.074)		
Middle exemptions x Self-employed						-.140**		
						(.066)		
High exemptions x Self-employed						.058		
						(.061)		
Low exemptions x Unincorporated							-.017	
							(.088)	
Middle exemptions x Unincorporated							-.075	
							(.078)	
High exemptions x Unincorporated							-.005	
							(.068)	
Low exemptions x Incorporated							.215	
							(.135)	
Middle exemptions x Incorporated							-.242***	
							(.078)	
High exemptions x Incorporated							.074	
							(.062)	
Low exemptions x Own business								.092
								(.069)
Middle exemptions x Own business								-.030

	By home equity level			By income level		By entrepreneurial status		
	Bottom	Middle	Top	Low	High			
								(.047)
High exemptions x Own business								.088*
								(.044)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend	Linear	Linear	Linear	Linear	Linear	Linear	Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Mean dependent variable	.070	.172	.325	.084	.272	.177	.177	.170
No. of Obs.	16,503	8,565	12,348	18,797	18,619	34,259	34,259	33,224
No. of Clusters	51	50	50	51	51	51	51	51
R-Squared	.02	.03	.02	.01	.02	.01	.01	.01

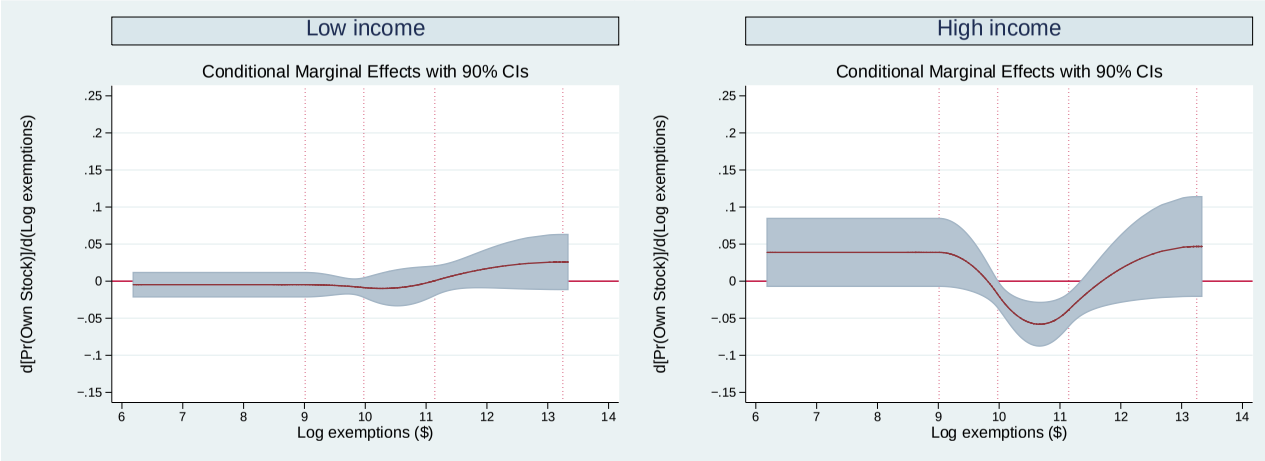
Notes. This table shows the result of estimating panel models using piecewise-linear spline regressions with two knots at log exemptions equal to 10 and 11.4. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009. The coefficients on Low, Middle and High exemptions correspond to log exemptions smaller than 10, between 10 and 11.4 and greater than 11.4 respectively. In columns 1 to 3 the sample is split by home equity terciles, defined based on the within-state home equity distribution by marital status. In columns 4 and 5 the sample is split between those with income above and below the median of the state. Interaction terms are included for households where the head reports being self-employed (col. 6), unincorporated or incorporated self-employed (col. 7) and for households that own all or part of a farm or business (col. 8). The status is based on reports from the first wave that the household enters into the sample and from the current wave; individuals changing status between waves are excluded. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Figure 3.2: **Regressions of stock market participation using restricted cubic splines: Marginal effects at various exemption levels**

Panel A. By home equity level



Panel B. By income level



Notes. The figures show the marginal effects of exemptions on stock ownership estimated using restricted cubic splines and the same set of controls and sample selection as in columns 1 to 5 of Table 3.6. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. The vertical dotted lines represent each of the four knots placed at the 5th, 35th, 65th, and 95th percentiles. These are equally spaced percentiles of the exemption's marginal distribution recommended by Harrell (2001) when the number of knots is four. 90% confidence intervals are obtained by clustering the standard errors at the state level.

In Panel A of Figure 3.2 I confirm that the negative marginal effects are restricted to households with higher holdings of home equity. Next, I split the sample by income level. Columns 4 and 5 show that households with income above the median of the state are the ones that respond to changes in exemptions. Doubling exemptions in that case reduces participation by 3.6p.p. at intermediate levels. In the light of this evidence, the protection channel receives higher support since only households more likely to trade in stocks reduce their stockholdings when they become less attractive.

In the last three columns of Table 3.6, I examine the presence of heterogeneous effects among entrepreneurs, more likely to respond to a reduction in exposure to background risk. I present the results of interacting the linear spline coefficients with the dummies for entrepreneurs. For self-employed the effects of exemptions are significantly larger than for wage workers at intermediate levels. In that case, doubling exemptions reduces their probability of stock ownership by almost 9.7p.p. more than for non self-employed. This response is driven by the incorporated, for which the decline is 16.8p.p. larger than for wage workers. Even when the mean, unweighted stock market participation among incorporated self-employed (56%) is large relative to the unincorporated (39%) and wage workers (17%), this can still be considered a sizable effect. For unincorporated self-employed and business owners I do not find significant effects, at least at intermediate exemption levels. Overall, these findings do not lend support to the risk channel, which predicts an increase in participation among households with income risk positively correlated with stock returns. This is not consistent with the decline observed among entrepreneurs, and in particular among the incorporated self-employed who are less likely to rely on the bankruptcy insurance than the unincorporated.

3.4.2 Other assets: Safe liquid assets, home equity and retirement accounts

If the protection channel is driving the results for stock market participation, then higher protection should also lead to a reduction in the holdings of other unprotected assets. In Table 3.7, Panel A, I explore the effect of exemptions on other assets that are lost in bankruptcy, both at the extensive and intensive margins. In columns 1 to 4 I estimate the effect on safe liquid assets, and find a negative coefficient of 0.059 at intermediate exemption levels, only significant for the ownership decision after accounting for state-specific linear trends. In the last four columns I look at the holdings of total liquid assets, that is, the sum of safe and risky liquid assets. The same pattern emerges: a decline is observed at middle levels, significant in the regression controlling for state-specific linear trends. The restricted cubic splines from Figure 3.3, Panel A, confirm that the marginal effects on ownership of safe liquid assets experience a decline at the same range of exemptions than stock ownership. This evidence provides further support to the protection channel.

A question that arises is: If higher protection leads to lower investment in stocks, where else are households investing those funds? An obvious candidate are the asset categories that are protected, such as home equity and retirement accounts. It is possible that higher home equity protection leads to more investment in housing itself, but also on other assets that will not be lost in bankruptcy, such as retirement accounts. In Panel B of Table 3.7 I find that higher bankruptcy protection has no effect on home ownership, which is consistent with the findings in Corradin et al. [2013]. Among home owners I find a negative effect on home equity at intermediate levels that becomes insignificant after accounting for state-specific linear trends. This finding is corroborated in Panel B of Figure 3.3, where the marginal effects are based on restricted cubic splines estimated using the preferred specification. In contrast, Corradin et al. [2013] find a bias towards home equity in states with high exemption levels, although they do not exploit changes in exemptions but in household wealth. Greenhalgh-Stanley and Rohlin [2013] estimate panel regressions and find positive effects both at the extensive and intensive margin using cubic polynomials.

Table 3.7: **Panel regressions of holdings of other unprotected and protected assets: Piecewise linear splines**

Panel A. Safe and total liquid assets

	Own safe liquid assets		Log safe liquid assets		Own any liquid asset		Log total liquid assets	
Low exemptions	.054***	.032*	.239**	.090	.014	-.007	.062	.343***
	(.014)	(.017)	(.104)	(.075)	(.012)	(.011)	(.084)	(.083)
Middle exemptions	-.022	-.059***	-.029	.019	-.008	-.033**	-.142	.169
	(.014)	(.018)	(.063)	(.102)	(.010)	(.015)	(.111)	(.119)
High exemptions	-.040***	-.009	-.300***	-.180	-.016	-.022	.290	.395**
	(.015)	(.040)	(.108)	(.153)	(.013)	(.026)	(.257)	(.196)
Inverse Mills ratio			6.230	4.053			-23.681***	-26.468***
			(3.862)	(4.175)			(4.120)	(4.144)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend		Linear		Linear		Linear		Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
No. of Obs.	37,416	37,416	20,073	20,073	37,416	37,416	23,841	23,841
No. of Clusters	51	51	51	51	51	51	51	51
R-Squared	.37	.38	.02	.03	.29	.29	.50	.50

Notes. This table shows the result of estimating panel models using piecewise-linear spline regressions with two knots at log exemptions equal to 10 and 11.4. The dependent variable is a dummy indicating ownership of safe liquid assets (col. 1 and 2), the log of the value of safe liquid assets (col. 3 and 4), a dummy indicating ownership of any liquid asset (col. 5 and 6) and the log of total liquid assets (col. 7 and 8). Household data is from the PSID for the period 1999-2009. The sample is restricted to owners of safe liquid assets (col. 3 and 4) and of any liquid asset (col. 7 and 8). In columns 3, 4, 7 and 8, I control for sample selection by adding the inverse Mills ratio/nonselection hazard estimated from the participation equation. The exclusion restriction in the participation equation is log wealth in t-1. Demographic and state level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

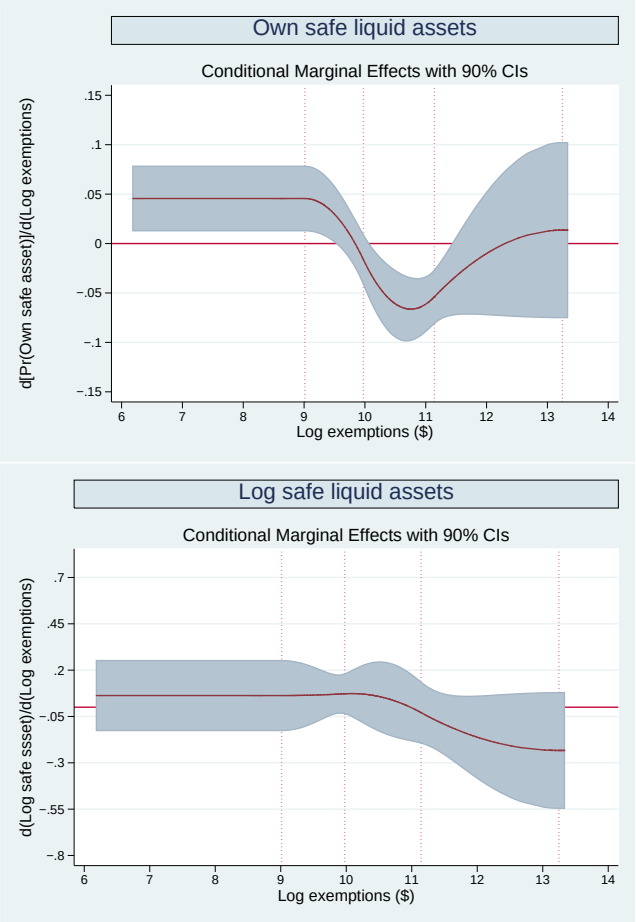
Panel B. Home equity and retirement accounts

	Log business equity		Log home equity		Log mortgage debt		Log other debt	
Log exemptions	-.433	-.556	-.033	.029	.013	.001	.030	.077
	(.276)	(.673)	(.057)	(.155)	(.020)	(.049)	(.046)	(.086)
Log exemptions'		-.251		-.496		.152		-.591
		(4.316)		(.757)		(.239)		(.467)
Log exemptions"		2.002		1.233		-.438		1.705
		(10.061)		(1.749)		(.526)		(1.103)
Inverse Mills ratio	26.773	28.026	5.927*	6.666*	-2.981	-2.832	-.200	.318
	(26.338)	(25.557)	(3.135)	(3.449)	(1.860)	(2.350)	(3.160)	(3.238)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Akaike's information criterion	12,489	12,491	50,635	50,633	18,751	18,750	38,741	38,737
Test of nonlinearity		.451		.266		.732		2.030
No. of Obs.	3,230	3,230	18,396	18,396	15,140	15,140	16,483	16,483
No. of Clusters	49	49	51	51	51	51	51	51
R-Squared	.15	.15	.09	.09	.03	.03	.04	.04

Notes. This table shows the result of estimating panel models using piecewise-linear spline regressions with two knots at log exemptions equal to 10 and 11.4. The dependent variable is a dummy indicating home ownership (col. 1 and 2), the log of the value of home equity (col. 3 and 4), a dummy indicating ownership of a retirement account (col. 5 and 6) and the log of the value of retirement assets (col. 7 and 8). Household data is from the PSID for the period 1999-2009. The sample is restricted to home owners (col. 3 and 4) and to owners of retirement accounts (col 7 and 8). In columns 3, 4, 7 and 8, I control for sample selection by adding the inverse Mills ratio/nonselection hazard estimated from the participation equation. The exclusion restriction in the participation equation is log wealth in t-1. Demographic and state level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Figure 3.3: **Regressions of holdings of other unprotected and protected assets using restricted cubic splines: Marginal effects at various exemption levels**

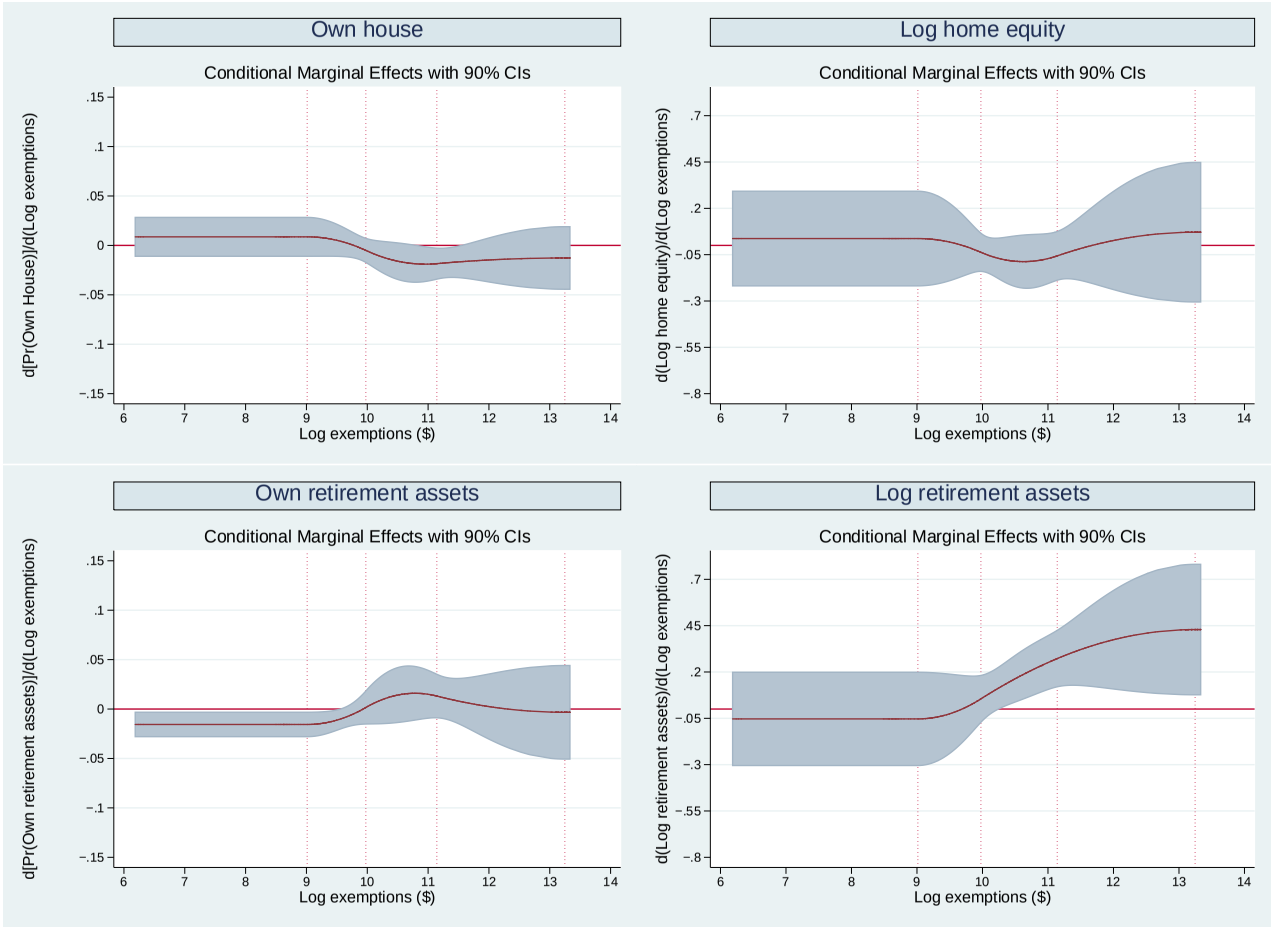
Panel A. Other unprotected assets



Notes. The figures show the marginal effects of exemptions estimated using restricted cubic splines and the same set of controls and sample selection as in columns 2 and 4 of Panel A, Table 3.7. The dependent variables are ownership and the amount invested conditional on asset holding for safe liquid assets. Household data is from the PSID for the period 1999-2009. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. The vertical dotted lines represent each of the four knots placed at the 5th, 35th, 65th, and 95th percentiles. These are equally spaced percentiles of the exemption's marginal distribution recommended by Harrell (2001) when the number of knots is four. 90% confidence intervals are obtained by clustering the standard errors at the state level.

Figure 3.3: **Regressions of holdings of other unprotected and protected assets using restricted cubic splines: Marginal effects at various exemption levels**

Panel B. Protected assets



Notes. The figures show the marginal effects of exemptions estimated using restricted cubic splines and the same set of controls and sample selection as in columns 2, 4, 6 and 8 of Panel B, Table 3.7. The dependent variables are ownership and the amount invested conditional on asset holding for home equity and retirement assets (Panel B).

In columns 5 to 8 I explore the effects of exemptions on holdings of retirement assets. I find no significant effect at intermediate levels, whereas the significant effects at low and high levels become insignificant after controlling for state-specific linear trends. In the last two columns of the table I estimate the effects on the log of the dollar amount invested in retirement accounts and find positive and significant effects at intermediate and high exemptions levels in the preferred specification. I corroborate these findings with the restricted cubic spline regressions in Figure 3.3, Panel B.

The evidence on the effect of exemptions on protected assets only suggests more investment in retirement assets and does not seem very strong overall. This could be attributed to the fact that: i) the BAPCPA has restricted the ability to shift assets towards housing before filing for bankruptcy; ii) there is a limit in terms of how much can be deposited into retirement accounts; and iii) retirement accounts only became protected categories after 2005. Thus, my interpretation of these findings is that households that invest less in stocks in response to the higher insurance may invest more in retirement assets and, although it cannot be tested, they may also consume more.

3.4.3 Risky portfolio shares

By looking at the risky portfolio share I can determine whether exemptions have any effect on the preference for risky versus safe assets and therefore I can test for the plausibility of the risk channel. In Table 3.8 I estimate regressions for the share of stocks in total liquid assets for the sample of stock market participants. These regressions may be biased if there is self-selection into stock market participation given that only a fraction of the households holds stocks. To address this issue and the fact that the bankruptcy exemptions also affect participation, I include among the regressors of the risky share the inverse Mills ratio based on the models for the probability of holding stocks.

Using piecewise-linear splines, the estimates in columns 1 and 2 suggest no effect of exemptions on the risky portfolio share for the whole sample. In the remaining columns I explore heterogeneous effects among entrepreneurs, given that their income is highly volatile. Moreover, since their income is likely to be positively correlated with stock returns, they should increase the risky portfolio share when the bankruptcy insurance increases.

Table 3.8: **Panel regressions of risky portfolio share: All the sample and heterogeneous effects by entrepreneurial status**

	Piecewise linear splines							
	By entrepreneurial status							
Low exemptions	-.060	-.085*	-.063	-.119*	-.063	-.119*	.011	-.054
	(.052)	(.050)	(.062)	(.063)	(.062)	(.062)	(.063)	(.060)
Middle exemptions	.010	-.002	-.005	-.006	-.009	-.011	-.081	-.130
	(.091)	(.108)	(.113)	(.137)	(.113)	(.138)	(.115)	(.145)
High exemptions	.026	.039	.046	.062	.047	.065	.056	.143
	(.037)	(.108)	(.047)	(.139)	(.047)	(.138)	(.047)	(.144)
Low exemptions x Self-employed			-.047	-.064				
			(.129)	(.134)				
Middle exemptions x Self-employed			.066	.063				
			(.068)	(.073)				
High exemptions x Self-employed			-.124***	-.134***				
			(.027)	(.027)				
Low exemptions x Unincorporated					.105	.071		
					(.130)	(.176)		
Middle exemptions x Unincorporated					.087	.090		
					(.109)	(.120)		
High exemptions x Unincorporated					-.078	-.077		
					(.054)	(.054)		
Low exemptions x Incorporated					-.152	-.148		
					(.173)	(.177)		
Middle exemptions x Incorporated					.159	.149		
					(.100)	(.099)		
High exemptions x Incorporated					-.141**	-.139**		
					(.056)	(.054)		
Low exemptions x Own business							-.077	-.100
							(.082)	(.082)
Middle exemptions x Own business							.099*	.101*
							(.051)	(.052)
High exemptions x Own business							-.072*	-.068*

	Piecewise linear splines							
	By entrepreneurial status							
							(.040)	(.039)
Inverse Mills ratio	.125	.434	.907	.752	1.105	.933	4.957	5.552
	(5.919)	(4.817)	(7.409)	(6.215)	(7.397)	(6.255)	(7.420)	(6.374)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend		Linear		Linear		Linear		Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
No. of Obs.	6,197	6,197	5,641	5,641	5,641	5,641	5,340	5,340
No. of Clusters	51	51	51	51	51	51	51	51

Notes. This table shows the results of estimating panel models using piecewise-linear spline regressions with two knots at log exemptions equal to 10 and 11.4. The dependent variable is the ratio of stocks held outside retirement accounts to total liquid assets. Household data is from the PSID for the period 1999-2009. Interaction terms are included for households where the head reports being self-employed (col. 3 and 4), unincorporated or incorporated self-employed (col. 5 and 6) and for households that own all or part of a farm or business (col. 8). The status is based on reports from the first wave that the household enters into the sample and from the current wave; individuals changing status between waves are excluded. In all columns the sample is restricted to stock market participants. I control for sample selection by adding the inverse Mills ratio/nonselection hazard estimated from the participation equation. The exclusion restriction in the participation equation is log wealth in t-1. Demographic and state level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

In columns 3 and 4 I find that the interaction terms for self-employed are of the opposite sign as for the participation regressions; i.e. negative at low and high exemption levels and positive at intermediate levels. Even when the positive estimate at intermediate levels are consistent with the risk channel, only the negative effects at high exemption levels are significant. The next two columns indicate that this respond correspond mainly to the incorporated self-employed. For business owners, columns 7 and 8 reveal a similar pattern, with positive estimated coefficients at middle exemption levels and negative at high levels, significant at the 10% level. Note that the inverse Mills ratio is not significant in all specifications, which suggests that selection bias may not be a serious problem.

The findings from Table 3.8 indicate that even when the effects of exemptions on the share of stocks in liquid assets are positive at intermediate levels, at least for entrepreneurs, they are not precisely estimated. This suggests that the risky portfolio share is not a plausible channel driving my results, given that bankruptcy protection does not shift financial portfolios towards risky assets among stock market participants. On the other hand, in the light of the data quality issues raised in section 3.2, I cannot completely rule out that measurement errors and the lack of data on active savings are confounding the estimates. For those reasons, the evidence at the intensive margin should be taken with caution.

3.4.4 Effects on holdings of household debt

Next, I explore how exemptions affect debt holdings to test for the plausibility of the credit market channel. An increase in debt holdings resulting from higher bankruptcy protection indicates that the demand response dominates, since households are willing to take more loans when bankruptcy becomes more generous. On the other hand, a decline in debt holdings can be explained by the prevalence of supply-side restrictions, given than lenders will reduce the availability of credit and increase interest rates when bankruptcy protection increases. Since only unsecured debt can be discharged in bankruptcy, in principle only its demand and supply should respond to changes in exemptions and no effects are expected in the secured debt market. However, it could be that households substitute secure for unsecured credit when the cost of the latter increases. Thus, I not only look at the effects on non-mortgage debt but also on total debt, which gives a more complete picture of the household borrowing constraints.

In columns 1 to 4 of Table 3.9 the dependent variable is a dummy indicating ownership of non-mortgage debt and in columns 5 to 8 is the log of non-mortgage debt, conditional on holding such debt. Notice that this measure only excludes mortgages and vehicle loans but still contains some components that are not dischargeable, such as student loans, tax obligations, alimony, child support obligations, etc. Thus, it is just a proxy for unsecured debt holdings. In the regressions at the intensive margin I control for endogenous selection into debt ownership by including the inverse Mills ratio among the regressors, based on the models for the probability of holding debt. As in the regressions for the risky portfolio share, the exclusion restriction is the log of total wealth lagged one period. The estimated effects at intermediate exemption levels are negative in general but not precisely estimated, both at the extensive and intensive margins, and after splitting the sample by income levels. In columns 9 to 12 I estimate the effects on ownership of any debt and in columns 13 to 16 I estimate the effects on the log of total debt for those holding debt at all. The effects at the extensive margin are negative and significant at middle exemptions. When I split the sample by income levels, the estimated coefficients are only significant for low-income households, the ones more likely to default and therefore to be denied a loan when bankruptcy becomes more generous. At the intensive margin, the effects are also negative at middle exemptions but insignificant.

Summarizing, higher bankruptcy protection leads to a decline in total debt holdings and -less precisely estimated- on non-mortgage debt. This is moderate statistical evidence supporting the prevalence of the supply-side constraints in the credit market which, as noted by Gropp et al. [1997] and von Lilienfeld-Toal and Mookherjee [2008] among others, tend to affect mostly low-income households. My results contrast with those of Severino et al. [2014], who find positive effects of exemptions on credit card debt, also in low-income areas. The different findings could be attributed to the fact that my estimates are based on within-individual rather than on within-county variation.[15] In any case, the estimated negative effects of bankruptcy protection on the debt holdings of low-income households do not lend support to the credit market channel as driving the results on stockholdings, which are observed among high-income households.

[15] In addition, my measure of unsecured debt is somewhat broader than the one used by Severino et al. [2014].

Table 3.9: **Effect of bankruptcy exemptions on debt holdings: Piecewise-linear splines**

	Own other debt				Log other debt				Own any debt				Log total debt			
			By income level				By income level				By income level				By income level	
			Low	High			Low	High			Low	High			Low	High
Low exemptions	-.009	-.012	-.044**	.013	.051	.020	.005	-.004	.000	.005	-.008	.008	.126	.207**	.497**	.072
	(.012)	(.019)	(.021)	(.037)	(.066)	(.071)	(.104)	(.117)	(.009)	(.011)	(.021)	(.028)	(.079)	(.103)	(.187)	(.141)
Middle exemptions	-.008	-.025*	-.032	-.016	-.017	-.013	.132	-.080	-.020**	-.032**	-.057***	-.011	-.076	-.081	-.302	.019
	(.010)	(.014)	(.020)	(.022)	(.062)	(.071)	(.125)	(.072)	(.009)	(.013)	(.021)	(.016)	(.058)	(.115)	(.226)	(.118)
High exemptions	-.001	.016	.010	.031	.152***	.149*	.066	.178	-.016	.004	.033	-.005	-.116*	-.121	-.310**	-.072
	(.010)	(.017)	(.029)	(.036)	(.055)	(.088)	(.199)	(.148)	(.012)	(.015)	(.026)	(.023)	(.061)	(.086)	(.132)	(.120)
Inverse Mills ratio					-1.088	.393	.491	1.132					.975	7.546	23.138*	-.690
					(.892)	(3.232)	(5.853)	(3.940)					(1.459)	(7.442)	(11.595)	(9.287)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Linear	Linear		Linear	Linear	Linear		Linear	Linear	Linear		Linear	Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
No. of Obs.	37,416	37,416	18,797	18,619	16,483	16,483	6,608	9,875	37,416	37,416	18,797	18,619	22,069	22,069	8,242	13,827
No. of Clusters	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
R-Squared	.01	.01	.01	.02	.04	.04	.08	.05	.02	.02	.02	.03	.07	.08	.09	.09

Notes. The table shows the results of estimating panel models using piecewise-linear regressions with two knots placed at log exemptions equal to 10 and 11.4. The dependent variable is a dummy indicating ownership of non-mortgage debt (columns 1 to 4), the log of non-mortgage debt (columns 5 to 8), a dummy indicating ownership of any debt (columns 9 to 12) and the log of total debt (columns 13 to 16). Household data is from the PSID for the period 1999-2009. In regressions by income level the sample is divided between those with income above and below the median of the state. I control for sample selection in the regressions for the dollar amount of debt by adding the inverse Mills ratio/nonselection hazard estimated from the participation equation. The exclusion restriction in the participation equation is log wealth in t-1. Demographic and state level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

3.4.5 Robustness Analysis

In this section I discuss a number of robustness checks that provide further evidence on the validity of my main results. I find that the results of the additional tests are generally similar to those in the main specifications.

Functional form. The first two columns of Table 3.10 display the results corresponding to a linear model. The estimated coefficients are negative but imprecisely estimated, before and after including state-specific linear trends. When the sample in restricted to home owners, the size of the estimated coefficient becomes larger but remains insignificant. As explained before, the absence of a linear effect of exemptions on stock ownership could be attributed either to the absence of average effects in the underlying population or to the inadequacy of the linear relationship assumed for the estimated model. Thus in columns 4 to 6 I use a quadratic transformation of the exemption level to account for non-linearities. In that specification all the coefficients are non-significant, suggesting that this transformation is not flexible enough to capture the effect of interest. After adding a cubic term in log exemptions in columns 7 to 9, the coefficients for the linear, quadratic and cubic terms become significant at the 1% level.

Since the interpretation of the individual coefficients is not straightforward, in Figure 3.4 I plot the marginal effects estimated using cubic polynomials as in columns 8 and 9 of Table 3.10. I find negative marginal effects when log exemptions are between 10 and just above 11. Thus, the polynomial regressions confirm the main findings of a reduction in risk-taking at intermediate exemption levels. These plots also indicate positive marginal effects at the lower end of the distribution that are highly significant. However, the positive effects disappear both for the whole sample and for home owners when I exclude outliers (19 observations for Delaware with log exemptions smaller than 8), whereas the negative effects at intermediate levels remain. This suggests that the positive effects estimated for the entire sample reflect the sensitivity to the presence of outliers of the polynomial fitting curve and its poor behavior at the tail of the distribution.

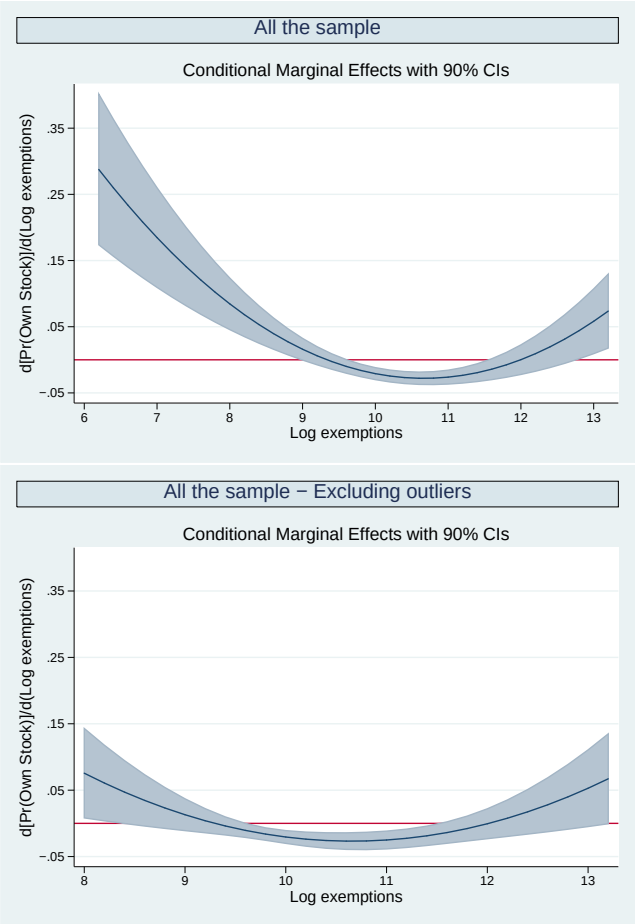
Pre-reform period. To detect any change in the treatment effect, I re-estimate my main results for stock ownership in Table 3.11 restricting the sample to the years 1999 to 2005. After the BAPCPA was passed in 2005 high-income households in principle became ineligible to file under Chapter 7 or were less able to exploit its benefits.

Table 3.10: **Regressions of stock ownership using linear, quadratic and cubic polynomial regressions**

	Linear regressions			Quadratic polynomial regressions			Cubic polynomial regressions		
			Home owners			Home owners			Home owners
Log exemptions	-.003	-.008*	-.013	.023	.056	.040	.989***	1.772***	3.529***
	(.003)	(.005)	(.011)	(.051)	(.081)	(.160)	(.316)	(.421)	(.670)
Log exemptions squared				-.001	-.003	-.003	-.093***	-.169***	-.337***
				(.002)	(.004)	(.008)	(.031)	(.041)	(.064)
Log exemptions cubed							.003***	.005***	.011***
							(.001)	(.001)	(.002)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Linear		Linear	Linear		Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Akaike's information criterion	-6,422	-6,542	2,620	-6,423	-6,544	2,620	-6,432	-6,556	2,605
Mean dependent variable	.178	.178	.293	.178	.178	.293	.178	.178	.293
No. of Obs.	37,416	37,416	15,292	37,416	37,416	15,292	37,416	37,416	15,292
No. of Clusters	51	51	51	51	51	51	51	51	51
R-Squared	.01	.01	.02	.01	.01	.02	.01	.01	.02

Notes. This table shows the results of estimating panel models using linear and polynomial transformations of "Log exemptions", defined as the log of the dollar value of the state homestead plus wildcard exemption, divided by 10,000. The dependent variable is a dummy indicating stock ownership. Household data is from the PSID for the period 1999-2009. In columns 3, 6 and 9 the sample is restricted to households that were always home owners. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Figure 3.4: **Regressions of stock market participation using cubic polynomials: Marginal effects at various exemption levels**



Notes. The figures show the marginal effects on stock ownership from cubic polynomial regressions as estimated in Table 3.10, column 8. I also plot the marginal effects for the same models excluding 19 observations from Delaware with log exemptions smaller than 8. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. 90% confidence intervals are obtained by clustering the standard errors at the state level.

As explained before, in practice many households still were able to overcome the requirements and file under Chapter 7. On the other hand, the most dramatic increases in state exemption levels occurred in more recent years, after the passage of the law. This implies that the intensity of the treatment became larger and stronger effects may have taken place in the post-reform years. Finally, the recession of 2008-2009 was characterized by substantial disruption in the credit and stock markets, so the investors' behavior in this period may differ from former years.

In columns 1 to 3 of Table 3.11 I estimate piecewise linear regressions. For the whole sample, the effects corresponding to 1999-2005 become slightly larger than for the period

1999-2009 but are not significant; the coefficient in column 2 is -0.048 compared to -0.031 in column 6 of Table 3.2, Panel A. The difference in the size of the effects is even larger when the sample is restricted to home owners (-0.123 versus -0.048), but in this case the coefficient at middle levels are significant at the 5% level.

Table 3.11: **Effects of exemptions on stock ownership before the 2005 bankruptcy reform**

	Piecewise linear splines			Restricted cubic splines		
			Home owners			Home owners
Low exemptions	.016	.024	-.022			
	(.018)	(.027)	(.054)			
Middle exemptions	-.040	-.048	-.123**			
	(.025)	(.032)	(.061)			
High exemptions	.015*	.018	.037			
	(.008)	(.015)	(.035)			
Log exemptions				.022	.030	-.011
				(.021)	(.033)	(.068)
Log exemptions'				-.207*	-.299*	-.475
				(.114)	(.150)	(.307)
Log exemptions"				.608*	.901**	1.614*
				(.312)	(.418)	(.844)
Demographic controls	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Linear		Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y
Mean dependent variable	.191	.191	.301	.191	.191	.301
No. of Obs.	23,637	23,637	10,160	23,637	23,637	10,160
No. of Clusters	51	51	51	51	51	51
R-Squared	.01	.01	.02	.01	.01	.02

Notes. This table shows the results of estimating panel models using piecewise linear splines with two knots at log exemptions equal to 9.8 and 10.8 (col. 1 to 3) and restricted cubic splines with four knots placed at the 5th, 35th, 65th, and 95th percentiles of the log exemption distribution (col. 4 to 6). The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2005. In columns 3 and 6 the sample is restricted to households that were always home owners. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

In columns 4 to 6 I estimate restricted cubic splines that are less sensitive to the placement of the knots, which is no longer the same as for the period 1999-2009.[16] A similar pattern emerges: even when I find stronger effects of exemptions during the pre-reform years, they are less precisely estimated than for the whole period. One explanation

[16] In the piecewise-linear splines the intermediate exemption levels are located at a lower segment of the exemption distribution in the pre-reform sample than in the whole sample.

for these findings is the smaller sample size, and in particular the exclusion of the years in which exemptions increase the most. Other explanations have to do with the liquidation of stocks to palliate the effects of the crisis and with the incentives to reduce capital income to pass the means test introduced in 2005.

Other checks. In Table 3.12, columns 1 to 3, I look at the effect of total asset exemptions rather than only homestead plus wildcard exemptions by including also the amounts exemptible under Chapter 7 for vehicles and bank deposits. The first two columns indicate that adding the exemptions for other asset categories has no substantial effect on the results, either for the whole sample or for home owners, relative to the baseline estimates in Table 3.2, Panel A. This is consistent with the fact that homestead exemptions are the main exemption category and that housing typically represents the biggest fraction of households' wealth. In the next three columns I re-estimate the main specifications using sample weights (the PSID Core/Immigrant Family Longitudinal Weight) from the first year that the individual enters into the sample. The magnitude of the estimated coefficients at middle exemptions is similar as in the baseline specifications and remain significant at the 5% level for the whole sample and at the 1% level for home owners. In the final three columns I drop from the sample observations where log exemptions are smaller than 8 since the exploratory graphs in Appendix A.2 show the existence of a few outliers in that region. These are 19 observations corresponding to Delaware in the years 1999-2005. The estimated coefficients remain of the same magnitude and significant at the 1% level. The plots with the marginal effects in Figure 3.5 look similar to those in Panels A and B of Figure 3.1, although the wide confidence intervals at the lower tail disappear as expected. This also corroborates the adequacy of using spline transformations to model non-linearities, which are less sensitive to the presence of outliers than the polynomials.

3.4.6 Effects on entrepreneurship

In this section I explore the effect of the bankruptcy exemptions on the decision to become self-employed and to own a business, other forms of household risk-taking. An increase in exemptions increases the amount of insurance available against bad outcomes, which increases the rewards of entrepreneurship. Thus, the risk channel has an unambiguously positive effect on entrepreneurship. In turn, the credit market channel may have a negative effect at this margin.

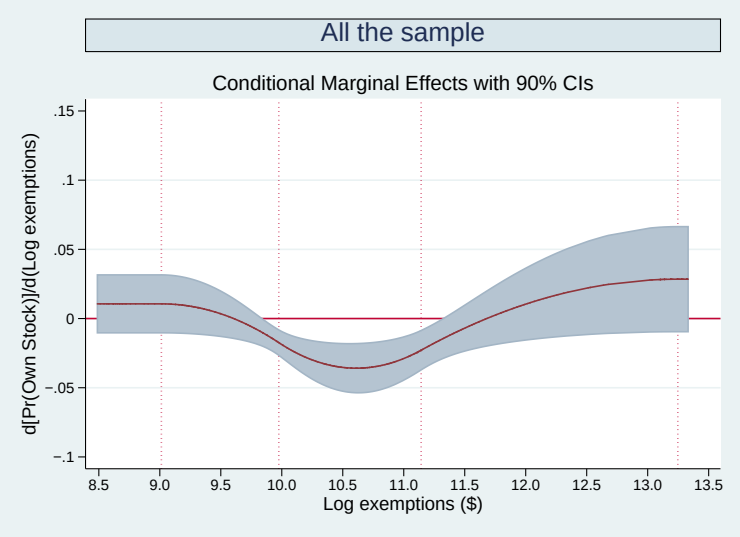
Table 3.12: **Additional robustness checks: Effects of total asset exemptions, use of sample weights and exclusion of outliers**

	Total asset exemptions			Weighted regressions			Log exemptions > 8		
			Home owners			Home owners			Home owners
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low total exemptions	.014	.014	.029						
	(.009)	(.013)	(.028)						
Middle total exemptions	-.018**	-.029***	-.048***						
	(.007)	(.009)	(.014)						
High total exemptions	.005	.008	.033*						
	(.016)	(.018)	(.018)						
Low exemptions				.010	.007	.021	.007	.003	-.004
				(.011)	(.016)	(.033)	(.007)	(.010)	(.014)
Middle exemptions				-.018**	-.030**	-.033*	-.019***	-.031***	-.047***
				(.008)	(.012)	(.018)	(.007)	(.009)	(.012)
High exemptions				.021	.031*	.054***	.008	.012	.033**
				(.023)	(.016)	(.017)	(.016)	(.017)	(.015)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
State x time trend		Linear	Linear		Linear	Linear		Linear	Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
No. of Obs.	37,416	37,416	15,292	33,383	33,383	13,909	37,397	37,397	15,284
No. of Clusters	51	51	51	51	51	51	51	51	51
R-Squared	.01	.01	.02	.01	.01	.02	.01	.01	.02

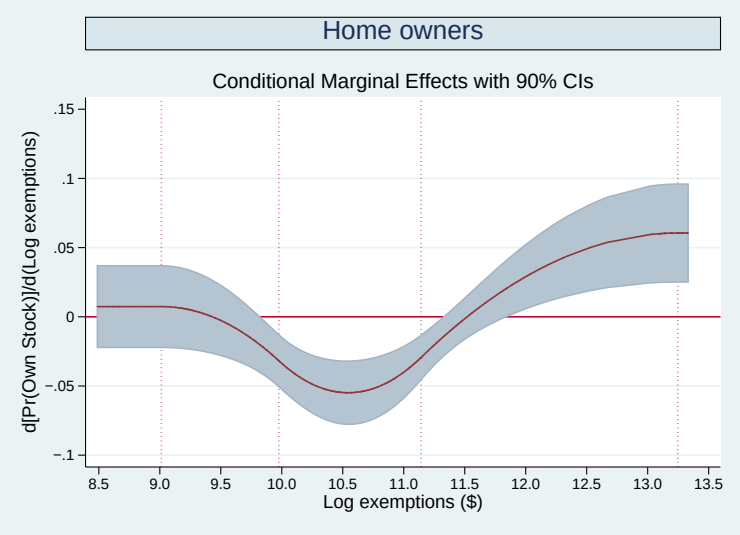
Notes. This table shows the result of estimating panel models using piecewise linear splines with two knots at log exemptions equal to 9.8 and 10.8. The dependent variable is a dummy indicating stock ownership. Household data is from the PSID for the period 1999-2009. The measure of total exemptions used in columns 1 to 3 include homestead, wildcard, vehicle and bank deposit exemptions. In columns 4 to 6 the regressions are weighted using the PSID core/immigrant family longitudinal weights from the first wave that the individual enters into the sample. In columns 7 to 9 I drop from the sample observations with log exemptions smaller than 8. In columns 3, 6 and 9 the sample is restricted to households that were always home owners. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Figure 3.5: **Regressions of stock market participation excluding outliers: Marginal effects at various exemption levels**

Panel A. All the sample



Panel B. Home owners



Notes. The figures show the marginal effects on stock ownership estimated using restricted cubic splines and the same set of controls and sample selection as in columns 8 and 9 of Table 3.12. The dependent variable is a dummy indicating ownership of stocks outside retirement accounts. Household data is from the PSID for the period 1999-2009 and the sample in Panel B is restricted to households that were always home owners. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. 90% confidence intervals are obtained by clustering the standard errors at the state level.

By reducing the supply of credit and increasing interest rates, some agents may be rationed out of the credit market, leading to less business creation, smaller firms and less entrepreneurs.

In Table 3.13 I find that exemptions have a significantly negative effect in the deci-

sion to become self-employed, either when I only control for state fixed-effects (column 1) or when I add individual fixed-effects (column 2). Doubling exemptions reduce self-employment by 1.5p.p. at intermediate levels, according to the estimates that include state-specific linear trends (column 3). This finding contrasts with some of the existing evidence. Positive effects on entrepreneurship are found by Armour and Cumming [2008], based on data from both Europe and North America, and by Fossen [2014], who studies the introduction of a fresh start policy in Germany. Using a cubic polynomial, Georgellis and Wall [2006] find positive effects of bankruptcy protection on the rate of entrepreneurship at intermediate levels and negative at low and high levels. This difference in the signs of the coefficients may be explained because I use a log transformation to deal with the skewness of the exemption distribution.

In columns 4 and 5 of Table 3.13 I distinguish between unincorporated and incorporated self-employed. I find that the effects are significant only for the unincorporated. The marginal effects estimated using restricted cubic splines from Figure 3.6, Panel A, confirm that they are the ones driving the negative results for the aggregate. These results are in line with Berger et al. [2011], who find that the unincorporated self-employed are more likely to be denied a loan or discouraged from borrowing than the incorporated. They also support the evidence in Armour and Cumming [2008] that the higher is the capital requirement for incorporation (i.e. less access to limited liability), the stronger the effects of the bankruptcy law on entrepreneurial activity. However, these results depart from the finding in Cerqueiro and Penas [2011] that higher exemptions accelerate the failure rate of corporations as a result of the lower credit availability, but not of unincorporated firms that inject personal funds in the firm to compensate for the lack of financing.

For business ownership I estimate negative effects at intermediate exemption levels, which are only significant in the regression with state-specific time trends (column 8). Cerqueiro and Penas [2011] also find a negative effect on the probability of survival of start-ups, accounting for firm fixed-effects. In contrast, positive effects on the probability of owning a business were found by Fan and White [2003], using a random-effect probit model, and by Greenhalgh-Stanley and Rohlin [2013] in pooled cross-sections but not in regressions controlling for state fixed-effects.

Overall, the findings in this section suggest that ex ante the supply-side constraints outweigh the positive demand effects of the bankruptcy protection on entrepreneurship.

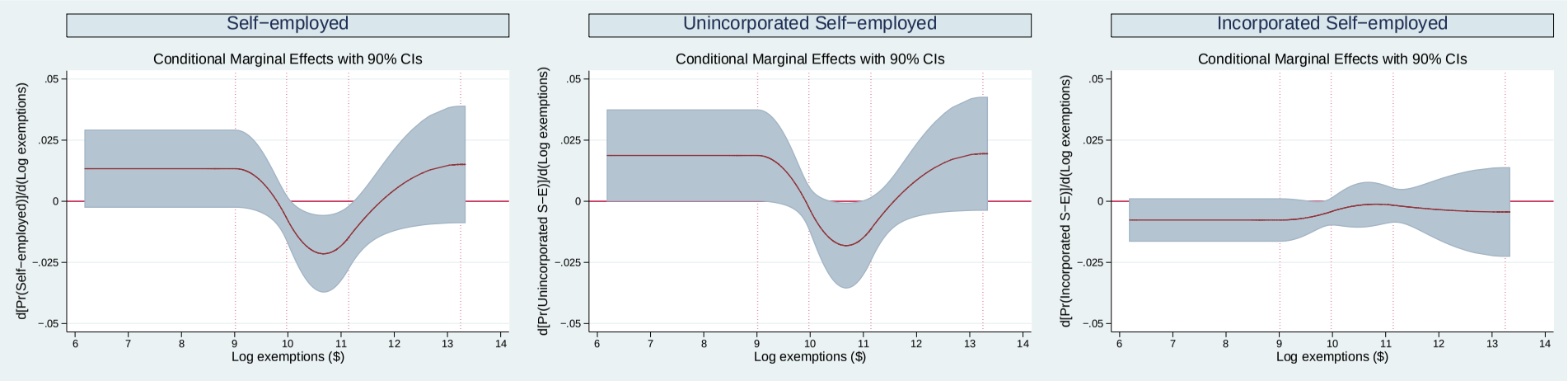
Table 3.13: **Effect of bankruptcy exemptions on self-employment status and business ownership**

	Self-employment					Business ownership		
				Unincorporated	Incorporated			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low exemptions	-.004	.007	.009	.015	-.007	-.001	.008	.006
	(.011)	(.006)	(.008)	(.009)	(.005)	(.011)	(.007)	(.006)
Middle exemptions	-.023***	-.017**	-.021**	-.019**	-.001	-.016*	-.010	-.023***
	(.008)	(.006)	(.008)	(.009)	(.005)	(.009)	(.007)	(.008)
High exemptions	-.007	.006	.009	.017*	-.006	-.017	-.009	.005
	(.009)	(.010)	(.010)	(.009)	(.008)	(.016)	(.017)	(.011)
Demographic controls	Y	Y	Y	Y	Y	Y	Y	Y
State-level controls	Y	Y	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y	Y	Y
Individual FE		Y	Y	Y	Y		Y	Y
State x time trend			Linear	Linear	Linear			Linear
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Mean dependent variable	.104	.104	.104	.069	.033	.109	.109	.109
No. of Obs.	37,416	37,416	37,416	37,342	37,342	37,416	37,416	37,416
No. of Clusters	51	51	51	51	51	51	51	51
R-Squared	.03	.01	.01	.01	.01	.07	.01	.01

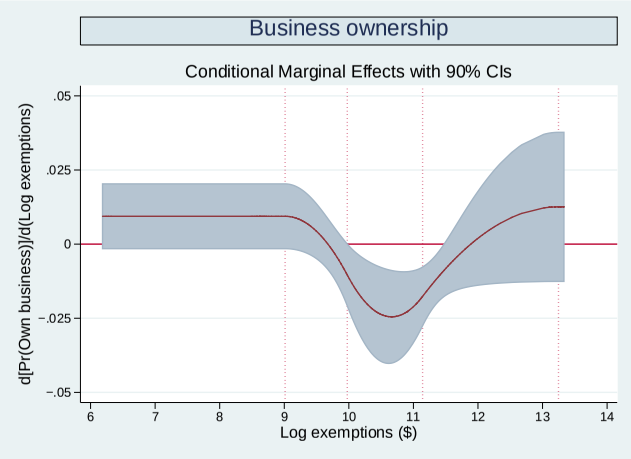
Notes. The table shows the effect of exemptions using piecewise-linear regressions with two knots placed at log exemptions equal to 10 and 11.4. The dependent variable is a dummy indicating self-employment status (col. 1 to 5), unincorporated and incorporated self-employment status (columns 4 and 5) and ownership of a business or a farm (col. 6 to 8). Household data is from the PSID for the period 1999-2009. Demographic and state-level controls are the same as in Table 3.2. Robust standard errors (clustered at the state level) are in parentheses. *significant at 10%; **significant at 5%; ***significant at 1%.

Figure 3.6: **Regressions of self-employment and business ownership using restricted cubic splines: Marginal effects at various exemption levels**

Panel A. Self-employment



Panel B. Business ownership



Notes. The figures show the marginal effects of exemptions on self-employment status and business ownership estimated using restricted cubic splines and the same set of controls and sample selection as in columns 3, 4, 5 and 8 of Table 3.13. The dependent variable is a dummy indicating self-employment status (Panel A) and business ownership (Panel B). Household data is from the PSID for the period 1999-2009. All marginal effects are plotted for various levels of log homestead plus wildcard exemptions and are estimated at the means of the remaining covariates. 90% confidence intervals are obtained by clustering the standard errors at the state level.

Since the protection channel is not plausible in this case, the credit market channel may be driving my findings as found by some previous studies. Thus, the risk channel does not seem to prevail at this margin either.

3.5 Discussion

This section discusses the magnitude and scope of the results and different explanations for my empirical findings.

3.5.1 Magnitude and scope of the effect

My results indicate that higher bankruptcy protection reduces stock market participation by 2p.p. when the home equity exemptions are between $22,000 and $90,000 approximately. Given that just around 20% of the selected PSID sample holds stocks, my estimated marginal effects represent a 10% decline when exemptions double. Among high-asset and high-income households, for which average participation increases to 33% and 27% respectively, the corresponding marginal effects represents almost a 15% decline. Thus, the magnitude of the treatment effect is moderate for the most affected groups.

I base my conclusions mainly on the estimates at intermediate exemption levels that correspond to more than a third of the sample. When exemptions are above $90,000, many households may be fully protected (the average home equity level in the sample is $68,000 and the median is $18,000, and among homeowners these figures increase to $110,000 and $68,000 respectively). In those cases increases in exemptions do not provide additional insurance and thus should not have any effect on households' or lenders' decisions. Moreover, identification is weaker by the lack of time variation in states with unlimited exemptions. When exemptions are below $22,000, further increases provide little additional insurance. Therefore, the effects on the probability of bankruptcy and on portfolio decisions are expected to be small. My estimates in this range show that the effects are positive and not robust. Table 2.1 shows the number of states at each exemption level per year, based on the cutoffs found in the data. The states with intermediate levels outnumber the ones with

low and high exemptions over the entire period. On average, 37% of the households in the sample are from states with intermediate exemptions, whereas the rest are split between low (36%), high (11%) and unlimited exemption states (16%). Note that by 2009, the fraction of households living in intermediate exemption states has increased up to 50%, whereas the fraction in low exemption states has declined to 18%.

3.5.2 Alternative explanations

My preferred explanation for the previous findings is that higher bankruptcy protection reduces the willingness to invest in unprotected assets. First, this interpretation is consistent with the fact that the effects are observed among high-income and high-asset households. Since they are more likely to trade in the stock market, they are the ones that will tilt their portfolios away from stocks when bankruptcy becomes more attractive. The effects among high-income households may seem surprising since after 2005 they face higher restrictions to file under Chapter 7. However, White [2007a] notes that in practice the restrictions were not so stringent and that the post-reform bankruptcy system still allows high-income households to file under Chapter 7. For instance, those with higher income levels who experienced a job loss or income fluctuations can choose to file when their income over the previous six months was lower. Second, my interpretation is consistent with the decline observed in the holdings of safe liquid assets and total liquid assets, which are also lost in bankruptcy. Finally, one would expect that the protection channels also leads households to invest more in exemptible assets. Unlike previous studies, I do not observe more investment in home equity. Especially after the 2005 reform this type of speculative behavior before filing has been curtailed. Households seem to be investing more in retirement assets (annuities, IRAs), but the effects are moderate, probably because there are restrictions in terms of the amounts that can be deposited into those accounts. It is also possible that at least part of the decline in stock market participation translates into an increase in consumption, given that those assets are going to be lost in bankruptcy anyway.

Since the effects of exemptions on stockholdings are less precisely estimated for the years 1999-2005, I speculate that the 2005 reform and the 2007-2008 financial crisis may have exacerbated the importance of the protection channel. Exit from the stock market during the crisis was the path taken by households in financial distress to meet housing consumption commitments [Chen and Stafford, 2014]. By reducing the attractiveness of

unprotected assets, an increase in exemptions could have accentuated this trend. On the other hand, after the introduction of the means test in 2005, it is possible that high exemptions increase the incentives of high-income households to reduce their capital income by selling stocks and become eligible for Chapter 7. This could have reinforced the importance of the protection channel and may explain the absence of heterogeneous effects among the unincorporated self-employed. The means test only is required to discharge consumer debt, but not to discharge non-consumer debt.[17] Thus, small firms, such as those owned by unincorporated self-employed, are automatically eligible to file under Chapter 7 and can discharge both types of debt in practice given that the distinction is blurry [Lawless and Warren, 2005]. However, the owners of incorporated firms still need to pass the means test because for them the personal and business debt are legally separate.

Two alternative explanations merit discussion. A first alternative explanation that I call the risk channel would account for a decline in participation if the stock return is negatively correlated with the risk of default. However, stronger negative effects are observed among entrepreneurs, who are more likely to have income risk positively correlated with the stock returns [Heaton and Lucas, 2000]. This is not consistent with the risk channel that predicts a positive effect for this group. In addition, this channel cannot account for the stronger effects found among incorporated self-employed and the lack of response from the unincorporated. The incorporated are less likely to exploit the bankruptcy insurance than the unincorporated because they already have limited liability. Thus, even when they still can discharge consumer debts in bankruptcy, they are less likely to respond to the risk-taking channel because they are less exposed to entrepreneurial risk. In addition, the absence of significant effects of exemptions on the risky portfolio share, even among entrepreneurs, suggests that they do not affect household preferences for risky versus safe assets.

A second alternative hypothesis is that higher exemptions reduce the demand for stocks by increasing debt interest rates and leading to credit rationing. However, the effects on the credit market are stronger among poor households and small firms, which is inconsistent with the effects on stockholdings found only for rich households and incorpo-

[17] Non-consumer debt includes business debts, tax debts, personal injury claims, other tort debts and credit cards used primarily to fund business operations.

rated self-employed. I measure the importance of the credit rationing channel by looking at holdings of both total household debt and other non-mortgage debt.[18] Strictly, only unsecured debt may be sensitive to changes in the exemption level. However, mortgage debt may also be affected if households increase the demand for secured credit when the cost of unsecured credit raises by taking more highly leveraged mortgages [Mitman, 2012]. My data shows that higher bankruptcy protection leads to lower holdings of total household debt at intermediate exemption levels, whereas the effects on non-mortgage debt are also negative but less precisely estimated. The effects on total debt ownership are stronger for low income households. Previous studies also find that the supply side restrictions of the bankruptcy protection impact more on poorer households, whereas the access to credit among wealthier households may actually increase (Gropp et al., 1997; von Lilienfeld-Toal and Mookherjee, 2008).

3.6 Conclusion

Understanding how households make portfolio choices is one of the major challenges faced by positive household finance. Despite the amount of wealth insurance provided by the government through social programs, its impact on households' portfolio decisions have received little attention. Addressing this question is important because providing insurance to individuals who fear the risk of negative wealth shocks may have positive externalities in their financial portfolios. At the aggregate level, the presence of uninsurable risks may lead to suboptimal risk-taking. This paper examines the effects of the asset protection guaranteed by the U.S. bankruptcy law on stock market participation. My results highlight that the insurance from bankruptcy does not encourage but actually discourages participation in stock markets among richer households. I find evidence of a negative effect at intermediate exemption levels (between $20,000 and $90,000). These effects, concentrated on wealthier, high-income households, correspond to about 37% of the sample.

I conclude that higher home equity protection from Chapter 7 reduces stockholdings by reducing the attractiveness of unprotected assets. Bankruptcy protection does not seem to affect the preference for risky versus safe assets since I do not find effects on the risky

[18] A positive effect of exemptions on the interest rates faced by households, especially those with low income, has been documented by Gropp et al. [1997] and Severino et al. [2014].

portfolio share. Finally, tighter credit constraints are not likely to mediate the estimated negative effects of the bankruptcy exemptions. These constraints affect mostly poorer households whereas the decline in stockholdings occurs among rich households.

It is not clear how these findings would affect social welfare. On the one hand, if households also respond to higher exemptions by investing more in other protected assets, in particular retirement accounts, the negative effects on risk taking would be offset. However, I cannot rule out that at least part of the decline in stockholdings translates into higher consumption, which can be seen as a less desirable externality. On the other hand, one also needs to consider if high-income households have more to gain from stockmarket participation than other households to evaluate whether exemptions are likely to be socially efficient. If rich households gain less from stock ownership, the effects of exemptions on social welfare may be less severe. Given that the income of rich households is more volatile and highly correlated with stock market fluctuations, they may benefit less from participation and more from the bankruptcy insurance. Many of the insurance opportunities available to poor households (unemployment and disability insurance, inter-vivos transfers, etc.) cannot insure the potentially large losses experienced by the wealthy, such as those coming from entrepreneurial income risk. From the perspective of the general desiderability of the bankruptcy protection, the effects estimated here need to be balanced against other costs and benefits of the law. This involves costs in terms of moral hazard from borrowers and worse credit market conditions and benefits in terms of consumption insurance and the possibility of a fresh start.

Appendix

D Definitions and sources

Table D.1: **Definitions of Household and State Variables**

This table summarizes the main household and state variables used in the paper. Except where indicated, all variables are extracted from the Panel Study of Income Dynamics.

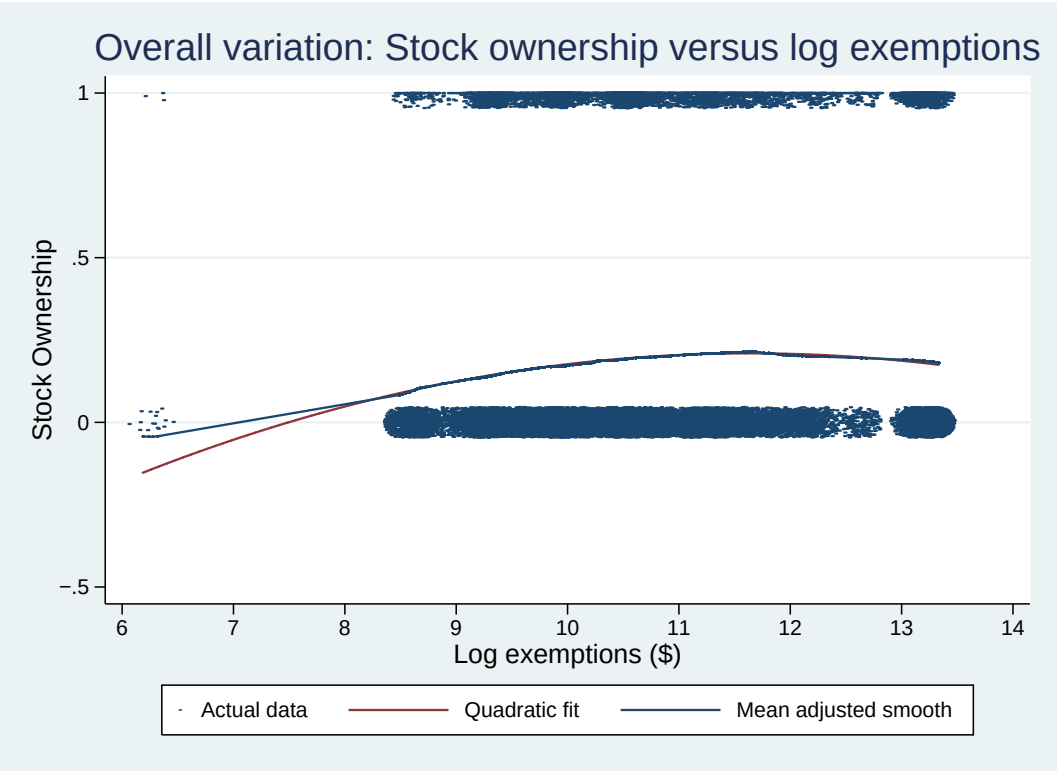
Variable	Description
Stocks	Dollar value of the shares of stock in publicly held corporations, mutual funds, or investment trusts, not including stocks in employer-based pensions or IRAs over liquid assets.
Stock market participation	Dummy variable equal to one if the head or anyone in the family have any stocks.
Stock market entry	Dummy variable equal to one if the household does not hold stocks at year t-1 and enters the risky asset market at year t.
Stock market exit	Dummy variable equal to one if the household holds stocks at time t-1 and exits the risky asset market at year t.
Safe liquid assets ($)	Dollar value of money in checking or savings accounts, money market funds, certificates of deposit, government savings bonds or treasury bills, and other assets (bond funds, cash value in a life insurance policy, a valuable collection for investment purposes, or rights in a trust or estate).
Total liquid assets ($)	Dollar value of stocks plus safe liquid assets.
Income ($)	Dollar value of the head's labor income, plus farm income and the labor portion of business income from unincorporated business, corresponding to the last calendar year.
Home equity ($)	Imputed dollar value of home equity, constructed as value of the home minus mortgage debt.
Retirement account ($)	Imputed dollar value of private annuities and Individual Retirement Accounts (IRAs).
Non-mortgage debt ($)	Dollar value of other debts different than mortgages on the main home and vehicle loans, such as credit card charges, student loans, medical or legal bills, or loans from relatives.
Total debt ($)	Total dollar value of mortgage debt plus other debt.
Business ownership	Dummy variable equal to one if the head or anyone in the family own all or part of a farm or business.
Self-employed	Dummy variable equal to one if the head of the household is "self-employed only" (excludes those self-employed that also work for someone else).

Variable	Description
Income ($)	Dollar value of the head's labor income, plus farm income and the labor portion of business income from unincorporated business, corresponding to the last calendar year.
Self-employed	Dummy variable equal to one if the head of the household is "self-employed only" (excludes those self-employed that also work for someone else).
Unincorporated firm	Dummy variable equal to one if the head of the household is self-employed and owns an unincorporated business.
Incorporated firm	Dummy variable equal to one if the head of the household is self-employed and owns a corporation.
Age of the head	Actual age of the head of the family unit.
Male	Dummy variable equal to one if the head is male.
Years of education	Highest grade or year of school completed by the household head.
Number of children	Number of persons in the family unit under 18 years of age, whether or not they are actually children of the head or wife.
Unemployment	Dummy variable equal to one if the head in the household is currently unemployed.
Married	Dummy variable equal to one if the head in the household is married or has a first-year cohabitor in the family unit.
Retired	Dummy variable equal to one if the head in the household is currently retired.
Size of the family unit	Number of persons in the family unit at the time of the interview.
House price	State-level house price index from Freddie Mac.
Unemployment rate	State-level unemployment rate from the Bureau of Labor Statistics.
Proprietor employment	State-level estimates of nonfarm self-employment, consisting of the number of sole proprietorships and the number of individual business partners not assumed to be limited partners (Bureau of Economic Analysis).
Per capita personal income	Total personal income divided by total midyear population (Bureau of Economic Analysis). I deflate this measure by the NIPA implicit price deflator for personal consumption expentidures (2004 q1 = 100).
State GDP	Real GDP by state in millions of chained 2009 dollars (Bureau of Economic Analysis).
Per capita medical expenses	Personal health care expenditures from the Centers for Medicare & Medicaid Services divided by the total state population.
Non-business bankruptcy filings (per 1,000 inhabitants)	Total number of non-business bankruptcy cases commenced (includes Chapters 7, 11 and 13) from the Statistics Division of the Administrative Office of the United States Courts, divided by the total state population (in 1,000s).

E Tests of nonlinearity and choice of the functional form

First, I check graphically whether the relationship between stock ownership and exemptions is nonlinear. Given the size of the dataset, it is hard to visualize it using scatterplots or residual-versus-fitted plots. Thus, I create a scatterplot that shows the relationship between stock ownership and exemptions using data from all panel observations. I add fitted quadratic regression and locally weighted regression curves to the scatterplot. I use a logarithmic transformation of the exemption level since its distribution is positively skewed. Indeed, 75% of the pooled observations correspond to states with exemptions below $105,000 and only the remaining 25% to states with exemptions that vary from $105,000 to $550,000 (or unlimited).

Figure E.1: **Overall scatterplot of stock ownership on log exemptions using all observations**



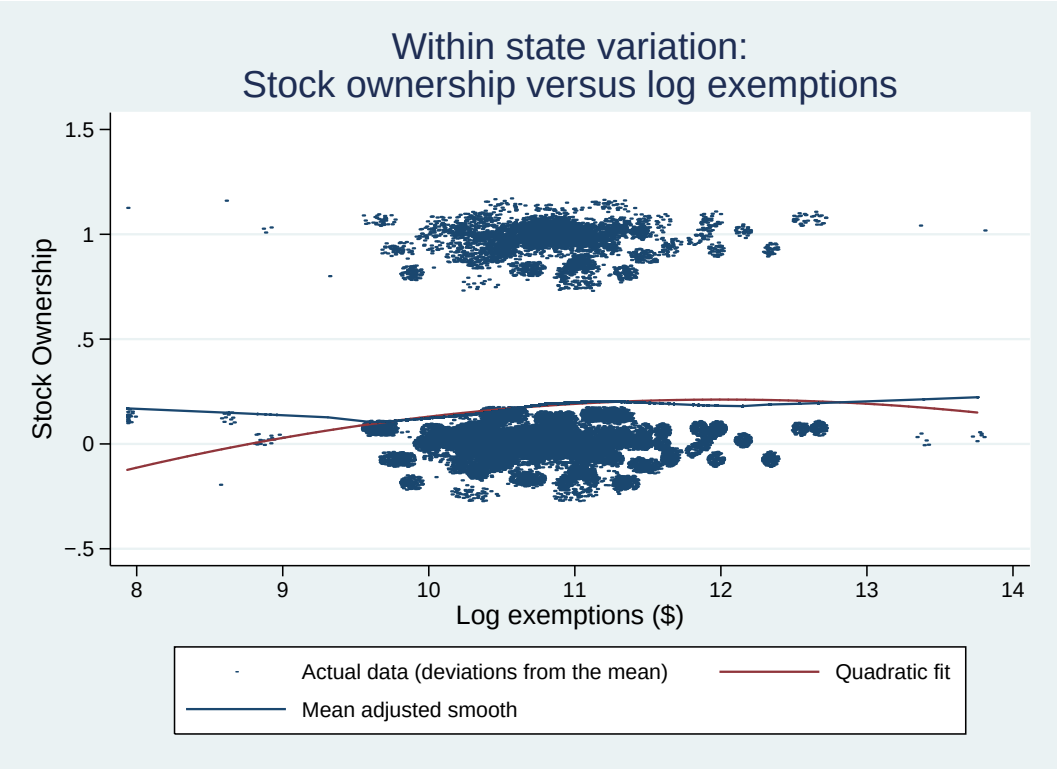
Notes. Each point of the scatterplot represents an individual-year pair. Some noise was added to the data to shift the points around for the visualization of the scatterplot. The red line is fitted by OLS of stock ownership on a quadratic in log exemptions. The line for the mean adjusted smooth is fitted by nonparametric regression using a locally weighted scatterplot smoothing (Cleveland's scatterplot smoother) of stock ownership on log exemptions. The resulting curve is adjusted (by multiplication) so that the mean of the smoothed values equals the mean of the unsmoothed values.

Figure E.1 suggests the presence of moderate nonlinearity, since stock ownership increases with log exemptions until they reach 11-12 ($60,000-160,000) approximately, at

which point it becomes flat.

Since my empirical strategy rests on within state variation, I also plot a within state scatterplot of stock ownership on log exemptions, expressed in terms of deviations from the means. Figure E.2 shows the values of stock ownership centered on $\overline{Y} = 0.18$ and the values of log exemptions centered on $\overline{X} = 10.8$, which are the sample means. The graph using within state variation in the data shows a weaker relationship between stockholdings and exemptions.

Figure E.2: **Within state scatterplot of stock ownership on log exemptions (deviations from the means)**



Notes. Each point of the scatterplot represents an individual-year pair expressed in deviations from state means, i.e. $Y_{ist} - \overline{Y_s} + \overline{Y}$ versus $X_{ist} - \overline{X}_s + \overline{X}$. See note in D.1 for description of the fitting curves.

Notice that these graphs are only exploratory; the unconditional relationship between exemptions and stock ownership can be misleading if it is capturing heterogeneity across states. To identify the relationship of interest it is necessary to use a multivariate and multivariable framework to control for the influence of other determinants of stock holdings. In particular, in the regression framework I can also control for individual-level, time-invariant heterogeneity.

Next, I use a factor variable approach to detect analytically the presence of nonlin-

earity. I formulate a logit regression model of stock ownership on exemption treated as a continuous variable and as a factor variable. The latter is feasible since I will use the dollar amounts specified by the bankruptcy law, which take a finite number of integer values. This allows to divide the relationship between stock ownership and exemptions into two components: the linear relationship and any nonlinear terms. The test of the indicator variables is significant at the 1% level ($\chi^2(122) = 1,448$, $p = 0.000$). This suggests that overall there is a significant contribution of the nonlinear components in the relationship between exemptions and stock ownership.

Polynomial specifications

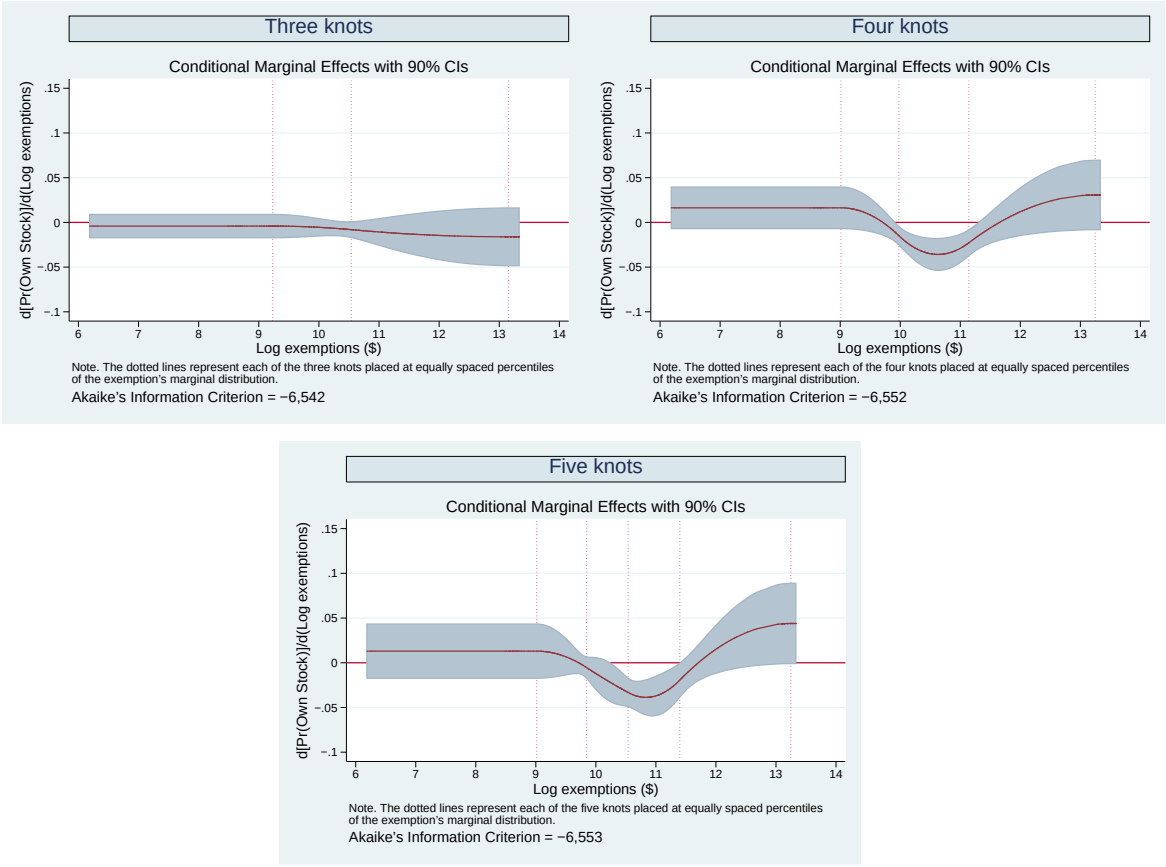
A common approach to deal with the nonlinearities is the use of a polynomial specification, where exemptions would enter not only linearly but also through a squared term and possibly cubic or of higher power. There are several reasons for why this is not a desirable strategy in this context. First, the polynomial curve has unwanted peaks and valleys. Second, it is not adequately fit "threshold effects", that is, sudden changes in the relationship of interest that occur after certain limit. Third, it is non-local, meaning that the fitted values at one segment of the curve depend strongly on the regressors some distance away. These elements imply that the fitted values at low exemption levels might be influenced by the fitted values at high exemption levels, even when the latter are relatively infrequent in this dataset.

Restricted cubic splines

For those reasons, I adopt in my preferred specifications a more flexible approach and estimate a restricted cubic spline regression, which does not present the same drawbacks. In fact, polynomials can be considered a special case of splines without knots. Stone [1986] has noted that the placement of the knots is not as crucial in the case of cubic splines as it is in linear splines. Since in this context there is not a strong a priori basis for the knots' placement, I use the one recommended by Harrell [2001]. Thus, I place the knots at equally spaced percentiles of the log exemption's distribution, which ensures that enough observations fall within each interval and prevents outliers having an excessive influence in the knot's location. The fit of the restricted cubic splines depends much more on the number of knots than on their placement. Thus, following Harrell's (2001) advice, I

estimate the model with 3 to 5 knots, as represented in Figure E.3.[19] This figure shows that the overall shape of the fitting does not change substantially as we increase the number of knots. In addition, when using 4 knots we get an improvement with respect to 3 knots by the inclusion of one knot at 11.1, where the data seems to present a bend. This is the point corresponding almost to the 65th percentile of the exemption distribution ($66,171). However, with 5 knots the curve remains essentially unchanged. Although the model with five knots maximizes the model likelihood ratio based on the Akaike's information criterion displayed at the bottom of each graph, the difference with the four-knot model is marginal. Thus, I restrict the number of knots to 4, which seems the one that provides the best compromise between flexibility and parsimony.

Figure E.3: **Restricted cubic spline regression: Marginal effects with three, four and five knots**



[19] Farrell (2001) notes that usually the number of knots varies between 3 to 5; often it is 4, for large samples the preferred number is 5 and for small samples is 3.

Linear splines

One of the drawbacks of the restricted cubic spline is that the flexibility of the curve comes at the cost of a more difficult interpretation of the results. To obtain point estimates that can be interpreted as regular regression coefficients, I also estimate linear splines. These provide a less smooth fitting but preserve other desirable features of the restricted cubic spline and doesn't suffer from the same drawbacks as the polynomial regression. Since I want a summary measure of the overall effects, I consider only one and two knots for the linear splines. By visual inspection of the cubic splines these numbers seems reasonable to model the relationship between exemptions and stock ownership. The main issue that needs to be addressed in linear splines is that they are very sensitive to where the knots are placed, which is not the case with cubic splines. Thus, I define the optimal knot location by selecting the one that minimizes the residual sum of squares.[20] I start with a guess for the knot placement of 10, based on the inspection of the cubic spline curves, and the automated process yields 10.5. Thus, I set at 10.5 the reference point for the model with one knot. Next, I replicate the same algorithm with initial plausible values of 10 and 11.5, and I get 10 and 11.4 as the values that minimize the residual sum of squares in a two-knot model.

In E.1 I summarize the coefficients estimated using one and two-knots linear splines. Then I compare them using the Akaike's information criterion (AIC) to choose which of the two models maximizes the model likelihood ratio and therefore fits the data better. I find that the model with two knots performs better (AIC of -6,550 versus -6,542 in the one knot model) and, therefore, this becomes the preferred specification.

[20] The exact algorithm is based on the one proposed by Mitchell [2012], pp. 109.

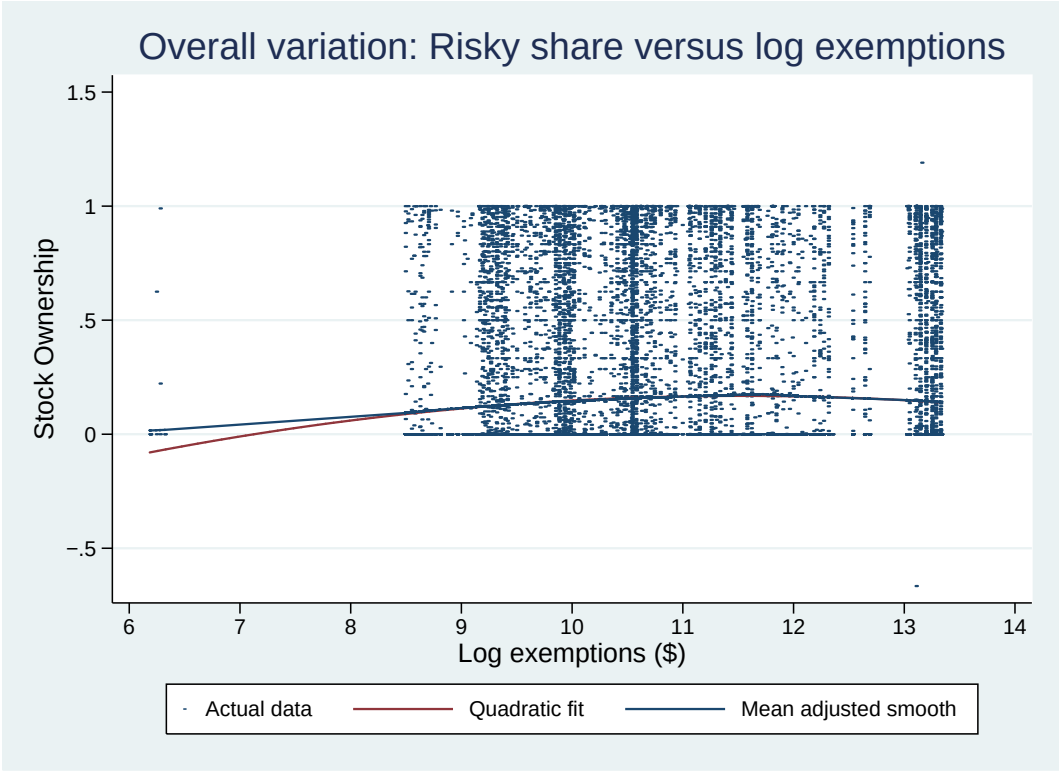
Table E.1: **Linear piecewise regression model with one and two knots**

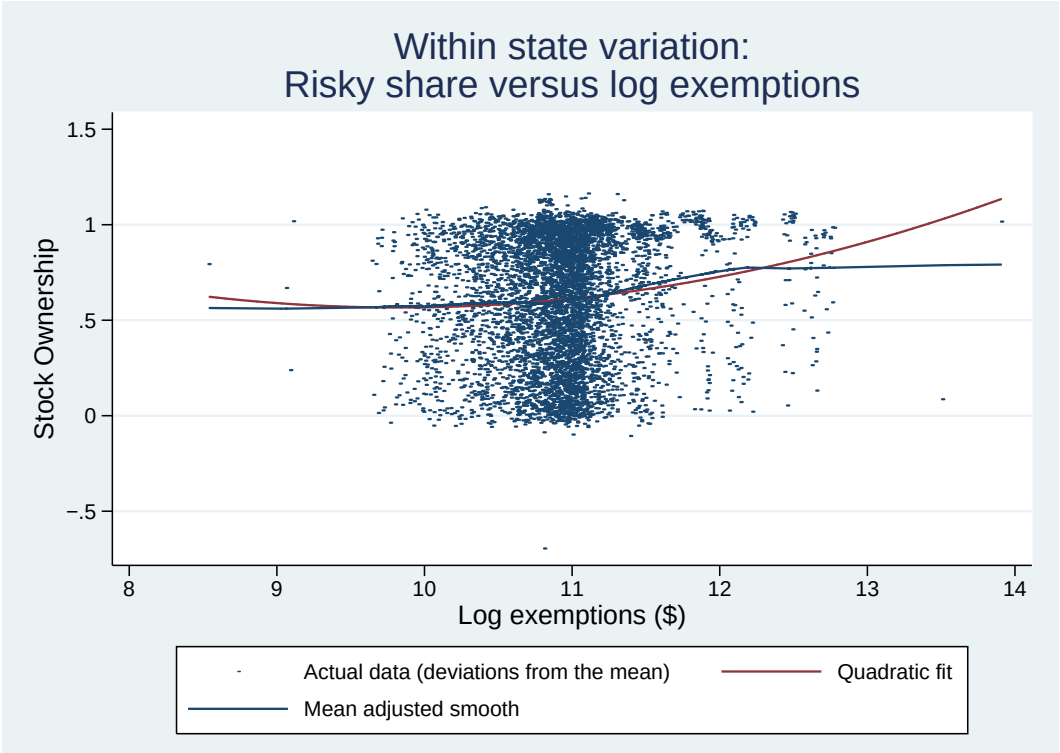
	One knot	Two knots
	(1)	(2)
	Coefficients	Coefficients
Log exemption < 10.5	-.004	
	(.006)	
Log exemption > 10.5	-.015	
	(.011)	
Log exemption < 10		.008
		(.011)
Log exemption 10-11.4		-.031***
		(.009)
Log exemption > 11.4		.013
		(.018)
Demographic controls	Y	Y
State-level controls	Y	Y
State FE	Y	Y
State x time trend	Y	Y
Year FE	Y	Y
AIC	-6,543	-6,550
No. of Obs.	37,416	37,416
No. of Clusters	51	51
R-Squared	.01	.01

F Additional figures

Figure F.1: **Scatterplots of the risky portfolio share on log exemptions**

Panel A. All the sample





Notes. See notes in Figures E.1 and E.2 for description of the curves.

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