Personal Bankruptcy, Entrepreneurial Financing, and the Economy

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Abstract

Entrepreneurship inherently carries risk. The majority of businesses are unincorporated, meaning the business debts become personal liabilities for the owner. Consequently, when such a business falters, the owner may be incentivized to file for personal bankruptcy. This paper studies the impact of wealth protection on entrepreneurial activities. Utilizing a regression kink design, I establish a first causal link between potential debt forgiveness and entrepreneurial activities. My findings indicate that more lenient debt relief policies motivate business owners to finance their enterprises. Specifically, an additional $1,000 in potential debt forgiveness increases the probability of debt financing for their businesses by up to 0.2 percentage points (0.6 percent), and boosts business debt size by 0.3%. To further this investigation, I introduce a quantitative general equilibrium model of household bankruptcy, integrating occupational choice. My results indicate that generous wealth protection can potentially amplify U.S. entrepreneurial activities by reallocating capital towards more productive yet less wealthy entrepreneurs, enhancing productivity and economic output, thus improving overall welfare.

1 Introduction

Entrepreneurship is a cornerstone of economic growth in the U.S. While many of the world's leading companies began as modest ventures, a significant portion of new businesses do not survive beyond a few years, highlighting the intrinsic risks of entrepreneurship. Personal bankruptcy laws offer a safety net in these situations, providing wealth protection in the worst case scenario. This protection facilitates smoother consumption for households. Essentially, more generous wealth protection provides a higher option value of bankruptcy. This option serves as an incentive for entrepreneurship by offering insurance against potential downturns. However, in a perfectly competitive financial environment, intermediaries anticipate the possibility of defaults and adjust their interest rates to reflect these risks. As a result, while personal bankruptcy laws offer an insurance, they may inadvertently exacerbate credit conditions.

Therefore, a complex trade-off arises: On the one hand, personal bankruptcy laws offer crucial wealth protection, potentially encouraging entrepreneurial ventures by mitigating risk. On the other hand, these laws can lead to increased financing costs, which may dampen entrepreneurial initiatives by making credit access more expensive and difficult. This delicate equilibrium between protecting personal assets and ensuring the availability of credit is pivotal in comprehensively understanding the broader impact of bankruptcy laws on entrepreneurial activities.

I investigate the influence of bankruptcy costs on entrepreneurial activities. In the U.S., separate procedures exist for personal and corporate bankruptcy. A significant majority of businesses are unincorporated, and thus, business debts translate directly into personal liabilities for the business owner. This means that when a business is unincorporated, lending to it is legally the same as lending to its owner. Given this framework, if the business encounters adversity, the owner might see an incentive to file for personal bankruptcy. In such cases, both the business and any unsecured debts of the owner are eliminated.

However, as noted by Berkowitz and White (2004), similar considerations might also apply to small corporations. Such entities could be perceived as less creditworthy than small non-corporate firms, primarily because small corporations rely solely on their corporate assets to secure business debts. In contrast, small non-corporate firms can leverage both the firm's assets and the owner's personal assets. Lenders are cognizant of the ease with which owners of small corporations can transfer assets between their personal and corporate accounts. Consequently, they may not regard the distinction between corporate and non-corporate firms as significant for smaller businesses. As a result, when extending credit to small corporations, lenders often insist on personal guarantees from the owners. Such requirements effectively dissolve the legal separation between the corporation and its owners for the concerned loan, thereby placing the owner's personal assets at risk in case of loan default.

By leveraging a comprehensive individual-level survey dataset from the U.S. Census covering the years 2000 to 2011, I have established a significant causal connection between bankruptcy costs and entrepreneurial activities. The findings of this study reveal that more generous debt relief policies are a motivating factor for business owners to seek financing for their enterprises, resulting in an increase in the size of their business debt. However, it is important to note that the impact of wealth insurance for entrepreneurs is relatively modest. This is particularly noteworthy considering that over half of U.S. business owners do not have any debts associated with their enterprises, suggesting a nuanced effect of bankruptcy policies on entrepreneurial financial decisions.

The existing literature presents a contrasting view on the relationship between the U.S. personal bankruptcy system and entrepreneurship. Previous studies, predominantly using observational data and regression analysis, suggest that lenient debt relief policies increase the likelihood of business ownership while simultaneously reducing the propensity of firms to accumulate business debt. These studies also indicate that such firms tend to have lower debt levels, with higher interest rates. However, these conclusions, potentially influenced by endogeneity, should be approached with caution as they might be biased and not necessarily indicative of a causal relationship.

My research challenges these existing findings. Employing a more robust research design, I demonstrate that more generous debt relief policies actually motivate business owners to incur greater debts for their enterprises, leading to an increase in overall debt size. This finding marks a significant departure from the preliminary Ordinary Least Squares (OLS) estimates, highlighting the importance of a rigorous methodological approach in understanding the true impact of bankruptcy policy generosity.

The primary role of personal bankruptcy in entrepreneurship is its function as insurance. Yet, this benefit is tempered by the drawback of deteriorated credit conditions. In an environment with incomplete credit markets where only basic debt contracts exist, bankruptcy introduces some contingency. This contingency serves as protection against the risks of entrepreneurship, but it also leads to tougher credit conditions. For instance, when bankruptcy laws rule out any possibility of default – essentially ensuring full commitment – borrowers can access credit at more favorable interest rates since they won't default. However, this means they lack a safety net against business setbacks. On the flip side, if bankruptcy provisions are more lenient about defaults, borrowers might find some protection against unfavorable outcomes. To balance this, banks might increase interest rates or limit the amount of credit they offer, given the heightened default risks. In both such scenarios, the equilibrium outcome could be very limited access to credit. This kind of environment often sees businesses that are smaller than ideal, with those owned by less wealthy entrepreneurs being particularly affected.

I construct an infinite horizon heterogeneous agent model, incorporating both bankruptcy and occupational choices. Agents vary based on their productivity, either as entrepreneurs or workers. Each period, they choose between entrepreneurship and employment, guided by an imperfect signal of their potential productivity. My model aims to quantitatively gauge the balance between two key factors: the insurance provided by bankruptcy and the resulting credit conditions. I then examine the impact of this balance on several areas: the number of entrepreneurs, the ability of less affluent agents to enter entrepreneurship, firm sizes, and broader issues like welfare, inequality, and social mobility.

This paper adds to the breadth of studies in entrepreneurship, particularly intersecting with the literature on borrowing constraints and entrepreneurial ventures. Researchers have noted that small business owners rely on external finance. Notably, Robb and Robinson (2014) empirically show that most startups heavily depend on the debt finance through personal balance sheets of the entrepreneur. Using KFS data, Robb and Robinson (2014) show that startups rely heavily on external debt sources, such as bank financing. They also show that many startups receive debt financed through the personal balance sheets of the entrepreneur, effectively resulting in the entrepreneur holding levered equity claims in their startups. Fonseca and Wang (2022) documents the increased importance of personal credit (rather than business credit) for entrepreneurs after 2008 financial crisis. Malkova (2020) and Herkenhoff et al. (2021) recently show that the importance of credit access to entry to entrepreneurship. Historically, researchers measured the the change in credit supply indirectly by deregulation and bank concentration. Bertrand et al. (2007) find that after deregulation, banks are less likely to bail out poorly performing firms, improving allocative efficiency across firms. Kerr and Nanda (2010) find after bank deregulation there was no change in startup size. Cetorelli and Strahan (2006) show that as bank concentration is higher, potential entrepreneurs find it hard to get an access to credit. Chen et al. (2017) small business credit declines with higher interest rates as bank concentration is higher.

This paper adds to the growing body of research on household bankruptcy. Fay et al.

(2002) find that a household's probability of filing for bankruptcy is increasing in the financial benefit from doing so. Ganong and Noel (2020) show that liquidity is the key driver in default and consumption decisions for borrowers. Indarte (2021) estimates that more generous homestead exemption results in more bankruptcy filings. She also shows that using ARM as an IV, higher mortgage payment results in higher rate of bankruptcy filing. Using a difference-in-differeces design, Auclert et al. (2019) study the effect of the great recession on hign vs. low debt relief states finding that high protection states had lower employment declines and higher unsecured debt charge-off.

This paper aligns with studies focusing on the interplay between the US personal bankruptcy system and entrepreneurship. White (2006) provide a good summary on the effect of homestead exemption on entry to entrepreneurship and small business credit. She concludes that high homestead exemption levels make it difficult for small businesses to borrow but make more people choose to be self-employed. Fan and White (2003) hypothesize that higher bankruptcy exemption levels benefit potential entrepreneurs who are risk averse by providing partial wealth insurance. They show that the probability of business ownership increases as the exemption level increases. Georgellis and Wall (2006) investigate the impact of marginal income tax rates and bankruptcy exemptions on entrepreneurship, finding an S-shaped relationship between bankruptcy exemptions and entrepreneurship. Rohlin and Ross (2016) also find that higher homestead exemption is associated with more business entry and more business exits due to more wealth protection. Berkowitz and White (2004) find that if small firms are located in states with unlimited rather than low homestead exemptions, they are more likely to be denied credit, and when loans are made, they are smaller and interest rates are higher.

This paper is associated with the study of bankruptcy and households. Livishits et al. (2007) and Chatterjee et al. (2007) analyze economies that include savings and unsecured debt, with debt prices varying based on loan size and household characteristics. These studies exclude the details of a household's exempt assets and liabilities, focusing solely on the net household position to concentrate on bankruptcy and unsecured credit. Lia and Sarte (2006) include durables in their default models to examine the impact of homestead exemptions. Mitman (2016) creates a framework that incorporates both secured and unsecured debt to investigate household bankruptcy. Akyol and Athrey (2011) examine economies that feature entrepreneurship alongside unsecured debt to explore the impact of U.S. personal bankruptcy on self-employment. Mankart and Rodano (2015) introduce secured debt, restricting borrowing to entrepreneurs who must use all their wealth in their business.

2 Background: Consumer Bankruptcy in the US

In personal bankruptcy, debtors can choose between two procedures: Chapter 7 and Chapter 13. For both options, all unsecured debts are wiped clean, and once a bankruptcy filing occurs, creditors are compelled to cease all collection activities and legal pursuits for repayment. Chapter 7, often referred to as a "fresh start", mandates that debtors relinquish any assets exceeding their state's exemption limit. However, all their future earnings remain protected. On the other hand, Chapter 13 doesn't demand debtors to give up their assets. Instead, they must propose a plan to repay part of their unsecured debts from future earnings, typically spanning 3 to 5 years.

For the majority of debtors, Chapter 7 is often the preferred route, largely because they usually lack nonexempt assets. (In fact, around 70 percent of all bankruptcy filings are made under Chapter 7.) For business owners, Chapter 13 tends to be less appealing compared to Chapter 7. This is because entrepreneurs, especially those whose ventures didn't succeed, often have no nonexempt assets. Moreover, the obligation to settle previous debts using future earnings can pose hurdles to launching a new business, as detailed by Fan and White (2003). As stipulated in 13 U.S.C. Section 1325(a)(4), creditors should expect to receive under Chapter 13 no less than what they would get in Chapter 7. Consequently, exemption levels are likely to have similar effects regardless of the chapter that entrepreneurs would choose in case of bankruptcy.

My primary focus is on the homestead exemption within Chapter 7 bankruptcy. While there are other types of exemptions such as equity in cars, cash, and various types of goods (clothing, furniture, cooking utensils, etc.), these constitute a relatively minor fraction of the total exemption. Notably, the homestead exemption stands out as the most significant component of household bankruptcy protection.

3 Data

I rely on the Survey of Income and Program Participation (SIPP) sourced from the U.S. Census, covering data from 2000 to 2011. My decision to utilize SIPP is based on three primary considerations. Firstly, SIPP presents a comprehensive panel sample that is representative of the U.S., capturing between 14,000 to 52,000 households over a span of up to four years. This depth enables me to observe a significant number of individuals as they embark on business ownership. Secondly, SIPP provides intricate details on household-level net worth, offering insights into specific components, like home equity. Lastly, SIPP maintains records of the business balance sheets for entrepreneurs, which is invaluable as it affords me a longitudinal view of both the scale and indebtedness of businesses.

The SIPP gathers a diverse array of information at both the individual and household levels. This includes questions like "Do you own a business?" and "What is the value of your business?" Such queries assist in pinpointing entrepreneurs within the sample. In this paper, entrepreneurs are characterized based on the following criteria: (1) ownership of a business; (2) working more hours for their own business than for an employer, if they are also employed; (3) the business being a sole proprietorship; and (4) the business possessing a positive value. The first two criteria are commonly employed in existing literature. However, the emphasis on a business having a positive value is a novel criterion introduced in this analysis, aimed at differentiating genuine entrepreneurs from casual business owners. This definition aligns with Hurst and Pugsley (2017), who highlighted that certain entrepreneurs might not harbor ambitions to expand their ventures and may have alternative motivations for business initiation. Such individuals aren't necessarily the archetypical entrepreneurs we often envision. For instance, roughly 30% of businesses in my sample report zero value. This discrepancy could potentially be attributed to measurement errors within the SIPP dataset. Throughout this paper, the value of a business is employed as an indicator of its size.

In constructing the sample for this study, I have adhered to methodologies commonly employed in the literature, as demonstrated by Hurst and Lusardi (2004). The focus is specifically on individuals aged between 30 to 64 years, thereby strategically circumventing the complexities associated with periods of education and retirement. In this dataset, each individual is categorized either as a worker or a business owner, resulting in a comprehensive sample that encompasses a total of 162,577 individuals across these two distinct categories.

It is crucial to acknowledge that the SIPP data tends to oversample households with lower incomes. To counteract this bias and ensure that the dataset remains nationally representative, sampling weights have been consistently applied throughout the analysis. Furthermore, all monetary values in the study are presented in real 2020 dollars, adjusted for inflation, to provide a consistent and accurate economic context.

To begin with, I present some descriptive statistics from the data. Table 1 outlines the demographic and asset summary statistics for different groups within the sample. Consistent with previous studies, entrepreneurs typically possess greater wealth compared to employed workers. The median net worth for workers stands at $183,500, while entrepreneurs boast a median net worth of $342,140. Furthermore, business owners generally have higher home equity compared to non-entrepreneurs; the median home equity for entrepreneurs is $131,940, in contrast to $94,800 for non-entrepreneurs. Entrepreneurs also tend to be older with more accumulated work experience than workers, calculated as age minus years of education minus 6. Demographically, entrepreneurs are more likely to be white and married and less likely to be female compared to employed workers.

Table 1 provides further insights by showcasing summary statistics related to the businesses themselves. The data reveals that the median business value among entrepreneurs is $13,570, indicating the typical scale of business operations. Interestingly, it appears that the median entrepreneur does not have any debt specifically linked to their business. Within the SIPP sample, only about 36% of entrepreneurs have positive business-related debts. This highlights a significant tendency towards minimal or no business debt among entrepreneurs. Additionally, the data shows a notable prevalence of sole proprietorships, which account for more than half of the business types represented in the sample. This distribution underscores the dominance of this business structure among U.S. entrepreneurs.

Table 1: Summary statistics: SIPP

	Entrepreneurs	Workers
Age	48.12	46.08
Net worth (median)	$342.14	$183.50
Home equity (median)	$131.94	$94.80
Education	Some college	Some college
White	0.84	0.78
Married	0.79	0.75
Female	0.36	0.50
Biz value (median)	$13.57	.
Biz debt (median)	$0	.
1(biz debt $>$ 0)	0.36	.
Sole proprietorship	0.61	.
Partnership	0.10	.
Incorporated	0.29	.
Obs.	24,398	138,179

Source: SIPP

$ thousands in 2020

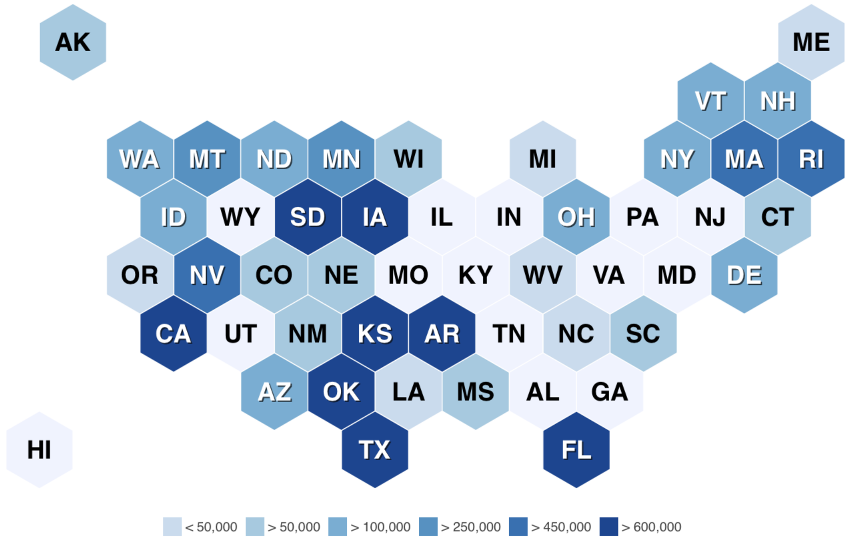


Figure 1: Homestead exemption in 2021

Table 2: Summary statistics: State-level homestead exemption (in nominal values)

Year	Min	25%	50%	75%	Max
2000	$0	$5,000	$25,000	$80,000	Unlimited
2001	$0	$8,000	$30,000	$100,000	Unlimited
2002	$0	$8,000	$30,000	$100,000	Unlimited
2003	$0	$10,000	$35,000	$100,000	Unlimited
2004	$0	$10,000	$35,000	$150,000	Unlimited
2005	$0	$10,000	$40,000	$150,000	Unlimited
2006	$0	$15,000	$45,000	$150,000	Unlimited
2007	$0	$15,000	$50,000	$250,000	Unlimited
2008	$0	$18,500	$51,450	$250,000	Unlimited
2009	$0	$20,000	$60,000	$250,000	Unlimited
2010	$0	$20,000	$60,000	$250,000	Unlimited
2011	$0	$20,000	$60,000	$250,000	Unlimited
2012	$0	$21,500	$60,000	$250,000	Unlimited
2013	$0	$22,975	$72,900	$250,000	Unlimited
2014	$0	$22,975	$72,900	$250,000	Unlimited
2015	$0	$22,975	$75,000	$250,000	Unlimited
2016	$0	$23,675	$75,000	$250,000	Unlimited
2017	$0	$23,675	$75,000	$250,000	Unlimited
2018	$0	$23,675	$75,000	$250,000	Unlimited
2019	$0	$25,000	$75,000	$250,000	Unlimited
2020	$0	$25,150	$75,000	$250,000	Unlimited
2021	$0	$30,000	$75,000	$450,000	Unlimited

This table presents a detailed overview of state-level homestead exemptions in 49 states across the United States, specifically excluding New York and Washington, which set their exemptions at the county level. It presents the homestead exemption values in nominal terms, covering the years 2000 to 2021. It illustrates the minimum, 25th percentile, median (50th percentile), 75th percentile, and maximum exemption values for each year.

Each state in the U.S. sets its own homestead exemption limit, resulting in considerable variation across the country. Figure 3 illustrates the distribution of these exemptions for the year 2021, capturing the diverse range of limits set by different states. Moreover, these exemption limits are not static; states adjust them over time, contributing to the observed variability. Table 2 provides summary statistics of state-level homestead exemptions in nominal values, spanning from 2000 to 2021. This data, derived from Indarte (2021), excludes New York and Washington, where homestead exemptions are determined at the county level.

For 2021, the federal exemption stands at $25,150. The lower quartile of state exemptions is approximately $30,000, while the median has escalated to around $75,000. Notably, the 75th percentile reaches $450,000, indicating that in some states, residents can protect up to this amount in home equity when filing for bankruptcy. Furthermore, certain states offer an unlimited exemption, contrasting sharply with those that have a zero exemption, where individuals must relinquish all home equity in bankruptcy cases. The trend over time reveals a general increase in these exemptions. For example, the median state exemption in 2000 was $25,000, increasing threefold to $75,000 by 2021. Similarly, the 75th percentile rose from $80,000 in 2000 to $450,000 in 2021. This upward trend in homestead exemptions likely reflects factors such as inflation and rising housing prices.

Both New York and Washington set homestead exemptions at the county level, differing from the state-specific data provided in the SIPP. Consequently, I have excluded these two states from my analysis to maintain consistency. Two crucial factors are considered in the study: the federal exemption and the provision for joint filing. More than a third of the states allow residents to choose between the state-specific exemption and the federal exemption. For example, in 2005, the federal exemption was $18,450. Households are likely to select the federal exemption when it is more advantageous than the state's option. Additionally, the majority of states offer married couples the opportunity to claim larger homestead exemptions when filing jointly for bankruptcy. In these cases, married couples can effectively double their homestead exemption. These variations and provisions have been carefully considered to accurately calculate the effective homestead exemption for the purposes of this analysis.

4 Causal inference

4.1 Research design

My analysis centers on Chapter 7 bankruptcy. The asset exemption laws across states dictate the level of debt relief available to bankruptcy filers. Under these laws, filers are required to repay creditors an amount that corresponds to the value of any assets exceeding the established exemption limits. Therefore, the net financial benefit derived from filing for bankruptcy effectively equals the amount of dischargeable debts minus the value of seizable assets. For simplicity, this analysis does not account for the fees associated with the legal and administrative processes involved in bankruptcy filing.

As highlighted in the work of Auclert et al. (2019), a significant portion of the variance in household debt relief can be attributed to the homestead exemption, which serves to protect the home equity of individuals filing for bankruptcy. To examine this aspect further, I begin by defining home equity distance. This is achieved by re-centering the home equity variable in the dataset:

$$\text{Home Equity Distance} = \text{Home Equity} - \text{Homestead Exemption}.$$

In this study, "home equity distance" is employed as the running variable. It's crucial to understand that when a household's home equity is below the state's homestead exemption limit, any marginal change in home equity does not affect the cost associated with bankruptcy. Conversely, if the home equity surpasses the exemption limit, any amount in excess becomes subject to seizure and is payable to creditors in the event of bankruptcy. This creates a significant change, or a "kink", in what is referred to as "seizable equity". Seizable equity can thus be defined as follows:

$$\text{Seizable Home Equity} = \max\{\text{Home Equity Distance}, 0\}.$$

It's crucial to highlight that the kink in seizable home equity determines the treatment status in this analysis. The key assumption in this analysis is that in the U.S., households home equities are effectively randomly distributed in areas close to the state-specific homestead exemptions. In other words, the "home equity distance" is as good as randomly assigned around zero. Consequently, I interpret this kink in seizable home equity as an exogenous variation in the bankruptcy wealth protection. Figure 2 illustrates this concept, showcasing a kink in seizable equity for Colorado in 2010—a year when Colorado's homestead exemption was median for the U.S. For clarity in presentation, the figure plots seizable home equity as a function of home equity itself, rather than the home equity distance. Figure 3 graphically represents the identification strategy employed in this research design. The exogenous variation in home equities, particularly around the exemption limits, induces a variation in wealth protection among different households. This, in turn, is posited to have a causal impact on the outcomes of interest in the study.

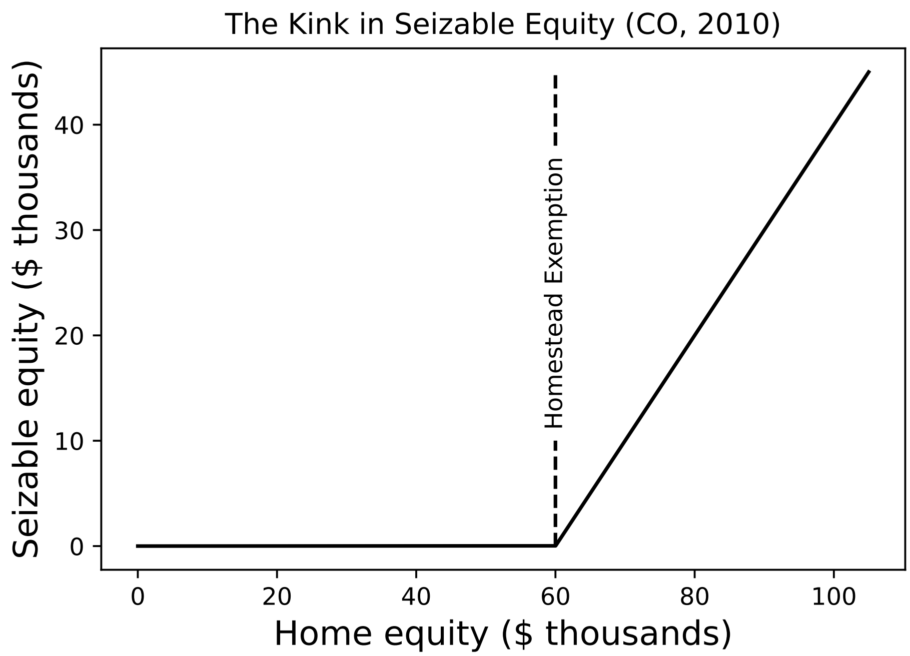


Figure 2: Homestead exemption in Colorado, 2010

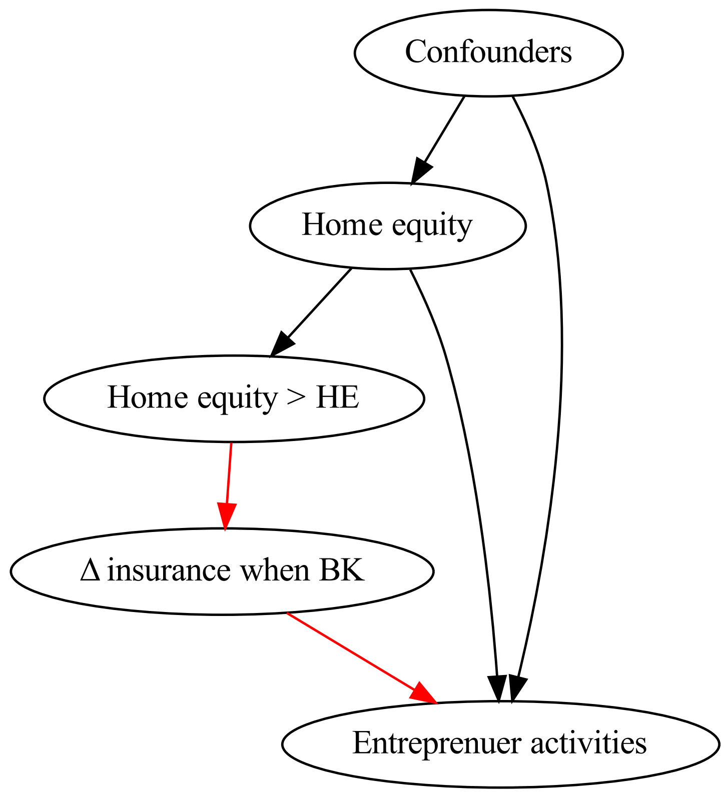


Figure 3: Directed acyclic graph for sharp RKD

A proper research design is crucial to ensure that the kink in seizable home equity is indeed exogenous. Without this, the results could be compromised by endogeneity. Fan and White (2003) and Rohlin and Ross (2016) show that the probability of business ownership increases with the exemption level. Also, Berkowitz and White (2004) find that small firms in states with unlimited rather than low homestead exemptions are more likely to be denied credit. Additionally, the loans they do receive are typically smaller, with higher interest rates. I replicate their regression results, finding similar effects, which are detailed in Appendix A. As the exemption level increases, so does the probability of entrepreneurship. Concurrently, business owners are less likely to acquire business debt and tend to have lower amounts of such debt. Nevertheless, due to potential endogeneity, these findings should be interpreted with caution as they might contain biases and cannot be conclusively deemed causal. Under a more rigorous research design, it becomes evident that the impact of bankruptcy generosity significantly diverges from these preliminary OLS estimates.

4.2 The effect of bankruptcy generosity on entrepreneurial activities

In this study, I utilize a sharp regression kink design (RKD) to identify the impact of bankruptcy costs, leveraging the kinks present in seizable home equity. The identification strategy for RKD in this research closely follows the methodology outlined by Card et al. (2015). Conceptually akin to a regression discontinuity design (RDD), RKD differs in that it leverages a discontinuity in the slope of the treatment function, rather than a change in its level. For a graphical representation of this identification strategy, Figure 3 provides a directed acyclic graph (DAG) to illustrate the process. In the model that follows, the variable Y_i represents the outcome of interest.

$$Y_i = \beta S(X_i) + g(X_i) + u_i \tag{1}$$

where X_i is a running variable; S is a treatment variable which is kinked at $X_i = x^*$; and $g(X_i)$ and $E[u_i \mid X_i]$ are smooth functions (continuously differentiable) of X_i without having a kink point at x^*. X_i is home equity distance and S_i is seizable home equity. Since I assumed that home equity distance is as good as randomly assigned around the threshold, zero, there is a kink in the function $S(X_i)$ at x^* which is zero. However, there is no kink in the function $g(X_i)$ or the function $E[u_i \mid X_i]$. Let d_0 and d_1 be slopes of $S(X_i)$ from left and right limits respectively.

In this model, X_i represents the running variable, while S denotes the treatment variable, which exhibits a kink at the point $X_i = x^*$, the designated threshold. The functions $g(X_i)$ and the expected value $E[u_i \mid X_i]$ are smooth and continuously differentiable across the range of X_i and do not display a kink at x^*, the threshold. In this context, X_i is defined as the home equity distance, and S_i as the seizable home equity. Given the assumption that home equity distance is effectively randomly assigned around the zero threshold, a kink in the function $S(X_i)$ occurs precisely at x^*. However, this kink is not present in either the function $g(X_i)$ or the expectation $E[u_i \mid X_i]$.

The slopes of $S(X_i)$ approaching from the left and right of this kink point are denoted as d_0 and d_1, respectively, defined as follows:

$$d_0 \equiv \lim_{x \uparrow x^*} \frac{\partial S(x)}{\partial x}, \tag{2}$$

$$d_1 \equiv \lim_{x \downarrow x^*} \frac{\partial S(x)}{\partial x}, \tag{3}$$

and $d_0 \neq d_1$. Furthermore, the derivative of the expected value of the outcome variable Y_i with respect to x can be expressed as:

$$\frac{\partial E\left(Y_i \mid X_i = x\right)}{\partial x} = \beta \frac{\partial S(x)}{\partial x} + \frac{\partial g(x)}{\partial x} + \frac{\partial E\left(u_i \mid X_i = x\right)}{\partial x}. \tag{4}$$

Now we can show that the causal parameter, β, is identified. The identification is achieved through the following derivation:

$$\begin{aligned} \frac{\lim_{x \downarrow x^*} \frac{\partial E(Y_i|X_i=x)}{\partial x} - \lim_{x \uparrow x^*} \frac{\partial E(Y_i|X_i=x)}{\partial x}}{d_1 - d_0} &= \frac{\lim_{x \downarrow x^*} \beta \frac{\partial S(x)}{\partial x} - \lim_{x \uparrow x^*} \beta \frac{\partial S(x)}{\partial x}}{d_1 - d_0} \\ &= \beta. \end{aligned} \tag{5}$$

Given that $d_0 = 0$ and $d_1 = 1$, the denominator of the above equation simplifies to 1. Hence, we focus on the following expression:

$$\beta = \lim_{x \downarrow x^*} \frac{\partial E\left(Y_i \mid X_i = x\right)}{\partial x} - \lim_{x \uparrow x^*} \frac{\partial E\left(Y_i \mid X_i = x\right)}{\partial x}. \tag{6}$$

In simpler terms, β captures the change in the *slope* of the expected outcome with respect to the running variable at the kink point. It effectively represents the treatment effect on the outcome variable.

The sharp RKD design employed in this study effectively captures a local average treatment effect (LATE) at the kink point, assuming perfect compliance. The SIPP sample used here aggregates data across various states and years, encompassing a range of exemption limits. As a result, the estimate for β represents an average of LATEs derived from these different exemption thresholds.

The actual estimation is as follows:

$$E[Y \mid X = x] = \alpha + \sum_{p=1}^{\bar{p}} \beta_p x^p + \sum_{p=1}^{\bar{p}} \widetilde{\beta}_p D x^p \tag{7}$$

$$\text{where } \ |x| \leq h. \tag{8}$$

In this equation, X is the running variable, representing the home equity distance, while $D = 1[X \geq 0]$ is an indicator for being above the kink threshold. The bandwidth size is denoted by h. The key parameter of interest is $\widetilde{\beta}_1$, which reflects the change in the slope of the conditional expectation function at the kink. For estimation, I employ local nonparametric polynomial estimation using a uniform kernel, as recommended in the sharp RKD literature.

A crucial assumption underpinning RKD is the smoothness condition, which posits that the population average potential outcomes are smooth (or continuous) functions of the running variable at the kink. This assumption is inherently untestable since we observe only realized outcomes, not potential ones. To address this challenge, I conduct tests to check for any potential manipulation of the running variable. It's also vital to confirm that no kinks occur in other covariates, as such anomalies could influence the study's outcomes. For example, if more generous debt relief policies lead banks to increase lending rates (resulting in a kink in this variable), this could negatively impact entrepreneurial activities. In other words, if lending rates exhibit a kink at the exemption threshold, it could compromise the validity of the RKD estimate. Therefore, I also perform checks for covariate balance to ensure the robustness of the findings.

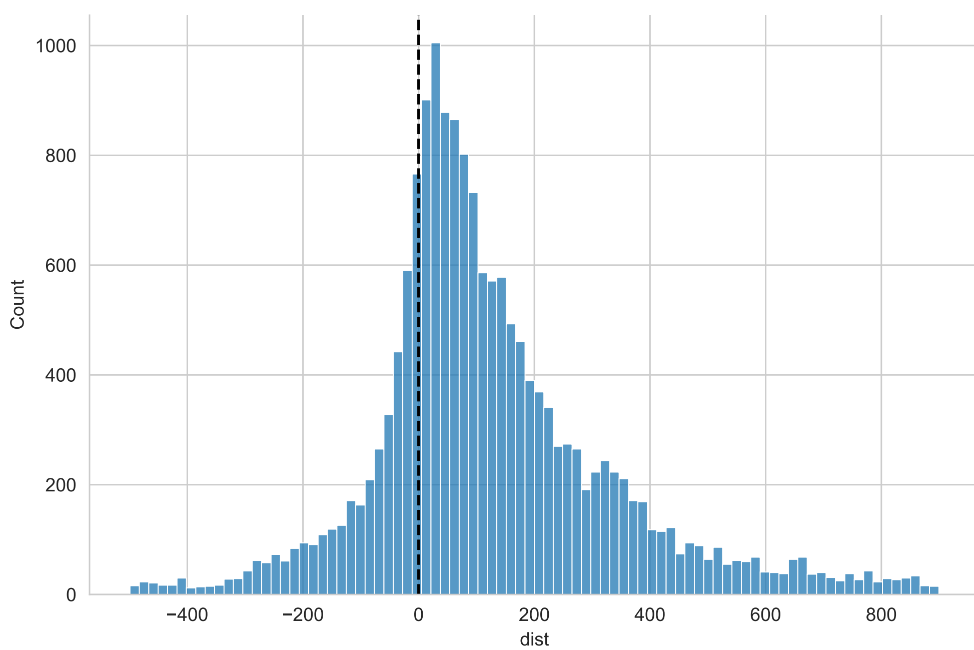


Figure 4: Density of home equity distance

To mitigate the possibility that bankruptcy filers might strategically reduce their home equity to fall below their state's exemption limit, thereby minimizing bankruptcy costs, I carefully examine the empirical distribution of the home equity distance, which serves as our running variable. Figure 4 presents the distribution of home equity distance for U.S. business owners spanning from 2000 to 2011. The vertical line in the figure denotes the re-centered cutoff for the homestead exemption, set at zero. The running variable exhibits an average value of $125.60 and shows a deviation of $201.34 from this mean. Observationally, the distribution appears to show minimal signs of endogenous sorting on either side of the threshold.

To substantiate this graphical observation, I conduct the McCrary Density test, a widely used diagnostic tool in the Regression Discontinuity Design literature. The results of this test yield a p-value of 0.81 at the threshold, indicating that the null hypothesis – which posits no discontinuity in the density of our running variable at the cutoff – cannot be rejected. This finding suggests an absence of manipulation in the home equity distance variable, enhancing the credibility of the running variable and the robustness of our analysis.

Table 3: The effect of increases in potential debt forgiveness on covariates

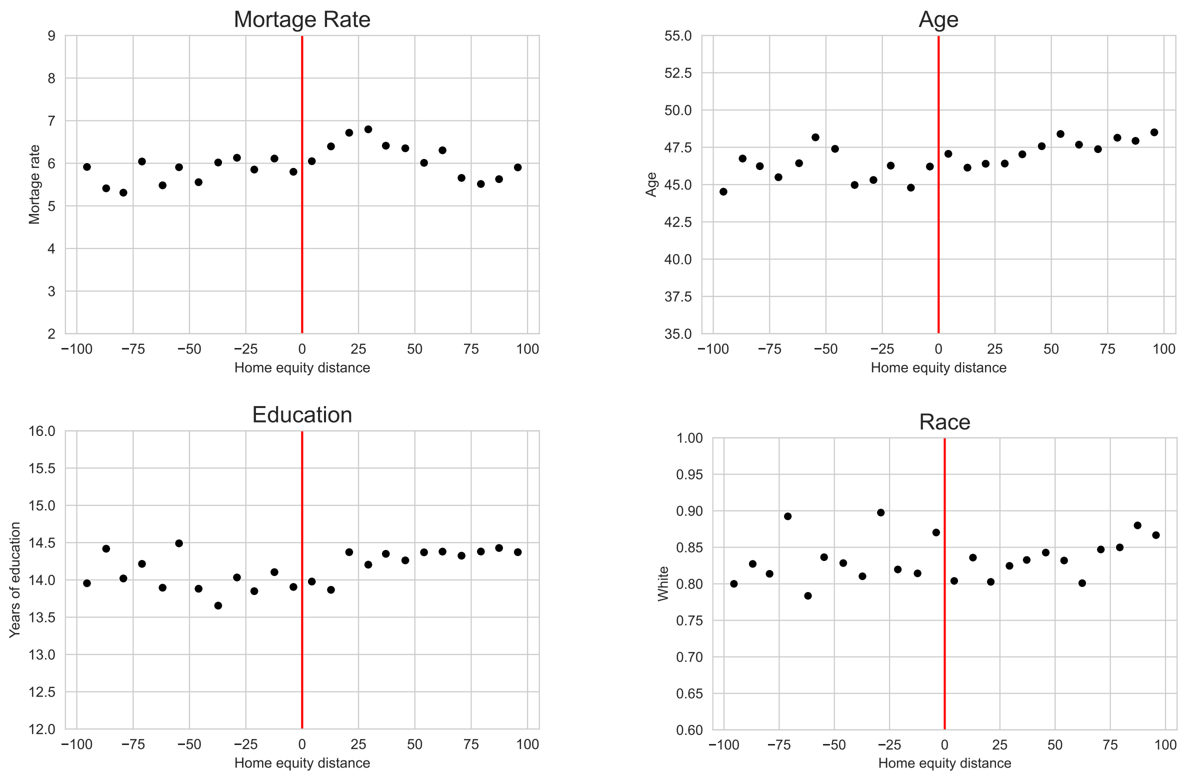
	Mortgage rate	Age	Education	Race	Gender	Marital status
RKD est.	-0.012	0.03	0.009	-0.0004	0.0003	0.0022
	(0.009)	(0.09)	(0.005)	(0.0004)	(0.0005)	(0.0020)
Bandwidth	80	80	80	80	80	80
RKD poly. order	1	1	1	1	1	1
Observations	10,431	10,431	10,431	10,431	10,431	10,431

This table contains regression kink based estimates of the effect of the bankruptcy generosity on covariates. All regressions have a bandwidth of 80 and use a uniform kernel for weighting. See Appendix C for more detailed results. Clustered robust standard errors are in parentheses. Significance levels are denoted as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

A crucial aspect of validating a regression kink design involves ensuring that the conditional expectation of any covariate remains twice continuously differentiable at the kink. This check is vital, as any kink in covariates could potentially confound our results. For example, if more generous debt relief were to cause banks to raise lending rates, this could influence entrepreneurial activities. In such a scenario, if lending rates display a kink at the threshold, it might undermine the integrity of the RKD estimate. To address this concern, covariate balance checks are conducted.

Table 3 presents the estimates assessing the impact of increases in potential debt forgiveness on various predetermined characteristics, which ideally should remain unaffected by the homestead exemption threshold. These estimates are derived using the same regression model as outlined in Equation 7, with each control variable serving as the dependent variable in turn. The local linear regression models employed use a bandwidth of 85 and a uniform kernel for weighting, incorporating approximately 40 percent of the available sample.

The analysis spans various demographics of entrepreneurs and the mortgage rate. In each case, the null hypothesis — that these predetermined characteristics are unrelated to the homestead exemption cutoffs for home equity — cannot be rejected. This lack of significant relationship in the regression coefficients indicates a balanced distribution of covariates across the threshold. Additional detailed results, including those from more flexible functional forms and alternative definitions of business owners, are provided in Appendix C. The findings are further corroborated graphically in Figure 5, reinforcing the conclusion that the homestead exemption cutoff does not systematically affect the covariates examined.



(a) Bankruptcy probability

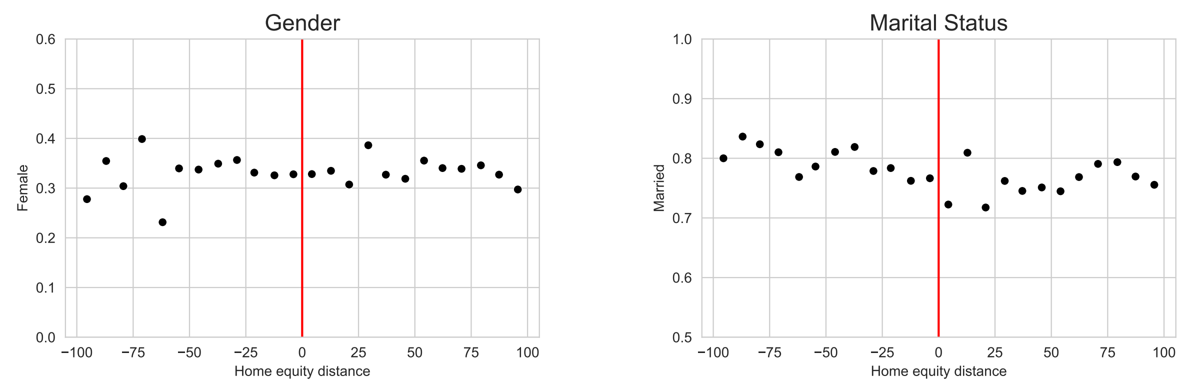


Figure 5: Homestead exemption threshold and characteristics

Figure 5 visually demonstrates the distribution of predetermined characteristics across bins, focusing on demographic factors such as age, race, education, gender, and marital status, as well as the current mortgage rate, a crucial indicator potentially influencing financing decisions. Notably, these characteristics remain stable across the homestead exemption threshold. The unchanged nature of the mortgage rate, in particular, is significant as it could directly impact entrepreneurial financing choices.

The consistent pattern observed in these predetermined characteristics, particularly their smooth transition at the kink, lends further credibility to the validity of the regression kink design employed in this analysis. This stability supports the core identification assumption of the regression kink design, suggesting that it can provide unbiased estimates in this context. The lack of significant fluctuations in these variables around the threshold reinforces the notion that the observed treatment effects are indeed attributable to changes in the homestead exemption and not to other confounding factors.

Table 4: The effect of increases in potential debt forgiveness on entrepreneurial enterprise

	(1)	(1)	(2)	(3)
Panel A: $Y = 1(business\ debt)$				
RKD est.	-0.0013***	-0.0019***	–0.0009**	-0.0009**
	(0.0004)	(0.0007)	(0.0004)	(0.0004)
Bandwidth	82.83	137.33	105.79	106.5
RKD poly. order	1	2	1	1
Observations	10,014	15,386	8,026	7,222
Panel B: $Y = \log(business\ debt)$				
RKD est.	-0.0031**	-0.0065**	-0.0046**	-0.0011
	(0.0017)	(0.0007)	(0.0022)	(0.0024)
Bandwidth	95.49	159.66	95.89	98.81
RKD poly. order	1	2	1	1
Observations	10,904	14,935	7,525	6,933
Panel C: $Y = \log(business\ size)$				
RKD est.	-0.0045	-0.0098**	-	-0.0028
	(0.0028)	(0.0043)	-	(0.0034)
Bandwidth	88.27	176.95	-	94.81
RKD poly. order	1	2	-	1
Observations	7,087	10,951	-	4,812
Panel D: $Y =$ Business entry decision				
RKD est.	-0.00002	0.00005	0.00002	-0.000002
	(0.00003)	(0.00006)	(0.00003)	(0.000006)
Bandwidth	80.22	130.13	82.15	108.5
RKD poly. order	1	2	1	1
Observations	68,290	92,826	71,208	88,698

In the definitions provided: (1) Entrepreneurs are defined as business owners; (2) entrepreneurs are characterized as those in (1) with a positive market value for their business; (3) entrepreneurs, as per (2), are specifically those operating a sole proprietorship. For Panel A and D, the estimates correspond to the percentage point change in each outcome in response to a \$1,000 increase in seizable home equity; for Panels B and C, the estimates correspond to the percentage change in each outcome in response to the same \$1,000 increase in seizable home equity. Approximation bias-corrected robust standard errors in this study are computed following the methodology established by Calonico et al. (2014). Additionally, the bandwidth, expressed in thousands of dollars, is optimally chosen for each specification using the MSE-minimizing procedure as outlined in Calonico et al. (2014). Clustered robust standard errors are in parentheses.

Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 12 details the primary results derived from the regression kink design (RKD) estimates. To ensure the robustness of these results, I have employed three distinct definitions of entrepreneurs. The first definition identifies any individual as an entrepreneur if they own a business, yielding a sample size of 24,398. The second definition narrows this down to those whose business has a positive market value, leading to a sample size of 17,200. The third definition further restricts it to sole proprietorships, resulting in a sample size of 13,734. For the comprehensive analysis, the primary focus will be on the first definition of entrepreneurs due to its larger sample size, though the results are consistent across the different entrepreneur definitions.

The estimation process includes constructing approximation-bias-corrected robust confidence intervals and selecting the optimal estimation bandwidth using the MSE-minimizing procedures described by Calonico et al. (2014). The selected bandwidth for each specification, expressed in thousands of dollars, is based on this MSE-minimizing procedure. The first column of the table estimates a local nonparametric linear model for the first definition of entrepreneurs. Additionally, a local nonparametric quadratic model, standard in RKD estimation as per Card et al. (2015) and Gelman and Imbens (2018), is used in the second column. However, for the second and third definitions of entrepreneurs, due to the smaller sample sizes which may lead to overfitting, only a local nonparametric linear model is employed for estimating the RKD coefficient.

Panel A of Table 12 presents the results for the binary outcome of whether a business owner has any business debt. The RKD estimate is -0.0013 and is statistically significant at the 1% level. This implies that having home equity above the homestead exemption threshold decreases a business owner's likelihood of having business debts by 0.13 percentage points. In other words, for every $1,000 reduction in seizable equity (equivalent to an additional $1,000 in potential debt forgiveness or wealth protection), a business owner's likelihood of having business debts increases by 0.13 percentage points (a 0.36% relative increase over the 36% average financing rate). This effect is consistent across definitions of entrepreneurs and is robust to different bandwidths and polynomial orders. The second column presents the results for the first definition of entrepreneurs using a local nonparametric quadratic model. The RKD estimate is -0.0019 and is also statistically significant at the 1% level. It implies that a $1,000 decrease in seizable equity, which increases generosity, increases a business owner's likelihood of having business debts by 0.19 percentage points (a 0.56% relative increase over the 36% average financing rate). For the second and third definitions of entrepreneurs, the RKD estimates with a local nonparametric linear model are -0.0009 and

-0.0009 respectively. The RKD estimate for the second definition is statistically significant at the 5% level, while the RKD estimate for the third definition is also statistically significant at the 5% level. The stability of the estimates across various definitions of entrepreneurs and the robustness to different bandwidths and polynomial orders suggest that the results are not driven by the choice of the model specification.

Panel B of Table 12 presents the results for the amount of business debt held. The RKD estimate is -0.0031 and is statistically significant at the 5% level. This implies that having home equity above the homestead exemption threshold decreases a business owner's amount of business debts by 0.3%. This implies that a decrease in seizable equity by $1,000 boosts business debt size by 0.3%. This relationship holds true across various entrepreneur definitions and remains steady under different bandwidths and polynomial orders. In the second column, the analysis focuses on the primary entrepreneur definition using a local nonparametric quadratic approach. The RKD estimate is -0.0065 and is also statistically significant at the 5% level. When applying a local nonparametric linear approach for the second and third entrepreneur definitions, the RKD results are -0.0046 and -0.0011, respectively. The outcome for the second entrepreneur definition is statistically significant at the 5% level, whereas the result for the third definition does not reach statistical significance.

Panel C of Table 12 outlines the outcomes regarding business size. While all RKD estimates for varying entrepreneur definitions are negative, only one achieves statistical significance at the 5% level. These findings align with the business debt results from Panel B, suggesting a potential direct connection between business debt and size. The lack of statistical significance in RKD estimates for business size can be attributed to two main factors. Firstly, the dataset concerning business size is smaller by one third compared to the business debt data, attributed to a higher incidence of missing values in the former. Secondly, within the SIPP framework, business size is gauged by its expected market value upon sale, as estimated by the owner. This subjective measure could introduce measurement errors due to its reliance on the owner's expectations. Nevertheless, these results still offer valuable insights into the impact of bankruptcy costs on business size, indicating that the influence of asset protection on business size could range from 0.1% to 0.7%.

The analysis reveals a negligible effect of bankruptcy generosity on decisions to enter into entrepreneurship. As detailed in Panel D of Table 12, the focus is on the transition from being an employee to becoming an entrepreneur. The RKD estimates, regardless of the entrepreneur definitions used, are consistently small and lack statistical significance. This points to a likely non-existent influence of bankruptcy costs on the decision to start a business, suggesting that enhanced wealth protection does not significantly motivate individuals to embark on entrepreneurial ventures. The findings instead suggest that wealth protection may function more effectively as a motivator for current business owners to expand their enterprises, rather than serving as an incentive for prospective new business owners to establish their ventures.

These results stand in contrast to findings in existing literature that examine the influence of bankruptcy generosity on entrepreneurial activities. For example, studies by Fan and White (2003) and Rohlin and Ross (2016) have found that a more lenient bankruptcy policy benefits potential entrepreneurs, especially those who are risk-averse, by providing a form of partial wealth insurance. Berkowitz and White (2004) also discovered that with more comprehensive bankruptcy wealth protection, businesses tend to have fewer debts, and any loans obtained are generally smaller. These disparities highlight the significance of employing an appropriate research design in order to accurately identify the effects of bankruptcy costs on entrepreneurial activities, while carefully addressing issues of endogeneity.

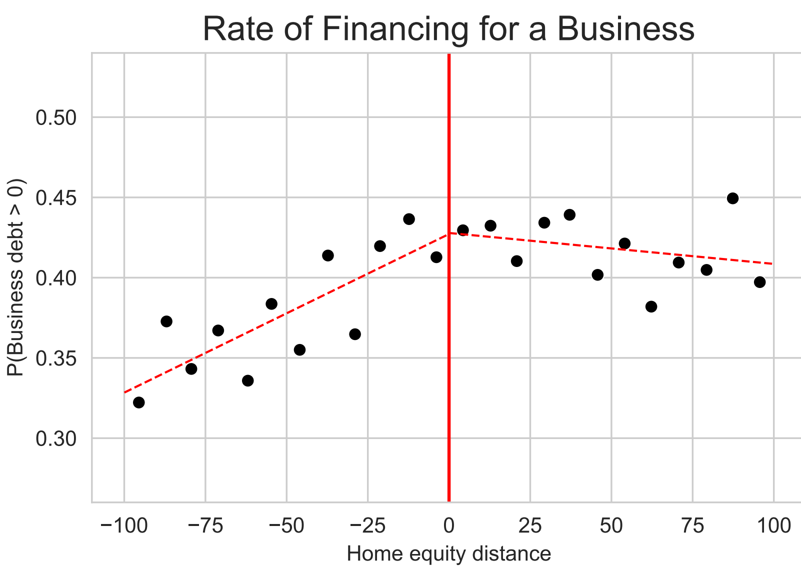


Figure 6: Potential debt forgiveness ($ thousands in 2020) and financing for a business

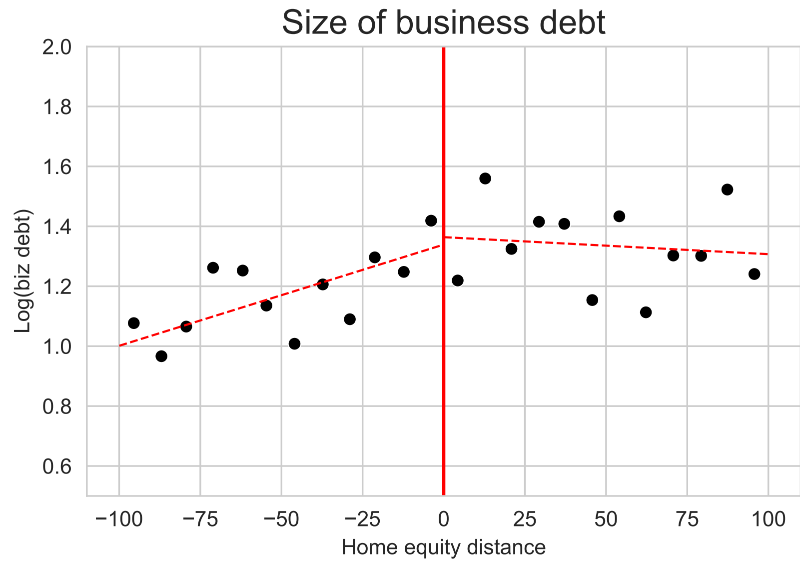


Figure 7: Potential debt forgiveness ($ thousands in 2020) and business debt size

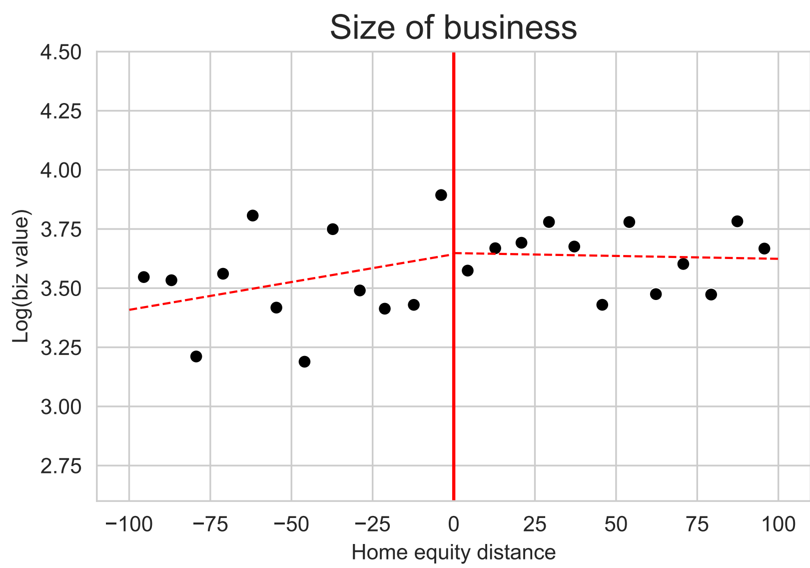


Figure 8: Potential debt forgiveness ($ thousands in 2020) and business size

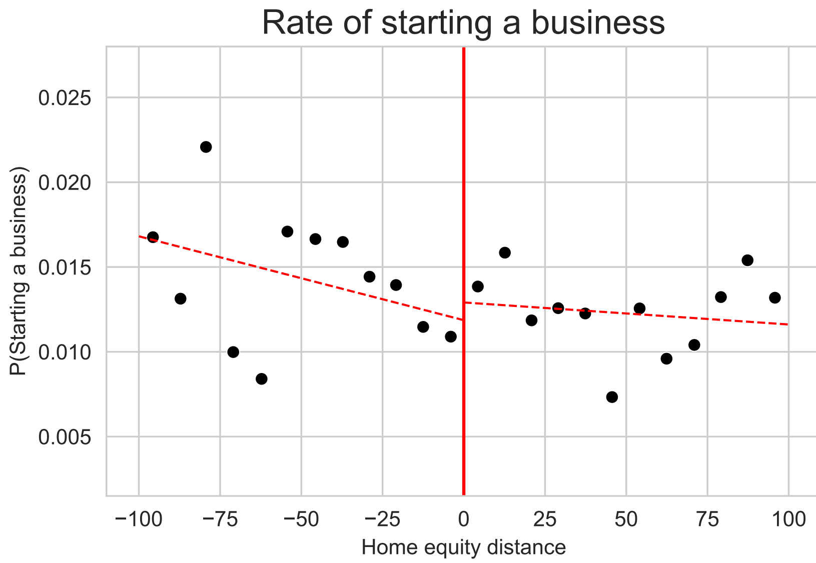


Figure 9: Potential debt forgiveness ($ thousands in 2020) and decisions to enter into entrepreneurship

Figure 6 plots means of business financing rates in bins, and predicted financing rates based on simple regression models for the first definition of entrepreneurs highlights the stark kink at the homestead exemption limit. The red dotted lines represent the fitted regressions in the intervals -100 to 0 and 0 to 100 ($ thousands in 2020). There is a sharp change in the slope of the relationship between home equity distance and the probability of having business debt at the cutoff. The substantial decrease in the slope of the fitted regression line is initial evidence that the increase in bankrupcty costs at the thresholds is effective in reducing the probability of having business debt. Similarly, Figure 7 showcases the amounts of business debt, where a notable change in the slope is observed in the relationship between home equity distance and the size of business debt. Meanwhile, Figures 8 and 9 display the results for business size and the decision to enter into entrepreneurship, respectively. Notably, neither of these figures exhibits a clear kink at the cutoff, instead showing high variance. It's important to note that all of these figures are predicated on the first definition of entrepreneurs, which categorizes business owners explicitly.

The foundational assumption of the regression kink design hinges on the premise that seizable home equity is the sole factor influencing business activities that exhibit a kink at the cutoff. Below the exemption threshold, an additional dollar of home equity does not impact the seizable equity. Conversely, above this limit, each extra dollar in home equity represents an additional amount a filer must surrender to creditors in case of bankruptcy.

In the absence of the kink in seizable equity, the relationship between the business activities and equity distance would have hypothetically continued smoothly across the homestead exemption boundary. Other factors might correlate with equity distance and business activities, contributing to the upward-sloping relationship observed below the cutoff. However, their effect is neutralized in the calculation of the slope change, provided they do not exhibit a kink at the cutoff.

Two key elements are probable contributors to the observed positive slope beneath the exemption limit. Firstly, households situated further below the cutoff are likely to have lesser amounts of unsecured debt, diminishing their incentive to file for bankruptcy and thereby resulting in lower wealth protection. This trend is influenced by the fact that households with lower equity distances typically reside in states offering more generous bankruptcy exemptions. As observed by Berkowitz and White (2004) , these households often face higher borrowing costs and consequently accumulate less unsecured debt. Secondly, as the equity distance increases, the option value of bankruptcy decreases, thereby encouraging more filings and leading to greater wealth protection. This dynamic is influenced by the requirement that households must typically wait seven years, before they can discharge debt through bankruptcy again. Filing for bankruptcy today thus entails the cost of forgoing the option to file again in the near future. When significantly below the cutoff, households can anticipate maintaining comparably low seizable equity in the foreseeable future, implying less wealth protection. However, as the equity distance grows, it becomes rational for them to expect increases in seizable equity due to rising house prices and the process of mortgage amortization.

The existence of multiple kinks across various states and time periods helps overcome two frequently encountered challenges in RKD analysis. Firstly, by aggregating a sample encompassing multiple exemption limits, it becomes feasible to adjust for home equity while utilizing equity distance as the primary variable of interest. Since home equity is likely to be closely associated with numerous factors influencing the decision to declare bankruptcy and entrepreneurial activitires, accounting for it can significantly enhance the statistical robustness of the analysis. Secondly, the pooling methodology employed in the RKD analysis permits the identification of a weighted Local Average Treatment Effect (LATE), representing a composite average aggregated from various exemption limits. Consequently, by including households from different exemption brackets, the RKD effectively captures the average response of a heterogeneous group of households, each with varying levels of home equity exemption.

4.3 Robustness

4.3.1 Model specification

The primary specification, as presented in column 1 of Table 12, employs a local nonparametric linear model without incorporating control variables. The bandwidth for each analysis, optimally determined using the method outlined in Calonico et al. (2014), is applied specifically within these parameters for the preferred specification. The results demonstrate consistency across various alternative specifications. Although both the preferred and benchmark estimates yield small values, increasing the polynomial order noticeably amplifies the magnitude of the point estimates. For instance, in the context of financing rate, the point estimate's magnitude escalates from -0.13 to -0.19, in the case of debt size from -0.31 to -0.65, and for business size, it rises from -0.45 to -0.98. However, further increasing the polynomial order of the running variable appears to have minimal impact. Similarly, the inclusion of additional control variables does not significantly alter the results. The use of different kernel types, such as Epanechnikov or triangular in place of a uniform kernel, also leads to comparable outcomes. The robustness of these findings is further supported by the similarity in estimates under varying bandwidth selections, as detailed in Appendix C.

4.3.2 Placebo exemption limits

Ganong and Jager (2018) introduce an alternative method for conducting inference in RKD analyses. Their approach involves repeatedly sampling placebo exemption limits from their empirical distribution, providing a conservative method for inference. This technique ensures exact size in finite samples, meaning it correctly rejects the null hypothesis at the desired level (e.g., 5%). However, this permutation test posits a more restrictive null hypothesis compared to typical statistical inference methods used with observational data. Specifically, it assumes not only the absence of any treatment effect but also that the treatments follow a particular distribution. In the context of RKD, this translates to no discernible kink (i.e., seizable equity having no impact on enterprises) and the assumption that the points of kink are drawn from a specified distribution. Therefore, interpreting the permutation test as evidence for the non-existence of a kink is contingent upon accurately specifying the distribution of counterfactual kinks

The test method involves repeatedly sampling placebo exemption limits from their empirical distribution. An illustrative example of this would be assigning Missouri's historical limits to California. For each iteration, I randomly assign historical homestead exemption limits and then calculate the equity distance for every household using these placebo exemption limits. Subsequently, I conduct the RKD estimation utilizing these placebo-based measures of equity distance. Intuitively, this test assesses the significance of the actual RKD estimate by comparing it with the estimates derived from the placebo data.

To perform the permutation test, I utilize 1,000 random draws from the historical homestead exemption limits. Figure 10 illustrates the distribution of the RKD coefficients for the financing rate, representing the placebo treatment effect. Under the Fisher sharp null hypothesis, where no treatment effect exists, this distribution (including the dotted line) represents the range of potential outcomes and their relationship to the treatment, with each bar signifying a different treatment assignment. The robustness of my RKD estimates is further validated by this permutation test. The dashed line in the figure marks the actual RKD coefficient of -0.13, which stands out as significantly extreme in comparison to the placebo counterparts. The empirical p-value obtained from this test is 0.006, decisively rejecting the null hypothesis at the 1% significance level.

Additionally, Figures 11 and 12 display the distribution of the RKD coefficients for the business debt size and the business value, respectively, also representing the placebo treatment effect. The exact p-values for these are 0.026 and 0.06, leading to the rejection of the null hypothesis at the 5% and 10% significance levels, respectively.

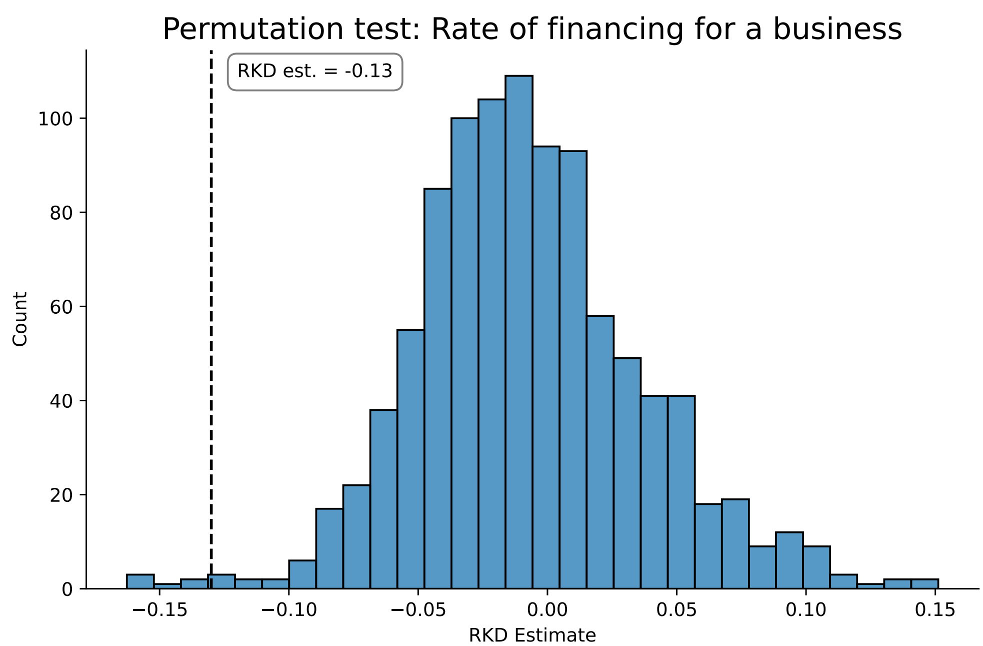


Figure 10: Permutation test for business financing rate

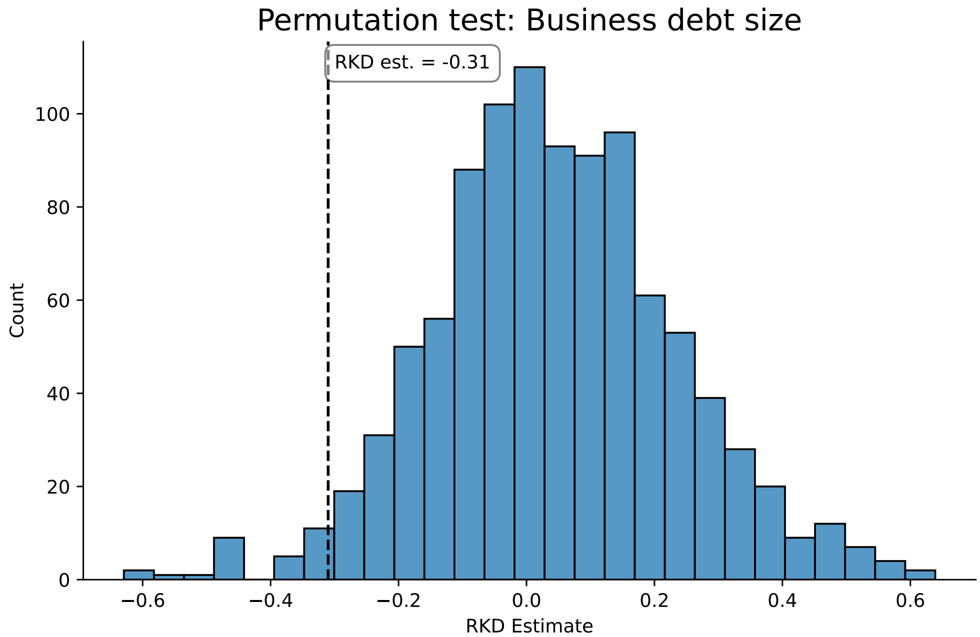


Figure 11: Permutation test for business debt size

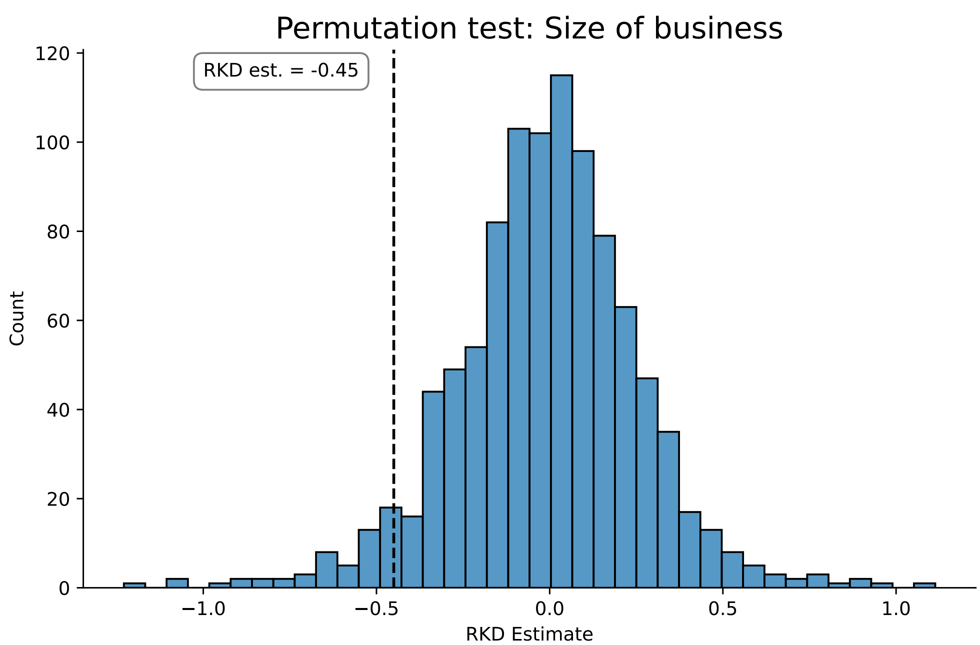


Figure 12: Permutation test for business value

4.3.3 Heterogeneity of exemption limits

In this analysis, the RKD estimate identifies a weighted average of Local Average Treatment Effects (LATE), essentially representing a composite of average LATEs at various exemption thresholds. Consequently, the RKD estimate reflects the average response from a diverse group of households, each having different levels of home equity exemption limits. A pertinent question arises: does the additional wealth protection differ in its impact between lower and higher exemption limits? The influence of a $1,000 increase in seizable home equity might vary based on the exemption limit within which a household falls. To explore this issue, I conduct an analysis by estimating the RKD within subsamples segregated by above and below the median homestead exemption limits.

The sample under consideration is restricted to individuals who fit the first definition of an entrepreneur, primarily based on the criterion of owning any business. Within this specific group, the median homestead exemption limit stands at $62,685, measured in thousands of dollars as of 2020. Further, the focus of the analysis is centered on the principal specification of the RKD analysis as detailed in the first column of Table 12, which employs a local linear estimation approach. For consistency and precision in assessing the heterogeneous impacts of different exemption limits, the same bandwidth selection used in the main RKD analysis is applied. The findings, as detailed in Table 5, reveal that the RKD estimates are consistent in both magnitude and significance across these subsamples. In Table 12, the left column includes business owners residing in states with exemption limits below $62,685, while the right column comprises those in states with limits above this threshold. These results indicate that the effect of a $1,000 increment in seizable home equity remains relatively uniform, irrespective of the homestead exemption limit. Nevertheless, it is observed that the estimates for the subgroup with higher exemption limits are somewhat lesser in magnitude, hinting that less affluent households might be more responsive to debt relief generosity.

Table 5: The heterogeneous impacts of different exemption limits on entrepreneurial enterprise

	Below median limit	Above median limit
Panel A: Outcome = 1(*business debt*)		
RKD est.	-0.0020***	-0.0010*
	(0.0007)	(0.0006)
Bandwidth	82.83	82.83
RKD poly. order	1	1
Observations	5,284	4,730
Panel B: Outcome = log(*business debt*)		
RKD est.	-0.0054**	-0.0030*
	(0.0024)	(0.0017)
Bandwidth	95.49	95.49
RKD poly. order	1	1
Observations	5,769	5,135
Panel C: Outcome = log(*business size*)		
RKD est.	-0.0049	-0.0062
	(0.0057)	(0.0037)
Bandwidth	88.27	88.27
RKD poly. order	1	1
Observations	3,722	3,365

The sample is restricted to entrepreneurs are defined as business owners. The estimates correspond to the percentage point change in each outcome in response to a $1,000 increase in seizable home equity. Clustered robust standard errors are in parentheses.
Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

5 Model

5.1 A simple model of entrepreneurship and personal bankruptcy

In this section, a two-period, single-agent model is presented, focusing on entrepreneurship and personal bankruptcy. This model succinctly encapsulates the core mechanisms underlying the hypothesis. It yields a series of predictions concerning the interplay between bankruptcy generosity and aspects such as firm financing and size, all of which are empirically examined in Section 4. Additionally, this model forms an integral component of the more comprehensive quantitative general equilibrium model that is elaborated upon in subsequent sections.

Consider the initial stage, labeled as period 0, where households possessing an initial wealth denoted by a engage in borrowing a one-period debt, receiving an amount d. Consequently, the size of their business is represented as $k = a + d$. In scenarios where the borrower opts for bankruptcy, they are relieved from repaying the debt. However, they must forfeit any output exceeding the threshold $\overline{\chi}$. Filing for bankruptcy also incurs a cost, labeled as τ. It is assumed that both $\overline{\chi}$ and τ remain constant. Advancing to period 1, stochastic entrepreneurial productivity z is drawn, with the following order: $z_1 > z_2 > z_3 > 0$.

$$z = \begin{cases} z_1 \quad \text{with} \quad p_1 : \text{no bankrupt}, \\ z_2 \quad \text{with} \quad p_2 : \text{bankrupt with } \overline{\chi} - \tau \text{ giving up } z_2 k^\alpha - \overline{\chi} \quad (\because z_3 k^\alpha > \overline{\chi}), \\ z_3 \quad \text{with} \quad 1 - p_1 - p_2 : \text{bankrupt with } z_3 k^\alpha - \tau \quad (\because z_3 k^\alpha < \overline{\chi}). \end{cases} \tag{9}$$

Once the stochastic entrepreneurial productivity, z, is realized, the entrepreneur produces output denoted as $f(k(a, d), z)$, where the function $f(\cdot)$ is strictly increasing, strictly concave, and twice differentiable. For simplicity, I assume the functional form $f(k, z) = zk^\alpha$. Taking into account the exemption limit $\overline{\chi}$, the household's expected utility, as a function of debt, can be expressed as follows:

$$V(d; a, r, \overline{\chi}, \tau) = \max_{d \geq 0} \left\{ p_1(z_1 k^\alpha - rd) + p_2(\overline{\chi} - \tau) + p_3(z_3 k^\alpha - \tau) \right\}. \tag{10}$$

Now we can determine the optimal size of the firm, and it is given by the following expression:

$$k = \left(\frac{\alpha(p_1 z_1 + p_3 z_3)}{p_1 r} \right)^{\frac{1}{1-\alpha}}. \tag{11}$$

Considering a risk-free rate, denoted as r, lenders adjust the interest rate based on the size of the loan and the exemption limit. This rate-setting mechanism is instrumental in ensuring the viability of their loan issuance process and in breaking even in their transactions.

$$r_f d = p_1 rd + p_2(z_2 k^\alpha - \overline{\chi}). \tag{12}$$

The borrowing rate for a given debt is determined as follows:

$$r = \frac{r_f d - p_2(z_2 k^\alpha - \overline{\chi})}{p_1 d}. \tag{13}$$

The detailed derivation of the parameters k and r is provided in Appendix D, offering a comprehensive explanation of their calculation.

Depending on the degree of bankruptcy leniency, variations in the optimal firm size and interest rate emerge, resulting in several testable implications. These implications pertain to entrepreneurial activities and can be rigorously examined through comparative statistical analysis.

Prediction 1: A rise in the bankruptcy exemption limit is predicted to result in an elevated borrowing rate.

$$\frac{\partial r}{\partial \overline{\chi}} > 0. \tag{14}$$

It is posited that an increase in the bankruptcy exemption limit will lead to a corresponding rise in borrowing rates. This prediction stems from the premise that as the threshold for bankruptcy protection is raised, lenders may perceive a heightened risk in loan recovery, prompting them to increase interest rates to mitigate potential losses. This elevation in borrowing rates is a direct reflection of the altered risk landscape in the lending environment. Such a dynamic provides a critical insight into how changes in bankruptcy laws can directly influence the cost of capital for entrepreneurs, ultimately affecting their financial decision-making processes.

Prediction 2: Considering the generally high levels of entrepreneurial productivity, it is anticipated that an increase in the bankruptcy exemption limit will lead entrepreneurs to incur greater levels of debt for their businesses. This, in turn, is expected to result in an expansion of business size.

$$\frac{dd}{d\overline{\chi}} > 0 \quad \text{and} \quad \frac{dk}{d\overline{\chi}} > 0. \tag{15}$$

The detailed derivation of the comparative statics mentioned above can be found in Appendix D, providing an in-depth explanation of the analytical process.

The second prediction focuses on the dimension of firm size. It posits that, given a high level of entrepreneurial productivity, increased bankruptcy wealth protection may incentivize entrepreneurs to undertake greater risks by securing additional financing for their business.

This aspect highlights the influence of bankruptcy leniency on entrepreneurial financing choices, as previously explored in the causal inference analysis. However, it is important to note several limitations within this simplified model. First, the model assumes a constant productivity threshold for bankruptcy, which may not accurately reflect real-world conditions where this threshold could fluctuate alongside changes in bankruptcy asset protection limits. Second, the degree to which households are safeguarded by bankruptcy asset protection could significantly influence their decision to enter into entrepreneurship.

Thus, to thoroughly evaluate the quantitative effects of household bankruptcy leniency on entrepreneurial activities and their consequent impact on aggregate economic outcomes, the use of a structural macroeconomic model becomes indispensable. Such models act as invaluable analytical laboratories, enabling the simulation of scenarios, like varying levels of bankruptcy generosity, while holding all other factors constant. In the following section, the simple model previously discussed will be integrated into a more complex heterogeneous agent general equilibrium framework. This integration is designed to provide a more nuanced and comprehensive analysis of the interplay between bankruptcy policies and entrepreneurial dynamics.

5.2 Equilibrium model

In each time period, individuals face a decision: either engage with an individual-specific technology, thus becoming an entrepreneur, or work in exchange for a wage. These individuals exhibit heterogeneity in terms of their entrepreneurial productivity, wage rates, unsecured debt, and physical capital. The model I present yields endogenous dynamics for the joint distribution of entrepreneurial productivity, unsecured debt, and physical capital, which plays a pivotal role in comprehending aggregate economic transitions.

The economy is populated by a continuum of households. The size of the population is normalized to one, and population growth is absent. Households live infinitely and time is discrete. Although the economy lacks aggregate uncertainty, individuals face idiosyncratic shocks.

5.2.1 Preferences

All households are endowed with an identical time-separable utility function characterized by constant relative risk aversion (CRRA) and a discounting of future utility at a rate of β. Preferences for consumption sequences from an individual's perspective in period t are captured by the following expression for expected utility:

$$\mathbb{E}_t \sum_{s=t}^{\infty} \frac{c_s^{1-\gamma}}{1-\gamma}$$

where γ is the coefficient of relative risk aversion. For the sake of simplicity, I simplify the labor-leisure decision. Each individual provides their unit of labor inelastically, either as a worker or as an entrepreneur. All individuals face a portfolio decision involving an unsecured bond, b, and a physical asset, k. If an individual defaults on unsecured debt, they are temporarily excluded from the credit market but are still permitted to save. They can regain access to the credit market with a probability of ζ.

Once shocks are realized, entrepreneurs produce products. At the end of the period, borrowers choose whether to pay back what they owe or declare bankruptcy. They also figure out how much to use for spending and how much to save. The bank determines the interest rate for every debt that isn't backed by collateral, considering the chance that the borrower might default.

5.2.2 Legal environment

The bankruptcy framework is designed based on the U.S. Chapter 7 bankruptcy law. The permissible equity that can be retained during bankruptcy, referred to as the state homestead exemption, is denoted as $\overline{\chi}$. Following the realization of shocks, individuals have the option to declare bankruptcy for unsecured debts. In simpler terms, individuals can go bankrupt on an unsecured debt b, while safeguarding their exempt assets k up to the limit of $\overline{\chi}$. If an individual opts for bankruptcy, the following events unfold in the current period:

1. The individual can keep his equity up to the exemption.

2. The individual's unsecured debt is reset to zero, and they are prohibited from borrowing further.

3. The individual's credit history state is marked as bad.

An individual's credit history changes to a good history with probability ζ and remains bad with probability $1-\zeta$. An indicator for bad credit history is $h=1$.

5.2.3 Technology

When an individual takes on the role of an entrepreneur, she engages with a production technology denoted as $f(k, y)$. In this representation, k denotes the level of capital, and y represents idiosyncratic entrepreneurial productivity. The value of y follows a Markov process, with its progression contingent upon the preceding period's entrepreneurial productivity. The assumed form of the production function is as follows:

$$f(k, y) = yk^{\alpha}$$

Numerous companies are both incorporated and sufficiently large to not be affected by personal bankruptcy law. Therefore, I assume a perfectly competitive corporate sector which is modeled as a Cobb-Douglass production function: $f(K_C, L_C) = AK_C^{\Omega}L_C^{1-\Omega}$ where K_C and L_C are the capital and labor employed in this sector. Because of perfect competition and constant returns to scale, the corporate sector shows zero profits. Capital depreciates at a rate of δ in both sectors. For normalization, A is set to 1 throughout the quantitative analysis, and $\Omega = 0.33$ to reflect the output share of capital. Individuals who are either workers or business owners have the option to declare bankruptcy.

5.2.4 Household decision problem

An agent who begins the period with a good credit history has lifetime utility as described below:

$$V_G(b, k, y) = V(b, k, y, h = 0) = \max\{W_{NB}(b, k, y), W_B(k, y)\} \tag{16}$$

where W_{NB} and W_B are the value of not going bankrupt and going bankrupt, respectively. Conditional on choosing not to go bankruptcy (W_{NB}^e), the agents solve:

$$\begin{aligned} W_{NB}(b, k, y) = \max_{b', k'} \; & u(c) + \beta \mathbb{E}\left[V_G(b', k', y') \,|y\right] \\ \text{s.t.} \;\; & c + q(b', k', y)b' + k' = \max\{w, f(k, y)\} + (1 - \delta)k + b, \\ & k' \geq 0, \end{aligned} \tag{17}$$

where b is the current unsecured bond holdings, b' is the next period's unsecured bond holdings, $q(b', k', y)$ is the price of unsecured debt, w is the wage rate as a paid worker, and $\pi(k, y)$ is the profit from operating a business.

For an individual who has gone bankrupt (W_B), the optimization problem can be stated as follows:

$$
\begin{aligned}
W_B(k, y) = \max_{b', k'} \; & u(c) + \beta \mathbb{E}\left[V_{BC}\left(b', k', y'\right) | y\right] \\
\text{s.t.} \;\; & c + \frac{b'}{1+r} + k' = h(w) + \min\{(1-\delta)k, \overline{\chi}\} \\
& b' \geq 0, \;\; k' \geq 0,
\end{aligned} \tag{18}
$$

where the agent only consumes what they produce, with a certain penalty, and is unable to borrow using unsecured credit. The function V_{BC} represents the value function for an agent commencing the period with a negative credit history and is defined as:

$$
\begin{aligned}
V_{BC}(b, k, y) =& V(b, k, y, h = 1) \\
=& \max_{b', k'} \;\; u(c) + \beta \Big[\xi \mathbb{E}\left[V_G\left(b', k', y'\right) | y\right] + (1-\xi)\mathbb{E}\left[V_{BC}\left(b', k', y'\right) | \, y\right]\Big] \\
& \text{s.t.} \;\; c + \frac{b'}{1+r} + k' = h(w) + (1-\delta)k + b \\
& \quad\;\; b' \geq 0, \;\; k' \geq 0.
\end{aligned} \tag{19}
$$

Through a comparison of the value functions, W_{NB} and W_B, individuals determine whether to declare bankruptcy. Consequently, the probability of an individual going bankrupt is calculated as follows:

$$
\delta\left(b', k', y\right) := \int \mathbb{I}\left\{W_{NB}(b', k', y') < W_B(b', k', y')\right\} p\left(y, y'\right) dy'. \tag{20}
$$

5.2.5 Financial intermediaries

Banks can borrow at a risk-free interest rate, denoted by r, which is considered a given. As the banking sector is competitive, banks are expected to make zero profit on each loan. When agents opt for saving through unsecured bonds (where $b' \geq 0$), q represents the price of purchasing a bond that promises a payment of b' units of the consumption good the following day. Notably, there's no bankruptcy risk associated with these savings, and thus:

$$
q\left(b', k', y\right) \leq \frac{1}{1+r}. \tag{21}
$$

The zero profit condition suggests that the bond price is determined solely by the risk-free rate, given by $q = \frac{1}{1+r}$ when $b' \geq 0$.

The price of an unsecured bond with negative face value b' depends on the household's bankruptcy probability and its non-exempt assets. When a household goes bankrupt and possesses physical capital beyond the exemption $\overline{\chi}$, the bank can recover a certain portion of it, represented by $\max\{(1-\delta)k' - \overline{\chi}, 0\}$. Therefore, The condition for a bank to issue an unsecured debt of size b' to an individual is as follows:

$$q\left(b', k', y\right) = \frac{1 - \delta\left(b', k', y\right)}{1+r} + \frac{\delta\left(b', k', y\right) \frac{\max\{(1-\delta)k' - \overline{\chi}, 0\}}{-b'}}{1+r}. \tag{22}$$

5.2.6 Equilibrium definition

In this context, each U.S. state is considered a small open economy with respect to the unsecured credit market, and the risk-free rate, r, is taken as a constant. Let μ denote the cross-sectional distribution of agents over the credit history, asset portfolio, entrepreneurial productivity, and occupation. My analysis focus on a stationary recursive equilibrium.

Definition: Given $\overline{\chi}$ and r, a stationary recursive competitive equilibrium consists of allocations $\{c(b,k,y,h), b'(b,k,y,h), k'(b,k,y,h)\}$, bankruptcy decision rules $\mathbb{I}_B(b,k,y,h=0)$, joint distribution $\mu(b,k,y,h)$, and prices $\{w, q(b,k,y,h=0)\}$.

1. Given $w, q(b,k,y,h), r$, and $\overline{\chi}$, $\{c(b,k,y,h), b'(b,k,y,h), k'(b,k,y,h), \mathbb{I}_B(b,k,y,h=0)\}$ solves the individual's problem in Equation 16 to 20.

2. Bank's zero profit condition: $q(b,k,y,h)$ solves Equation 22

3. The joint distribution $\mu(b,k,y,h)$ evolves according to the following equilibrium mapping (For computational details, see Appendix E):

   If $h = 0$ (G)

$$\begin{aligned}\mu'\left(b', k', y', 0\right) = & \int_y \int_k \int_b \mathbb{I}_{k'=k'(b,k,y,0)} \cdot \mathbb{I}_{b'=b'(b,k,y,0)} \cdot [1 - \mathbb{I}^B(b,k,y,0)] \mu(db, dk, y, 0) p\left(y, y'\right) dy \\ & + \xi \int_y \int_k \int_b \mathbb{I}_{k'=k'(b,k,y,1)} \cdot \mathbb{I}_{b'=b'(b,k,y,1)} \mu(db, dk, y, 1) p\left(y, y'\right) dy.\end{aligned}$$

If $h = 1$ (BC)

$$\mu'(b', k', y', 1) = \int_y \int_k \int_b \mathbb{I}_{k'=k'(b,k,y,0)} \cdot \mathbb{I}_{b'=b'(b,k,y,0)} \cdot \mathbb{I}^B(b,k,y,0)\mu(db,dk,y,0)p(y,y')\,dy$$
$$+ (1-\xi)\int_y \int_k \int_b \mathbb{I}_{k'=k'(b,k,y,0)} \cdot \mathbb{I}_{b'=b'(b,k,y,1)}\mu(db,dk,y,1)p(y,y')\,dy.$$

6 Quantitative analysis

6.1 Calibration

In order to quantify the theory, I calibrate a set of structural parameters encompassing preferences, technology, credit market, and bankruptcy policy. The data is sourced from the Survey of Income and Program Participation (SIPP) by the U.S. Census, covering the years 2000 to 2011. A subset of parameters is drawn from macroeconomic literature. The remaining parameters are selected to minimize the difference between model-derived moments and their data counterparts from the SIPP. Table 6 provides a summary of the calibrated parameter values.

The time period considered is one year. According to Mitman (2016), the average aggregate Chapter 7 bankruptcy rate from 1995 to 2004 was 1.1%. Consequently, the discount factor β is set to 0.93 to yield a corresponding bankruptcy rate of 1.1%. The coefficient of relative risk aversion is chosen to be 2, in line with standard practices in the literature.

Entrepreneurial productivity y follows an autoregressive process with normal innovations, $\log y' = \rho \log y + \epsilon$ where $\epsilon \sim N(0, \sigma_\epsilon^2)$. This process is approximated with a 20-state Markov chain using Tauchen's method. Following Tan (2022), the parameters ρ and σ_ϵ are 0.85 and 0.20, respectively. The curvature of entrepreneur's production function α is calibrated to capture an entrepreneur share of 15% as observed in the SIPP data, thus set to 0.18. Capital is assumed to depreciate at a rate of 8%.

The exemption limit is a key parameter of interest, as it is strongly associated with entrepreneurs' financing decisions. I calibrate the exemption limit to 0.75 to capture an entrepreneur's debt-taking rate of 36% in the SIPP data. After filing for Chapter 7 bankruptcy, households are excluded from filing again for six years. I set $\zeta = 0.2$, so that on average, households regain access to credit after five years, enabling them to file for Chapter 7 bankruptcy in the subsequent year. The risk-free interest rate is set at 2.5%.

Table 6: Parameter Values

Parameters	Explanation	Value	Target/Source
β	Discount factor	0.93	Bankruptcy rate of 1.1%
γ	Coefficient of relative risk aversion	2	Standard
ρ	Persistence of productivity shock	0.85	Tan (2022)
σ_ϵ	Variance of productivity shock	0.20	Tan (2022)
α	Curvature of entrepreneur's production function	0.18	Entrepreneur share of 15%
δ	Depreciation rate	0.08	Standard
$\overline{\chi}$	Exemption limit	0.75	Entrepreneur's debt-taking rate of 36%
ζ	Probability of bad credit history removal	0.2	Mitman (2016)
r	Interest rate	0.025	Standard

6.2 Model Fit

I present the calibration results and the properties of the model in Table 7 , which outlines both targeted and untargeted moments. The model aligns well with the empirical data on bankruptcy rates, the share of entrepreneurs, and the business debt-taking rate. Although the model does not target the bad credit rate, it predicts that approximately 5% of agents have a bad credit history in the steady state. The model also reflects that workers are net savers while business owners are net borrowers. However, the model underestimates the worker-to-entrepreneur net worth ratio, indicating that entrepreneurs in the model are less wealthy compared to real-world data, and workers' wealth is over-represented. Additionally, the table provides insights into aggregate bond holdings, average business size, aggregate productivity, and aggregate output, further illustrating the model's comprehensive representation of economic behaviors.

Table 7: Model Moments

Moments	Model	Data
Bankruptcy rate	0.01	0.01
Bad credit rate	0.05	-
Entrepreneur share of 15%	0.14	0.15
Entrepreneur's debt-taking rate	0.35	0.36
Worker-to-entrepreneur net worth ratio	0.67	0.91
Aggregate bond holdings for workers	0.03	-
Aggregate bond holdings for entrepreneurs	-0.04	-
Average business size	0.12	-
Aggregate productivity	0.23	-
Aggregate output	0.22	-

In this model, there is no unique interest rate (or bond price). Figure 13 provide the price of bond holdings as a function of next period's capital and bond holdings, and the current level of entrepreneur productivity. For visual purpose, I fix the level of entrepreneur productivity to a certain level. First of all, as the agent borrows more bond (more negative value of B') the bond price decreases. In other words, they have to pay higher interest rate. Second, as the agent has more capital, they can borrow at lower interest rates, in other words, higher bond price. This is because more capital means wealthier individual, which means less risky borrower. Lastly, from Figure 14 , we observe that higher entrepreneur productivity leads to borrowing at a higher bond price (lower interest rates). Given the nature of the business productivity shock, the higher business productivity, the more reliable that person is.

In this model, there is no unique interest rate or bond price. Figure 13 illustrates the bond price as a function of next period's capital and bond holdings, as well as the current level of entrepreneurial productivity. For visual clarity, I fix the level of entrepreneurial productivity to a certain value. First, as the agent borrows more (reflected by more negative values of B'), the bond price decreases, implying a higher interest rate. Second, as the agent's capital increases, they can borrow at lower interest rates, indicated by a higher bond price. This is because more capital signifies a wealthier individual, making them a less risky borrower. Finally, from Figure 14, we observe that higher entrepreneurial productivity results in borrowing at a higher bond price (lower interest rates). This relationship exists because higher business productivity indicates a more reliable borrower, given the nature of business productivity shocks.

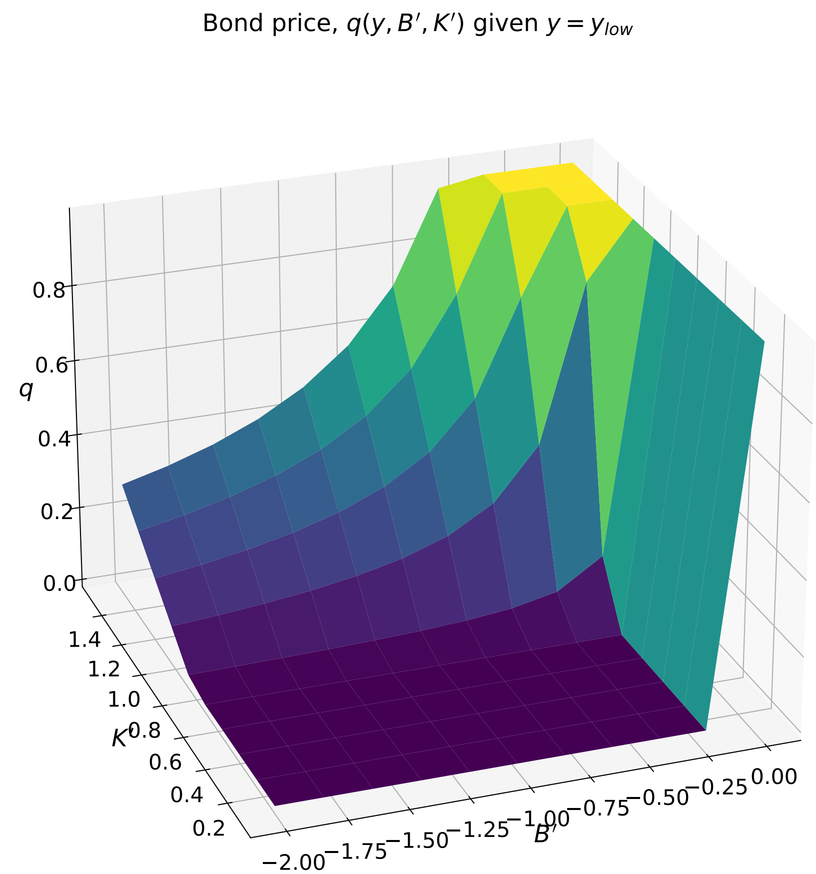


Figure 13: Bond price

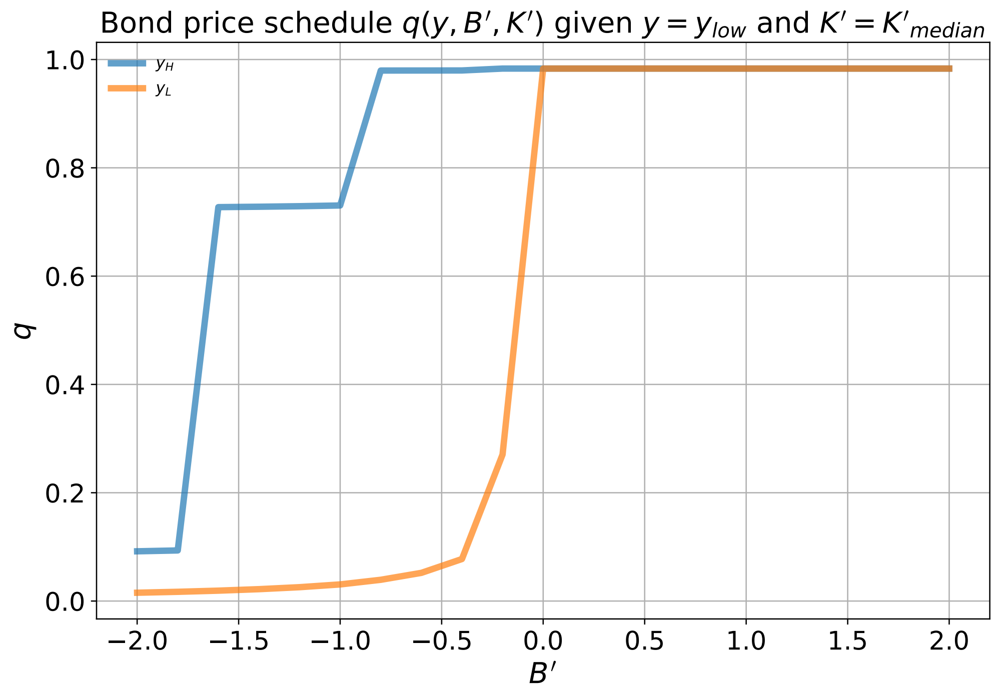


Figure 14: Bond price

Figure 15 shows the probability of bankruptcy as it relates to next period's capital, bond holdings, and current entrepreneurial productivity. For visual clarity, the entrepreneurial productivity is fixed at a certain level. Similar patterns to bond pricing emerge from the bankruptcy probabilities, primarily because bankruptcy risk is crucial for bond pricing. First, as borrowing increases (more negative B' values), bankruptcy likelihood rises due to higher risk. Second, more capital lowers the chance of bankruptcy, as there's more to lose. Lastly, higher entrepreneurial productivity results in a reduced bankruptcy rate due to the persistence of productivity shocks.

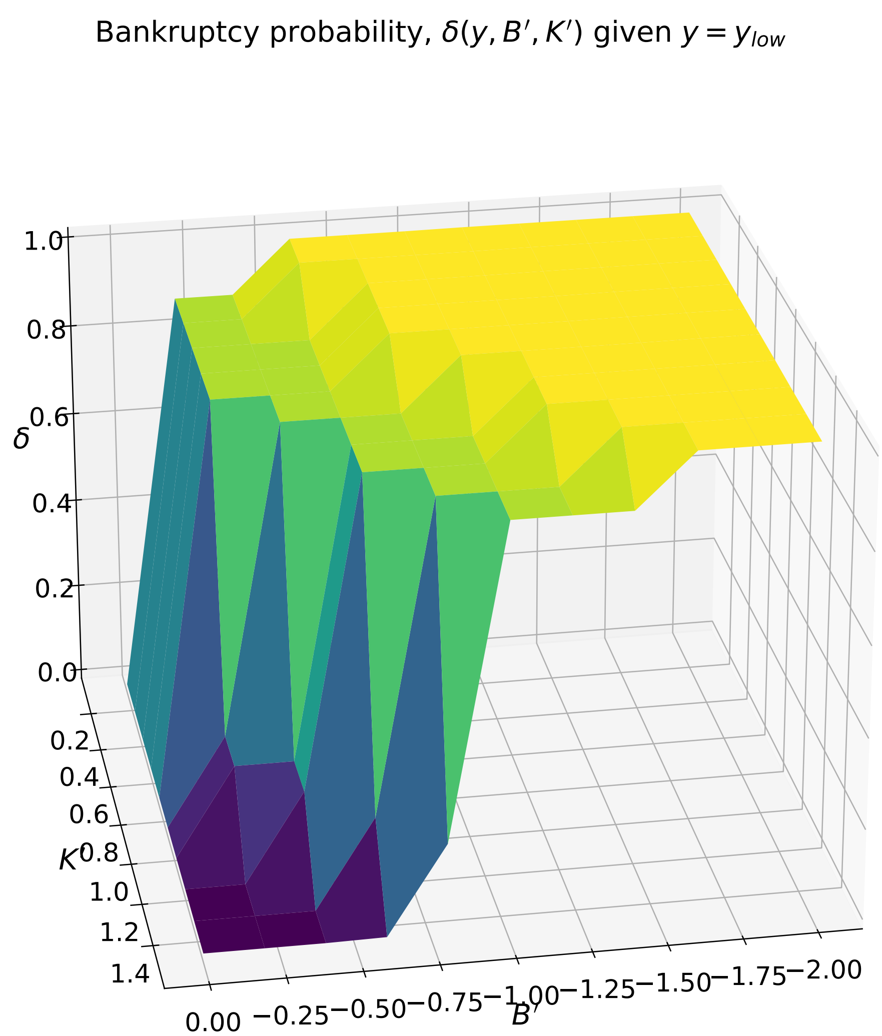


Figure 15: Bankruptcy probability

6.3 Counterfactual Analysis

To study the effect of more generous debt relief policies on the economy, I analyze a counterfactual scenario with varying unsecured debt exemption limits. I focus on small changes around the calibrated current exemption limit of $\overline{\chi} = 0.75$, examining a range from a 10% reduction to a 10% increase. This experimentation provides valuable insights not only on the measurable moments in the data but also on those that are difficult to capture empirically.

The key mechanisms include: (1) the insurance effect and (2) the interest rate effect. First, as the exemption limit becomes more generous, agents receive greater wealth protection when filing for bankruptcy, encouraging riskier activities, particularly entrepreneurship. Additionally, higher exemption limits motivate individuals to save and accumulate capital up to at least the exemption limit. Lastly, more lenient debt relief policies may lead to increased interest rates because creditors have more at stake in the event of bankruptcy, incentivizing filings. These two effects could counterbalance each other. The goal of this section is to integrate the causal evidence from the previous section.

Figure 16 presents the evolution of the data-driven moments in response to changes in the exemption limit. These moments were used to calibrate the model to the data. Generally, all moments increase as bankruptcy generosity rises, although these relationships are not linear. More lenient bankruptcy policies lead to higher bankruptcy filings and an increased likelihood of becoming an entrepreneur. Additionally, a more generous exemption limit encourages entrepreneurs to finance their businesses more frequently.

When the exemption limit increases by 5%, the debt-taking rate of entrepreneurs rises by 1.37 percentage points (or 4%), implying that a 1% increase in the limit raises the debt-taking rate by 0.274 percentage points (or 0.8%). In the previous section, I found that a $1,000 increase in potential debt forgiveness increases the probability of debt financing for businesses by 0.2 percentage points (or 0.6 percent). Assuming a median homestead exemption of $75,000, this suggests that my causal estimates align with the model's units for comparable results. Depending on the assumed median homestead exemption, the model could either overestimate or underestimate the effect of more generous bankruptcy policies on the debt-taking rate relative to the causal estimate. However, the overall direction remains consistent, providing valuable insights.

Figure 17 illustrates the evolution of business-related moments. As the exemption limit increases from the current level, we observe changes in the balance sheet of business owners. In the previous section, I found that a $1,000 increase in potential debt forgiveness boosts business debt size by 0.3%. My model predicts a similar direction but with a slightly larger effect of 3%. Consequently, the average size of businesses increases by 1.15% due to the larger debt.

Figure 18 illustrates the evolution of aggregate moments. As the exemption limit increases from the current level, average productivity also rises. This increase, combined with the tendency to take on more debt and larger debt sizes, implies that less wealthy but highly productive individuals are more likely to start businesses. Consequently, aggregate output increases, though it plateaus after a 5% increase in the exemption limit. Additionally, the average bond price declines as the exemption level rises, indicating that higher exemption limits are reflected in bond pricing. In my model, the insurance effect outweighs the interest effect, resulting in more entrepreneurs, increased debt-taking, and larger amounts of debt as the exemption limit increases.

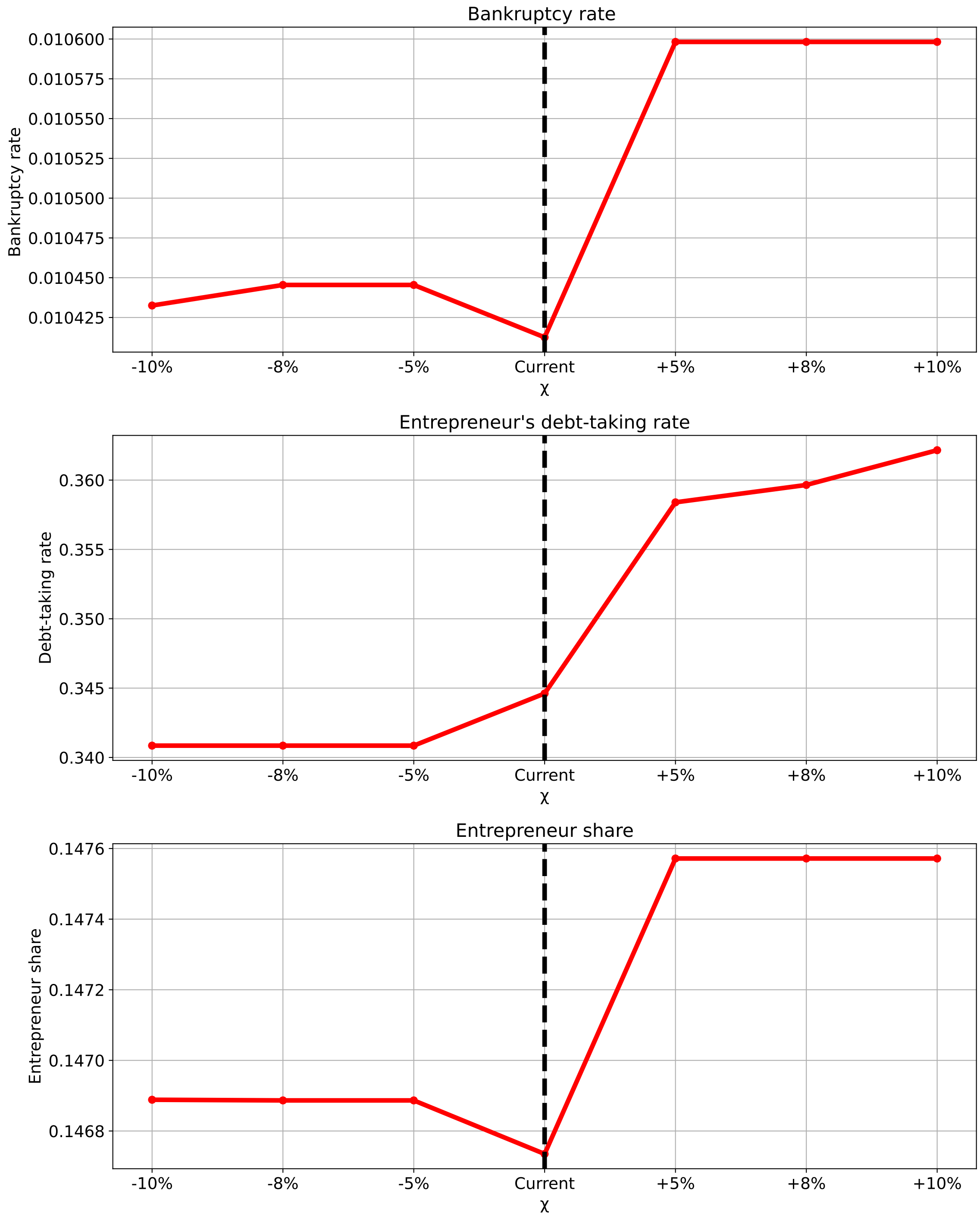


Figure 16: Data-driven moments: Bankruptcy rate, business debt-taking rate, and entrepreneur share

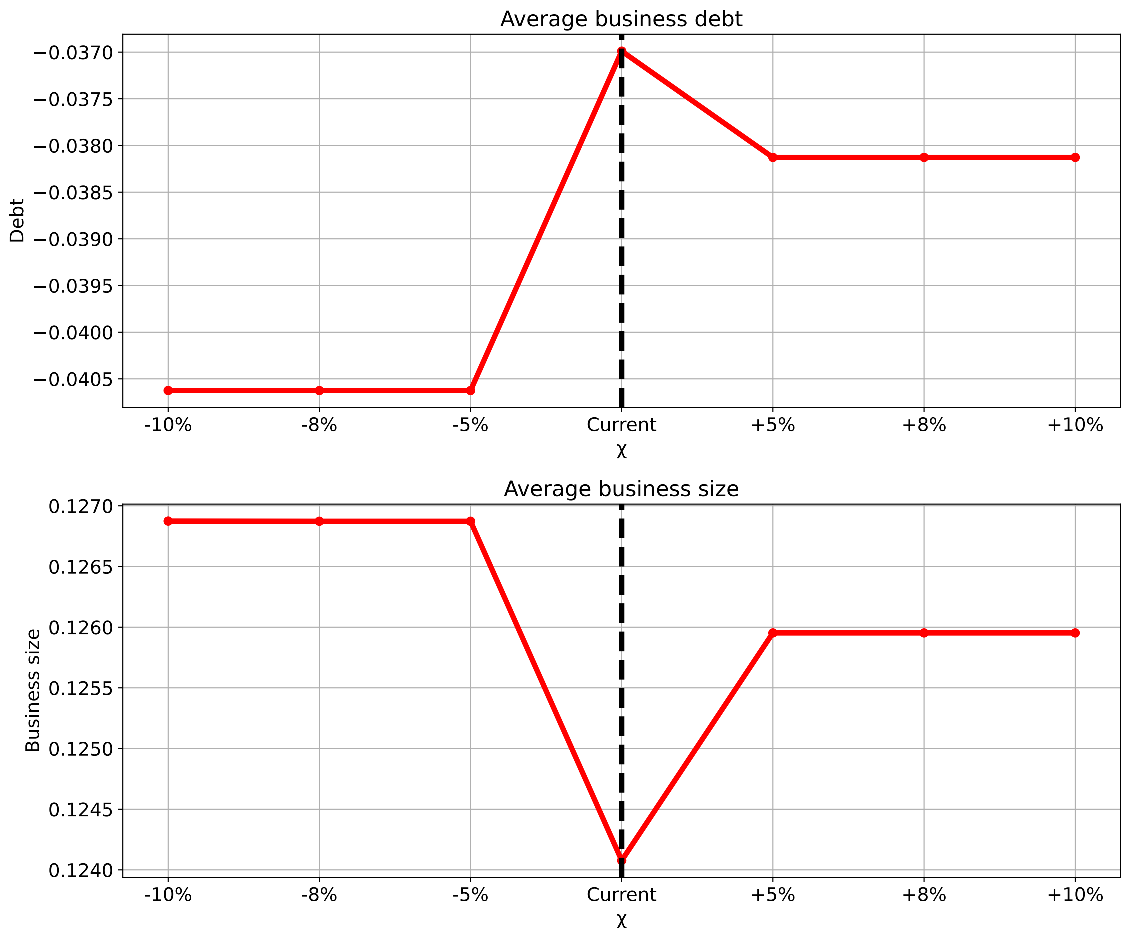


Figure 17: Business related moments: Average business debt and average business size

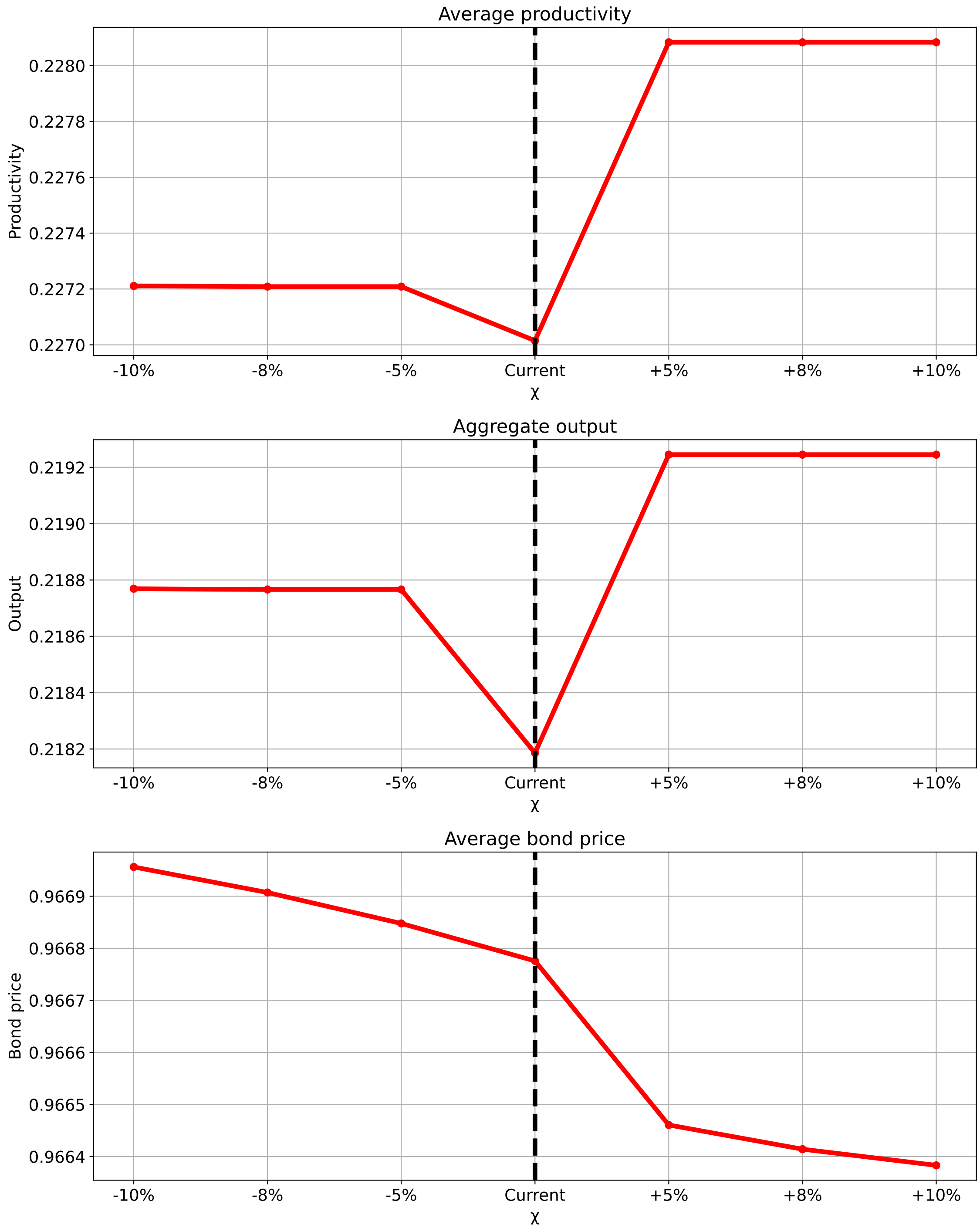


Figure 18: Aggregate economy: Average productivity, aggregate output, and average bond price

7 Conclusion

This research underscores the inherent risks associated with entrepreneurship. The study has demonstrated, through the application of a regression kink design, a causal relationship between potential debt forgiveness and entrepreneurial activities. It reveals that more lenient debt relief policies effectively encourage business owners to seek financing for their ventures. Specifically, it was observed that an additional \$1,000 in potential debt forgiveness increases the probability of debt financing for their businesses by up to 0.2 percentage points (0.6 percent), and boosts business debt size by 0.3%.

This study implies that providing more wealth protection might not only mitigate financial risks but could also actively boost U.S. entrepreneurial activities. This effect is particularly notable through the reallocation of capital to more productive yet less wealthy entrepreneurs, potentially enhancing productivity and economic output, thus improving overall welfare. These findings highlight the importance of bankruptcy policies in shaping the entrepreneurial landscape and provide valuable insights into the dynamics of entrepreneurship amid financial uncertainties. This research significantly contributes to the understanding of how financial protection mechanisms can influence entrepreneurial decisions and, consequently, broader economic welfare.

A Appendix: Naive OLS

In the Appendix, I address the limitations inherent in the naive OLS estimation approach that has been commonly employed in economics research. While this method offers some insights, it treats the homestead exemption merely as a proxy for bankruptcy leniency. In my analysis, I utilize pooled OLS estimation with panel data spanning from 1996 to 2014, as represented in the following equation:

$$Y_{ist} = \beta_0 + \beta_1' HE + \beta_2' X_{it} + \beta_3' Z_{st} + \lambda_t + \theta_s + \epsilon_{ist}.$$

Here, Y_{ist} represents the outcome of interest for individual i, with HE indicating the homestead exemption limit. The term X_{it} controls for individual-time demographic variables including various individual assets, while Z_{st} accounts for time-state level variables. The model also incorporates time fixed effects λ_t and individual fixed effects θ_s. The coefficient β_1' is of particular interest as it measures the relationship between the outcome and the exemption limit. However, this approach has limitations, primarily in its potential for omitted variable bias and its assumption of a linear and homogeneous relationship between the homestead exemption and the outcome. Further, it may not adequately account for the dynamic nature of bankruptcy policies and their impacts on individual financial decisions. This section of the Appendix will delve into these issues, offering a critique of the naive OLS estimation method and suggesting avenues for more robust and nuanced econometric modeling.

The analysis is conducted using two different specifications: The first specification showcases results where the unlimited exemption limit is treated as the dummy variable of interest. The second specification presents the results by categorizing the exemption limit into five distinct groups. These groups include the zero exemption limit as the reference group, followed by the 2nd, 3rd, and 4th quartiles of the exemption limit, and finally, the category for an unlimited exemption limit

The naive OLS results, as detailed in Tables 8, 9, and 11, reveal several critical insights. It is important to note that HE in these tables stands for the homestead exemption limit. They present several key observations: First, an increase in the generosity of bankruptcy exemptions correlates with a decrease in business size. Second, there is a discernible negative correlation between the degree of bankruptcy leniency and the level of business debt. Third, a rise in potential debt forgiveness is associated with a lower rate of business financing.

It is indeed intriguing that these findings align with previous results in the literature. However, it is imperative to underscore that these observations, while suggestive of certain patterns or correlations, should not be prematurely construed as indicative of causal relationships. The estimates, in their current form, are subject to significant biases. These biases may stem from a range of issues, such as omitted variables, endogeneity, and other unaccounted-for confounding factors that could skew the analysis. As is the case with any empirical research, these results warrant meticulous examination and further exploration to avoid erroneous conclusions. To mitigate these issues and ensure a more rigorous analysis, the main text of this study employs a robust identification design.

Table 8: Exemption limit and business debt

VARIABLES	(1) *Log(biz debt)*	(2) *Log(biz debt)*	(3) *Log(biz debt)*	(4) *Log(biz debt)*
$1(HE,\ unlimited)$	-0.581***		-0.868	
	(0.168)		(0.879)	
HE, 2nd quartile		-0.009		-0.054
		(0.020)		(0.151)
HE, 3rd quartile		0.034		-0.238
		(0.025)		(0.190)
HE, 4th quartile		0.013		-0.534**
		(0.032)		(0.259)
HE, unlimited		-0.587***		-0.882
		(0.170)		(0.885)
Log(biz value)	No	No	Yes	Yes
Net worth, housing equity	Yes	Yes	Yes	Yes
State/year FE	Yes	Yes	Yes	Yes
Biz type/ind/demog FE	Yes	Yes	Yes	Yes
Observations	24,398	24,398	24,398	24,398
R-squared	0.044	0.044	0.089	0.090

Entrepreneurs in this analysis are defined as business owners. The estimates shown in the table represent the percentage change in each specific outcome as a response to changes in the respective dummy variables. The analysis controls for state-level wildcard exemptions. Clustered robust standard errors are indicated in parentheses.

Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Exemption limit and whether having business debt

	(1)	(2)	(3)	(4)
VARIABLES	1(*biz debt*)	1(*biz debt*)	1(*biz debt*)	1(*biz debt*)
1(HE, *unlimited*)	-0.602***		-0.509***	
	(0.174)		(0.182)	
HE, 2nd quartile		-0.006		-0.005
		(0.020)		(0.019)
HE, 3rd quartile		0.035		0.043*
		(0.025)		(0.024)
HE, 4th quartile		0.015		0.034
		(0.032)		(0.031)
HE, unlimited		-0.606***		-0.512***
		(0.174)		(0.182)
Log(biz value)	No	No	Yes	Yes
Net worth, housing equity	Yes	Yes	Yes	Yes
State/year FE	Yes	Yes	Yes	Yes
Biz type/ind/demog FE	Yes	Yes	Yes	Yes
Observations	24,398	24,398	24,398	24,398
R-squared	0.046	0.047	0.098	0.098

Entrepreneurs in this analysis are defined as business owners. The estimates shown in the table represent the percentage point change in each specific outcome as a response to changes in the respective dummy variables. The analysis controls for state-level wildcard exemptions. Clustered robust standard errors are indicated in parentheses.

Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Exemption limit and business size

VARIABLES	(1) Log(biz value)	(2) Log(biz value)
$1(HE,\ unlimited)$	-0.628*	
	(0.340)	
HE, 2nd quartile		-0.108
		(0.090)
HE, 3rd quartile		-0.269**
		(0.114)
HE, 4th quartile		-0.469***
		(0.161)
HE, unlimited		-0.703**
		(0.344)
$1(biz\ debt)$ ## $\log(biz\ debt)$	Yes	Yes
Net worth, housing equity	Yes	Yes
State/year FE	Yes	Yes
Biz type/ind/demog FE	Yes	Yes
Observations	24,398	24,398
R-squared	0.337	0.339

Entrepreneurs in this analysis are defined as business owners. The estimates shown in the table represent the percentage change in each specific outcome as a response to changes in the respective dummy variables. The analysis controls for state-level wildcard exemptions. Clustered robust standard errors are indicated in parentheses.

Significance levels are denoted as follows: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 11: Exemption limit and decisions to enter into entrepreneurship

VARIABLES	(1) 1(biz entry)	(2) 1(biz entry)
1(HE, *unlimited*)	0.006	
	(.001)	
HE, 2nd quartile		-0.001
		(0.009)
HE, 3rd quartile		0.023**
		(0.009)
HE, 4th quartile		0.016*
		(0.009)
HEHE, unlimited		0.001
		(0.010)
Net worth, housing equity	Yes	Yes
State/year FE	Yes	Yes
Biz type/ind/demog FE	Yes	Yes
Observations	162,577	162,577
R-squared	0.004	0.008

Entrepreneurs in this analysis are defined as business owners. The estimates shown in the table represent the percentage point change in each specific outcome as a response to changes in the respective dummy variables. The analysis controls for state-level wildcard exemptions. Clustered robust standard errors are indicated in parentheses.

Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

B Appendix: Kernel Robustness

Table 12: The effect of increases in potential debt forgiveness on entrepreneurial enterprise

	Triangular		Epanechnikov	
Panel A: Outcome = 1(*business debt*)				
RKD est.	-0.0013***	-0.0009***	-0.0013***	-0.0024***
	(0.0004)	(0.0007)	(0.0003)	(0.0009)
Bandwidth	110.12	140.95	104.70	146.51
RKD poly. order	1	2	1	2
Observations	11,960	13.864	11,564	14,183
Panel B: Outcome = log(*business debt*)				
RKD est.	-0.0032*	-0.0103**	-0.0027*	-0.0106*
	(0.0018)	(0.0049)	(0.0016)	(0.0048)
Bandwidth	113.16	138.53	115.24	135.32
RKD poly. order	1	2	1	2
Observations	12,124	13,736	12,265	13,521
Panel C: Outcome = log(*business size*)				
RKD est.	-0.0059*	-0.012**	-0.0054*	-0.0121**
	(0.0031)	(0.0055)	(0.0029)	(0.0052)
Bandwidth	98.66	176.95	97.53	170.85
RKD poly. order	1	2	1	1
Observations	7,689	10,783	7,604	10,781

Entrepreneurs are defined simply as business owners. The estimations for the first two columns are conducted using a Triangular kernel, while the Epanechnikov kernel is applied for the last two columns. For Panel A, the estimates correspond to the percentage point change in each outcome in response to a $1,000 increase in seizable home equity; for Panels B and C, the estimates correspond to the percentage change in each outcome in response to the same $1,000 increase in seizable home equity. Clustered robust standard errors are in parentheses.
Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

C Appendix: Covariate Balance

Table 13: The effect of increases in potential debt forgiveness on covariates

	Mortgage rate	Age	Education	Race	Gender	Marital status
RKD est.	-0.0062	0.0217	-0.0391*	-0.0004	0.0004	0.0024
	(0.005)	(0.0144)	(0.005)	(0.0234)	(0.0004)	(0.0030)
Bandwidth	78.05	76.36	104.8	93.89	101.3	73.21
RKD poly. order	1	1	1	1	1	1
Observations	9,132	9,254	11,568	10,762	11,334	9,031

Entrepreneurs are defined as business owners. The estimates correspond to the change in each outcome in response to the same $1,000 increase in seizable home equity. Approximation bias-corrected robust standard errors in this study are computed following the methodology established by Calonico et al. (2014). Additionally, the bandwidth, expressed in thousands of dollars, is optimally chosen for each specification using the MSE-minimizing procedure as outlined in Calonico et al. (2014). Clustered robust standard errors are in parentheses.

Significance levels are denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

D Appendix: Derivation of simple model's predictions

In the previously discussed simple model, we derived two key equations to understand the dynamics of firm size and borrowing rates in the context of entrepreneurship and bankruptcy. The equations are as follows:

$$k = \left(\frac{\alpha(p_1 z_1 + p_3 z_3)}{p_1 r}\right)^{\frac{1}{1-\alpha}}, \tag{23}$$

$$r = \frac{r_f d - p_2(z_2(a+d)^\alpha - \overline{\chi})}{p_1 d}. \tag{24}$$

Now the firm's debt d can be expressed as follows:

$$d = \left(\frac{\alpha(p_1 z_1 + p_3 z_3)}{p_1 r}\right)^{\frac{1}{1-\alpha}} - a$$

Let $d = f(r)$ and $r = g(d : \overline{\chi})$. To explore the sensitivity of these variables with respect to a parameter θ which could represent any external factor influencing the model (like policy changes or market conditions), we derive the following:

$$\frac{dd}{d\theta} = \frac{df}{dr} \cdot \frac{dr}{d\theta}, \tag{25}$$

$$\frac{dr}{d\theta} = \frac{\partial g}{\partial d} \cdot \frac{dd}{d\theta} + \frac{\partial g}{\partial \theta}. \tag{26}$$

These differential equations enable us to understand how small changes in θ can impact the borrowing rate r and, in turn, the debt level d, thus providing insights into the responsiveness of the entrepreneurial environment to external changes.

By integrating the derived expressions, we obtain a consolidated equation that encapsulates the total differential relationship between the debt level and the external parameter. This relationship is expressed as:

$$\frac{dd}{d\theta} = \frac{\frac{df}{dr}\frac{\partial g}{\partial \theta}}{1 - \frac{df}{dr}\frac{\partial g}{\partial d}}. \tag{27}$$

Now we need to compute $\frac{\partial g}{\partial d}$, $\frac{\partial g}{\partial \theta}$, and $\frac{df}{dr}$. First of all, to compute $\frac{\partial g}{\partial d}$, we apply the quotient rule. The calculation proceeds as follows:

$$\begin{aligned} \frac{\partial g}{\partial d} &= \frac{(r_f - p_2 z_2 \alpha (a+d)^{\alpha-1}) p_1 d - (r_f d - p_2(z_2(a+d)^\alpha - \overline{\chi}) p_1)}{p_1^2 d^2} \\ &= \frac{-p_2 z_2 \alpha (a+d)^{\alpha-1} d + p_2(z_2(a+d)^\alpha - \overline{\chi})}{p_1 d^2} \\ &= \frac{p_2 \left[z_2 (a+d)^{\alpha-1}(a + (1-\alpha)d)) - \overline{\chi} \right]}{p_1 d^2} \end{aligned} \tag{28}$$

By further simplifying this expression under the assumption that $a = 0$, we get:

$$\frac{\partial g}{\partial d} = \frac{p_2 \left[z_2 d^{\alpha-1}(1-\alpha)d) - \overline{\chi} \right]}{p_1 d^2}. \tag{29}$$

To obtain $\frac{\partial g}{\partial \theta}$, a partial derivative of the function g with respect to θ is taken, yielding:

$$\frac{\partial g}{\partial \theta} = \frac{p_2}{p_1 d} > 0.$$

Similarly, for $\frac{df}{dr}$, a partial derivative of the function f with respect to the interest rate r

is calculated:

$$\frac{\partial f}{\partial r} = \frac{1}{(\alpha-1)r}\left(\frac{\alpha(p_1 z_1 + p_3 z_3)}{p_1 r}\right)^{\frac{1}{1-\alpha}} < 0. \tag{30}$$

After substituting the derived values of $\frac{\partial g}{\partial d}$, $\frac{\partial g}{\partial \theta}$, and $\frac{df}{dr}$ into Equation 27, we determine the sign of $\frac{dd}{d\theta}$. The analysis shows that for entrepreneurs who do not file for bankruptcy and possess high productivity, coupled with a high exemption limit, the value of $\frac{dd}{d\theta}$ turns out to be positive. This implies that an increase in the exemption limit θ would result in an increase in the debt level d, suggesting that higher exemption limit correlates with greater debt uptake under certain conditions.

E Appendix: Stationary Distribution

The joint distribution $\mu(b, k, y, h)$ evolves according to the following equilibrium mapping:

If $h = 0$ (G)

$$\begin{aligned}\mu'\left(b', k', y', 0\right) = & \sum_{y} \sum_{k'=k'(b,k,y,0)} \sum_{b'=b'(b,k,y,0)} [1-\mathbb{I}^B(b,k,y,0)]\mu(b,k,y,0)p\left(y,y'\right) \\ & + \xi \sum_{y} \sum_{k'=k'(b,k,y,1)} \sum_{b'=b'(b,k,y,1)} \mu(b,k,y,1)p\left(y,y'\right).\end{aligned}$$

If $h = 1$ (BC)

$$\begin{aligned}\mu'\left(b', k', y', 1\right) = & \sum_{y} \sum_{k'=k'(b,k,y,0)} \sum_{b'=b'(b,k,y,0)} \mathbb{I}^B(b,k,y,0)\mu(b,k,y,0)p\left(y,y'\right) \\ & + (1-\xi) \sum_{y} \sum_{k'=k'(b,k,y,1)} \sum_{b'=b'(b,k,y,1)} \mu(b,k,y,1)p\left(y,y'\right).\end{aligned}$$

References

Akyol, Ahmet and Kartik Athrey (2011) "Credit and Self-Employment," *Journal of Economic Dynamics & Control*.

Auclert, Adrien, Will Dobbie, and Paul Goldsmith-Pinkham (2019) "Macroeconomic Effects of Debt Relief: Consumer Bankruptcy Protections in the Great Recession," *NBER Working Paper*.

Berkowitz, Jeremy and Michelle White (2004) "Bankruptcy and Small Firms' Access to Credit," *RAND Journal of Economics*.

Bertrand, Marianne, Antoinette Schoar, and David Thesmar (2007) "Banking Deregulation and Industry Structure: Evidence from the French Banking Reforms of 1985," *Journal of Finance*.

Calonico, Sebastian, Matias Cattaneo, and Rocio Titiunik (2014) "Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs," *Econometrica*.

Card, David, David Lee, Zhuan Pei, and Andrea Weber (2015) "Inference on Causal Effects in a Generalized Regression Kink Design," *Econometrica*.

Cetorelli, Nicola and Philip Strahan (2006) "Finance as a Barrier to Entry: Bank Competition and Industry Structure in Local U.S. Markets," *Journal of Finance*.

Chatterjee, Satyajit, Dean Corbae, Makoto Nakajima, and Jose-Victor Rios-Rull (2007) "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default," *Econometrica*.

Chen, Brian, Samuel Hanson, and Jeremy Stein (2017) "The Decline of Big-Bank Lending to Small Business: Dynamic Impacts on Local Credit and Labor Markets," *NBER Working Paper*.

Fan, Wei and Michelle White (2003) "Personal Bankruptcy and the Level of Entrepreneurial Activity," *Journal of Law and Economics*.

Fay, Scott, Erik Hurst, and Michelle White (2002) "The Household Bankruptcy Decision," *American Economic Review*.

Fonseca, Julia and Jialan Wang (2022) "How Much Do Small Businesses Rely on Personal Credit?" *Working Paper*.

Ganong, Peter and Simon Jager (2018) "A Permutation Test for the Regression Kink Design," *Journal of the American Statistical Association.*

Ganong, Peter and Pascal Noel (2020) "Liquidity versus Wealth in Household Debt Obligations: Evidence from Housing Policy in the Great Recession," *American Economic Review.*

Gelman, Andrew and Guido Imbens (2018) "Why High-Order Polynomials Should Not Be Used in Regression Discontinuity Designs," *Journal of Business and Economic Statistics.*

Georgellis, Yannis and Howard Wall (2006) "Entrepreneurship and the Policy Environment," *Federal Reserve Bank of St. Louis Review.*

Herkenhoff, Kyle, Gordon Phillips, and Ethan Cohen-Cole (2021) "The Impact of Consumer Credit Access on Self-Employment and Entrepreneurship," *Journal of Financial Economics.*

Hurst, Erik and Annamaria Lusardi (2004) "Liquidity Constraints, Household Wealth, and Entrepreneurship," *Journal of Political Economy.*

Hurst, Erik and Benjamin Pugsley (2017) "Wealth, Tastes, and Entrepreneurial Choice," *Measuring Entrepreneurial Businesses: Current Knowledge and Challenges.*

Indarte, Sasha (2021) "Moral Hazard versus Liquidity in Household Bankruptcy," *Working Paper.*

Kerr, William and Ramana Nanda (2010) "Banking Deregulations, Financing Constraints, and Firm Entry Size," *Journal of the European Economic Association.*

Landais, Camille (2015) "Assessing the Welfare Effects of Unemployment Benefits Using the Regression Kink Design," *American Economic Journal: Economic Policy.*

Lia, Wenli and Pierre-Daniel Sarte (2006) "U.S. consumer bankruptcy choice: The importance of general equilibrium effects," *Journal of Monetary Economics.*

Livishits, Igor, James MacGee, and Michele Tertilt (2007) "Consumer Bankruptcy: A Fresh Start," *American Economic Review.*

Malkova, Alina (2020) "Knockin' on the Bank's Door: Why is Self-Employment Going Down?" *Working Paper.*

Mankart, Jochen and Giacomo Rodano (2015) "Personal Bankruptcy Law, Debt Portfolios, and Entrepreneurship," *Journal of Monetary Economics*.

Mitman, Kurt (2016) "Macroeconomic Effects of Bankruptcy and Foreclosure Policies," *American Economic Review*.

Nielsen, Helena Skyt, Torben Sørensen, and Christopher Taber (2010) "Estimating the Effect of Student Aid on College Enrollment: Evidence from a Government Grant Policy Reform," *American Economic Journal: Economic Policy*.

Robb, Alicia and David Robinson (2014) "The Capital Structure Decisions of New Firms," *The Review of Financial Studies*.

Rohlin, Shawn and Amanda Ross (2016) "Does Bankruptcy Law Affect Business Turnover? Evidence from New and Existing Business," *Economic Inquiry*.

Tan, Eugene (2022) "Entrepreneurial Investment Dynamics and the Wealth Distribution," *Working Paper*.

White, Michelle (2006) "Bankruptcy and Small Business – Lessons from the U.S. and Recent Reforms," *CESifo DICE Report*.