Student Debt and Entrepreneurship in the US*

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Abstract

I study the interplay of educational choices and entrepreneurial outcomes along the life-cycle of households. Using US micro-level data, I show that having a student loan is associated with a lower likelihood of opening a firm and obtaining funding, and is linked to smaller firm size and lower revenues. I then develop a heterogeneous agents framework to analyse the educational and entrepreneurial choices of agents during their youth and adult life. In the model, student loans slow down the accumulation of wealth and reduce the collateral entrepreneurs can pledge to rent capital on financial markets. I calibrate my framework to US data and show that it can match between 30 and 60% of the gap in entrepreneurial rates and outcomes between agents with and without college, and with and without student loans. Moreover, the increase in university tuition and student debt between the 1980's and today is shown to account for half of the decline in the entrepreneurial rates of college-graduates with loans. Finally, exploiting the US 1998 reform to educational loans bankruptcy, I establish a causal relationship between student debt and entrepreneurial outcomes in the data, which I replicate in my quantitative framework. The model informs about the effect of bankruptcy availability on the extensive and intensive margin of entrepreneurship, aggregate output and factors allocation in the US.

Keywords: Student Debt, College Tuition, Entrepreneurship, Financial Constraints, TFP.

JEL Classification: E21, E23, I2, L26

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1 Introduction

More than 65% of US college-graduates and nearly 1 in 3 American adults borrow to finance their degrees. Student loans have become the second largest debt market in the country – worth 1.5 trillion dollars – and are currently at the center of its public debate. While educational loans represent the major (or the only) gateway to university for most US students, the cost of attending college has been rising faster than inflation and faster than the college premium in the last years. With the median borrower piling up more than 30K dollars of debt, recent studies have in fact documented far reaching consequences of student loans for individuals' life choices, including their job search strategies and home-ownership rates.[1] Yet, less is known on whether and how educational debt interact with entrepreneurial margins. Since highly-educated individuals are generally associated with better business outcomes,[2] could student loans have also repercussions for US firm dynamism, capital allocation and aggregate output? This paper specifically investigates the interplay of educational and occupational choices along the life-cycle of households, and highlights the quantitative impact of student debt on entrepreneurial margins and aggregate quantities.

In my empirical exploration, I use micro-level data from the US Survey of Consumer Finances (SCF) and focus on the 1989-2019 period. First, I document a negative relationship between student loans – both the initial amount taken and the outstanding balances at the time of the survey – and entrepreneurial outcomes. In the cross-section, higher levels of education are overall associated with better business outcomes for entrepreneurs, as noted in Michelacci and Schivardi (2020). Yet, individuals who carry and/or took out student loans are less likely to become business owners and to obtain external business funding compared to agents without a degree and to college-graduates without student debt. Their firms are also relatively younger, tend to employ less workers and to generate less revenues and profits in absolute terms. My results are robust to the inclusion of several demographic and firm-level controls and a battery of fixed effects.

I argue that the association between student debt and entrepreneurial outcomes can be due to the presence and extent of entrepreneurial borrowing constraints. On the one hand, educational loans may lower risk tolerance and discourage or delay entrepreneurial careers due to the fact that they carry (mostly fixed) repayment plans and practically cannot be discharged in bankruptcy. On the other hand, since outstanding liabilities are discounted in new loan applications by banks, student debt could also impair entrepreneurs' chances to secure external funding. If such financial barriers to business ownership were plausible, one should also expect college-graduate entrepreneurs with student loans to undergo a stricter selection into the entrepreneurial pool. Consistently, I show that entrepreneurs with student debt are in fact associated to businesses with better profit margins. I also present suggestive evidence of the absence of negative selection into having student loans both in terms of financial and individual productivity characteristics.

These findings are then rationalized into a general equilibrium heterogeneous agents life-cycle

[1] See for example Alon et al. (2021), Luo and Mongey (2019), Folch and Mazzone (2020) and Abbott et al. (2019).
[2] See for example Poschke (2013) and Michelacci and Schivardi (2020).

model, where individuals differ by wealth, productivity, age and student debt. Assets are accumulated over time and idiosyncratic productivities consist of an uninsurable stochastic component and a deterministic life-cycle profile. Households live through three main life-stages: an education period, a working period, and retirement. They save out of their income and consume a final good, which is produced by heterogeneous entrepreneurial firms using their productivity, capital and labor. During youth, individuals decide whether to attend college or to enter directly the labor markets. Going to university entails a tuition, and households have to decide how much to take out in educational loans, which will be repaid upon graduation. Parallel to that, college education gives agents a income premium through higher deterministic productivity growth. During their adult life, all individuals make occupational choices and decide whether to open a firm or become workers. In retirement, they consume their pension and their savings, and leave bequests. Finally, there is a government that collects income taxes, holds student loans and distributes pensions.

In the model, student debt and entrepreneurial choices are interconnected because of two main channels: first, the repayment of educational loans upon graduation reduces the amount of available resources that individuals can save, and slows down wealth accumulation. Since personal assets are the collateral against which entrepreneurs borrow to finance capital acquisition, this mechanism has a direct negative effect on the entrepreneurial rates and outcomes of college-graduates with student loans, particularly at the beginning of their working career. Secondly, I assume that student debt outstanding balances are discounted from the amount of personal resources that entrepreneurs can pledge to acquire capital on financial markets. By tightening their borrowing constraint, student loans ex-ante reduce entry into entrepreneurship and ex-post limit the expansion of firms run by indebted college-graduates. The model can hence generate and account for the interplay of student debt with both the *extensive* and *intensive* margins of entrepreneurship.

Calibrated on US data, my quantitative framework replicates the estimated cross-sectional differences between the entrepreneurial outcomes of individuals with and without education, and with or without student debt. I am able to match closely the business ownership rates of non-college and college-graduates, and the bulk of the gap in the extensive margin of entrepreneurship across individuals with university education that differ in their student debt balances. In the calibrated economy, educational loans not only discourage and delay entry into entrepreneurship, but also lower firm capital and profits. As such, I can replicate between 30 and 60% of the empirical differences in the average sales, size and collateralized debt of business owners with and without student debt. In a further validation exercise, I then vary the returns to college education and the price to attend university between the late 1980's and today to match the related change in college attainment rates. The subsequent increase in student debt can explain up to 50% of the decline in the entrepreneurial rates of US college-graduates with educational loans over the same period.

Finally, I exploit the exogeneity in the 1998 reform to educational loans bankruptcy to establish an empirical causal link between student debt and entrepreneurship. Using SCF data and employing regression discontinuity designs (RDD) and difference-in-difference (DiD) frameworks, I estimate a 9.16% elasticity of business ownership rates to educational loans. Then, I expand my

quantitative framework to include and allow for student loans bankruptcy under the legal terms that were in order in the US before the 1998. In particular, I assume that college-graduates who took out student loans can discharge them after 7 years into repayment, having their outstanding balances covered by government expenditure. After matching the average share on bankrupt households in the 90's, I establish that allowing for student loan bankruptcy would increase the entrepreneurial rates of college-graduates with student debt by 10.40%, which replicates closely its empirical counterpart. In such counterfactual scenario, capital misallocation would also decrease by 9.2% and US aggregate welfare and output would increase by 0.2 and 0.4% respectively.

In future analyses, the model could be used as a quantitative laboratory to assess the effect of specific government policies on individuals' choices and aggregate outcomes. For instance, my quantitative framework could be suitable to study the impact of college aid expansions and/or income-based student debt repayment plans on entrepreneurship, capital allocation and aggregate productivity in the US.

Related Literature. This paper contributes to the macroeconomic literature on financial constraints and entrepreneurship, and more specifically to several studies related to capital allocation (see Buera et al. (2011) and Midrigan and Xu (2014)), occupational decisions (see Cagetti and De Nardi (2006)) and their impact on aggregate quantities. In particular, I combine educational and occupational choices together into a heterogeneous agents life-cycle model, which is characterized by the interplay of student debt decisions and repayment plans with entrepreneurial borrowing constraints. The model can account for the relationship between educational loans and business ownership rates and performances over individuals' life-cycle – as I document empirically – and informs about its consequences on talent and factor allocation and total output.

Secondly, I relate to a recent body of applied research that has started documenting a link between student debt and several individuals' choices over their life-time. For example, Looney and Yannelis (2015a), Yannelis (2016) and Mueller and Yannelis (2019) have investigated the trend in repayment and default rates among college-graduates and their causes. Parallel to that, Mezza et al. (2020) have studied the effect of student loans on the likelihood and timing for buying a house, while Catherine and Yannelis (2020) have shown an effect of educational loans on family formation. As in Ambrose et al. (2015) and Krishnan and Wang (2019), I instead focus on student debt and business ownership, and use micro-level data to document a relation between educational loans and both the extensive and intensive margins of entrepreneurship. Moreover, I complement my empirical findings with a theoretical modeling and a quantitative macroeconomic exploration.

In combining both empirical strategies and a quantitative framework to study the macroeconomic consequences of student debt, I am similar in spirit to Alon et al. (2021), Ji (2021), Folch and Mazzone (2020), and Luo and Mongey (2019). Differently from these papers, I do not focus on human capital accumulation, job search strategies or home-ownership choices, but rather on educational loans and entrepreneurial outcomes. In this respect, my work relates to Kerdelhué (2021), who analyses the impact of education financial aid on entrepreneurship and inequality. I

however investigate the effect of the interplay of student debt and entrepreneurship on US capital misallocation and aggregate output, both in the cross-section and over time. Moreover, the key elasticities between entrepreneurial outcomes and educational loans estimated in the SCF data are used to discipline my model, and to make it quantitatively suitable for the analysis of policy counterfactuals on income-based repayment plans for student debt and university grant schemes.

The paper is organized as follows: Section 2 documents the association between student debt and entrepreneurship in the SCF data. In Section 3, I develop a model of educational and occupational choices that is then calibrated on the US in Section 4, where I assess its quantitative fit with respect to my empirical evidence. In Section 5, I establish a causal link between student debt and entrepreneurship by exploiting an exogenous change in its repayment policy, and I replicate quantitatively the effects of student debt bankruptcy in the model. Finally, Section 6 concludes.

2 Empirical Analysis

In the following section, I present suggestive evidence on the relationship between student debt and entrepreneurship in the US. Specifically, I first focus on the extensive margin of entrepreneurship and show that educational loans are associated with a lower likelihood of opening a business. Secondly, I analyse business outcomes that regard the intensive margins of entrepreneurship: student debt is shown to be negatively related to the probability of receiving business loans, and to negatively correlate with business profits, size and revenues. Finally, I discuss whether possible mechanisms of selection into student debt and into entrepreneurship find support in the SCF data.

2.1 Student Debt and Business Ownership

For my empirical exploration, I rely on the SCF, a triennial cross-sectional representative survey of US families conducted by the Federal Reserve Board, which provides information on household's demographic characteristics and balance sheet variables, including income, assets and debt.[3] When applicable, it also reports information on respondents' spouses. In my analysis, I use the 1989-2019 combined sample and focus on agents in the labor force and between 25 and 65 years old, which are approximately 170,300 households. Furthermore, I apply survey weights in regressions and comparative analyses to always ensure the representativeness of my sample.

Even if the SCF does not exclusively target entrepreneurs, firm owners are over-represented and constitute more than 20% of the total sample, which is a reason why the SCF has been frequently used in studies of US entrepreneurship (see Cagetti and De Nardi (2006) for example). The section related to the businesses owned by the respondents contains data on their revenues, profits, collateralized debt and equity, as well as information on the industry, the legal status and the funding date of firms. It also reports how the business was initially started, the ownership share of the respondents and their working hours. I classify as business owners individuals that

[3] Table A1 in the Appendix reports a list of all the variables used in my regressions, along with a brief explanation.

actively manage an enterprise in which they hold a share of the ownership, and who report at least one employee.[4] A list of the variables used and their definition is included in Table A2.

The SCF also asks respondents information regarding their student debt, for example whether they have any educational loan, the initial amount take and the amount still to be repaid at the time of the interview, the year in which the loan was taken and started to be repaid, the interest rate charged and the repayment plan (see the full list of variables in Table A3). In the sample period I consider, 20.3% of all respondents affirms to have a student loan to repay, and the average debt taken is around 30,800$, which is in line with estimates from the National Center of Education Statistics.[5]

Table 1: Entrepreneurial Rates and Student Loans: A Comparison

Whole Sample	*Avg*	*No Loan*	*Loan*	**2010-2019**	*Avg*	*No Loan*	*Loan*
College	15.5%	16.76%	11.29%	College	13.80%	15.73%	9.94%
Non College	11.05%	-	-	Non College	10.50%	-	-

Importantly, over the recent decades, business ownership rates have declined and the average amount of student debt per person has increased, as reported in Figure A.1. The first trend speaks to the steady decline in US entrepreneurial rates extensively documented by Decker et al. (2014), while the second one has been argued to reflect changes in the returns to college and in the educational system, for example regarding tuition costs, loan limits and funding schemes. In Section 5, I will analyse the co-evolution of business rates and student loans over time; here, I limit my focus on the cross-sectional differences between individuals with and without student debt.

As reported in Table 1, entrepreneurial rates of households with college are higher than those of non-college graduates, both when considering the whole sample and the most recent decade.[6] Moreover, firm ownership rates of college-graduates with student loans are substantially lower than for their non-indebted counterpart, and closer to the ones of non-college graduates. If anything, non-college graduates have maintained higher business ownership rates with respect to college-graduates with student debt over the last years. To further assess the interaction between educational loans and firm ownership, I then estimate the likelihood of becoming entrepreneurs

[4] I hence exclude self-employed households from the definition of entrepreneurs.

[5] Over the last decade in particular, roughly 35% of the US population aged 25 and older is reported to have earned a college degree. Among college graduates, on average 65% have to borrow for college. Hence, 23% of the US population above 25 years old is estimated to have negative student loan balances after graduation. Moreover, borrowers on average take between 30 and 50K $ in student loans, as reported by Looney and Yannelis (2015b).

[6] A large literature has established that education correlates positively with entrepreneurial rates, see for example Poschke (2013). College can enhance and provide individuals with skills and inter-personal connections that have a positive effect on entrepreneurial outcomes.

for agents in my sample by running a set of probit regressions of the following form:

$$Pr(BusOwner_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_{it} + \delta' \mathbf{\Gamma}_i + \gamma' \mathbf{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \quad (1)$$

where *BusOwner* is a binary variable that takes a value of 1 if individuals are entrepreneurs at the time of the survey, and 0 if they are not. Thanks to the richness of the data, I can make use of three different variables to define the key explanatory regressor *Student Loan*. First, I exploit the initial amount of student loans taken by the individual, which does not depend on the survey year t. Secondly, I can either employ a dummy variable that signals the presence of pending student loans in the balance sheet of the households, or use the actual amount still to be repaid as of the survey year t. It is important to stress that 80% of households with student debt has only one recorded loan on their balances, while a smaller fraction of the sample has two to three educational loans.[7] Here, I consider the total amount of student debt hold or taken by the households.

I then include a set of controls $\mathbf{\Gamma}_i$, which capture factors pre-determined to the choice of taking on student loans that may also affect entry into entrepreneurship (e.g. gender, ethnicity and parental education). Finally, I also sequentially introduce a set of controls variables recorded at the time of the survey that were not pre-determined in the moment in which individuals made their student loans choices, such as their age, education level, marital and home-ownership status, and personal wealth. Note that all regressions include survey year fixed effects (α_t).

Table 2: Business Ownership

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0029***	-0.0019***		
	(0.0002)	(0.0002)		
Dummy(Have Loan)			-0.0188***	
			(0.0024)	
Amount Still Owed				-0.0020***
				(0.0003)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Personal Wealth	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Observations	160,202	160,202	160,202	160,202
Pseudo-R^2	0.0373	0.0432	0.0433	0.0433

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity (Table A5 includes parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions. I consider business owners with 100% of the company equity, for a better mapping to the theoretical model later on. Nonetheless, Table A6 provides the regression results for the robustness check without such exclusion.

As reported in Table 2, student debt shows a negative correlation with business ownership across a host of different regression specifications. In Column (1), where only pre-determined

[7] This is the case of separate loans to finance undergraduate and graduate studies, for example.

demographic controls are included, the magnitude of the coefficient indicates that an increase of 1000$ in student debt is associated with a 2% lower likelihood of becoming an entrepreneur. Columns (2) to (4) instead control for variables recorded at the time of the interview that can correlate with the current business ownership status of the respondents. This second set of regressions assesses how student loan balances of individuals within the same age, wealth or income categories, for example, correlate with their likelihood of being entrepreneurs. Column (2) shows that the initial amount of debt taken has a 1.5% negative relationship with business ownership, similarly to what reported in Column (4), which focuses on the amount still owed at the time of the survey. In Column (3), I use as main regressor a dummy variable that is 1 if the respondent reports having (currently) a student loan to repay, and 0 otherwise. In line with the other results, having a student loan is also associated with a 1.8% lower likelihood of becoming an entrepreneur.[8]

Moreover, as a robustness check, in Table 3 I estimate again Equation 12 excluding non-college graduates and focusing on the first biggest educational loan of survey respondents. Among individuals with at least a bachelor degree, the presence and extent of student debt in the household's balance sheet correlates negatively with business ownership. Interestingly, the magnitudes of the coefficients across the different specifications are moderately bigger than in Table 2, suggesting that the estimated gap in entrepreneurial rates by student loan status is in fact wider within college-graduates (which is consistent with the comparison of simple averages shown in Table 1).

Table 3: Business Ownership, College Graduates Only

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0058***	-0.0020***		
	(0.0004)	(0.0004)		
Dummy(Have Loan)			-0.0240***	
			(0.0039)	
Amount Still Owed				-0.0021***
				(0.0004)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Personal Wealth	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Observations	75,758	75,758	75,758	75,758
Pseudo-R^2	0.0202	0.0432	0.0369	0.0367

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' age, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

Focusing more closely on business owners and on the enterprises they run, it is also possible

[8]Each control is also interacted with the student loan variable to check that results are not driven by one demographic group only. Throughout these robustness checks, the coefficient on the student loan variable remains negative and statistically significant. Interaction terms are of interest per sè: for instance, the negative correlation between student debt and business ownership is stronger for demographic groups that are under-represented in entrepreneurship, such as women and non-white households, which could suggest tighter constraints and higher barriers on their end.

to check that individuals that took out bigger student loans to finance their college education have on average a higher amount of personal wealth collateralized for their businesses, as reported in Table A4. This can be suggestive evidence that entrepreneurs carrying large student debt balances might have to provide more collateral to back up their entrepreneurial operations. Along a similar line of thought, Figure A.2 analyses the business legal status of enterprises run by individuals with and without student loans. Indebted owners are less likely to open corporations or limited liability companies, as opposed to individuals without current student loan balances to repay.[9]

Finally, Figure A.2 shows that college-graduates that do not report student loans tend to start their enterprise earlier on in life. For this comparison, I focus on entrepreneurs that funded their own business, as opposed to inheriting or joining it. On average, firms of indebted entrepreneurs are 5 years younger, which suggests that households with educational debt delay undertaking their entrepreneurial careers. As also pointed out by Alon et al. (2021), student loans can incentivize individuals to trade-off higher earnings upon graduation with careers of better long-run prospects. In a similar way, Luo and Mongey (2019) show that agents with student debt generally choose to work for highly-paid jobs with worse amenities early on in their career, while still repaying their loan balances. Consistent with their mechanisms, I argue that educational loans could similarly discourage or delay business firm, as opening a business can lead to high earnings but also involves taking higher risk. I will go back to this trade-off in the quantitative section.

2.2 Student Debt and Business Outcomes

After having assessed the link between student debt and the *extensive* margin of entrepreneurship, I now focus my analysis on the business outcomes across entrepreneurs of different educational loans balances. In terms of the *intensive* entrepreneurial margins considered, I first examine business financing, and I then turn to business size, sales, profits and profitability measures.

2.2.1 Business Financing

Enterprises generally need funds to run their operations, and one way to obtain finances is through business borrowing. The SCF records information on whether the respondent applied for and obtained a business loan within 12 months from the time of the interview. First, in Table A7, I report estimates of the likelihood of applying for a business loan. Neither the initial amount of student debt taken nor the actual balances in the survey year t significantly correlate with the probability of asking for business funding, suggesting little to no role for credit *demand* heterogeneity across indebted and non-indebted entrepreneurs. Secondly, I estimate the likelihood of being turned down in a business credit application via a probit regression of the following form:

$$Pr(LoanApproved_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_{it} + \boldsymbol{\delta}'\boldsymbol{\Gamma}_i + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \tag{2}$$

[9]The business legal status reported at the time of the interview is likely to be the one with which the business originally started. Changing the legal status of an enterprise is very infrequent in the US, and bureaucratically complex.

where *LoanApproved* is a binary variable that takes a value of 1 if the business loan request of entrepreneurs was approved, and 0 if it was rejected. As for the previous regressions, I alternate three different variables to define the key explanatory regressor *Student Loan*. First, I use the initial amount of student debt taken by the individual. Secondly, I use a dummy variable that signals the presence of pending educational loans in the balance sheet of the households, and then the actual amount still to be repaid at the time of the survey year t. As before, whenever more than one student loan is recorded for a given respondent, I consider the total amount of educational debt hold or taken. I also include the controls and fixed effects as in Equation 12.

Table 4: Business Loan Approval

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0120***	-0.0128***		
	(0.0028)	(0.0027)		
Dummy(Have Loan)			-0.1408***	
			(0.0279)	
Amount Still Owed				-0.0137***
				(0.0028)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Personal Wealth	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	5,196	4,261	4,261	4,261
Pseudo-R^2	0.0333	0.2995	0.3011	0.3003

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the entrepreneur received business funding in the past 12 months, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity (Table A5 includes parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status. Firm controls include profits, business age, legal type and individuals working hours (I can use business size as a control instead of profits too). Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

As reported in Table 4, student debt shows a negative correlation with business loan approval across a host of different regression specifications. In Column (1), I only control for demographic characteristics that were pre-determined at the time the student loan was taken, such as individuals' gender, ethnicity and parental education. In particular, the magnitude of the coefficient indicates that an increase of 1000$ in student debt for entrepreneurs is associated with a 8.3% lower likelihood of getting business funding. Columns (2) to (4) instead control for variables recorded at the time of the survey interview that may correlate with business loan approvals. This second set of regressions therefore assesses how the student loan balances of entrepreneurs within the same age, wealth or business income categories for example, correlate with their likelihood of securing external finances. Column (2) shows that the initial amount of student loans taken has a 9.5% negative relationship with business loan approval. In Column (3), I use as main regressor a dummy variable that is equal to 1 if the respondent reports having still a student loan to repay,

and to 0 otherwise. Similarly to the previous result, having a student loan is associated with a 14% lower likelihood of receiving business credit. Finally, the regression in Column (4) exploits the total amount still owed at the time of the survey, finding similar results to Column (2).[10]

2.2.2 Business Size and Profits

An impaired access to business financing from external sources is likely to subsequently influence the operations of the firms run by affected entrepreneurs. For this reason, I next focus on the size, sales, net worth and profits of the enterprises in the SCF sample, and examine whether the amount of student debt taken to attend college is associated in any way to these key business performance indicators. For example, due to more severe difficulties in accessing business credit, entrepreneurs that took out larger amounts of educational loans or still have to repay substantial balances at the time of the survey interview might be running smaller firms (measured in numbers of employees). Parallel to that, if external credit is used to finance capital acquisition, even within the same business size categories, firms run by indebted entrepreneurs could also generate lower revenues. To test for this hypothesis, I run the following set of regressions:

$$y_{it} = \beta_0 + \beta_1 Student\ Loan_{it} + \boldsymbol{\delta}'\boldsymbol{\Gamma}_i + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it} \tag{3}$$

where $y = \{employees\ ;\ sales\ ;\ profits\ ;\ net\ worth\}$ is a vector containing either the number of employees, the gross sales, the profits or the net worth of the business reported by entrepreneurs in the SCF sample at the time the interview took place. The net worth of a business is to be intended as the value at which the business could have been sold in the year of the survey. My key explanatory regressor is *Student Loan*, which represents the initial amount of student loans taken by the individual, and does not depend on the survey year t.[11] I allow for sets of pre-determined controls, general controls and firm-level controls, as previously explained. Note that all regressions include survey year fixed effects (α_t). Results for size and sales are displayed in Table 5, while business profits and net worth are instead analysed in Table A9 and Table A10.

The estimation of Equation 3 reveals that the amount of student debt taken by entrepreneurs to finance college education is linked to a lower business size: specifically, an increase of 1000$ in student loans is associated to hiring 12 employees less. Moreover, within businesses of comparable profile (including size) and for entrepreneurs of similar demographic and financial characteristics, an increase of 1% in the initial amount of student debt upon graduation correlates with 4-6% lower sales, 2-4% lower profits, and 5-7% lower business net worth. Results are stable to the sequential introduction of controls, which suggests that the magnitude and statistical significance of the coefficient of interest is not simply driven by the specific choice of the included regressors.

[10] I can further restrict the focus only to entrepreneurs that are college graduates. Similar to what observed for entrepreneurial rates in the previous section, this choice reduces noticeably the sample size and gives (statistically significant) stronger effects across the different regression specifications in Table 4. All results are available upon request.

[11] Table A8 reports robustness checks using a dummy for whether the entrepreneur has a student loan to repay at the time of the interview, as well as the actual amount still to be repaid. Results are in line with the baseline specification.

Table 5: Business Outcomes: Size and Gross Sales

	Employees	Employees	Sales	Sales
Initial Amount Edu Loan	-1.9828***	-1.9919***	-0.0648***	-0.0423***
	(0.1656)	(0.1890)	(0.0055)	(0.0048)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	N	Y
Firm Controls	N	Y	N	Y
Personal Wealth	N	Y	N	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	N	Y
Observations	40,145	39,461	37,540	36,855
R^2	0.0026	0.0339	0.0780	0.4054

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are either the number of employees or $\log(Sales)$. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status. Firm controls include business age, legal type and individuals working hours (and business size in Columns (3)-(4)). Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

2.3 Selection Effects

2.3.1 Selection into Entrepreneurship

So far, I have shown that the amount of student debt taken to finance college education, as well as the amount still to be repaid, are correlated with a lower likelihood of becoming an entrepreneur, and are associated with opening businesses of smaller size and sales. In this paper, I advance the hypothesis that the financial burden implied by educational loans can act as a deterrent from entry into entrepreneurship. On the one hand, making repayments on the initial debt balance and paying interest rates for 10 to 20 years upon graduation can have a negative income effect on households' available resources, and slow down their wealth accumulation. This can discourage or delay firm ownership because entrepreneurs' personal asset are known to be crucial for establishing and running small-medium businesses (see Quadrini (2009) for a review of the literature).

On the other hand, the influence of student loans on entrepreneurial outcomes could also be of a financial collateral nature. Lending institutions are known to discount the amount of outstanding debt individuals carry whenever they apply for additional credit. In this sense, educational loans may decrease the likelihood of getting funds (or the amount one can get) for running or starting a business, which is consistent with the evidence from the SCF presented in Table 4. Moreover, both channels would imply that barriers to entrepreneurship are higher for individuals with higher initial or current student loan balances, which could result in a stronger selection into the entrepreneurial pool. As a consequence, more productive and/or richer households would be more likely to open a business if they took or still carry large amounts of educational debt.

To check for instances of selection into entrepreneurship, I follow the approach in Morazzoni and Sy (2021), and compute profitability indicators such as profits per dollar revenues, or profits

per dollar of collateralized debt. Then, I assess how these profitability measures correlate with student loans for the entrepreneurs in my sample by running the following regression:

$$y_{it} = \beta_0 + \beta_1 Student\ Loan_{it} \times Business\ Size_{it} + \delta' \mathbf{\Gamma}_i + \gamma' \mathbf{\Phi}_{it} + \alpha_t + \epsilon_{it} \tag{4}$$

where $y = \{\log\left(\frac{\text{Profits}}{Revenues}\right); \log\left(\frac{\text{Profits}}{CollDebt}\right)\}$ is a vector containing the measures of profit per dollar revenues and profit per dollar of collateralized debt based on the information reported by SCF entrepreneurs at the time the interview took place. I regress both variables against the amount of student loan took by the respondent, the size of their business and an interaction term to ensure that results are not driven by bigger (or smaller) firms only. Control variables and survey year FE are as in Equation 3, while results are reported in Table 6 below and in Table A11 in the Appendix.

Table 6: Business Outcomes: Profitability

	$\log\left(\frac{\text{Profits}}{Revenues}\right)$	$\log\left(\frac{\text{Profits}}{Revenues}\right)$	$\log\left(\frac{\text{Profits}}{CollDebt}\right)$	$\log\left(\frac{\text{Profits}}{CollDebt}\right)$
Initial Amount Edu Loan	0.0204***	0.0122***	0.0052**	0.0058**
	(0.0026)	(0.1890)	(0.0019)	(0.0017)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	N	Y
Firm Controls	N	Y	N	Y
Personal Wealth	N	Y	N	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	N	Y
Observations	40,150	39,461	40,150	39,461
R^2	0.0230	0.1411	0.0083	0.0575

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are either the number of employees or $\log(Sales)$. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status. Firm controls include business age, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

Column(1) and (3) report regression outcomes for the simplest specifications, which include the initial amount of education loans (without the interaction term *Student Loan* × *Business Size*) and controls that were pre-determined at the time the student loan was taken. Column(2) and (4) consider the full set of controls and the interaction term in Equation 4 and show that the coefficient on *Student Loan* is significant and positive, above and beyond any confounding effect coming from the size and characteristics of the businesses run by the entrepreneurs in the sample. Owners with a larger initial amount of educational loans have higher profitability per dollar revenues or per dollar of collateralized debt. In particular, a 1% increase in the initial amount of student loans is associated with 4 to 9% higher business profit margins, which can suggest that owners who took larger amounts of educational debt in college may have also undergone a stricter selection into entrepreneurship.

2.3.2 Selection into Student Loans

An important question to ask at this point is who are the individuals that borrow for college education. If agents were to select into student debt on characteristics that are linked to a lower likelihood of becoming entrepreneurs and running productive firms, my results would primarily capture such selection mechanism and have little to say about the financial or income effects of educational loans themselves on entrepreneurial outcomes. I tackle this issue in two steps: I devote the remainder of this section to discuss suggestive evidence on the fact that *negative* selection into educational loans is a concern of limited impact for my results. Then, in Section 5, I use an exogenous change in the repayment policy of student debt to illustrate a causal relationship between educational loans and entrepreneurship, above and beyond any confounding selection effect.

What does it take to open and run a firm? Data and theories converge on pointing at wealth and entrepreneurial ability as two crucial factors behind the majority of business stories (see Cagetti and De Nardi (2006) and Buera et al. (2011) for example). Hence, it seems important to assess whether student loan borrowers significantly differ from non-borrowers along these two dimensions. Let's first focus on family and personal wealth. Parents' finances have been and still are an important determinant of college attendance for US high-school graduates. However, family wealth has recently become a weaker predictor for the likelihood of borrowing to finance education (see Lochner and Monge-Naranjo (2016)). According to estimates from the National Center for Education Statistics, over the 1989-2004 period student loans growth at the extensive margin (percent borrowing) and at the intensive margin (amount per borrower) was actually most pronounced for the highest family income quartile (see Berkner (2000) and Wei and Berkner (2008)).

Such steady increase in student loans borrowers among the highest family income quartiles might have likely reflected the introduction of unsubsidized federal loans, which can be taken out irrespective of financial need. Along this line, Looney and Yannelis (2015b) have for example shown that rich US households are now more likely to use educational loans to pay for tuition and boarding costs, especially at top universities and Ivy League Schools.[12] Moreover, it is crucial to stress that aid schemes, such as the Pell Grant,[13] typically target low and middle-income students, whose family and personal background qualifies for tuition subsidies.[14] Finally, individuals with student loan balances are those who acquired an higher education and hence those that will more likely have better career prospects and earnings profiles. It does not seem therefore that student loan borrowers only pertain to the bottom of the income or wealth distribution, considering either their family or personal finances.

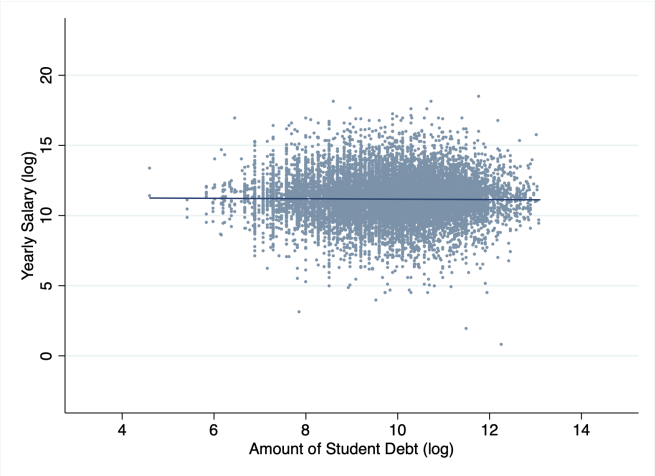
On the other hand, it seems difficult to argue that student loan borrowers have clearly and significantly lower entrepreneurial skills than non-borrowers. Entrepreneurial skills are complex to measure but have been often proxied by educational attainments (see Poschke (2013)). Only students that choose to get higher education get a student loan, and higher education has been

[12] www.brookings.edu/opinions/students-at-elite-schools/

[13] www.brookings.edu/research/the-economic-case-for-doubling-the-pell-grant/

[14] https://studentaid.gov/understand-aid/types/grants/pell

Figure 1: Yearly Salary and Student Debt Balance upon Graduation



often found to positively impact entrepreneurial outcomes (see Guo et al. (2016) and Michelacci and Schivardi (2020) for example). Comparing individuals with and without student debt, one should in fact expect the latter group to be more likely to open and run a successful business.

Shifting the focus on college-graduates, a possible confounding mechanism would be that students with higher talent get more often access to grants and hence do not borrow for their degrees. Merit-based aid is certainly limited and infrequent, covering at most 15 to 30% of the average financial needs of relatively few perspective students, and leaving the rest to be covered either by family contributions or through borrowing.[15] More importantly, the negative selection of students into borrowing finds little support empirically. To provide a finer measure for individual talent, I use data from the National Longitudinal Survey of Youth (NLSY97), which contains results to cognitive and attitudinal tests administered to all survey respondents, irrespective of their educational attainment. In Table A12, I show that cognitive abilities are a strong predictor of both receiving grants and taking up student loans at college. Results illustrate that cognitive abilities do not correlate with getting higher amounts of grants as opposed to educational loans.

Secondly, if students were to negatively select on having educational loans according to their idiosyncratic skills, it should be reflected in their broader entrepreneurial outcomes. Contrary to that, I have shown in Table 6 that profitability measures are higher (not lower) for student loan borrowers. Using NLSY97, in Table A13 I also regress self-employment rates on the interaction between individual educational loans and cognitive abilities to show that student debt is still significantly and negatively associated to entrepreneurial outcomes. Along this line, both Luo and Mongey (2019) and Alon et al. (2021) have documented that regressing individuals' wages on student debt leads to non-significant results, which I can verify in the SCF data (see Figure 1).[16] In this sense, I can rule out that individuals with student loans are evidently the least productive ones among college-graduates, otherwise it should be reflected in their wages as well.

[15] `www.urban.org/urban-wire/what-better-data-reveal-about-pell-grants-and-college-prices`

[16] Their IV set ups also confirm that educational loans have a positive effect on wages upon graduation.

Since student debt and occupational choices are endogenous individual outcomes, I next build a model that can account for both decision margins and their interaction. Then, in Section 5 I go back to the data and exploit an exogenous policy change in the bankruptcy availability for student loans to reinforce the idea that student debt can have a causal effect on entrepreneurial outcomes.

3 Model

In the next section, I present a general equilibrium framework with heterogeneous agents that nests together education decisions and occupational choices over the life-cycle of individuals. Households in the model live through three main stages in life: an education period, a working period, and retirement. They are born with heterogeneous wealth and idiosyncratic productivity, which both accumulate and change over time. In the education stage of their lives, agents decide whether to attend college by paying a tuition cost, and whether to take on student loans, which they will repay upon graduation. Households are endowed with one unit of time that they either supply inelastically, if they choose to be workers, or use to run a firm, if they choose to become entrepreneurs. They also save out of their income and consume a final good, which is produced by the heterogeneous firms run by entrepreneurs. In particular, output is produced combining capital and labor, and entrepreneurs are subject to financial constraints. Finally, there is a government that collects income taxes, holds student loans and distributes pensions in the economy.

In the model, student debt and entrepreneurial choices are interconnected because of two main channels: first, loan repayment upon graduation reduces the amount of available resources that individuals can save, and slows down the accumulation of wealth. Since personal assets are the collateral against which entrepreneurs borrow to finance capital acquisition, this mechanism has a direct negative effect on the entrepreneurial rates and outcomes of college-graduates with student loans, particularly at the beginning of their career. Secondly, during the repayment period, the outstanding balance of student debt is discounted from the amount of personal resources that entrepreneurs can pledge to finance capital acquisition. By tightening their borrowing constraint, student loans ex-ante reduce entry into entrepreneurship and ex-post limit the expansion of the firms run by indebted college-graduates. The model can account for the interplay of student debt with both the *extensive* and *intensive* margins of entrepreneurship documented in Section 2.

3.1 Primitives

Preferences: Households have a strictly increasing concave utility function, which satisfies standard Inada conditions, and where the coefficient of risk aversion is denoted by γ:

$$u(c) = \frac{c^{1-\gamma} - 1}{1-\gamma}$$

Moreover, agents discount utility over future consumption at rate β.

Timing: Households are born as if they were out of high-school. In the first stage of their lives, T_{edu}, they decide whether to attend college or to enter directly the labor force. In the years between $T_{edu}+1$ and T_{work}, all agents work, consume and save. Between $T_{work}+1$ and T_{end} they retire and live off their savings and pensions until death. Survival probabilities are denoted by θ_t.

Productivity: Individuals are characterized by heterogeneous idiosyncratic productivities z. Workers' productivity evolves deterministically over their life-cycle according to the following process:

$$e^{z_{work,t}} = e^{\ell_t} \quad \text{with} \quad \ell_t = \zeta_1^i \times age - \zeta_2^i \times age^2 \quad \text{and} \quad i \in \{college, nocollege\}$$

where ζ_1^i and ζ_2^i govern the slope and curvature of the growth in productivity over individuals' age. Both parameters differ across households with and without college education, to reflect the heterogeneities in the income profile of agents across educational attainments. In this modeling choice I hence embed the college premium that characterizes my framework, and which determines the incentives of young adults to acquire a college degree. In the calibration, ζ_1^i and ζ_2^i will be pinned down by the fact that college-graduates have higher average life-cycle income growth.

Entrepreneurial productivity is characterized by both a deterministic and a stochastic component. The deterministic component is given by the same expression for e^{ℓ_t} as previously indicated for workers. The stochastic component follows instead a standard AR(1) process. Entrepreneurial productivity is then given by their combination according to:

$$e^{z_{entr,t}} = e^{\ell_t} \times e^{\rho z_{entr,t-1} + \epsilon_t} \quad \text{with} \quad \epsilon \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

which is characterized by the conditional distribution $d\Xi(z'_{entr}|z_{entr})$. In particular, ρ_z is the persistence in productivity, while ϵ_t is the idiosyncratic risk component. Hence, my model features idiosyncratic shocks to entrepreneurial productivity and no source of aggregate uncertainty.

Occupation Choice: At every point in time during their working life and until retirement, agents decide their occupation $o(a, z_{entr}, d)$, based on their wealth a, idiosyncratic entrepreneurial productivity z_{entr} and on the amount of outstanding student debt d. How each state variable influences this occupational choice will be explained in detail below. Households can choose to be either entrepreneurs (*entr*) or workers (*work*). Entrepreneurs own a firm and earn business profits π, while workers inelastically supply one unit of labor and earn an efficiency units salary $\tilde{w}$, given by the equilibrium wage scaled by their idiosyncratic working productivity z_{work}: $\tilde{w} = e^{z_{work}} * w$.

Firm's Technology: Entrepreneurs produce with a standard production function that combines entrepreneurial productivity z_{entr}, capital k and labor l. The production function is increasing in all its arguments, strictly concave in capital and labor, and decreasing returns to scale, allowing for a non-degenerate distribution of the enterprise size. In particular, $f(z_{entr,t}, k_t, l_t)$ is given by:

$$f(z_{entr,t}, k_t, l_t) = e^{z_{entr,t}} (k_t^\alpha l_t^{1-\alpha})^{1-\nu}, \quad \text{with} \qquad 0 < 1 - \nu < 1$$

where α is the capital share in production and $1-\nu$ is the span of control as in Lucas (1978). Both capital and labor are static inputs and rented on their respective markets at each point in time.

Financial Markets: There is a perfectly competitive intermediary sector that receives deposits from savers and lends funds to firms, without intermediation costs. The rental rate of capital is given by r_t, the deposit rate which will be determined in general equilibrium. Financial markets are incomplete, and entrepreneurs can borrow up to a fraction of their assets a_t, net of any educational loan d_t they might carry at a given time t. Capital constraints are hence given by:

$$k_t \leq \lambda(a_t - d_t * \mathbb{I}_{EduLoan,t}); \qquad a_t \geq 0$$

where $a_t \geq 0$ (intertemporal borrowing is ruled out for simplicity) and λ measures the degree of the constraints. If $\lambda = 1$, agents operate in a zero credit environment, as opposed to the case in which $\lambda = \infty$ and individuals can borrow according to their productivity, regardless of their (net) financial wealth. The indicator $\mathbb{I}_{EduLoan,t}$ states the presence of educational loans in the college-graduates' balance sheet, which reduce the amount of collateral they can pledge to borrow on financial markets at time t. Note that $\mathbb{I}_{EduLoan,t} = 0 \; \forall t$ in the case of entrepreneurs without college education and for entrepreneurs with college education that did not take on student debt. Moreover, $\mathbb{I}_{EduLoan,t}$ becomes 0 when indebted college-graduates finish to repay their student loans.

Profit Maximization: Entrepreneurs' profit maximizing problem at a given t reads as follows:

$$\pi_t = \max_{l_t, k_t} \left\{ e^{z_{entr,t}} (k_t^{\alpha} l_t^{1-\alpha})^{1-\nu} - w_t l_t - (r_t + \delta) k_t, \quad \text{s.t.} \quad k_t \leq \lambda(a_t - d_t * \mathbb{I}_{EduLoan,t}) \right\} \tag{5}$$

where the price of output is normalized to 1. All entrepreneurs pay capital rental costs $(r_t + \delta)k_t$ and salaries $w_t l_t$ as variable input costs, where I denote by δ the depreciation rate of capital. Importantly, the differences in the profit maximization problem of individuals with and without college education are given by the different processes that characterize their idiosyncratic entrepreneurial productivity $z_{entr,t}$, and by their capital constraint, which varies according to the presence of student loans in the household's balance sheet, signaled by $\mathbb{I}_{EduLoan,t}$. There is no further source of heterogeneity by education in the production technology or in the input costs paid by entrepreneurs.

3.2 Educational Period

Agents start their life with heterogeneous wealth, drawn from an initial distribution $F(a)$, and heterogeneous idiosyncratic productivity, drawn from a distribution $F(z)$. Both distributions will be characterized quantitatively in the calibration exercise. In T_{edu}, they have to make an educational choice, namely decide whether to attend college or not. College has a tuition κ – net of subsidies s funded by the government – that can be paid also by contracting debt, denoted by d. If they do not go to college, agents enter immediately the labor markets, make an occupational choice $o(a, z)$ and

decide whether to work for a salary or to become entrepreneurs and earn the net profits generated by their firm. The value function maximization of agents that go to college is given by:

$$\begin{aligned} V^c(a,z,age) &= \max_{a',d',c} \left\{ u(c) + \beta\theta_t V^{c\prime}(a',z',d',age') \right\} \\ &\text{s.t.} : c + a' = (1+r)a - \kappa - d' \\ &\text{and} : a' \geq 0, \quad c \geq 0, \quad \underline{d} \leq d' \leq 0 \end{aligned}$$

where $\underline{d}$ is the student debt borrowing limit, which will be pinned down numerically in the calibration based on the average maximum amounts of educational loans granted. Moreover, the value function of agents that do not go to college, denoted by V^{nc}, can be expressed as:

$$V^{nc}(a,z,age) = \max \left\{ V^{nc,work}(a,z,age=1), V^{nc,entr}(a,z,age') \right\} \tag{6}$$

which accounts for the occupational choice made by non-college individuals that enter directly the labor markets. More specifically, the value function for working individuals is given by:

$$\begin{aligned} V^{nc,work}(a,z,age) &= \max_{a',c} \left\{ u(c) + \beta\theta_t \int V^{nc\prime}(a',z',age') d\Xi(z'|z) \right\} \\ &\text{s.t.} : c + a' = (1+r)a + (1-\tau)\tilde{w} \\ &\text{and} : a' \geq 0, \quad c \geq 0 \end{aligned}$$

where τ denotes the income tax levied by the government. The value function of agents that choose entrepreneurship as their occupation is instead summarized by the following expression:

$$\begin{aligned} V^{nc,entrep}(a,z,age) &= \max_{a',c} \left\{ u(c) + \beta\theta_t \int V^{nc\prime}(a',z',age') d\Xi(z'|z) \right\} \\ &\text{s.t.} : c + a' = (1+r)a + (1-\tau)\pi(a,z;r,w) \\ &\text{and} : a' \geq 0, \quad c \geq 0, \quad k \leq \lambda a \end{aligned}$$

Finally, the education choice made by young households boils down to the following expression:

$$\max\{V^c; V^{nc}\}$$

namely to comparing the present and continuation value of getting or not a college degree.

3.3 Working Period

In each year t between $T_{edu}+1$ and T_{work}, all households make consumption and saving decisions and choose their occupation. For households that attended college, the value function V^c to

maximize is defined over agents' asset, productivity, student debt and age and given by:

$$V^c(a,z,d,age) = \max\left\{V^{c,work}(a,z,d,age), V^{c,entr}(a,z,d,age)\right\} \tag{7}$$

which accounts for the occupational choice made by college-graduates. More specifically, the value function for working individuals can be written in the following form:

$$\begin{aligned} V^{c,work}(a,z,d,age) = \max_{a',c}\left\{u(c) + \beta\theta_t \int V^{c\prime}(a',z',d',age')d\Xi(z'|z)\right\} \\ \text{s.t.}: c + a' = (1+r)a + (1-\tau)\tilde{w} - \mathcal{R}\times\mathbb{I}_{(t\leq T_{repay})} \\ \text{and}: a' \geq 0, \quad c \geq 0, \quad \mathcal{R} = \min\left\{\frac{d_{edu}}{T_{repay}} + r^d d, 0\right\} \end{aligned}$$

where $\mathcal{R}$ is the repayment of the student debt. During the repayment period, households with educational loans have to pay a fixed amount of the original balance, where d_{edu} is the accumulated debt in stage 1 of life, and the interest rate r^d on the principal. I denote by T_{repay} the established repayment length. The law of motion for the outstanding student debt is hence given by:

$$d' = d - \mathcal{R}$$

The value function of agents that choose entrepreneurship can be characterized as follows:

$$\begin{aligned} V^{c,entrep}(a,z,d,age) = \max_{a',c}\left\{u(c) + \beta\theta_t \int V^{c\prime}(a',z',d',age'1)d\Xi(z'|z)\right\} \\ \text{s.t.}: c + a' = (1+r)a + (1-\tau)\pi(a,z,d;r,w) - \mathcal{R}\times\mathbb{I}_{(t\leq T_{repay})} \\ \text{and}: a' \geq 0, \quad c \geq 0, \\ \text{and}: k \leq \lambda(a - d\mathbb{I}_{EduLoan}), \quad \mathcal{R} = \min\left\{\frac{d_{edu}}{T_{repay}} + r^d d, 0\right\} \end{aligned}$$

As before, the value function of agents that do not go to college, V^{nc}, is instead given by:

$$V^{nc}(a,z,age) = \max\left\{V^{nc,work}(a,z,age), V^{nc,entr}(a,z,age)\right\} \tag{8}$$

which accounts for the occupational choice made by non-college graduates. More specifically, the value function for working individuals has the following form:

$$\begin{aligned} V^{nc,work}(a,z,age) = \max_{a',c}\left\{u(c) + \beta\theta_t \int V^{nc\prime}(a',z',age')d\Xi(z'|z)\right\} \\ \text{s.t.}: c + a' = (1+r)a + (1-\tau)\tilde{w} \\ \text{and}: a' \geq 0, \quad c \geq 0 \end{aligned}$$

The value function of agents that choose entrepreneurship is instead given by:

$$V^{nc,entrep}(a,z,age) = \max_{a',c} \left\{ u(c) + \beta\theta_t \int V^{nc\prime}(a',z',age')d\Xi(z'|z) \right\}$$
$$\text{s.t.} : c + a' = (1+r)a + (1-\tau)\pi(a,z;r,w)$$
$$\text{and} : a' \geq 0, \quad c \geq 0, \quad k \leq \lambda a$$

3.4 Retirement Period

In each year t between $T_{work}+1$ and T_{end}, all households retire and make consumption and saving decisions till the end of their lives. They all receive a pension p^i for $i \in \{college, nocollege\}$, which is funded by the government and represents a given share of the income they earned in their last working year, before retirement. Given the different path for the productivity and income profile of agents across educational attainment, pensions vary by the productivity z of individuals in their last working period. Finally, in the last year of their lives, denoted by T_{end}, households leave a fraction b of their remaining assets as bequest to the next cohort. This modeling choice ensure that the wealth distribution of any new young generation remain stable and can be pinned down quantitatively. For households that attended college, the value function V^c to maximize during retirement is hence defined over agents' asset, productivity, and age and given by:

$$V^c(a,z,age) = \max_{a',c}\{u(c) + \beta\theta_t V^{c\prime}(a',age')\}$$
$$a' = (1+r)a - c + p^c - (b*a) \times \mathbb{I}_{(t=T_{end})}$$
$$\text{and} : a' \geq 0, \quad c \geq 0$$

For households that did not attend college, the value function V^{nc} to maximize is defined over agents' asset, productivity, and age and can be characterized as follows:

$$V^{nc}(a,z,age) = \max_{a',c}\{u(c) + \beta\theta_t V^{nc\prime}(a',age')\}$$
$$a' = (1+r)a - c + p^{nc} - (b*a) \times \mathbb{I}_{(t=T_{end})}$$
$$\text{and} : a' \geq 0, \quad c \geq 0$$

3.5 Government

The role of the government in the model is twofold. On the fiscal side, the public sector collects income taxes (the tax rate has been denoted by τ throughout the exposition) and provides pensions to retired agents. On the educational side, the government issues student loans and holds in place the grant schemes to foster enrollment in college, especially for low-income households. While both the pension rate and the extent of the grant scheme is calibrated quantitatively to match their empirical counterparts, the tax rate τ is computed so that it clears the government budget

constraint. In particular, fiscal revenues from tax collection are given by:

$$\sum_{t=T_{edu}}^{T_{work}} \int \tau * (\max\{\pi_t(a,z;r,w);\tilde{w}_t\} dH_t^{nc}(a,z)) + \sum_{t=T_{edu}+1}^{T_{work}} \int \tau * (\max\{\pi_t(a,z,d;r,w);\tilde{w}_t\} dH_t^{c}(a,z,d))$$

where $H_t^{nc}(a,z)$ and $H_t^{c}(a,z,d)$ denote the distribution of non-college and college households in each time t. Parallel to that, the items in government expenditure are given by pensions:

$$\sum_{t=T_{work}+1}^{T_{end}} \int p * \tilde{w}_{T_{work}} dH_t^{nc}(a,z) + \sum_{t=T_{work}+1}^{T_{end}} \int p * \tilde{w}_{T_{work}} dH_t^{c}(a,z)$$

and by college loans d_t and grant schemes $s_{T_{edu}}$ according to:

$$\sum_{t=T_{edu}}^{T_{repay}} \int d_t dH_t^{c}(a,z,d) + \int s_{T_{edu}} * dH_{T_{edu}}^{c}(a,z,d)$$

3.6 Equilibrium Conditions

At time $t = T_{edu}$, given the initial distribution $H_0(a,z,d)$, the equilibrium of the economy is characterized by a sequence of allocations $\{edu_t, o_t, c_t, a_{t+1}, k_t, l_t\}_{t=edu}^{T_{end}}$, factor prices $\{w_t, r_t\}_{t=0}^{T_{end}}$, and distributions for college and non-college graduates $H_t^c(a,z,d)_{t=edu}^{T_{end}}$ and $H_t^{nc}(a,z)_{t=edu}^{T_{end}}$ such that:

1. $\{edu_t, o_t, c_t, a_{t+1}, k_t, l_t\}_{t=end}^{T_{end}}$ solves the individuals' policy functions for given factor prices.
2. Capital, labor and good markets clear:

$$\int_{o_t(a,z)=e} k_t dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=e} k_t dH_t^{c}(a,z,d) = \int a dH_t^{nc}(a,z) + \int a dH_t^{c}(a,z,d)$$
$$\int_{o_t(a,z)=e} l_t dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=e} l_t dH_t^{c}(a,z,d) = \int_{o_t(a,z)=w} dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=w} dH_t^{c}(a,z,d)$$
$$\int c_t dH_t^{nc}(a,z) + \int c_t dH_t^{c}(a,z,d) + \delta k_t = Y_t$$

with total output Y_t given by:

$$\int_{o_t(a,z)=e} \left[e^{z_t}(k_t^{\alpha} l_t^{1-\alpha})^{1-\nu}\right] dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=e} \left[e^{z_t}(k_t^{\alpha} l_t^{1-\alpha})^{1-\nu}\right] dH_t^{c}(a,z,d)$$

4 Quantitative Exercise

This section of the paper quantifies how much of the entrepreneurial differences across individuals with and without university education can be explained by the presence of student loans in the balance sheet of college-graduates. I first begin by estimating the model on the US economy using various sources of data, and I then analyze the main quantitative predictions of my framework in terms of individual choices and aggregate outcomes. In the next sections, I will also investigate

the impact of student loans bankruptcy availability on both the *extensive* and *intensive* margins of entrepreneurship, and study how the rise in college tuition has affected the outburst of student debt and the decline in entrepreneurial rates over the last decades.

4.1 Calibration

In what follows, I present the calibration strategy and discuss the quantitative fit of my framework with respect to targeted moments from the data. Of the 21 parameters I need to estimate, 10 are fixed outside of the model and summarized in Table 9. As standard, I set the coefficient of risk aversion $\gamma = 2$ and the capital share $\alpha = 0.36$. I choose a depreciation rate $\delta = 0.1$,[17] and an income tax rate $\tau = 0.1$.[18] Secondly, according to OECD estimates, I set the pension replacement rate in the model economy to be 50% of the income in the last working year of households,[19] which is close to the one used by De Nardi et al. (2020). Moreover, the fraction of assets bequested by individuals upon their death, denoted by b, is calibrated such that the sum of the bequests across the old population can cover the sum of the assets of the newly-born cohorts. This ensures that the new generations of young households have all the same initial asset distribution. Finally, survival probabilities are set to reflect survival rates and life-expectancy for the US.[20]

Table 7: Externally Fixed Parameters

Fixed	**Value**	**Description**
γ	2	Risk aversion
α	0.36	Production function curvature
δ	0.1	Capital depreciation rate
τ	0.1	Income tax rate
p	0.50	Pension replacement rate
b	(see text)	Bequest
T_{repay}	10	Student loan repayment term
r^d	(see text)	Interest rate student loans
$\underline{d}$	(see text)	Lower bound on student loans
s	(see text)	College grant
θ	(see text)	Survival probabilities

With respect to the college-related parameters, in the baseline calibration I set the length of the student loan repayment $T_{repay} = 10$, noting that, before 2010, almost the totality of educational

[17] Commonly used values for δ range from 0.06, as in Buera and Shin (2013), to 0.1, as in Clementi and Palazzo (2016).

[18] In the US, it is estimated that the average net income tax of single and married workers is 22% and 7% respectively (see `https://www.oecd.org/unitedstates/taxing-wages-united-states.pdf`). Since I abstract from family dynamics, and since most labor force participants is married, I target an intermediate value for the net tax rate.

[19] `https://data.oecd.org/pension/net-pension-replacement-rates.htm`

[20] I take the direct estimates from: `https://benjaminmoll.com/wp-content/uploads/2021/04/STEG_course.pdf`

loans were repaid though 10-years fixed repayment plans. Repayment plans that are instead tied to the income of individuals – so-called income based plans – have been recently growing, but they are estimated to represent only 10-15% of the total repayment plans subscribed in the last decade. I will nonetheless explore more in detail the difference between fixed and income based repayment plans and their implication for workers and entrepreneurs in the next section. The scholarship s is instead calibrated in order to reflect the fact that grant aid funded by the government tends to cover 30% of the average financial need of incoming students.[21]

I now discuss the internally fitted parameters, which are reported in Table 8. First, I pick $\beta = 0.97$ to match an average annual interest rate for the US economy of $r = 4.5\%$.[22] I then set the wedge between r and the interest rate on student debt such that $r^d = 0.06$, in line with the average interest rate on educational loans prevailing in the last years.[23] The college tuition parameter κ is instead calibrated to replicate the average share of the US adult population with a college degree, which is estimated to be around 30% in the last decade.[24] Accordingly, the lower bound on student loans $\underline{d}$ – the borrowing limit – is set to be equal to the full amount of the college tuition κ.[25] I also need to assign values to the parameters defining the initial distribution of wealth across the population, which has been denoted by $F(a)$ in the theoretical section. I assume that $F(a)$ follows a log-normal shape, I normalize the mean to 1 and I set the volatility σ_a to match the fat right tail of the US wealth distribution, following the recent estimates of Zucman (2019).

Secondly, the span of control parameter is fitted such that the income share of the top 20% agents in the distribution of earnings is the same in the data and in the model. This choice is motivated by the fact that $1 - \nu$ regulates firms' scale of operations and, as a consequence, affects the profits of the entrepreneurs, who are likely to be at the top deciles of the earnings distribution. In that, I follow a recent and extensive literature on earnings and wealth distributions in the US (see Batty et al. (2019) and Zucman (2019) for example), which shows that the top 20% richest Americans make up for almost 50% of total earnings in the economy. My estimated value for the span of control parameter $1 - \nu = 0.835$ is close to the one obtained by several other papers on US entrepreneurship.[26] As a robustness check, I can alternatively calibrate $1 - \nu$ to match the share of entrepreneurial wealth in aggregate wealth,[27] without changing the nature of my results.

To identify the volatility σ_ϵ of the entrepreneurial productivity shock, I target the employment share of the top 25% largest firms, which is computed using the Business Dynamics Statistics dataset. A bigger σ_ϵ implies greater dispersion in the productivity process (by means of thicker

[21] `www.urban.org/urban-wire/what-better-data-reveal-about-pell-grants-and-college-prices`

[22] This figure reflects well the average interest rate prevailing in the US economy over the last 30 years.

[23] `https://educationdata.org/average-student-loan-interest-rate`

[24] `https://www.census.gov/newsroom/press-releases/2020/educational-attainment.html`

[25] Since I abstract from graduate studies, I consider the average maximum amount of student loans granted for undergraduate degrees across dependent and independent students, including subsidized and non-subsidized federal loans, see `https://studentaid.gov/understand-aid/types/loans/subsidized-unsubsidized`.

[26] Values for the US typically range from 0.79 (see Buera and Shin (2013)) to 0.88 (see Cagetti and De Nardi (2006)).

[27] This is the calibration strategy followed by Cagetti and De Nardi (2006).

Table 8: Internally Fitted Parameters

Fitted	Value	Description	Moment	Model	Data
β	0.97	Discount factor	Interest rate	0.045	0.045
κ	4.10	College tuition	Educational rate	0.31	0.30
σ_a	5.25	St deviation initial wealth	Top10 wealth share	0.71	0.70
ν	0.835	Span of control	Top20 income share	0.46	0.49
σ_ϵ	0.30	St deviation prod shocks	Top25 employment share	0.58	0.65
ρ_z	0.92	Persistence prod shocks	Serial correlation revenues	0.82	0.80
λ	2.50	Financial constraint	Avg. corporate debt/GDP	0.45	0.45
ζ_1^c	0.08	Trend income growth (college)	Income growth year 0 - 20	0.87	1.00
ζ_2^c	0.002	Curv. income growth (college)	Income growth year 20 - 40	0.28	0.25
ζ_1^{nc}	0.04	Trend income growth (no college)	Income growth year 0 - 20	0.42	0.48
ζ_2^{nc}	0.001	Curv. income growth (no college)	Income growth year 20 - 40	0.17	0.15

tails in the distribution) and higher employment generation by large businesses.[28] My final value $\sigma_\epsilon = 0.30$ is in line with the range of US estimates provided by Lee and Mukoyama (2015). Moreover, I use the average serial correlation of revenues across US firms to identify the persistence in the entrepreneurial productivity process ρ_z.[29] Next, to calibrate the parameter λ, which governs the extent of entrepreneurial financial frictions, I match the average US non-financial corporate debt over GDP between 1990 and 2014,[30] and I provide related alternatives.[31] I focus on non-financial corporate debt because other measures of total (country's) debt merge together household and corporate liabilities and cannot be mapped into my theoretical framework.

Finally, I have to calibrate 4 parameters related to the deterministic component of the productivity process of agents with and without college. I follow estimates from Lagakos et al. (2018) and set ζ_1^c and ζ_1^{nc} to mimic the growth in the income profiles of US households in the first 20 years of their working life. I then pin down ζ_2^c and ζ_2^{nc} targeting again the average growth in individuals' income profiles, but focusing on the last 20 years in the working life of US households. The estimated values reflect the fact that income growth is faster at the beginning of the life-cycle of workers, and instead slows down progressively as agents move towards retirement.

[28] Size is measured in terms of total employees, as also in Buera and Shin (2013) and Midrigan and Xu (2014).

[29] As discussed in Clementi and Palazzo (2016), estimates for ρ_z can be found to be as low as 0.8 and as high as 0.97. My final estimate $\rho_z = 0.88$ is similar to the one used by papers in this field such as Lee and Mukoyama (2015).

[30] See the entire series on FRED website: `https://fred.stlouisfed.org/graph/?g=VLW#0`.

[31] As an alternative, one can use Compustat, a dataset covering all publicly listed North American firms between 1980 and 2016. The ratio of current liabilities over revenues is on average 0.41, in line with estimates from FRED data.

4.2 Cross-Sectional Properties

In what follows, I discuss the quantitative fit of the model with respect to several dimensions of the SCF data that were not targeted during the calibration. First, my framework can replicate the average US business ownership rate in the last decade,[32] both for college and non-college graduates. In particular, the gap in business ownership rates across individuals of different educational attainments is 5 percentage points (p.p.) in the data and 4 p.p. in my set up. In the model economy, having higher education is positively related to entering entrepreneurship due to the higher deterministic growth in the idiosyncratic productivity of individuals with a bachelor degree. Similarly, in the data, having a college education is also a strong predictor of higher entrepreneurial rates, which have been attributed for example to higher human capital accumulation, strengthened complementarity between higher education and labor market experience and peer effects.[33]

Table 9: Untargeted Moments

	Model	**Data**
Entrepreneurship		
Average Entrepreneurial Rate	0.06	0.07
Entrepreneurial Rate College Graduates	0.08	0.11
with Student Debt	0.07	0.08
without Student Debt	0.12	0.14
Entrepreneurial Rate Non-College Graduates	0.04	0.06
Business Outcomes: College Graduates Without vs With Student Debt		
Ratio Average Revenues	1.05	2.26
Ratio Average Debt	1.12	1.87
Difference in Employment (number of workers)	4.35	14.52

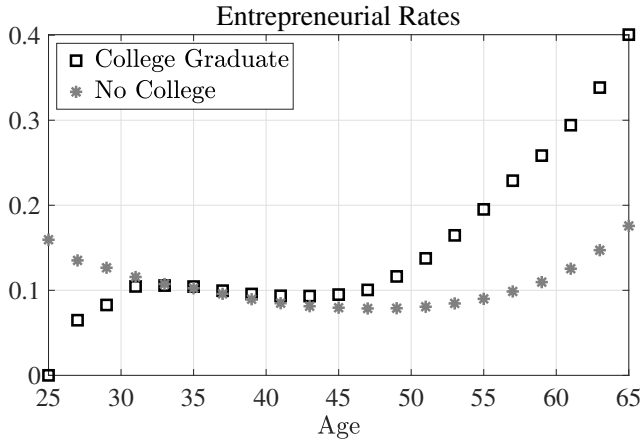
Focusing on households with a college degree, I can further analyse the differences in entrepreneurial outcomes distinguishing between graduates with and without educational loans. First, the model can match more than 80% of the p.p. gap in business ownership rates between individuals with and without student debt. In my framework, student debt repayments slow down the accumulation of wealth, while the actual debt balances lower the amount of collateral that can be pledged by entrepreneurs when renting capital on financial markets. Before the loan is fully repaid, student debt therefore discourages or delay entry into entrepreneurship. As shown in Figure 2, households with student loans see a catch up in business ownership rates compared

[32] In the SCF, the average share of business owners in the 1989-2019 sample is 0.09, down to 0.07 considering the last decade only. Similar statistics are reported by other sources, such as the OECD (see `https://data.oecd.org/entrepreneur/self-employed-with-employees.htm`).

[33] See for example Michelacci and Schivardi (2020), Lerner and Malmendier (2013) and Van der Sluis et al. (2008).

to those without student loans 5 to 10 years upon graduation.[34] The combination of the aforementioned mechanisms can partially replicate the different empirically estimated likelihood of becoming entrepreneurs for college-graduates with and without educational loans.

Figure 2: Extensive Margin



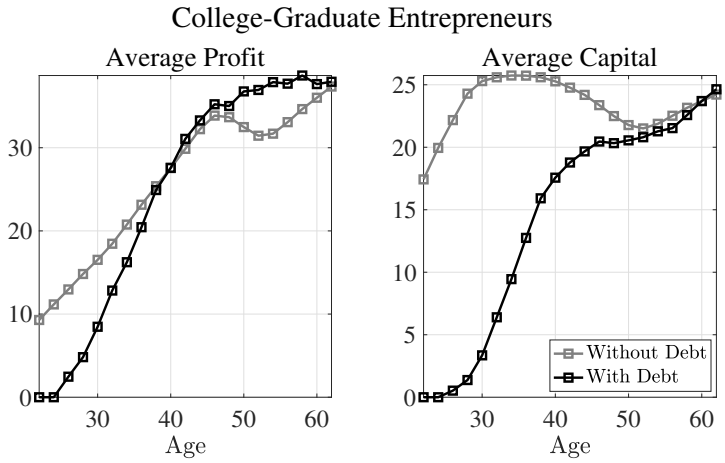
Secondly, focusing again on college-graduate entrepreneurs, businesses run by individuals with educational loans to repay are smaller compared to those of owners without student debt, and can secure less external funding. In terms of number of workers employed and total revenues generated, my model can match between 30 and 60% of the differences across college-graduate entrepreneurs with and without student debt. For instance, the ratio between the average sales of entrepreneurs without and with student loans is 2.26 in the SCF and 1.05 in my model economy, while the difference in the average number of employees hired is 14.25 in the data and 4.35 in my calibrated framework. At the same time, the gap in the amount of business debt secured by owners with student debt in the model replicates 60% of its counterpart in the data.[35]

Finally, in the model economy as in the data, entrepreneurial performances improves over time. Assets accumulation and productivity growth boost entrepreneurial profits over households' life-cycle, as depicted in Figure 3. In particular, I can replicate the average 2% elasticity of entrepreneurial profits to age estimated in the SCF sample. Moreover, as reported in Figure 3, the gap in the average profit or capital between college-graduate entrepreneurs with and without educational loans decreases over time, especially after indebted households have finished repaying their educational loans, which have a repayment plan of 10 years upon graduation. However, since overcoming firm's financial frictions through savings takes time, the gap in the average capital rented by college-graduates that took or did not take student loans to attend university is wider

[34]The deterministic growth in individuals' productivity is also responsible for the growth in entrepreneurial rates over the life-cycle of households. In the data, the elasticity of business ownership rates to age is 0.0028 (netting out the effect of assets, demographic factors and year FE), while it is 0.0016 in the model economy. This result also highlights the importance of modeling entrepreneurial productivity as the combination of both a stochastic and deterministic component, with the latter precisely capturing the growth in skills and experience of households over their life time.

[35]The SCF only reports the amount of business debt collateralized by entrepreneurs' personal assets, whereas my model does not distinguish between business loans taken in the name of the firm or in the name of the owner.

Figure 3: Intensive Margin



and persists for relatively longer compared to other dimensions of business performance.

4.3 The Rise in Student Loans and the Decline in Entrepreneurship

In what follows, I proceed to use my calibrated model to analyse the rise in student loans and the drop in entrepreneurship in the last 3-4 decades. As documented by several authors in the literature, US entrepreneurial rates and dynamism have steeply declined over the past 30 years (see Decker et al. (2014)). Moreover, Jiang and Sohail (2017) and Salgado (2020) have recently shown that such drop seems to have been bigger for college-graduates, a phenomenon referred to as the "skill-biased entrepreneurial decline". In Figure 4, I further suggest that, among skilled individuals, the decline in entrepreneurship has been more significant for college-graduates with student loans. Could then the rise in student loans and the decline in entrepreneurship – especially for skilled individuals – be related, and, if so, how could we rationalize their co-movement?

To think about such question, one can first observe that there are at least two important trends related to the rise in student loans over the past decades, namely the increase in both the college premium and the college tuition. As extensively documented in Goldin and Katz (2010), Heathcote et al. (2010), and recently by Doepke and Gaetani (2020) for example, the gap in average salaries between college and non-college graduates has been widening over time. Today, workers that hold a bachelor degree earn on average 20-25% more than in the late 80's relative to high-school graduates.[36] Parallel to that, the average price to attend either public or private universities has more than doubled since the late 80's,[37] and has been growing faster than US inflation.[38] Several papers have in fact related the rise in the average college tuition to the rise

[36] Researchers point at the so called skill biased technological change as a possible reason for such a rise in the college wage premium. In my exercise, I nonetheless consider such change over time as exogenously given, as it goes beyond the scope of my project to investigate what caused the rise in the wage of skilled compared to unskilled workers.

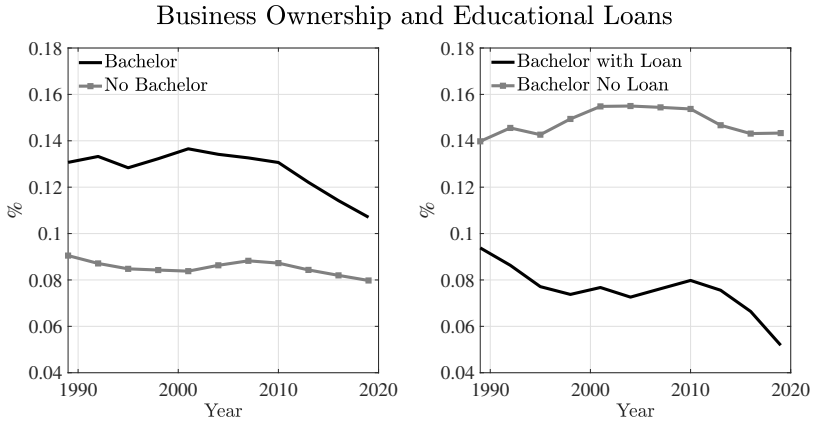
[37] https://nces.ed.gov/fastfacts/display.asp?id=76

[38] https://www.bloomberg.com/news/articles/2021-10-25/college-tuition-cools-off-lagging-inflation-by-most-since-1970s

in the college premium, both theoretically and empirically (see Fortin (2006)). My exercise hence tries to precisely link the increase in student loans to the rise in the demand for college and in college prices possibly engineered by the widening of the college wage premium. I then explore the consequences of carrying a higher student debt burden for entrepreneurial margins.

I first estimate the model to the US economy of the late 80's: in particular, I have to vary the cost of education κ^{1985} to deliver a college-attainment rate of 18% in 1985.[39] Second, I keep all the other parameters fixed and quantify the changes in entrepreneurial rates and outcomes caused by a 20% rise in the wage college premium, captured by an increased in the parameter ζ_1 in the life-cycle profile of individuals' productivity. Parallel to that, I re-calibrate the parameter κ^{2015} to deliver the average share of adults with a college degree in the US of the last few years, which is around 30%, as discussed in the strategy for the baseline calibration. This is crucial because, if the tuition for university was not to increase following the rise in the college premium, I would observe an abnormal soar in college attainment rates, which will overestimate the current higher-education rates and fail to match the increase in the tuition costs over the last three decades.

Figure 4: Entrepreneurial Rates of College Graduates



Results from the counterfactual exercise are shown in Table 10. As explained in previous paragraphs, raising the college premium by 20% and adjusting accordingly the price to attend university leads to a consistent increase in the share of college graduates.[40] The model can then match 1/6 and 1/3 of the overall decline in entrepreneurial rates for college and non-college graduates respectively. This second effect is due to the reallocation of individuals from the subsample of 'non-college' to the one of 'college' graduates, and it is not imputed to the soar of student debt per sé. On the contrary, the rise in college tuition between the 1980's and the late 2010's can account for more than half of the decline in business ownership rates for college graduates with student loans. The rise in educational debt followed by the increase in college tuition might have therefore played an important role in determining the decline in entrepreneurial dynamism for

[39] https://en.wikipedia.org/wiki/Educational_attainment_in_the_United_States

[40] https://www.statista.com/statistics/184272/educational-attainment-of-college-diploma-or-higher-by-gender/

indebted highly-educated individuals over the last decades. My findings complement Salgado (2020) and Jiang and Sohail (2017) on the relationship between the rise in the skill premium and the skill-biased entrepreneurial decline by highlighting the role of soaring college tuition and student debt in depressing the business ownership rates of indebted highly-skilled individuals.

Table 10: Change between 1980's and 2010's

	Data	Model
College Attainment	+ 98.37%	+ 95.75%
College Tuition	+ 179.2%	+ 182.5%
Entrepreneurial Rate College Graduates	- 3.24 p.p.	- 0.45 p.p.
With Loans	- 5.31 p.p.	- 2.75 p.p.
Entrepreneurial Rate Non-College Graduates	- 1.86 p.p.	- 2.64 p.p.

5 Bankruptcy Availability

A cornerstone of US consumer credit markets is the personal bankruptcy law, which can provide loan discharge to distressed debtors under specific procedures.[41] Unlike other forms of consumer debt, student loans are almost completely non-dischargeable in bankruptcy since 1998.[42] Exceptions regards individuals that join the public sector or the army, people affected by disabilities and any person who can prove *undue hardships*. However, fewer than 0.001% of borrowers meet these standards and succeed in filing for bankruptcy (see Iuliano (2012)), and 8% of the outstanding student debt is currently in default.[43] As discussed by Yannelis (2016), policy makers are now actively debating about reintroducing educational loan discharge, and the White House has made attempts to reintroduce some bankruptcy protections for student debt both in 2015 and 2018.[44]

Why the availability of student loan bankruptcy could matter for entrepreneurship? Krishnan and Wang (2019) argue for example that educational debt can reduce the "tolerance for risk", including the propensity to open and run a risky entrepreneurial venture. By making bankruptcy unavailable, the 1998 reform may have increased the aversion to undertake entrepreneurial projects for indebted college-graduates. But several other mechanisms could also apply. Before the reform took place, student loans were a form of *unsecured* debt, which was easier to default upon (see Yannelis (2016)), particularly when agents were facing financial hardships. Moreover, entrepreneurs

[41] The US Supreme Court in 1934 stated that the bankruptcy discharge "gives to the honest but unfortunate debtor...a new opportunity in life and a clear field for future effort, unhampered by the pressure and discouragement of pre-existing debt", (see *Local Loan Co. v. Hunt, 292 U.S. 234*).

[42] The *Higher Education Amendments* bill was first introduced in House in January 1997, approved by House in May 1998, approved by Senate in July 1998 and finally put in place in October 1998.

[43] See `https://educationdata.org/student-loan-default-rate`.

[44] See for example: `https://www.wsj.com/articles/trump-administration-looking-at-bankruptcy-options-for-student-debt-1519146215`

seeking business funding could see their chances reduced by college debt, as banks typically discount the outstanding loans balances of their potential borrowers. Student debt discharge instead ensured households a "fresh start", especially because in the US the credit risk scores are known to recover faster for bankrupt individuals compared to those remaining insolvent (see Albanesi and Nosal (2018)). Nowadays, individuals that cannot repay their student loans may see their wages or social security contributions garnished, and cannot abide to their debt obligations.

Leveraging the fact that, before the 1998 Higher Education Act, student loans were dischargeable in bankruptcy after seven years in repayment, I analyse the effects of such reform on entrepreneurship in two steps. First, I combine both difference-in-difference estimators and regression discontinuity designs to establish a link between student loans and the *extensive* and *intensive* margins of entrepreneurship in the SCF. I exploit information on the repayment year in which individuals were at the time of the reform,[45] and focus on the effect of student debt on entrepreneurship for cohorts of college-graduates who started repaying their student loan before or after 1991.[46]

Secondly, I use the model build in Section 3 to estimate the macroeconomic impact of the 1998 reform on entrepreneurship along the life-cycle of the individuals, as well as on capital misallocation and aggregate US output. In particular, I map the elasticities empirically estimated through diff-in-diff and RDD regressions in the SCF to my theoretical framework, and quantify the general equilibrium effect that bankruptcy availability might have had on business dynamism and macroeconomic aggregates. To the best of my knowledge, this is the first study to analyse such reform using the above-mentioned combination of empirical and quantitative techniques.

5.1 The 1998 Reform to Student Debt Bankruptcy

To quantify the impact of the 1998 bankruptcy reform on the extensive margin of entrepreneurship, I estimate a diff-in-diff probit regression of the following form:

$$Pr(BusOwner_{it} = 1) = F\left(\beta_0 + \beta_1 Post_{it} + \beta_2 Reform_{it} + \beta_3 Post_{it} \times Treated_{it} + \boldsymbol{\gamma}' \boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \quad (9)$$

where $BusOwner$ is a binary variable equal to 1 if individuals are entrepreneurs at the time of the survey, and to 0 if they are not. The regressor $Post_{it}$ captures the difference in business ownership rates before and after the 7th year of repayment, while $Treated_{it}$ is an indicator equal to 1 if individuals fall in the treated group and 0 if they belong to the control group. I consider three cases: in the first regression, the treatment group includes agents that started repaying their debt between 1992 and 1997, and the control group includes those that started repaying in or before 1991. In the second case, the treatment group is composed of individuals that started their repayment in

[45] It would be imprecise to instead focus on the graduation year of individuals, which does not coincide with the year in which loans start to be repaid due to grace periods and/or enrollment in post-graduate education.

[46] Krishnan and Wang (2019) instead analyse the group of students that graduated on or before 2001 and had a student loan on or prior to 1997. However, the law also applied to graduates who took loans before 1998 and had not reached the 7th year in repayment, or had reached it but did not declare bankruptcy before 1998. For this reason, I can instead use a diff-in-diff and an RDD framework to analyse the 1998 bankruptcy reform.

or before 1991 but had still not finished repaying their educational loans, while the control group contains households that had finished their repayment period by the time the reform stroke. Finally, in a third set of regressions I compare individuals who started repaying their loans between 1992 and 1997 and those who started repaying after the reform took place in 1998.

Table 11: Business Ownership

	(1)	(2)	(3)	(4)
Post×*Reform*	-0.1190***	-0.1348***	-0.2363***	0.0118
	(0.0269)	(0.0299)	(0.0492)	(0.0186)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Personal Wealth	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Observations	4,398	4,398	3,421	17,756
Pseudo-R^2	0.0390	0.0644	0.0772	0.0213

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In all three cases, the coefficient of interest is β_3, which captures the differential likelihood of transitioning into entrepreneurship for individuals that were subject to the reform, after their 7th year in student debt repayment. I then include a set of controls $\mathbf{\Phi}$, which capture factors pre-determined to the choice of taking on student loans and also include variables recorded at the time of the survey that were not pre-determined at the time in which the individuals made their student loans choices, such as their age, educational level, marital and home-ownership status, and personal wealth. All regressions include survey year fixed effects (α_t) and use survey weights.

Columns (1) to (2) in Table 11 report the results of the first set of regressions, comparing individuals who started repaying their student loans before or after 1991. The inclusion of controls that are not pre-determined by the time the loan was taken does not alter the estimates: households who did not reach the 7th year into repayment by 1998 are 13% less likely to have become entrepreneurs. Moreover, Column (3) focuses on agents that started repaying before 1991 but compares those who had and had not finishing paying their loans by 1998. Interestingly, the sign and magnitude of the estimated coefficient illustrates that those who were on time to declare bankruptcy before the reform took place, but lost such opportunity, are less likely to become entrepreneurs compared to those who were completely done paying by 1998. Since the regressions control for survey year fixed effects, the results are unlikely to be due to a declining time trend in business entry only. This is further confirmed by the estimate in Column (4), which shows that college-graduates who started repaying between 1992 and 1997 are not less likely to become entrepreneurs compared to the new cohorts who started repaying after the reform took place.

Furthermore, as reported in Table 12, being subject to the reform and hence not being able

Table 12: Business Performance: $\frac{\text{Profits}}{\text{Revenues}}$

	(1)	(2)	(3)
Post×*Reform*	0.0603**	0.16138***	-0.0065
	(0.0311)	(0.0485)	(0.0238)
Pre-College Controls	Y	Y	Y
General Controls	Y	Y	Y
Personal Wealth	Y	Y	Y
Survey Year FE	Y	Y	Y
Observations	4,398	3,421	17,756
R^2	0.0783	0.0832	0.0884

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

to discharge student loans in bankruptcy has a positive effect on the profit margin of treated entrepreneurs, consistent with a phenomenon of stricter selection into the entrepreneurial pool. Once again, the effect primarily regards individuals who started repaying after 1991 but before the reform took place, and agents who started repaying before 1991 but did not finish repaying their loans by 1998. The results therefore suggest an effect of the 1998 reform to student loans bankruptcy availability also on the *intensive* margin of entrepreneurship for treated cohorts.

To strengthen my evidence, I use the discontinuity in the availability of student loan bankruptcy by repayment year to estimate the effect of the 1998 reform on entrepreneurship by means of a RDD regression. In particular, before the 1998, borrowers could discharge their student debt in bankruptcy only after 7 years into repayment. As illustrated by Table B15, being past the 7th year of repayment has a strong positive effect on the likelihood of becoming an entrepreneur for the cohorts entering repayment before 1991, while for those entering after 1991 seems not to matter at all. Furthermore, since most repayment plans had a duration of 10 years anyway, most agents were likely to exercise the bankruptcy option right after reaching the 7th year into repayment, as confirmed in the last 3 Columns of Table B14. Accordingly, I can exploit the discontinuity in the availability of bankruptcy represented by the 7th year into repayment to estimate the differential likelihood of becoming entrepreneurs for cohort who started repaying before 1991 versus those who started sometime in between 1992 and 1997. I run the following RDD probit regression:

$$Pr(BusOwner_{it} = 1) = F\left(\beta_0 + \beta_1 SubjectReform_i + \beta_2 \Delta_i^{cutoff} + \boldsymbol{\gamma}' \boldsymbol{\Phi}_{it} + \alpha_t + \varepsilon_{it}\right) \tag{10}$$

where *BusOwner* is a binary variable equal to 1 if individuals are entrepreneurs at the time of the survey, and to 0 if they are not. The regressor $SubjectReform_i$ is an indicator that takes a value of 1 if the individuals was before the 7th repayment year by 1998. Instead, Δ_i^{cutoff} captures how far from the 7th year cutoff individuals were by the time the reform stroke. Controls and fixed effects

are as in Equation 9. Results are shown below in Table 13 and in Figure B.1, which uses the in-built Stata package from Calonico et al. (2015) to illustrate graphically the discontinuity at the 7th year of student loans repayment and its relationship with the likelihood of business ownership later on in individuals' life. Moreover, Table B16 in the Appendix contains and discuss standard placebos tests that strengthen and confirm the empirical validity of my RDD estimates.

Table 13: RDD Estimates

	Bus. Ownership (2Years Bandwidth)	Bus. Ownership (2Years Bandwidth)	Bus. Ownership (3Years Bandwidth)	Bus. Ownership (4Years Bandwidth)
Subject to Reform	-0.0916***	-0.0901***	-0.0731**	-0.0772**
	(0.0369)	(0.0369)	(0.0296)	(0.0261)
Pre-Coll Controls	N	Y	Y	Y
General Controls	Y	Y	Y	Y
Personal Wealth	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Observations	1,565	1,565	2,168	2,887
R^2	0.0294	0.0472	0.0634	0.0487

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

5.2 Macroeconomic Impact

In what follows, I attempt to estimate the impact of bankruptcy availability on the extensive and intensive margins of entrepreneurship in the model economy, and then investigate its impact on aggregate output and welfare. To do so, I allow for exogenous student loans discharge after 7 years into repayment – the same way bankruptcy was implemented before the 1998 reform. When households in the model discharge their student debt, they become free of obligations on their remaining balances, which are instead covered by government funds. It is important to stress that, to keep my framework tractable, bankruptcy is modelled as an exogenous shock and not as an endogenous choice. Notwithstanding this simplifying assumption, I carefully calibrate the probability of bankruptcy to replicate the average share of student debt that used to be discharged before the 1998 reform (see Yannelis (2016)). Specifically, roughly 1% of student loans were discharged in bankruptcy per cohort filing before 1998. Since the repayment term in my model is 10 years, I calibrate the probability of bankruptcy – $p^{bankruptcy}$ – to be equal to 0.005 per repayment year after the 7th one.

Two immediate effects of student debt discharge are worth discussing: on the one hand, college-graduates who discharge their educational loans after 7 years into repayment are then able to accumulate higher assets, as they become free of repayment obligations. At the same time,

under the assumption that bankruptcy comes at no cost,[47] entrepreneurs' borrowing constraint becomes less tight and enables them to rent higher levels of business capital. Both mechanisms are expected to increase entrepreneurial rates of households with a college degree and who took out educational loans to finance it, and to increase the amount of capital rented for their business.

On the other hand, the amount of student debt that gets discharged in bankruptcy becomes a financial burden for the government, who is forced to increase income taxation to cover the remaining balances and meet its budget constraint. In turns, higher taxes can decrease consumption and wealth accumulation for all agents in the economy. The resulting effect on aggregate output and welfare is therefore ambiguous and needs to be quantitatively estimated in the model.

In this counterfactual exercise, I keep the parameters and the calibration strategy as discussed in Table 8 and Table 9, and allow for the exogenous probability of student debt bankruptcy after the 7th year in repayment ($p^{bankruptcy} = 0.005$). Prices and taxes in the economy are computed again in general equilibrium. For example, the tax rate τ targeted in the baseline calibration increases by 13.59% to cover for bankrupt educational loans. At the same time, the availability of student debt discharge fosters entrepreneurial rates of indebted college-graduates and, through GE effects, increases the demand for capital and labor. The effect of bankruptcy on the extensive and intensive margin of entrepreneurship and aggregate outcomes are reported in Table 14.

Table 14: Counterfactual

Outcome	**Change wrt to Baseline**
Entrepreneurial Rate College-Graduates With Debt	+ 10.40% (+ 9.16% data)
Difference in $arpk$ College-Graduates With and Without Debt	- 9.19%
Aggregate Output	+ 0.4%
Aggregate Welfare	+ 0.2%

Bankruptcy availability increases entrepreneurship for college-graduates with debt. Exploiting the exogenous 1998 reform, RDD and DiD regression have found an elasticity of business ownership to student debt of roughly -7 to -11%, depending on the specification. I take as a reference Column (2) of Table 13, which estimates the effect of being subject to the reform for individuals within a narrow 2 years window around the 7th year cutoff by the time the bankruptcy reform stroke in 1998. The model performs well and delivers a -10.40% elasticity, therefore fitting more than 80% of the empirical estimates. Bankruptcy availability would also decrease the difference in the $arpk$ of college-graduate entrepreneurs with and without debt by 9.19%, thereby reducing capital misallocation in the economy. The positive effects stemming from improvements along the extensive and intensive margins of entrepreneurship have repercussions on aggregate outcomes

[47] This is not a straightforward assumption to make, as individuals declaring bankruptcy in the US are typically assigned a bankruptcy flag by banks, which lasts on their records for maximum 10 years. However, as found by Cohen-Cole et al. (2013), more than 90% of bankrupt individuals tend to receive credit shortly after filing.

as well. In the model, I compute total output by aggregating entrepreneurial output across firms, while welfare is defined as utility over consumption and then aggregated across all households. Production and welfare both increases in the counterfactual economy: taking as a reference US GDP of 2020,[48] student debt bankruptcy availability could raise output by roughly 10 billions $, if the share of bankrupt students was to be similar to the one in the 90's.[49]

6 Conclusion

In this paper, I have investigated the interplay of educational and occupational choices along the life-cycle of households. Using micro-level data from the US Survey of Consumer Finances and for the 1989-2019 period, I have documented a negative relationship between student loans and entrepreneurial outcomes. Specifically, individuals carrying student debt balances and who took out loans to finance their college degree are less likely to become business owners and obtain external funding. Their firms also tend to be smaller and to generate less revenues and profits.

I have rationalized my findings into a GE heterogeneous agents life-cycle model, where individuals differ by wealth, productivity, age and student debt. During youth, households decide whether to attend college and how much to take out in educational loans. College gives them a income premium through higher deterministic productivity growth, but student debt has to be repaid upon graduation. During their adult life, all individuals make occupational choices and decide whether to open a firm or be workers. When in repayment, educational loans slow down wealth accumulation of college-graduates and tighten the borrowing constraint of indebted entrepreneurs. Calibrated on the US, my model replicates between 30 and 60% of the empirical differences between entrepreneurs with and without education, and with or without student debt.

Finally, I used the 1998 reform to educational loans bankruptcy to establish a causal link between student debt and entrepreneurship. Using the SCF data and both RDD and DiD regression, I have estimated a 9.16% elasticity of business ownership rates to educational loans. I have then expanded my quantitative framework to include and allow for student loans bankruptcy under the legal terms in order before the 1998. I found a 10.40% elasticity of entrepreneurship to student debt bankruptcy, which replicates closely its empirical counterpart. In the counterfactual scenario, capital misallocation would decrease and aggregate welfare and output in the US would increase.

While I have focused most of my empirical and quantitative analysis on cross-sectional patterns, in the future, I plan to investigate further the relationship between the rise in college costs and student debt and the decline in entrepreneurship over the past 40 years. Finally, the model could also be used as a quantitative laboratory to assess the effect of specific public policies on individuals' choices and aggregate outcomes. For instance, my quantitative framework could be suitable to study the impact of college aid expansions and/or income-based student debt repayment plans on entrepreneurship, capital allocation and aggregate productivity in the US.

[48] See `https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US`.

[49] Today, educational loans in default are estimated to be 7.8% of the total, more than twice their share in the late 90's.

Appendix

A Data Appendix

In Table A1, I describe the variables used in the main regressions of the paper that refer to individuals' demographic characteristics and average income or financial position. Then, in Table A2 and Table A3 I define the variables related to agents' businesses and student loans respectively.

Table A1: Description of Demographic Controls

Variable	*Description*
Age	Continuous age of the household.
Ethnicity	Ethnicity of the household (White, Black, Latino, Other).
Education	It is a categorical variable measuring the highest level of education attained by owners. The original scale is from 1 (less than 4th grade) to 12 (professional school or doctorate). When specified, they are recoded into two levels, namely high school (and lower) and college (and higher) level. The latter refers to education categories "some college, but no degree", "associate's degree" and "bachelor's degree", "master's degree" and "professional school or doctorate".
Marital status	It is a binary variable = 1 if the household is married.
Number of Kids	Total number of kids in the household (0 to 10+).
Personal Debt	Includes principal residence debt (mortgages and HELOCs), other lines of credit, debt for other residential property, credit card debt, installment loans,and other debt.
Personal Assets	The sum of financial assets and non-financial assets held by households, such as savings account, bonds, annuities, retirement accounts, residences, vehicles among others.
Spouse Income	Income of working spouse, either from employment of self-employment
Home-Ownership	It is a categorical variable equal to 1 if households own the house where they live.
Parents' Education	It is a categorical variable measuring the educational attainment of the father and the mother. The levels are "less than high-school", "high-school diploma", and "college degree".

In Figure A.1, I report the negative correlation of entrepreneurial rates and the average student debt per person over time. In consider loans with balances greater than 0 at the time of the interview. The graph controls for demographic characteristics such as gender, age, educational level, marital status, ethnicity and assets, and uses survey weights to ensure representativeness. Figure A.2 breaks down the legal type of the businesses opened by college graduates with and without student loans. Possible categories are given by "sole-proprietorships", "partnerships", "corporations" (including C and S-corporations), and "limited liabilities companies". In the first

two categories, the entrepreneurs have themselves unlimited liability for the business they run, either alone or with a partner. Both the second two categories provide limited liability protection, with the main difference being that a LLC is owned by one or more individuals, and a corporation is owned by its shareholders.

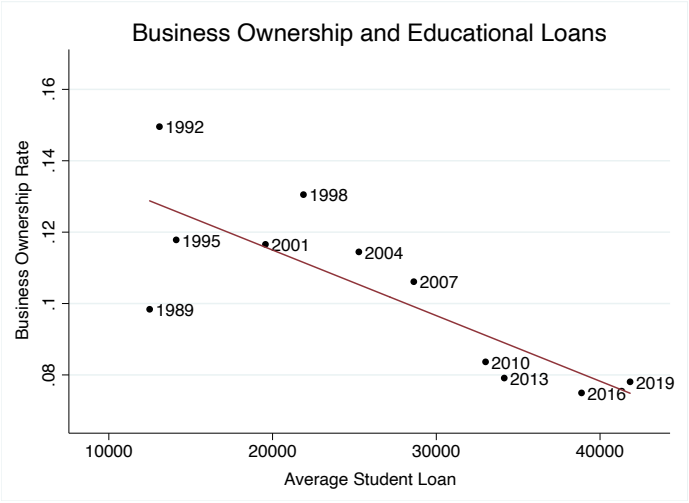
Table A2: Description of Main Business Variables

Variable	*Description*
Ownership share	Continuous measure for the share in firm's ownership by respondents.
Hours worked	Average number of hours per week devoted to the business.
Legal status	Categorical variable for the legal status of the firm. Categories are sole proprietorship, partnership, limited liability company or corporation.
Collateralized debt	Business finance collateralized by the owner using personal assets.
Employees	Number of employees working for the business of the respondent.
Gross sales	Gross sales receipt in the year before the time of the interview.
Profits	Total pre-tax net income in the year before the time of the interview.
Net worth	Value at which respondent could sell the business at the time of the interview. Should exclude business loans and include business assets (implements and materials too).
Business age	Survey year minus the year in which the business was started.
Business origin	Categorical variable for whether the business was "started", "bought", "inherited" or "joined" by the respondent.
Sector FE	It refers to the 1-digit industry code.

Table A3: Description of Student Loans Variables

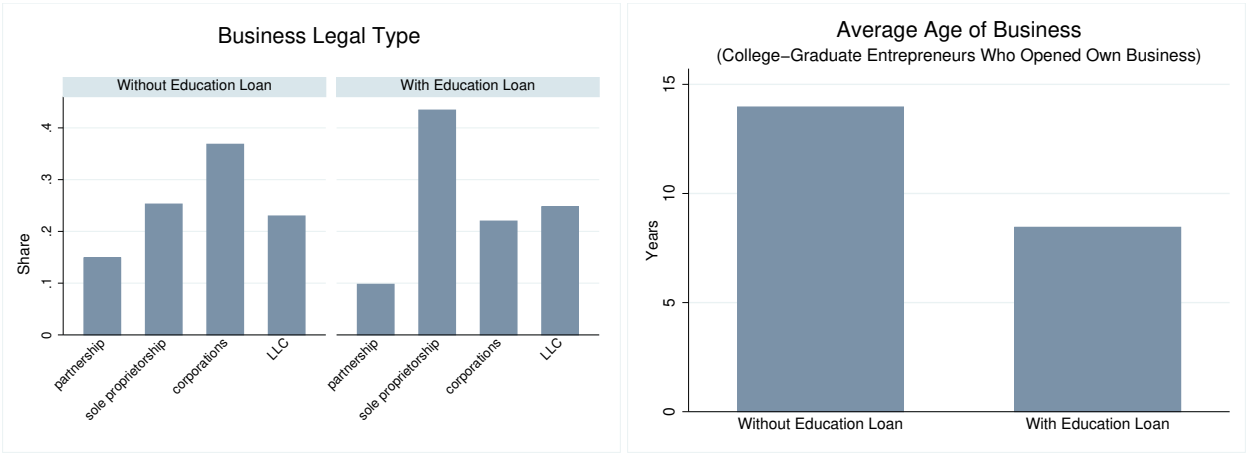
Variable	*Description*
Number of loans	Total number of educational loans. Possible range: 0 to 6. However, 99% of the sample considered has between 0 and 3 educational loans.
Amount of loan	How much was borrowed, not counting the finance charges
Amount to be repaid	How much is still owed on the loan at the time of interview
Repayment rate	Amount to be repaid periodically until extinguishing the loan
Interest rate	Annual rate of interest charged on the loan
Year loan taken	Year respondent took out his/her loan
Year started repayment	Year respondent started making payments on his/her loan
On schedule	Categorical variable for whether the loan is being paid off ahead of schedule, behind schedule, or on schedule.
IBR	Whether the respondent is enrolled in a income based repayment plan

Figure A.1: Comparison over Time: 1989-2019



Moreover, in the right panel of Figure A.2, I report the average age (in years) of businesses started from entrepreneurs that have a college degree, distinguishing for whether they had to take student loans or not (similarly if I were to focus on those still repaying their loans at the time of the survey interview). In the SCF, individuals can indicate whether the business they own and actively manage was either "bought", "started", "inherited" or "joined". I focus on entrepreneurs that started themselves their own business and find that owners who had to borrow for college run on average 5 years younger firms, suggesting a delay in the actual funding year. Finally, as reported in Table A4, entrepreneurs with larger amounts of student debt (either considering the initial debt taken or the balance still to be repaid at the time of the survey interview) post more personal collateral for their businesses, comparing enterprises and owners of similar characteristics.

Figure A.2: Legal Status and Business Age



In Table A5, I report the same regression as in Columns (1)-(2) of Table 2 and Table 4 controlling for parental education, which is available only for the 2016 and 2019 surveys. Results are prac-

Table A4: Collateral

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0018	0.0168*		
	(0.0086)	(0.0088)		
Dummy(Have Loan)			0.1672*	
			(0.0873)	
Amount Still Owed				0.0158*
				(0.0092)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	40,085	39,401	39,401	39,401
R^2	0.0169	0.0846	0.0846	0.0846

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status and personal wealth. Firm controls include profits, business size, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

tically unchanged from their baseline counterparts. In Table A6, I instead conduct a robustness check for the results in Table 2 without restricting the ownership share of individuals to be 100% in order for them to count as business owners. In the SCF sample of entrepreneurs, 74% of them hold the entire ownership of their business, while almost 25% of them have at least 50% of their business. The share of entrepreneurs with less than 50% of their business is hence smaller than 1%. Moreover, as clear from the comparison of the sample size, this procedure implies including very few additional observations, which does not change the quality and extent of the results.

Table A5: Entrepreneurial Margins (Controlling for Parental Education)

	Ownership	Ownership	Loan Approval	Loan Approval
Initial Amount Taken	-0.0031***	-0.0010**	-0.0180***	-0.0198***
	(0.0004)	(0.0004)	(0.0051)	(0.0053)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	N	Y
Survey Year FE	Y	Y	Y	Y
Observations	31,652	31,595	1,422	1,422
R^2	0.0475	0.0555	0.2164	0.2643

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College Controls* refer to agent's gender, ethnicity and parental education. *General Control* variables include agents' education level, age, marital status, home-ownership status, and assets. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

Table A6: Entrepreneurial Rates (No Ownership Share Restrictions)

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0028***	-0.0017***		
	(0.0002)	(0.0003)		
Dummy(Have Loan)			-0.0188***	
			(0.0024)	
Amount Still Owed				-0.0017***
				(0.0003)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	160,262	160,262	160,262	160,262
Pseudo-R^2	0.0383	0.0456	0.0457	0.0456

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status and personal wealth. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In Table A7, I report the estimates for the probability of applying for a business loan given a set of control variables as well as the presence and extent of student loans in the household's balance sheet. The probability of applying for business credit is estimated via the following probit regression:

$$Pr(Apply_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_{it} + \delta' \mathbf{\Gamma}_i + \gamma' \mathbf{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \tag{11}$$

where the outcome variable $Apply$ is an indicator equal to 1 if the entrepreneur mentions to have applied for a business loan in the 12 months before the interview took place, and 0 otherwise. Controls and regressors are the same as for the specifications reported in Table 4. The initial amount of student loans taken for college education does not correlate with the probability of applying for business funding (see Columns (1)-(2)). A similar observation holds true when using as main regressor a dummy for whether the individual carries still student debt balances to repay at the time of the interview, as shown in Column (3). The total amount to be repaid is only mildly significant, but the size of the standard errors calls for caution in interpreting the result.

In Table A8, I run alternative specifications for the regressions included in Table 5, using as main regressors either a dummy variable that signals the presence of pending student loans in the balance sheet of the households, or the actual amount still to be repaid as of the survey year t. In Table A9, I report the results from the regression in Equation 3, focusing on profits and business net worth. Then, in Table A10, I conduct robustness checks using as main regressors either a dummy variable that signals the presence of pending student loans in the balance sheet of the households,

Table A7: Business Loan Applications

	(1)	(2)	(3)	(4)
Initial Amount Taken	-0.0006	0.0014		
	(0.0009)	(0.0009)		
Dummy(Have Loan)			0.0098	
			(0.0093)	
Amount Still Owed				-0.0017*
				(0.0009)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	20,017	19,693	19,693	19,693
Pseudo-R^2	0.0283	0.1155	0.1154	0.1156

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity. General control variables are agents' education, age, marital and home-ownership status and personal wealth. Firm controls include profits, business size, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

or the actual amount still to be repaid as of the survey year t. All the results are consistent with the baseline specifications in the main text.

Table A8: Business Outcomes: Size and Gross Sales

	Employees	Employees	Sales	Sales
Dummy(Have Loan)	-18.5950***		-0.4475***	
	(1.7959)		(0.0474)	
Amount Still Owed		-2.0644***		-0.0436***
		(0.1975)		(0.0051)
Pre-College Controls	Y	Y	Y	Y
General Controls	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	39,461	39,461	36,855	36,855
Pseudo-R^2	0.0339	0.0339	0.4059	0.4053

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are either the number of employees or $\log(Sales)$. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status and personal wealth. Firm controls include business age, legal type and individuals working hours (and business size in Columns (3)-(4)). Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In Table A11, I run alternative specifications for the regressions included in Table 6, using as

main regressors either a dummy variable that signals the presence of pending student loans in the balance sheet of the households, or the actual amount still to be repaid as of the survey year t.The full set of controls is used. Results are consistent with the baseline specifications in the main text: entrepreneurs with student loans to repay tend to have between 6% and 12% higher profitability, depending on the regression specification. Furthermore, an increase of 1000$ in the amount of educational debt still to be repaid is associated with 4% to 9% higher business profitability.

Table A9: Business Outcomes: Profits and Net Worth

	Profits	Profits	Net Worth	Net Worth
Initial Amount Taken	-0.0376***	-0.0294***	-0.0660***	-0.0523***
	(0.0057)	(0.0052)	(0.0045)	(0.0036)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	33,673	33,014	36,001	43,988
R^2	0.0658	0.3219	0.0787	0.3150

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status and personal wealth. Firm controls include size, business age, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

Table A10: Business Outcomes: Profits and Net Worth

	Profits	Profits	Net Worth	Net Worth
Dummy(Have Loan)	-0.3314***		-0.5395***	
	(0.0504)		(0.0356)	
Amount Still Owed		-0.0306***		-0.0550***
		(0.0055)		(0.0038)
Pre-College Controls	Y	Y	Y	Y
General Controls	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	33,014	33,014	43,988	43,988
Pseudo-R^2	0.3224	0.3218	0.3157	0.3151

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status and personal wealth. Firm controls include size, business age, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

Table A11: Business Outcomes: Profitability

	$\log\left(\frac{\text{Profits}}{\text{Revenues}}\right)$	$\log\left(\frac{\text{Profits}}{\text{Revenues}}\right)$	$\log\left(\frac{\text{Profits}}{\text{CollDebt}}\right)$	$\log\left(\frac{\text{Profits}}{\text{CollDebt}}\right)$
Dummy(Have Loan)	0.1227***		0.0579***	
	(0.0243)		(0.0172)	
Amount Still Owed		0.0128***		0.0062***
		(0.0027)		(0.0017)
Pre-College Controls	Y	Y	Y	Y
General Controls	Y	Y	Y	Y
Firm Controls	Y	Y	Y	Y
Personal Wealth	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	39,461	39,461	39,461	39,461
R^2	0.1415	0.1413	0.0575	0.0575

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are either the number of employees or $\log(Sales)$. *Pre-College* controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General control variables are agents' education, age, marital and home-ownership status. Firm controls include business age, legal type and individuals working hours. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In Table A12, I show that individuals' cognitive abilities are correlated with both higher amounts of grants and educational loans. To this end, I use the US 1997 National Longitudinal Survey of Youth, which surveys and track a panel of households that were between 12 and 17 years old in 1997 and were followed since then. The survey means to be representative of the population, but I again make use of sample weights to further ensure representativeness. In terms of educational outcomes, the survey records the amount of grants and loans received by agents during college. Moreover, it reports the results to the Armed Services Vocational Aptitude Battery (CAT-ASVAB), which measures the respondents' skills in Arithmetic Reasoning, Electronics Information, Numerical Operations, Assembling Objects, General Science, Paragraph Comprehension, Auto Information, Mathematics Knowledge, Shop Information, Coding Speed, Mechanical Comprehension and Word Knowledge. This measure was included also in the previous 1979 National Longitudinal Survey of Youth and has been used by researches to proxy for households' underlying abilities, see for example Guvenen et al. (2020).

I control for college characteristics (eg: public vs private), and individuals' characteristics that were pre-determined to their college choices, such as their gender, ethnicity, parental education, family income and birthday year. Higher cognitive abilities correlate with both higher amounts of grants, as it is likely to capture merit-based aid, whereas it does not relate to the total amount of loans take out to finance college education. Moreover, I can check that higher cognitive skills do not predict higher grants compared to loans. This is consistent with the fact that grants for US universities cover typically a fifth of the total university tuition and are available only to individ-

uals meeting specific background characteristics. Moreover, grants tend to be complemented by either borrowing or out-of-pocket contributions.

Table A12: Educational Outcomes in NLSY97

	Difference Grants vs Loans	Total Loans	Total Grants
Cognitive Skills	0.0025	0.0007	0.0031**
	(0.0019)	(0.0014)	(0.0013)
Controls	Y	Y	Y
Observations	4,107	4,873	5,765
R^2	0.1005	0.0776	0.1317

Notes: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. Controls include agent's gender and ethnicity, parental education, age, college type, college tuition, full-time vs part-time college attendance, and family income. Robust to the inclusion of *Cognitive Skills* as the only main regressor.

In Table A13, I instead show that student debt is still negatively associated with the likelihood of owning a business after controlling for individuals' cognitive skills. This strengthens the idea that the negative correlation between student debt and entrepreneurial outcomes is not driven by a group of particularly low-skilled households who happened to take out great amount of educational loans. In particular, I run the following set of probit regressions:

$$Pr(BusOwn_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_i * Cognitive\ Skills_i + \boldsymbol{\delta}'\boldsymbol{\Gamma}_i + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \quad (12)$$

Table A13: Business Outcomes in NSLY97

	Ownership	Ownership	Ownership	Ownership
Dummy(Have Loan)	-0.0231***	-0.0279***		
	(0.0053)	(0.0072)		
Amount Taken			-0.0189***	-0.0189
			(0.0061)	(0.0122)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	48,345	28,688	8,354	39,461
R^2	0.0225	0.0242	0.0411	0.0411

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. *Pre-College* controls refer to agent's gender and ethnicity, parental education and income and birthday year. General control variables are agents' marital status, region of residency and assets. Column (4) clusters standard errors at the individual level and has a *p-value*=0.12.

where Y_{it} is a dummy signaling whether the respondent is an active business owner or not. I include both controls that were pre-determined to the choice of education, as in Table A12, and contemporaneous control variables such as their region, marital status and wealth. Results are shown in Table A13 for the main regressors of interest, which is are an indicator for whether the

household took out student debt or the original amount taken.

B Bankruptcy Reform

In Table B15, I document that being past the 7th year of educational loan repayment correlates with the likelihood of transitioning into entrepreneurship only for cohorts that had the bankruptcy option available. I both control for factors that pre-determined to the choice of college and student debt as well as a battery of subsequent controls that can be contemporaneous to the choice of becoming entrepreneurs. In particular, after controlling for age effects, being past the 7th year of repayment for recent cohorts does not matter anymore, but used to matter for cohorts that had the possibility to declare bankruptcy on their student debt after 7 years into full repayment.

Table B14: Business Ownership

	(1) After 1991	(2) Before 1991	(3) After 1991	(4) Before 1991
Past 7th Year	-0.0269	0.5745***	-0.0286	0.5773***
	(0.0247)	(0.0971)	(0.0251)	(0.1121)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	N	Y	Y
Personal Wealth	N	N	Y	Y
Survey Year FE	N	N	Y	Y
Observations	17,751	1,768	17,751	1,768
Pseudo-R^2	0.0141	0.0569	0.0232	0.0973

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender, cohort year, and ethnicity. General control variables are agents' education, loan size, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In Table B15, I run a similar set of regressions as in Table B14 to show that, before the 1998 reform took place, being past the 9th or 10th (or higher) repayment year cutoffs had no relationship with the likelihood of transitioning into entrepreneurship. The relevant repayment year cutoff was the 7th or the 8th one, suggesting that probably most of bankruptcy discharges were happening as soon as agents were past the 7th year into repayment had had legal access to the bankruptcy option. Moreover, I also check that these cutoffs are no longer significantly associated with the likelihood of transitioning into entrepreneurship for cohorts that started repaying their loans after 1991 and hence did not have any bankruptcy regime available (results available upon request).

Finally, Table B16 conducts placebo tests to assess the validity of the RDD regressions in Table 13. In Columns (1) and (2) I include individuals that were theoretically past the 7th year repayment cutoff. My running variable counts the distance (in years) from a fictitious 9th repayment year cutoff and hence compare cohorts that, for example, started repaying their loans between 1988 and 1991 and cohorts that started repaying between 1984 and 1987. In Columns (3) and (4)

Table B15: Business Ownership

	(1) Before 1991	(2) Before 1991	(3) Before 1991
Past 8th Year	0.3375**		
	(0.1233)		
Past 9th Year		-0.0794	
		(0.1299)	
Past 10th Year			-0.1580
			(0.1194)
Pre-College Controls	Y	Y	Y
General Controls	Y	Y	Y
Personal Wealth	Y	Y	Y
Survey Year FE	Y	Y	Y
Observations	1,768	1,768	1,768
Pseudo-R^2	0.0818	0.0741	0.0956

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. *Pre-College* controls refer to agent's gender, cohort year, and ethnicity. General control variables are agents' education, loan size, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

I include individuals that were theoretically all below the 7th year repayment cutoff and hence are all treated by the reform in 1998. My running variable counts the distance from a fictitious 4th repayment year cutoff and hence compare cohorts that, for example, started repay their loans between 1992 and 1994 and cohorts that started repaying between 1995 and 1997. I consider 2 years and 4 years bandwidths to show that the results are not driven by the choice of the window around the cutoff year of interest. I show regression outcomes for the full set of control variables, but results are robust to the inclusion of pre-determined controls only (available upon request).

Figure B.1: RDD Estimates

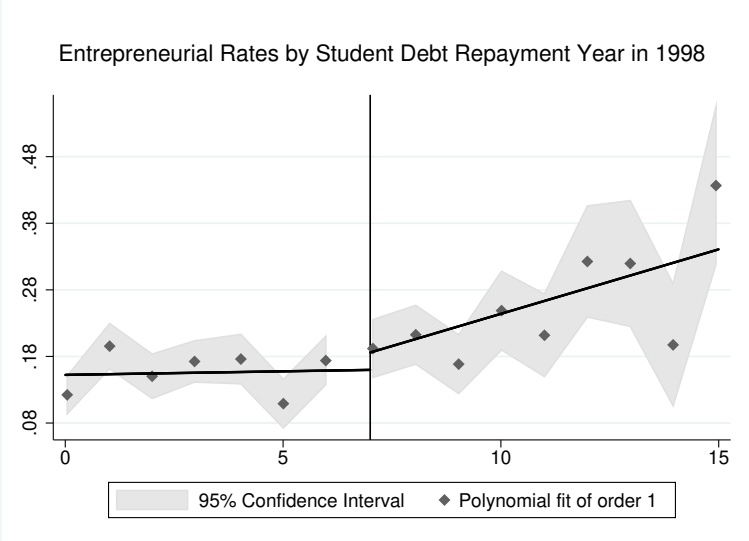


Table B16: Business Ownership

	(1) Non-Affected 2-Y Bandwidth	(2) Non-Affected 4-Y Bandwidth	(3) Affected 2-Y Bandwidth	(4) Affected 4-Y Bandwidth
Subject to Reform	0.0113	0.0111	0.0286	0.0075
	(0.0471)	(0.0431)	(0.0280)	(0.0261)
Pre-College Controls	Y	Y	Y	Y
General Controls	Y	Y	Y	Y
Personal Wealth	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y
Observations	1,310	1,531	2,133	2,660
Pseudo-R^2	0.0918	0.0755	0.0680	0.0538

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variable is a binary indicator $= 1$ if the individual is a business owner, and $= 0$ if not. *Pre-College* controls refer to agent's gender, cohort year, and ethnicity. General control variables are agents' education, loan size, marital and home-ownership status. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

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