Student Debt and Entrepreneurship in the US*

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Abstract

Policy makers and researchers are actively debating over the consequences of student debt for individuals' choices and aggregate quantities in the US. Using micro-level data and focusing on entrepreneurial outcomes, I document that having a student loan is associated with a lower likelihood of opening a firm and obtaining funding, and is linked to lower business size and revenues. To rationalize my findings, I build a heterogeneous agents model with education and entrepreneurial decisions, where student debt slows down the accumulation of wealth and reduces the collateral entrepreneurs can pledge to rent capital on financial markets. Calibrated to US data, my framework matches between 30 and 80% of the gaps in entrepreneurial margins across agents with and without college, and with or without loans. I also show that the increase in university prices and student debt since the late 1980s accounts for a third of the decline in the entrepreneurial rate of college graduates with loans. Finally, I use my model as a quantitative laboratory to study the effect of several policy proposals, such as expanding grants, raising college borrowing limits and switching to income-driven repayment plans.

Keywords: Student Debt, Education, Entrepreneurship, Financial Constraints, Productivity.

JEL Classification: E21, E23, I2, L26

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1 Introduction

As of today, 60% of all college graduates and nearly 1 in 4 labor force participants in the US have borrowed to finance their degrees. Student loans have become the second largest debt market in the country – valued at 1.6 trillion dollars and worth 6% of the GDP – and are currently at the center of a vivid public debate. In particular, while college borrowing represents the main pathway to university for many US students, the cost of higher education has been rising faster than inflation and faster than the college premium over the past years. Such a steady increase in university prices has been accompanied by an unprecedented surge in the level of student debt per person. With the median borrower piling up more than 35K dollars of education loans, recent studies have documented far reaching implications of rising student debt for individuals' life choices, including their job search strategies, marital decisions and home-ownership rates.[1]

An aspect that has received less attention by the literature is whether and how student loans interact with entrepreneurial dynamics. In several countries – including the US – entrepreneurs play a pivotal role in enhancing job creation and innovation, and analyses of micro-level data reveal that firms started by college graduates tend to be bigger and exhibit higher returns and life-cycle growth (see Michelacci and Schivardi (2020) and Queiró (2021)).[2] While student loans can open the gate to higher education in the US, evidence from studies of household finance also suggests that they can lead young adults to suffer from debt overhang (see Di Maggio et al. (2019)). Since owners typically need funds to run their businesses, a natural question that follows is whether college borrowing could interact with the entrepreneurial decisions of indebted graduates. And if so, could this also have repercussions for US firm dynamism and macroeconomic aggregates?[3]

This paper precisely intends to study the effects of student loans on occupational choices. The US student loans program allows individuals to afford higher education and potentially achieve higher productivity and earnings. But the key to college might not come without a cost, and student loans could in fact distort the entrepreneurial outcomes of indebted college graduates. To explore this perspective, I first provide novel empirical evidence on the link between education loans and entrepreneurial outcomes. I then build a quantitative model with interactions between college borrowing and entrepreneurial choices over the life-cycle of individuals, and analyse the importance of the US student loans program and its implications for firm creation, capital allocation and output. Finally, I use my framework as a laboratory to analyse potential reforms to

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

[2] Queiró (2021) uses the universe of firms and workers from Portugal to document that education affects firm size and growth, and that educated entrepreneurs seem to be specifically better at innovation and technology adoption. With data from the US, Michelacci and Schivardi (2020) further show that a high degree of complementarity between education and experience determines higher returns to entrepreneurship for graduate and post-graduate individuals.

[3] A recent survey by the US Chamber of Commerce found that 30% of small business owners think student loans have impacted their ability to grow their business. Moreover, the concern that student debt may constitute a barrier to entrepreneurship has long been a topic of political debate. For example, on June 30th, 2021, Republican Nydia Velazquez, who is the chair of the House Small Business Committee, introduced a bill to establish a student loan debt forgiveness and deferment program for entrepreneurs (i.e: The 2021 Supporting America's Young Entrepreneurs Act).

university financing, such as expanding need- and merit-based grants, raising college borrowing limits, adopting income-driven repayment plans and cancelling outstanding education loans.

The first contribution of my work is to empirically document a negative relationship between college loans and the *extensive* and *intensive* margins of entrepreneurship. To this end, I leverage micro-level data from the Fed Survey of Consumer Finances (SCF) and focus on the 1989-2019 period. In the cross-section, higher levels of education are on average associated with better business outcomes for entrepreneurs, as shown in Michelacci and Schivardi (2020). Yet, individuals who took out student loans or carry higher outstanding balances at the time of the survey are less likely to become business owners and obtain funding compared to agents without a degree and to college graduates without student debt. Their firms are also relatively younger, tend to employ fewer workers and generate lower revenues and profits in absolute terms. Importantly, robustness analyses point towards the fact that my results are not systematically driven by negative selection into having student debt, both in terms of financial and individual productivity characteristics.

Several mechanisms could explain these findings: for the most part, education loans are settled through fixed repayment plans, carry a relatively high interest rate and cannot be discharged in bankruptcy, which may discourage or delay agents' entrepreneurial careers. Since outstanding liabilities can increase the chances of debt overhang, college borrowing could also tighten entrepreneurial financial constraints. Both factors may represent barriers to firm ownership, and, consistent with this observation, I show that indebted college graduates run businesses with higher profitability (relative to their size), which suggests they undergo a stricter selection at entry.

To rationalize my results, I develop a heterogeneous agents life-cycle framework, where individuals differ by wealth, productivity, age, education, and student debt. I build on the entrepreneurial models in Cagetti and De Nardi (2006) and Buera et al. (2011), but include an endogenous choice of college and student debt to analyse the interplay of education and entrepreneurial outcomes. Specifically, during youth, individuals decide whether to attend college or enter the labor market directly. University entails a tuition – net of grants – and students choose how much to take out in college debt, which is repaid after graduation. A unique feature of student loans is that they are *unsecured* credit granted by the Federal Government to a broad set of individuals, without requiring collateral and with the goal of reducing barriers to higher education. However, they are neither dischargeable nor collateralized by any physical asset one can borrow upon, which motivates the choice of modeling college borrowing and personal wealth separately.

In the model, education gives agents an income premium through a higher deterministic efficiency profile over their life-cycle, which is an incentive to enroll in college. Then, during adulthood, individuals make occupational choices and decide whether to open a firm or become workers. They save out of their income and consume a final good, which is produced by entrepreneurs combining their idiosyncratic productivity, capital and labor. In retirement, agents consume their pension and savings, and leave bequests. Finally, there is a government that collects income taxes, holds student debt and distributes grants and pensions. Equilibrium outcomes include the wage,

the interest rate and the tax rate, and the general equilibrium (GE) setting of my framework allows me to study counterfactuals and policy reforms accounting for the full response of the economy.

The key contribution of the model is to link the dynamics of student debt and entrepreneurial choices through two main channels. First, the repayment of loans after graduation reduces the amount of resources 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 negative effect on the entrepreneurial outcomes of graduates with loans, particularly at the beginning of their career. Second, outstanding student debt balances are discounted from the amount of resources entrepreneurs can pledge to rent capital. Since entrepreneurial productivity is stochastic and not pre-determined at the time of college enrollment, potentially productive graduates may be later prevented from acquiring capital due to their student debt. By tightening their borrowing constraint, education loans ex-ante reduce and make entry into entrepreneurship more selective, and ex-post limit the expansion of firms run by indebted graduates.

Calibrated to US data, my quantitative framework replicates as untargeted moments several cross-sectional differences between entrepreneurs with and without education, and with or without student debt. I fit closely the share of student borrowers, the business ownership rates of non-college and college graduates, and the composition of the entrepreneurial sample. Moreover, I can replicate between 30 and 80% of the empirically estimated heterogeneity in firm profits, sales and size across owners with and without student debt. Importantly, the model infers sizeable distortions generated by the discounting of education loans from the amount of resources that firm owners can pledge to rent capital. In fact, equalizing access to business credit across individuals with and without student debt would decrease capital misallocation by 4.96%, increase college graduates' entrepreneurial production by 5.39% and result in a 2.11% rise in aggregate output.

The second quantitative contribution of the paper is to use the calibrated framework to analyse the recent rise in student debt and the decline in entrepreneurship for US college graduates. A vast literature has focused on the drop in business dynamism and its potential causes, while few contributions document a steeper decrease in firm ownership rates for college graduates (see Salgado (2020)). I use SCF data to show that a large share of the decline in entrepreneurship for college-educated individuals since the 1980s is driven by graduates with loans. Next, I interpret this finding through the lens of my theory, and, in particular, through the effect of outstanding student loans on entrepreneurial financial constraints. Quantitatively, I compare two different steady states of my model, by varying the return and the price of higher education to match the changes in the college premium and attainment rate between the late 1980s and today. This channel brings about a consistent increase in student debt and in the share of borrowers, and explains a third of the decline in the entrepreneurial rate of US college graduates with loans over the same period.

As an additional exercise, I leverage the exogeneity of the 1998 reform to student debt bankruptcy to establish a stronger empirical link between outstanding college loans and entrepreneurship, which I then replicate in the model. In so doing, I follow a recent strand of literature reviewed

in Buera et al. (2021b), which draws upon applied-economics techniques to discipline or validate macro models. In particular, before 1998, college borrowers could discharge their loans after 7 years into repayment, which enables me to exploit the discontinuity in the availability of bankruptcy by repayment year when the reform hit. Employing a regression discontinuity design (RDD) on SCF data, I estimate an elasticity of firm ownership to education loans between 6 and 9%.[4] Then, I use my model to simulate a counterfactual scenario in which some graduates are allowed to discharge their loans after 7 years into repayment, following the legal terms in order before the reform. After matching the share of bankrupt households in the 90s, I show that introducing student debt discharge would increase the entrepreneurial rate of graduates with loans by 8% on average, a partial equilibrium elasticity that closely replicates its empirical counterpart.

Finally, I use the model as a laboratory to study the implications of expanding college grants and borrowing limits, switching to income-based repayment plans and canceling outstanding education loans. All exercises are carried out as neutral to the budget balancing of the government, and allow for GE responses. Note that, while Luo and Mongey (2019) and Abbott et al. (2019) have analysed the effect of changes to college financing on wages and labor market outcomes, there is a lack of understanding with respect to how such policies may impact workers and entrepreneurs differently, and affect aggregate quantities through multiple channels. Specifically, in my model, agents are born with uninsurable heterogeneous wealth and productivity, and student loans foster college enrollment. However, while education ensures higher income growth over the life-cycle, outstanding debt can distort both extensive and intensive entrepreneurial margins. Consistently, higher university subsidies and loans limits, or the possibility of tying debt repayments to one's income all raise college enrollment in my counterfactuals. Moreover, income-driven plans provide relief to indebted graduates when hit by adverse shocks, while merit-based grants can successfully decrease debt overhang for productive students. Yet, changes in the composition of the pool of borrowers and in the average amount borrowed do not increase the entrepreneurial rate of graduates across all policy experiments, and do not necessarily improve capital allocation and output.

Related Literature. This project contributes to a rich macroeconomic literature on financial frictions and entrepreneurship, which has studied the effects of firm borrowing constraints for capital allocation, entrepreneurial decisions and aggregate output (see, among others, Cagetti and De Nardi (2006), Buera et al. (2011) and Midrigan and Xu (2014)). From a theoretical and quantitative point of view, the novel focus of my work is to combine education and entrepreneurial choices together in a heterogeneous agents life-cycle model, which is characterized by the interplay of student debt and its repayment structure with the borrowing constraint faced by entrepreneurs.

Secondly, my work relates to a recent body of applied research that documents several links

[4]This policy change to the provision of college loans bankruptcy is also analysed in Yannelis (2016) in order to link outstanding student debt and strategic default on other types of credit. More similar to my approach, Krishnan and Wang (2019) study the effect of the 1998 reform on the likelihood of becoming entrepreneurs. There are however key differences with respect to my work: first, I adopt a different regression strategy that exploits the discontinuity in the availability of bankruptcy by repayment year in 1998. Secondly, I use the results to quantitatively validate my model.

between student debt and individuals' life choices. For example, Looney and Yannelis (2015a), Yannelis (2016) and Mueller and Yannelis (2019) investigate different trends in repayment and default rates among college borrowers and their potential causes. Parallel to that, Mezza et al. (2020) study the impact of student debt on the likelihood and timing of buying a house, and Di Maggio et al. (2019) show that education loans can cause debt overhang and affect borrowers' geographical mobility and their probability of changing jobs. Catherine and Yannelis (2020) also suggest an effect of college borrowing on family formation. As in Ambrose et al. (2015) and Krishnan and Wang (2019), I concentrate on firm ownership, but use micro-level data to document a relationship between education loans and both the extensive and intensive margins of entrepreneurship. In addition, I complement my findings with a theoretical model and a quantitative exploration.

In combining empirical analyses and a quantitative framework to examine 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 the consequences of education loans for entrepreneurial outcomes. In this respect, my research relates to a contemporaneous work by Kerdelhué (2021), who explores the impact of college financial aid on entrepreneurship and inequality. Other than using different datasets and empirical strategies, a key distinction of my study is to endogenize the choice of student debt in the model, and investigate the effect of the interplay of education loans and entrepreneurship on capital misallocation and output. Moreover, my quantitative exercises focus on linking the decline in entrepreneurship to the rise in college debt over time, and analysing different policy reforms to college financial aid.

Finally, my paper connects to a growing literature on the macroeconomic effect of higher education policies in the US. For instance, Colas et al. (2021) study the optimal design of student financial aid as a function of parental income, Matsuda (2020) shows that back-loaded subsidies may increase the supply of college-educated labor, and Chatterjee and Ionescu (2012) argue that loan forgiveness for college dropouts could raise welfare. Moreover, Matsuda and Mazur (2022) examine the welfare changes associated with income-contingent plans, while Vardishvili (2020) stresses that decreasing uncertainty over the generosity of financial aid can be welfare-improving. Parallel to that, research by Daruich (2018), Abbott et al. (2019) and Blandin and Herrington (2020) compares government interventions affecting children as opposed to college students, and points out the importance of pre-college investments for university completion and lifetime earnings. With respect to these studies, I investigate how expanding university grants, raising college borrowing limits or switching to income-driven repayment plans affect college enrollment, college graduates' entrepreneurial outcomes, output and welfare. My work is also one of the first assessments of the recent proposal of President Biden to cancel off part of outstanding student loans.

The paper is organized as follows: Section 2 documents the link between student debt and entrepreneurship in SCF data. In Section 3, I develop a life-cycle model of education and occupational choices with college borrowing that is then calibrated to US data in Section 4, where I assess

its quantitative fit with respect to my empirical evidence. In Section 5, I study empirically the effect of student debt discharge on entrepreneurial outcomes, and then replicate it quantitatively in the model. In Section 6, I assess the aggregate implications of policy changes to the provision of college financial aid and to the repayment plans of education loans. Finally, Section 7 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 education loans are associated with a lower likelihood of opening a business. Secondly, I analyse outcomes that regard the intensive margins of entrepreneurship: the presence and extent of college borrowing are linked to a lower probability of receiving business loans, and correlate negatively with business profits, size and revenues. Finally, I discuss whether possible mechanisms of selection into student debt and into entrepreneurship find support in the data.

2.1 Student Debt and Business Ownership

In my empirical exploration, I rely on the SCF, an extensive triennial and cross-sectional 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.[5] When applicable, it also reports information on respondents' spouses. In my analysis, I use the 1989-2019 dataset and focus on agents in the labor force and between 25 and 65 years old, which leaves me with approximately 170,300 observations.[6] 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 self-employed individuals, these constitute more than 20% of the sample, which makes it suitable for studies of US entrepreneurship (see Michelacci and Schivardi (2020) and Cagetti and De Nardi (2006)). The section related to the businesses owned by respondents contains data on their size, revenues, profits and equity, and information on the 1-digit industry code, the legal status and the funding date of the firms. It also reports how the business was started, the ownership share of the respondents and their working hours. In this paper, I classify as firm owners those that actively manage an enterprise in which they hold the majority share of the ownership, and who report employing at least one salaried worker.[7]

[5] Table A1, Table A2 and Table A3 in the Appendix report a list of all the variables used in my regressions, including demographic, business and student debt-related ones, along with a brief explanation and their unit of measure. In Table A4 and Table A5, I instead list several distributional moments and patterns regarding student debt take-up and repayment, comparing the estimates I compute from the SCF to those reported in other available surveys and papers.

[6] In the SCF, the information is stored in five separate imputation replicates (which are denominated as "implicates"). For example, for the 5,783 families interviewed during the 2019 survey, there are 28,915 records in the final data set.

[7] My analysis is robust to considering also self-employed households as entrepreneurs. Moreover, while SCF does not contain information on the reason why entrepreneurs started or operate their business, existing evidence from the Global Entrepreneurship Monitor shows that less than 15% of business owners in the US opens a firm out of necessity.

The SCF also asks respondents information regarding their student debt, for example whether they have education loans, the initial amount taken and the amount still to be repaid at the time of the interview, the year in which the loan was issued and started to be repaid, the interest rate charged and the type of repayment plan agents are enrolled into. In the sample period I consider, 20.3% of all respondents affirms to have a student loan to repay,[8] and the average debt taken is around 30,800$, which is in line with estimates from the National Center of Education Statistics.[9]

Table 1: Entrepreneurial Rates: 1989-2019

Educational Level	*Average*	*Without Loan*	*With Loan*
College Graduates	14.23%	15.56%	10.27%
Non College Graduates	10.42%	-	-

As reported in Table 1, entrepreneurial rates of households with college are higher than those of non-college graduates.[10] Yet, 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. Note that Table 1 shows averages for the 1989–2019 period: however, over the recent decades, business ownership rates have decreased 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 instance regarding tuition costs, loan limits and funding schemes. In Section 4, I will analyse the co-evolution of business rates and student loans over time; here, I instead focus on the cross-sectional differences between individuals with and without college borrowing. To assess the interplay of education loans and firm ownership, I hence estimate the likelihood of becoming an entrepreneur for agents in my sample by running a set of probit regressions of the following form:

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

[8] Before 2016, the SCF did not ask specifically for whose education the loan was taken. For this reason, I first check that my results hold whenever focusing only on the last 2 surveys (2016 and 2019), for which I can identify the correspondence between the person interviewed and the actual underwriter of the student loan reported. Secondly, when pooling together all the survey years, I check that my results hold true whenever focusing on a restricted subsample of the population, namely on those between 25 and 40 years old, which should exclude cases of parents taking or having to repay loans in the name of their children. See Hershbein and Hollenbeck (2015) for several discussions on this issue.

[9] 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 to finance college. Hence, 23% of the US population above 25 years old is estimated to have negative student loan balances to repay after graduation. Moreover, borrowers on average take out between 30K and 50K $ in student loans, as reported by Looney and Yannelis (2015b).

[10] A large literature has established that education correlates positively with entrepreneurial rates, for example Poschke (2013). College can enhance human capital accumulation, provide individuals and facilitate inter-personal connections or networks that may improve entrepreneurial outcomes. Moreover, starting a firm in particular fields often requires specialized education because of the nature of certain industries (e.e: civil engineers and biologists, etc).

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. Focusing on the right-hand side of the equation, three variables can define the explanatory regressor *Student Loan*. First, I use the (log) original amount of student debt taken out by the individual, which does not depend on the survey year. Secondly, I either employ a dummy variable that signals the presence of pending student loans in the balance sheet of the household, or the (log) amount still to be paid as of the interview. Note that 80% of college borrowers has only one recorded loan, while a smaller fraction of the sample reports two to three loans.[11] Here, I consider the total amount of student debt hold or taken out by the households.

Table 2: Business Ownership

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0034***	-0.0024***		
	(0.0002)	(0.0002)		
Dummy(Have Loan)			-0.0241***	
			(0.0024)	
log(Student Debt Still Owed)				-0.0025***
				(0.0003)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Survey Year FE	N	Y	Y	Y
Observations	170,302	170,302	170,302	170,302
Pseudo-R^2	0.0373	0.0493	0.0521	0.0520

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. Pre-College controls refer to agent's gender and ethnicity (Table A8 includes parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Robust to including spousal income, households' leverage or assets, and to using either an income or wealth category by age and educational level instead of their personal income. Table A9 provides regression results for the cases in which business ownership is defined without any restriction on the size of the ownership share of respondents.

The regressions include a set of controls $\mathbf{\Gamma}_i$, which capture factors that were pre-determined to the choice of getting a student loan and could affect entry into entrepreneurship (e.g. age, gender, ethnicity and parental education). Finally, I sequentially introduce several control variables recorded at the time of the survey that were not pre-determined to the moment in which individuals contracted college borrowing, such as their education level, marital and home-ownership status, income or wealth.[12] These latter regressions also include survey year fixed effects (FE).

Table 2 shows that student debt correlates negatively with business ownership. In Column (1), where only pre-determined controls are included, an increase of 1% in student debt is associated with a 0.34% lower likelihood of becoming an entrepreneur. To interpret this result, note that the average entrepreneurial rate in the sample is 12%, while the average size of college borrowing is $31,000. Hence, a $3,100 higher amount of student debt at graduation is associated to a roughly 0.5 percentage points (p.p.) difference in the likelihood of becoming entrepreneurs relative to the

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

[12] Due to the high degree of endogeneity of both income and wealth, I can alternatively use the average income or assets of agents within the same age and/or education category (robust to do it by age and/or education and year too).

mean. In Columns (2)-(4), I then control for variables recorded at the time of the interview that may correlate with business ownership. Both the initial amount of debt taken and the amount still owed at the time of the survey have a negative relationship with business ownership. More specifically, in Column (3), I use as main regressor a dummy variable that is 1 if the respondent reports having a student loan still to repay, and 0 otherwise. In line with the other coefficients, having a student loan is associated with a 3% lower likelihood of becoming an entrepreneur.[13,14]

Table 3: Business Ownership, College Graduates Only

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0058***	-0.0025***		
	(0.0004)	(0.0004)		
Dummy(Have Loan)			-0.0294***	
			(0.0039)	
log(Student Debt Still Owed)				-0.0027***
				(0.0004)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Survey Year FE	N	Y	Y	Y
Observations	80,157	80,157	80,157	80,157
Pseudo-R^2	0.0202	0.0452	0.0455	0.0453

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. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of agents' personal income, and to considering owners with any given equity share.

As a robustness check, Table A10 conducts the analysis focusing only on the first education loan reported by respondents. Moreover, Table 3 estimates again Equation 1 excluding non-college graduates. The presence and extent of student debt correlate negatively with business ownership also among individuals with at least a bachelor degree. 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 debt is in fact wider within college graduates. This is consistent with the comparison of unconditional entrepreneurial rates shown in Table 1. Moreover, the negative correlation between education loans and entrepreneurship is 3 times stronger when I focus my analysis on the last 15 years of data (i.e: 2005-2019 vs 1989-2004).

Next, in Table 4, I investigate whether the link between outstanding student debt and entrepreneurial decisions varies across the distribution of income. For agents with information of personal earnings, I run a set of regressions similar to Equation 1, including the amount of education loans individuals graduated with as an additional control and isolating the effect of their

[13]Robust to interacting controls with student debt to check results are not driven by one demographic group only.

[14]Results are in line with recent studies on the relevance of available credit and entrepreneurial personal balance sheets for firm ownership and financing (see Herkenhoff et al. (2021) and Robb and Robinson (2014)). It is important to mention that, in a previous contribution, Hurst and Lusardi (2004) found little role for household's net worth in determining entrepreneurship. However, Hurst and Lusardi (2004) focused on self-employment (as opposed to firm ownership) and could not observe instances of financial constraints, as opposed to more recent analyses on the matter.

outstanding balances. Column (1) reports results without conditioning or controlling for agents' income: a 1% increase in the amount of student debt owed at the time of the survey is associated with a 0.9% lower likelihood of being an entrepreneur. Yet, the interplay of outstanding education loans and the extensive margin of entrepreneurship is stronger for agents in the bottom half of the earnings distribution, for whom a 1% higher balance on college loans is associated with a 2.6% lower likelihood of being a business owner. Similarly, Table A11 shows that the coefficient attached to outstanding student debt decreases with individuals' age, suggesting a stronger negative correlation between college loans and entrepreneurship early on in agents' life-cycle.

Table 4: Business Ownership and Outstanding Student Balances by Earnings

	Business Ownership			Firms with 20+ Employees		
	Full Sample	Earnings<p50	Earnings>=p50	Full Sample	Earnings<p50	Earnings>=p50
SLoans Owed	-0.0094***	-0.0257***	-0.0071***	-0.0161***	-0.0112***	-0.0507***
	(0.0031)	(0.0059)	(0.0022)	(0.0044)	(0.0028)	(0.0186)
Controls	Y	Y	Y	Y	Y	Y
Survey Year FE	Y	Y	Y	Y	Y	Y
Observations	170,302	83,229	84,287	37,051	23,749	10,521
Pseudo-R^2	0.0381	0.1060	0.0177	0.0263	0.0346	0.0312

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. In Columns (1)-(3), the dependent variable is a binary indicator = 1 if the individual is a business owner, and = 0 if not. In Columns (4)-(6), the dependent variable is a binary indicator = 1 if the business owned by the respondent has 20+ employees, and = 0 if it has less than 20 employees. Controls refer to agent's gender and ethnicity, age, student loan size at graduation, educational level, marital and home-ownership status.

When I focus on the likelihood of owning a relatively big enterprise (i.e: 20+ employees), the association between student debt and entrepreneurship becomes stronger. Overall, Column (4) in Table 4 shows that a 1% increase in the amount of student loans owed at the time of the survey is associated with a 1.6% lower likelihood of running relatively big firms. Yet, the effect is larger for individuals in the top half of the earnings distribution (see Column (5)-(6)). Taken together, these results suggest that student debt correlates negatively with entrepreneurship by more for low-income earners, but that education loans may have a stronger influence on business size for top earners. Note also that, when repeating regressions in Columns (3) and (6) for individuals above the 90th percentile of the earnings distribution, I no longer find a significant negative association between entrepreneurship and outstanding student debt, which instead is still negatively correlated with big firms ownership.[15] This may be indicative of the heterogeneity in the barriers to the creation of firms and big-firms along the spectrum of the earnings distribution, and it is consistent with findings in Hurst and Lusardi (2004) and Herkenhoff et al. (2021), who document a non-linear relation between wealth and self-employment, and between credit access and business ownership. Results are robust to doing the analysis by agents' position in the asset distribution.[16]

[15] The coefficient on the amount of student debt owed decreases to -0.0312, significant at the 10% confidence level.

[16] Table A7 reports a robustness check for regressions in Table 2, in which I analyze the correlation between en-

Focusing then more closely on business owners and on the enterprises they run, I find 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 A6. This can suggest that entrepreneurs carrying larger student debt balances might have to provide more collateral to back up their entrepreneurial operations. Along similar lines, Figure A.2 analyses the business legal status of enterprises run by individuals with and without education loans. Indebted owners are less likely to open corporations or limited liability companies, as opposed to individuals without student debt balances to repay.[17] Figure A.2 also shows that college graduates without student loans tend to start their enterprises earlier on in life.[18] In particular, conditional on the same educational attainment, firms of indebted entrepreneurs are 5 years younger, which indicates that households with student debt may delay undertaking their entrepreneurial career.

As pointed out by Alon et al. (2021), the repayment of 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 life-cycle, while they are still repaying their loan balances. Consistent with their mechanisms, I argue that college borrowing could similarly discourage or delay business ownership, as opening a firm can lead to potentially higher earnings, but also involves taking higher risk. I will further explore this trade-off in the quantitative section.

2.2 Student Debt and Business Outcomes

After having investigated the link between student debt and the extensive margin of entrepreneurship, I now focus on analysing several business outcomes across entrepreneurs with different education loans balances. In terms of the intensive entrepreneurial margins considered, I first examine business financing, and 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.[19] The SCF records information on whether the respondent applied for and obtained a business loan within the 12 previous months before the interview. First, in Table A12, I report estimates for the likelihood of applying for a business loan. Neither the initial amount of

trepreneurship and education loans controlling for agents' net worth (excluding student debt). This stresses the relevance of student loans for entrepreneurial decisions beyond the effect of individual wealth and additional indebtedness.

[17] 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.

[18] For this comparison, I focus on entrepreneurs that funded their own business, as opposed to inheriting or joining it. In the period considered, 75% of the business owners report funding their own business, 18% buying it, 4% inheriting it, and 3% joining it as a partner. Moreover, more than 95% of entrepreneurs hold a $>$50% share in their business.

[19] Using a sample of US startups from the Kauffman Firm Survey, Morazzoni and Sy (2021) show that business borrowing from financial institutions tend to represent the most important source of funding for entrepreneurs.

student debt taken nor the outstanding balances as of the survey year t correlate with the probability of asking for business funding, suggesting little to no role for any heterogeneity in the demand for credit across indebted and non-indebted entrepreneurs. Secondly, I estimate the likelihood of being turned down in a business loan application via a probit regression of the following form:

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

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. Similar to previous regressions, I first use the (log) initial amount of student debt taken by the individual, then a dummy variable that signals the presence of pending education loans in the balance sheet of the households, and finally the (log) 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 education debt hold or taken. I introduce individual-level variables and fixed effects as in Equation 1, as well as a set of firm-level controls that include business size, age, legal type and 1-digit industry code.[20]

Table 5: Business Loan Approval

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0120***	-0.0118***		
	(0.0028)	(0.0025)		
Dummy(Have Loan)			-0.1308***	
			(0.0262)	
log(Student Debt Still Owed)				-0.0125***
				(0.0026)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Firm Controls	N	Y	Y	Y
Survey Year FE	N	Y	Y	Y
Industry FE	N	Y	Y	Y
Observations	5,196	5,075	5,075	5,075
Pseudo-R^2	0.0365	0.2174	0.2188	0.2178

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 owner had a business loan application approved within the 12 previous months before the survey interview. Pre-College controls refer to agent's gender and ethnicity (Table A8 includes parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include size, business age, legal type and individuals working hours. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of agents' personal income, and to considering owners with any given equity share.

As reported in Table 5, student debt shows a negative correlation with business credit approval. In Column (1), I only control for demographic characteristics that were pre-determined at the time the loan was taken, such as gender, ethnicity and parental education: for entrepreneurs, an increase of 1% in student debt is associated with a 1.2% lower likelihood of getting business funding. In all the other specifications, I control for variables recorded at the time of the interview

[20] Results are robust to excluding firms offering accounting and legal services, and are available upon request.

that may correlate with business credit approvals, therefore assessing how student loans of entrepreneurs within the same wealth or business income categories correlate with their likelihood of securing external finances. Column (2) shows that the initial amount of student debt has a 1.3% negative relationship with business loan approval. In Column (3), I instead use as main regressor a dummy variable equal to 1, if the respondent is still in repayment, and to 0 otherwise. Consistent with previous results, having a student loan is associated with a 13% lower likelihood of receiving business credit. Finally, the regression in Column (4) exploits the amount of college borrowing still owed at the time of the survey, finding a similar coefficient to the one in Column (2).[21]

2.2.2 Business Size, Sales, Net Worth and Profits

An impaired access to business financing from external sources is likely to subsequently influence the operations of firms run by indebted 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 education 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 and business operations, firms owned by indebted entrepreneurs might also generate lower revenues and profits, even within the same size category. 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 (log) gross sales, the (log) profits or (log) net worth of the business as 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 interview. I allow for the sets of firm and individual-level controls previously explained, and include survey year fixed effects (α_t). Results for size and sales are displayed in Table 6, while those concerning business profits and net worth are instead reported in Table A14 and Table A15.

The estimation of Equation 3 reveals that the amount of student debt taken by entrepreneurs to finance education is linked to a lower business size:[22] specifically, an increase of 1000$ in college borrowing is associated to hiring 12 employees less. Moreover, within businesses of comparable profile (including size) and for entrepreneurs of similar demographic and financial characteris-

[21] 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 5. All results are available upon request.

[22] Table A13 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.

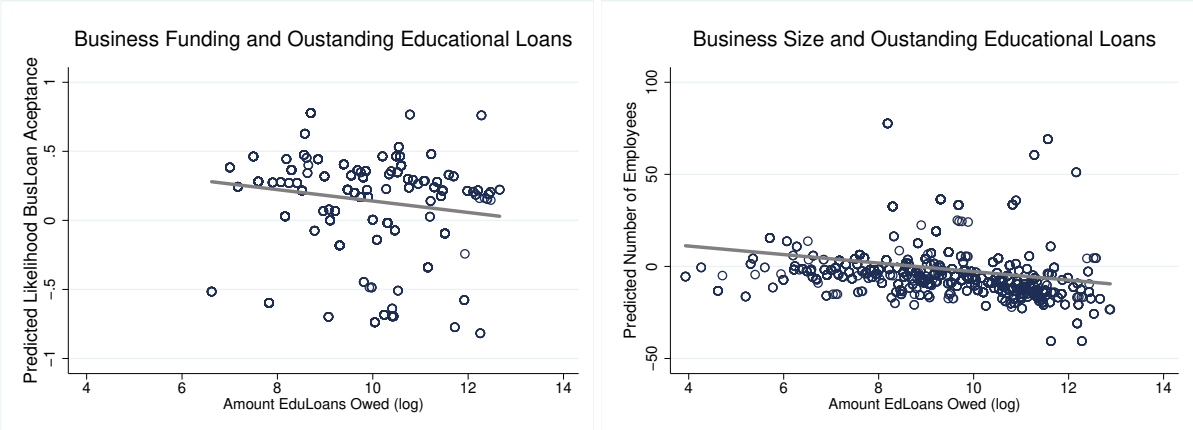
Table 6: Business Outcomes: Size and Gross Sales

	Employees	Employees	Sales	Sales
log(Original Student Debt Taken)	-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
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: 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 the log(*Sales*) of entrepreneurs in the sample. Pre-College controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include business age, legal type and individuals working hours (and business size in Columns (3)-(4)). Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of personal income, and to considering owners with any given equity share.

tics, 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 coefficients of interest are not simply driven by the choice of the regressors included. Also, the coefficient β_1 is almost 3 times larger when considering only firms that are active in Manufacturing and Wholesale Trade industries, two sectors where entrepreneurs tend to need larger finances to operate. Finally, Figure 1 further confirms that, conditional on having taken out loans to finance a degree, the amount still owed at the time of the interview has a negative impact both on the likelihood of having a business funding application accepted and on the size of the business.

Figure 1: Business Outcomes by Student Debt Outstanding Balances



Notes: Residuals from OLS and Linear Probability regressions. Survey weights are used. The dependent variables are the number of employees and a dummy for whether a business loan application was accepted in the 12 months before the survey date (in the panel on the left, the upper limit is set at the p95 of the distribution of residuals for illustration purposes). Control variables are as in the baseline regressions, namely as in Equation 2 and Equation 3.

2.3 Selection Effects

2.3.1 Selection into Entrepreneurship

So far, I have shown that the amount of debt contracted to finance college education, as well as the amount still to repay at a given time throughout individuals' life-cycle, are correlated with a lower likelihood of being an entrepreneur and obtaining funding, and are associated with opening firms of smaller size, profits and sales. To rationalize my results, this paper advances the hypothesis that the financial burden implied by education loans, combined with the risk involved in running a firm, could act as a deterrent to entrepreneurial entry and as a barrier to business activities.[23]

On the one hand, making debt repayments and disburse interest rates for 10 to 25 years after graduation can have a negative income effect on households' available resources, and slow down wealth accumulation, with the effect being relatively more severe for low-income earners. Note that the current average monthly payment college graduates have to make on their student debt is around $450, nearly 10% of an average monthly salary.[24] Loan repayments may therefore reduce savings and discourage or delay firm ownership, as entrepreneurs' personal asset are crucial for establishing and running businesses (see Quadrini (2009) for a review of the literature and Robb and Robinson (2014) for recent empirical evidence). Consistent with this mechanism, I have shown in Table 4 that, conditional on demographics and on the initial amount of debt taken for college purposes, the negative correlation between outstanding education loans balances and business ownership is three times stronger for individuals below the median in the earnings distribution.

On the other hand, the influence of college borrowing on entrepreneurial outcomes could also be of a financial nature. Lending institutions are known to discount the amount of outstanding debt individuals carry whenever they apply for other types of loans, and the negative effect of student debt on the access to credit is estimated to be more severe in tightly underwritten markets (see Mezza et al. (2021)). Similarly, there is extensive evidence on how student loans are associated not only with a higher likelihood of being credit constrained, (see Folch and Mazzone (2020) and Mezza et al. (2020) on the effect on home-ownership rates) but also with a higher likelihood of declaring consumer credit bankruptcy (see Gicheva and Thompson (2015))[25]. At the same time, Brown et al. (2015) have shown that student debt borrowers have lower average credit scores nowadays as opposed to the beginning of the century, when their risk profiles were comparable

[23] As mentioned before in the introduction, the concern that student debt could prevent entrepreneurial activities has long been debated by the public opinion. As a nice summary, the magazine Forbes has recently reported the insights of 13 members of its Business Council with respect to how student loan debt can affect an entrepreneur's journey.

[24] See `https://educationdata.org/average-student-loan-payment` and Avery and Turner (2012). Importantly, for agents with graduate loans, monthly payments are on average between $700 and $1500. Hua (2021) also documents that the fraction of college graduates with negative net worth has increased steadily over the past decades.

[25] This seems not to have been the case before the last two decades: Brown et al. (2015) document that the association between student loans and other debt, such as mortgages, credit cards and auto loans used to be positive. This suggests that, historically, student debt might have been an indicator of borrowers having a higher level of education and projected income, a signal of financial prosperity that might have reversed or partially changed in more recent days.

to non-borrowers.[26] Consistent with this set of results, it is possible that education loans may also decrease the likelihood of getting funds (or the amount one can get) for running or starting a business,[27] which is in line with the evidence from the SCF data I presented in Table 5.

Interestingly, an impaired access to external credit could also imply that barriers to business ownership may be more pronounced for individuals with higher initial or outstanding college loans balances, resulting in a stronger selection into the entrepreneurial sample. As a consequence, one may also expect individuals who took out or carry large amounts of student debt and became entrepreneurs to be marginally more productive. To check for instances of selection into entrepreneurship, I 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 set of regressions:

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

Table 7: Business Outcomes: Profitability

	$\log\left(\frac{\text{Profits}}{Revenues}\right)$	$\log\left(\frac{\text{Profits}}{Revenues}\right)$	$\log\left(\frac{\text{Profits}}{CollDebt}\right)$	$\log\left(\frac{\text{Profits}}{CollDebt}\right)$
log(Original Student Debt Taken)	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
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. Pre-College controls refer to agent's gender and ethnicity (robust to include parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include business age, legal type and individuals working hours. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of personal income, and to considering owners with any given equity share.

where $y = \{\log\left(\frac{Profits}{Revenues}\right); \log\left(\frac{Profits}{CollDebt}\right)\}$ is a vector containing the (log) measures of profits per dollar revenues and profits 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 (log) amount of student loans 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, and results are displayed below in Table 7. Moreover,

[26] Brown et al. (2015) also documents that, amid the general trend of household deleveraging after the financial crisis, debt balances fell much more for borrowers with education loans, especially those with high levels of student debt.

[27] Business loans from financial institutions are the main source or funding for entrepreneurs in the US. Using the Kauffman Firm Survey, Morazzoni and Sy (2021) shows that funding from secondary sources such as family and friends tend to represent less than 8% of outside debt and less than 4% of equity contributions for typical US entrepreneurs.

Table A16 shows the outcomes of robustness analyses that use as main regressors either the (log) amount of college debt still owed at the time of the interview, or a dummy variable that is equal to 1 if the respondent reports pending student loans on their balance sheets, and to 0 otherwise.

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* $\times$ *Business Size*) and controls that were pre-determined at the time the student loan was taken. Columns (2) and (4) consider instead 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 confounding effects coming from the size and characteristics of the businesses run by the entrepreneurs. Larger initial amounts of education loans correlate with higher firm profitability per dollar revenues or per dollar of collateralized debt. In particular, a 1% increase in the original amount of college borrowing is associated with 4 to 9% higher business profit margins, which suggests that owners with larger balances of student loans may have also undergone a stricter selection into entrepreneurship.

2.3.2 Selection into Student Loans

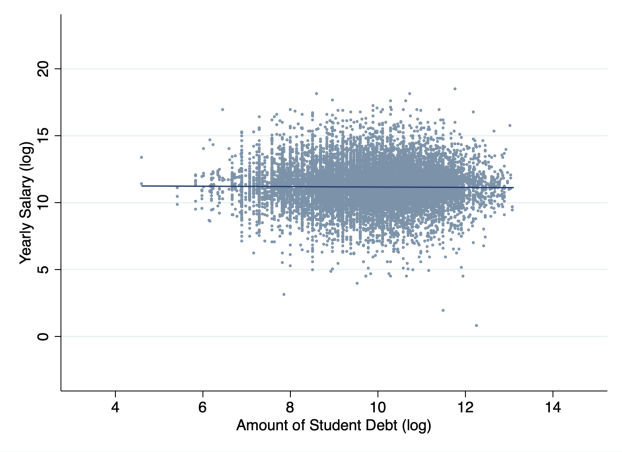
An important question to ask at this point is who are the individuals that borrow for college education. If agents were to select into student debt on characteristics that are also linked to a lower likelihood of becoming entrepreneurs and running productive firms, my results would primarily capture such selection mechanism and have little to say about the financial or income effects of education loans on entrepreneurial outcomes. I tackle this issue in two steps: in the remainder of this section, I first discuss suggestive evidence of the fact that my results do not seem to be biased by major instances of negative selection into college borrowing. Then, in Section 5, I exploit an exogenous change in the repayment policy of student debt to strengthen the correlation between education loans and entrepreneurship, above and beyond confounding selection effects.

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 debt 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, student loans growth at the extensive margin (percent borrowing) and at the intensive margin (amount per borrower) was actually more pronounced for the highest family income quartile over the 1989-2004 period (see Berkner (2000) and Wei and Berkner (2008)). Federal data also shows that, among graduates from the 2012 cohort, half of the students from

higher-income families borrowed for college, twice the share compared to the 1992-93 cohort.[28]

Such steady increase in the share of borrowers from the highest family income quartiles might reflect the introduction of unsubsidized federal loans, which can be taken out irrespective of financial need,[29] and the fact that other aid schemes such as Pell Grants only target low and middle-income students that qualify for subsidies.[30] Along these lines, Looney and Yannelis (2015b) have shown that rich US households are now more and more likely to use education loans to pay for tuition and boarding costs, especially at top universities and Ivy League Schools.[31] Although I have no data on family wealth or income for the SCF respondents, I have controlled for parental education in my baseline regressions, and interacted it with college debt as well. In addition, individuals with student loans are those who acquired a higher education and hence will likely have better career prospects and earnings profiles.[32] Consistently, I have also interacted individuals' student debt balances with their wealth or income percentile, without registering changes to my main results. Therefore, this preliminary exploration does not suggest that the link between student loans and entrepreneurship is due to the fact that borrowers only pertain to the bottom of the income or wealth distributions, considering either their family's or their personal finances.

Figure 2: Yearly Salary and Student Debt Balance upon Graduation



Parallel to that, it seems difficult to argue that student loan borrowers might clearly and significantly have lower entrepreneurial skills compared to non-borrowers. Entrepreneurial skills are complex to measure but are typically proxied by educational attainments (see Poschke (2013)). Only students that choose to acquire higher education get a student loan, and higher education has been often found to positively impact entrepreneurial outcomes (see Guo et al. (2016) and Michelacci and Schivardi (2020)). Comparing individuals with and without student debt, one

[28] https://www.pewresearch.org/social-trends/2014/10/07/.

[29] Unsubsidized Federal loans were first introduced with the 1992 Higher Education Act.

[30] In the case of Pell Grants, the typical share of college tuition covered is less than 30%. See: www.brookings.edu/research/the-economic-case-for-doubling-the-pell-grant/

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

[32] See also www.peoplespolicyproject.org/2020/11/16/what-is-the-current-student-debt-situation/.

should in fact expect the latter group to be more likely to open and run a successful business.

Shifting the focus to 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 overall limited and infrequent, offsetting at most 20% of the average financial needs of relatively few perspective students (roughly 15% of them), and leaving the rest to be covered either by family contributions or through borrowing. More importantly, the negative selection of students into borrowing finds little support empirically. To provide a finer measure for individuals' talent, I use data from the US National Longitudinal Survey of Youth (NLSY97), which contains results to cognitive and attitudinal tests administered to all respondents, irrespective of their educational level. In Table A17, I show that cognitive abilities are a strong predictor of both receiving grants and taking out student debt for college. Results also illustrate that cognitive abilities do not correlate with getting higher amounts of grants as opposed to education loans.

Secondly, if students were to negatively select into having education loans according to their idiosyncratic skills, it should be reflected in their entrepreneurial outcomes. Contrary to that, I have shown in Table 7 that profitability measures are higher (not lower) for college borrowers. Using NLSY97, in Table A18 I then regress self-employment rates on the interaction between individuals' education loans and cognitive abilities to show that student debt per sé is still significantly and negatively associated with 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 correlations, which I can also verify in the SCF data (see Figure 2).[33] In this sense, I can rule out that individuals with student loans are evidently the least productive ones among college graduates, otherwise it should likely be reflected in their earnings as well.

To conclude the discussion, I check for any heterogeneity in the correlation between college borrowing and entry into entrepreneurship by student debt balances. Specifically, I estimate the elasticity of business ownership to outstanding college debt – analogous to β_1 in Equation 1 and in Column (4) of Table 2 – for individuals in different quartiles of the student loans distribution. As shown in Figure A.4, conditioning on the respondent having taken out college debt, the negative correlation between outstanding balances and the extensive margin of entrepreneurship is stronger for agents below the 75^{th} percentile in the student debt distribution. This is in principle consistent with the fact that individuals with larger education loans (above the 75^{th} percentile of the distribution, for example) might be those who attended costly and possibly prestigious universities. The fact that, for these respondents, education loans do not correlate with entrepreneurial entry suggests that they could be positively selected into having student debt either on their wealth, their talent or both. This could further confirm that my results do not depend on respondents with large education loans, and that having large education loans does not necessarily mean being negatively selected on characteristics that predict worse entrepreneurial outcomes.

Using SCF data has still several limitations, above and beyond not observing individuals' id-

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

iosyncratic productivity or their family's income. The dataset lacks information on the college fees paid by respondents, as well as on the amount of grants and family contributions they have benefited from. Since student debt and occupational choices are endogenous outcomes that reflect the selection of individuals along their main characteristics, I next build a model that can account for both decision margins and their interaction. Then, in Section 5, I will go back to the data and exploit an exogenous policy change to the availability of education loans bankruptcy in order to reinforce the idea that student debt can indeed have a negative effect on entrepreneurial outcomes.

3 Model

This section presents a general equilibrium framework that nests together education decisions and occupational choices over the life-cycle of individuals. Households in the model live through three main stages: education, working life, and retirement. They are born with heterogeneous wealth and idiosyncratic productivity, which accumulate and change over time. During youth, agents decide whether to attend college by paying a tuition (net of grants), and whether to take out student loans, which are repaid after 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 be entrepreneurs. They save out of their income and consume a final good, which is produced by the entrepreneurial sector. In particular, output is obtained combining productivity, capital and labor, and entrepreneurs face a limited pledgeability constraint to rent capital.[34]

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, borrowers' outstanding balances are discounted from the amount of personal resources that can be pledged to finance capital acquisition. By tightening their collateral 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 account for the interplay of student debt with both the extensive and intensive margins of entrepreneurship, as I have documented in Section 2.

[34] In the Appendix, I also consider a version of the model augmented with an unconstrained productive sector.

3.1 Primitives and General Settings

Preferences: Agents have a strictly increasing and concave utility function over consumption, which satisfies standard Inada conditions, and whose coefficient of risk aversion is denoted by γ:

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

Moreover, individuals discount their 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 vary by age and are denoted by θ_{age}. To ease the exposition, I suppress time subscripts whenever they are not strictly necessary.

Productivity: Individuals are characterized by heterogeneous idiosyncratic entrepreneurial productivities z, which evolve stochastically over time according to a standard AR(1) process:

$$z' = \rho z + \epsilon \quad \text{with} \quad \epsilon \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

Such process is defined by a conditional distribution $d\Xi(z'|z)$, where I indicate by ρ_z the persistence of individuals' productivity and by ϵ its idiosyncratic risk component. Both terms do not vary by college attainment. Note that my theoretical framework features idiosyncratic shocks to productivity but no source of aggregate uncertainty. As in models à la Buera et al. (2011), I assume that z evolves constantly in the background of individuals and over their life-cycle, regardless of their occupational choices. However, this idiosyncratic productivity component is used only in entrepreneurial production, and does not scale the wage of workers. This is why z can be thought as agents' comparative advantage of pursuing entrepreneurship as opposed to paid work.

Parallel to that, all households – including workers and entrepreneurs – are also characterized by a tenure or efficiency profile, denoted by ℓ^i_{age}, which differs by educational attainment i and evolves exogenously and deterministically over the life-cycle according to the following process:

$$\ell^i_{age} = \zeta^i_1 \times age - \zeta^i_2 \times age^2 \quad \text{with} \quad i \in \{college, nocollege\}$$

Note that the parameters ζ^i_1 and ζ^i_2 govern the slope and curvature of the deterministic efficiency profile of individuals, and will reflect heterogeneities in the income growth of households across educational attainments and over their life-cycle. In this modeling choice, I hence embed the college premium that determines the incentives of young adults to acquire a university degree.

It is important to stress that total entrepreneurial productivity comprises both a deterministic and a stochastic or idiosyncratic component, given by the expressions for ℓ^i_{age} and z previously

discussed.[35] Total entrepreneurial productivity is then given by their combination according to:

$$e^{\xi^i_{age}} = e^{\ell^i_{age}} \times e^z \quad \text{with} \quad i \in \{college, nocollege\}$$

Firm's Technology: Output is produced through a standard production function that combines total entrepreneurial productivity ξ^i_{age}, 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, $f(\xi^i_{age}, k, l)$ is given by:

$$f(\xi^i_{age}, k, l) = e^{\xi^i_{age}}(k^\alpha l^{1-\alpha})^{1-\nu}, \quad \text{with} \quad 0 < 1-\nu < 1, \quad \text{and} \quad i \in \{college, nocollege\}$$

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, the deposit rate which is determined in general equilibrium. Financial markets are incomplete, and entrepreneurs can borrow intra-temporally up to a fraction of their assets a, net of any education loan d they might carry at a given time t. Capital constraints are hence given by:

$$k \leq \lambda(a - \eta d); \qquad a \geq 0$$

where $a \geq 0$ (intertemporal borrowing is ruled out for simplicity) and λ measures the degree of the financial constraint, as micro-founded in Buera et al. (2011). 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. Importantly, the presence of education loans in the balance sheet of college graduates limits the amount of collateral they can pledge to rent capital on financial markets at any given time t during repayment. The parameter η governs precisely the extent to which college loans reduce the amount of wealth entrepreneurs can use to back up capital renting.[36] Note that $d = 0 \ \forall t$ in the case of entrepreneurs without

[35] As argued by Michelacci and Schivardi (2020), entrepreneurs with graduate degrees have higher returns to their business ventures, and increasingly so by previous experience. This rationalizes including the deterministic life-cycle efficiency component – and the college premium embedded into it – within overall entrepreneurial productivities.

[36] This formulation for the collateral constraint faced by entrepreneurs builds on the way financial frictions are modeled in Buera and Shin (2013), and can be related to the microfoundations of collateral pledgeability limits by Kiyotaki and Moore (1997). In particular, I assume that the amount of debt entrepreneurs can take intra-temporally to finance their operations cannot exceed the returns on capital (which I call ϕk), and that creditors discount student loans from the business debt they grant to owners. Note that the model does not allow for assets to be negative, and creditors are concerned about the amount of liabilities that have to be served in a given period. Since student loans cannot be discharged in bankruptcy (i.e: they are a senior form of debt) , I assume that creditors do not discount from the amount of pledgeable assets all outstanding student debt, but rather a fraction ηd. This latter term reflects the sum of per-period principal payments and interest rates that may be due intra-temporally. Denoting firm liabilities by b one can write:

$$b + \eta * d \leq \phi k$$

college education and for entrepreneurs with college education that did not take out student debt. Moreover, d becomes 0 when indebted college graduates finish repaying their student loans.

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

$$\pi^* = \max_{l,k} \left\{ e^{\xi^i_{age}} (k^\alpha l^{1-\alpha})^{1-\nu} - wl - (r+\delta)k, \quad \text{s.t.} \quad k \leq \lambda(a - \eta d) \right\} \tag{5}$$

where the price of output is normalized to 1. All entrepreneurs pay capital rental costs $(r+\delta)k$ and salaries wl as variable input costs, where I denote by δ the depreciation rate of capital. Importantly, in this baseline version, I abstract from any other type of production costs, including fixed ones.[37] Moreover, the differences in the profit maximization problem of individuals with and without college education are given by the different processes that characterize their idiosyncratic total entrepreneurial productivity ξ^i_{age}, and by the capital constraint, which varies according to the presence of student loans in the balance sheet of the households. There is no further source of heterogeneity by education in the production technology or in the input prices paid by entrepreneurs.

Occupation Choice: In each year during their working life and until retirement, agents decide their occupation o, based on their wealth a, idiosyncratic comparative advantage as entrepreneurs z, and on the amount of outstanding student debt d. Households choose to be either entrepreneurs ($entr$) or workers ($work$).[38] Entrepreneurs own a firm and earn business profits $\pi(a, z, d, age; r, w)$, while workers inelastically supply one unit of labor and receive an efficiency-units salary $\tilde{w}_{age}$, given by the general equilibrium wage w and scaled according to the their age-dependent efficiency profile: $\tilde{w}_{age} = e^{\ell^i_{age}} * w$. Recall that, in this baseline version of the model, I have assumed wages to be fully deterministic, while entrepreneurial profits have an uncertainty component.[39]

Since the net wealth entrepreneurs carry on to the next period is $a = k - b$, I rewrite the above borrowing constraint as:

$$k \leq \frac{1}{1-\phi}(a - \eta d) \quad \rightarrow \quad k \leq \lambda(a - \eta d)$$

where I denote by λ the borrowing multiplier given by $\frac{1}{1-\phi}$. For example, let us focus on the zero-credit-environment case in which $\lambda = 1$: what I am assuming is that, due to the risky nature of running a business, college-indebted entrepreneurs are required to keep a buffer to face the periodic repayment on student debt they owe to federal authorities.

[37] Including a fixed cost of operation as in Buera and Shin (2013) would strengthen selection into entrepreneurship, by introducing a non-convexity and making a given technology feasible only if operated above a minimum scale. Moreover, stochastic fixed costs that are realized at the end of any given period t would increase the risk associated with opening a firm. This would in turn affect entry patterns and amplify misallocation, but would not change the qualitative implications of the effect of student loans on entrepreneurial margins. I hence consider my baseline version to be a lower bound for the potential distortions created by student debt overhang on business entry and operations.

[38] I abstract from any inter-generational transmission of businesses because inheritances make up for only 4% of existing enterprises in the SCF over the three decades considered. This result from the SCF compares well to other surveys: for example, Kaplan and Rauh (2013) find that more than 80% of Forbes 400 businesses in 2011 were first-generation. Moreover, Hurst and Lusardi (2004) reports that 6.5% of business owners covered by the 1993 National Survey of Small Business Finances inherited their firm, while the analysis of the 1992 US Census survey on the Characteristics of Business Owners by Fairlie and Robb (2009) reveals that roughly 2% of owners inherit their business.

[39] In this respect, I follow typical assumptions in standard entrepreneurship models, such as those developed in Buera et al. (2011) and Midrigan and Xu (2014), who assume stochastic idiosyncratic productivity to matter only for entrepreneurs, and focus on the relative risk of opening a firm as opposed to be a worker. To stress the plausibility of this modeling choice, I use SCF data and further show in Figure A.3 that, while the average wage and profit of

3.2 Educational Period

Agents start their life with heterogeneous wealth a and heterogeneous idiosyncratic productivity z. The distribution of initial assets and productivity in the economy is stationary and denoted by $F(a, z)$, whose parametrization will be characterized quantitatively in the calibration exercise. Moreover, I assume that initial assets – interpreted as parental wealth – and individual productivity are correlated at birth, to reflect well-documented evidence on the inter-generational persistence of wealth and labor market outcomes in the US. Even though the model does not feature overlapping generations with altruism and/or paternalism, the relation of a and z at birth can be calibrated to deliver the correlation in earnings across generations reported in Chetty et al. (2014).

Young households have to make an education choice and decide whether to attend university or not. College entails a tuition χ, net of subsidies s funded by the government, which are both proportional to individuals' idiosyncratic productivity (i.e: *merit based*) and inversely related to individuals' wealth (i.e: *means-tested*),[40] as it will be further explained in the calibration exercise. College tuition can be paid also by contracting student debt, denoted by d, which is administered by the government.[41] Since applying for financial aid in the US is free and done on-line through the Free Application for Federal Student Aid (FAFSA) form,[42] I do not include costs for obtaining grants or federal loans. Note that young households are heterogeneous in their initial financial resources, and there are no markets to insure against being unable to pay for university. Since college is costly, education grants and debt therefore facilitate enrollment into higher education.

Since agents spend 4 years in college, corresponding to 1 stage in the model, I report the correct time conversion in the Appendix. To ease notation, here V^c and V^{nc} refer to agents' value function during youth – based on their education decision – while W^c and W^{nc} are the continuation values during their working stage. The maximization problem for agents that decide to go to college is:

$$\begin{aligned} V^c(a, z, age) = \max_{a', d_{edu}, c} & \left\{ u(c) + \beta\theta_{age} \int W^c(a', z', d', age') d\Xi(z'|z) \right\} \\ \text{s.t.} : & \; c + a' = (1+r)a - \chi + d_{edu} \\ \text{and} : & \; a' \geq 0, \quad c \geq 0, \quad 0 \leq d_{edu} \leq \underline{d} \end{aligned}$$

where $\underline{d}$ is the student debt borrowing limit, which will be pinned down numerically in the cal-

individuals tend to diverge over their life-cycle, measures of relative volatilities (and hence risk) stay the same.

[40] Nowadays, 80% of students with family income below 30K$ receive a Pell grant, and the award does not generally vary by college. Pell grants can fund enrollment at accredited institutions, including 2-years or part-time programs.

[41] In the US, 90% of college borrowers – worth 92.6% of the total value of student debt – receive loans from Federal Sources. The remaining 10% of the students who borrow for their degrees obtains credit from private lenders, which however have different borrowing conditions. For a perspective on this topic, see the study of Ionescu and Simpson (2016), who quantitatively assess the macro effects of the private market for student loans on college enrollment.

[42] After prospective students submit their FAFSA form, the US Department of Education computes the expected family contribution based on students' dependency status, family size and income. Then, the financial offices of universities put together aid packages for incoming students before the start of the term. Under the Federal Title IV Aid program established in 1965, financial aid is generally offered in the form of loans, grants and, sometimes, work-study plans.

ibration based on the average maximum amount of education loans granted for college.[43] Note that federal loans borrowing limits in the US are such that students cannot borrow up to the entire amount of the tuition, which means that $\underline{d} < \chi$. This is a source of social inefficiency in the model economy, as the private cost of higher education exceeds its social cost: in Section 6, I will analyze the gains that can be obtained by increasing borrowing limits and expanding grants provision.

Agents that do not go to college enter directly the labor market, make an occupational choice and decide whether to work for a salary or to become entrepreneurs and earn the net profits generated by their firm.[44] Their value function during youth, denoted by V^{nc}, is given by:

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

which accounts for the occupational choice made by non-college-educated individuals that decide to enter directly the labor market. More specifically, the problem for workers can be expressed as:

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

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:

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

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

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

namely to comparing the present and continuation value of getting or not a college degree. Note that the choice to attend university is made once in the model, without the possibility of dropping

[43] In the US, eligibility for federal student loans (except parent PLUS loans) is universal. Loan limits are more binding for undergraduate borrowers, while typically graduate students can borrow up to the entire cost of their program. More specifically, at the undergraduate level, loan limits vary across the first, the second and the third/fourth year in college, between two broad categories of family-dependency status and across types of loans (eg: direct subsidized vs direct unsubsidized loans). Since I abstract from dependency statuses or debt types and I model college as a one-period choice (i.e: no further graduate education is considered), I assume everyone face the same limit $\underline{d}$ on student loans.

[44] I am hence ruling out the possibility for work-study combinations while in college, especially due to the assumption of inelastic labor supply. Currently, 40% of full time students work during university, but the vast majority of them have part-time jobs that total at most 20 hours per week. On the contrary, full time workers in college tend to be both older and householders, and represent just 8% of the total (see `https://nces.ed.gov/programs/coe/indicator/ssa`).

out of college. While college dropout is certainly an important phenomenon to keep in mind for future extensions of the present paper, Abbott et al. (2019) already argue that it occurs far more often in freshman years and among part-time students. Here instead, I limit my focus to full-time students and college-completers, assuming full commitment to graduating from university.

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' assets, productivity, student debt and age and given by:

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

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

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

where $\mathcal{R}$ is the repayment function of student debt. Note that, in my baseline model, there is no element of uncertainty in the repayment of college borrowing: I will discuss in greater detail the introduction of income-based repayment plans and the implications of education loans bankruptcy in the quantitative section of the paper. In the Appendix, I also consider a modified version of the $\mathcal{R}$ function, which allows for periods of non-repayment through student debt forbearance.

During the repayment period, households with education loans have to pay a fixed amount of the original balance, where d_{edu} denotes the accumulated debt in stage 1 of their life. Moreover, they also need to pay an interest on the outstanding principal amount. Importantly, r^d is calculated including a wedge on top of the overall general equilibrium interest rate r, and it is not allowed to fluctuate over the life of the education loan, which reflects the fact that student debt interest rates have become fixed (as opposed to floating) since 2006.[45] I denote by T_{repay} the established repayment length, which is assumed to be the same for all borrowers, independently of their initial

[45]The interest rate is computed as a percentage of the unpaid principal amount, and it is set by Federal Laws based on the 10-year treasury note rate of a given year. For example, in 2021, subsidized and unsubsidized loans to undergraduate students carried roughly a 4% interest rate, unsubsidized loans to graduate students had a 5.5% interest rate and parent PLUS loans involved almost a 6.5% interest rate. Between 2006 and 2013, interest rates were much higher on average, oscillating between 5% for subsidized undergraduate loans and 8.5% for parent PLUS loans.

or current balances.[46] The law of motion of outstanding student debt is hence given by:

$$d' = (1 + r^d)d - \mathcal{R}$$

The value function of college-graduates that choose entrepreneurship can be characterized by:

$$\begin{aligned} W^{c,entrep}(a,z,d,age) = \max_{a',c} \Big\{ u(c) + \beta\theta_{age} \int W^c(a',z',d',age')d\Xi(z'|z) \Big\} \\ \text{s.t.} : c + a' = (1+r)a + (1-\tau)\pi(a,z,d,age;r,w) - \mathcal{R} \\ \text{and} : a' \geq 0, \quad c \geq 0, \\ \text{and} : k \leq \lambda(a - \eta d), \quad \mathcal{R} = \max\left\{ \frac{d_{edu}}{T_{repay}} + r^d d, 0 \right\} \end{aligned}$$

with college debt d' following the same law of motion outlined above.[47] Having defined the value functions of college graduates, one can clearly see the second important departure from social efficiency that is embedded in the model, namely that private returns to higher education are lower than their social counterpart. This is due to three main factors: first, the economy features incomplete markets, which introduce an element of uncertainty in the returns to educational investments, specifically with respect to entrepreneurial careers. Second, there are firm financial frictions that also depend on the presence and extent of student loans. Finally, distortionary taxation reduces the gains from obtaining a higher efficiency profile through college education. These elements will be also key to understand the effects of the policy reforms analysed in Section 6.

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

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

which accounts for the occupational choice made by non-college graduates. More specifically, the value function for working individuals without a university degree has the following form:

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

[46] To preserve tractability, an important simplifying assumption of my model is to rule out the possibility that agents make excess repayments on their loan to pay it off more quickly. However, looking at SCF data over the 1989-2019 period, roughly 25% of the student debt borrowers interviewed affirmed to be making payments ahead of schedule.

[47] Since agents choose the maximum value between becoming entrepreneurs or workers, the net salary $(1-\tau)\tilde{w}_{age}$ is to be considered as the minimum income they can dispose of with certainty in a given year. This feature of the model excludes the possibility of defaulting on the repayment of student debt, even when individuals have no savings.

The value function of non-college graduates that choose entrepreneurship is instead given by:

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

At the end of their working life, households retire. In T_{work}, the continuation value that characterizes agents problem is given by $U^c(a, z_{T_{work}}, age)$ and $U^{nc}(a, z_{T_{work}}, age)$, further explained below.

3.4 Retirement Period

Between $T_{work}+1$ and T_{end}, households make consumption and saving decisions as retirees. 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 earned in their last working period. Since agents differ in income profiles according to their education $i \in \{college, nocollege\}$ and entrepreneurial productivity z, pensions vary across individuals with and without a college degree, and are affected by the realization of z in $t = T_{work}$. Note that, both in the last year of their lives T_{end} and throughout their life-cycle, households leave any remaining assets upon death as bequest to the next cohort. This ensures that the wealth distribution of new generations remain stable and can be pinned down quantitatively. For households that attended college, the value function U^c to maximize during retirement is defined over their assets, last-working-period productivity, and age and given by:

$$U^c(a, z_{T_{work}}, age) = \max_{a',c} \{ u(c) + \beta\theta_{age} U^c(a', z_{T_{work}}, age') \}$$
$$\text{s.t.} \quad a' = (1+r)a - c + p^c \quad \text{and} \quad a' \geq 0, \quad c \geq 0$$

For households that did not attend college, the value function U^{nc} to maximize is defined over agents' assets, last-working-period productivity, and age and can be characterized as follows:

$$U^{nc}(a, z_{T_{work}}, age) = \max_{a',c} \{ u(c) + \beta\theta_{age} U^{nc}(a', z_{T_{work}}, age') \}$$
$$\text{s.t.} \quad a' = (1+r)a - c + p^{nc} \quad \text{and} \quad a' \geq 0, \quad c \geq 0$$

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 education side, the government issues student loans and holds in place grants schemes to foster enrollment in college, especially for low-income households. While both the pension rate and the extent of the grant scheme are calibrated quantitatively to match

their empirical counterparts, the tax rate τ is a general equilibrium outcome and has to clear 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:

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

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

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

$$\int_{o_t(a,z)=entr} k_t dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=entr} k_t dH_t^{c}(a,z,d) = \int a_t dH_t^{nc}(a,z) + \int a_t dH_t^{c}(a,z,d)$$

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

$$\int_{o_t(a,z)=entr} l_t dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=entr} l_t dH_t^{c}(a,z,d) = \int_{o_t(a,z)=work} dH_t^{nc}(a,z) + \int_{o_t(a,z,d)=work} dH_t^{c}(a,z,d)$$

with total output Y_t given by:

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

3. The budget constraint of the government clears, as outlined in Section 3.5.

4. The sum of incidental bequests (by non-surviving individuals) and bequests by the oldest generation alive in T_{end} covers the sum of the assets of the new generation of young adults:

$$\int (1-\theta_t) a_t dH_t^{nc}(a,z) + \int (1-\theta_t) a_t dH_t^{c}(a,z,d) +$$
$$b * \int (a_{T_{end}} dH_{T_{end}}^{nc}(a,z) + a_{T_{end}} dH_{T_{end}}^{c}(a,z)) = \int a_{T_{edu}} dH_{T_{edu}}(a,z,d)$$

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 begin by estimating the model on the US economy using various sources of data, and 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 the extensive and intensive margins of entrepreneurship, and study how the rise in college tuition and premium has affected the increase in student debt and the decline in entrepreneurial rates of college graduates 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 of the data. The reference period in the model is a year: agents that decide to attend college spend 4 years in university (i.e: $T_{edu} = 23$), then all individuals are active on the labor markets for 40 years more and retire at the age of 63 (i.e: $T_{work} = 63$), potentially living for 25 additional years in retirement (i.e: $T_{end} = 88$). Note that survival probabilities are set to reflect survival rates and life-expectancy for the US.[48] Of the 22 parameters I need to estimate, 9 are fixed outside of the model and summarized in Table 8. As standard, I use the coefficient of risk aversion $\gamma = 2$, the capital share $\alpha = 0.36$, and the yearly depreciation rate $\delta = 0.1$.[49] Secondly, I set the pension replacement rate in the model economy to be on average 50% of households' income in their last working period,[50] which is close to the one reported by De Nardi et al. (2020).

Furthermore, I set the length of the student loan repayment term to $T_{repay} = 15$, because, before 2010, almost the totality of college borrowers were enrolled in 10-years fixed repayment plans, which often extended to 20 years (see Abbott et al. (2019) and Daruich (2018) for a similar strategy). Plans that are instead tied to the income of individuals have been recently growing, but represent only 10-15% of the repayment programs subscribed in the last decade. I will nonetheless

[48] I directly take estimates from: `https://benjaminmoll.com/wp-content/uploads/2021/04/STEG_course.pdf`
[49] Commonly used values for δ range from 0.06, as in Buera and Shin (2013), to 0.1, as in Clementi and Palazzo (2016).
[50] `https://data.oecd.org/pension/net-pension-replacement-rates.htm`

Table 8: Externally Fixed Parameters

Fixed	Value	Description
γ	2	Risk aversion
α	0.36	Share of capital in production
δ	0.10	Capital depreciation rate
p	0.50	Pension replacement rate
T_{repay}	15	Student loan repayment term
r^d	0.05	Interest rate on student loans
$\underline{d}$	\$9,800	Borrowing limit on student loans
s	\$5,625	College grant(s)
θ	(see text)	Survival probabilities

explore more in depth the difference between fixed and income-based repayment plans and their implication for workers and entrepreneurs in the next section. It is also important to mention that I calibrate several education-related parameters – r^d, $\underline{d}$, s – to reflect the current legislation on student loans and to follow common strategies already adopted in this literature, but their final values also depend on other internally fitted parameters, as it is explained in further detail below.

In particular, as in Abbott et al. (2019), I allow the scholarship term s to have two components, denoted by s_1 and s_2. The former is need-based and hence depends on individuals' financial resources, while the latter is proportional to students' merit. In particular, I assume the first grant to be inversely related to initial wealth and given by: $s_1 = \phi_1 a^{-\psi_1}$, while the second one to increase with individuals' initial productivity according to: $s_2 = \phi_2 z$. Overall, the parameters ϕ_1 and ϕ_2 are calibrated so that scholarships cover respectively 15% and 10% of the average financial need of incoming students (shares are computed taking into consideration the mean amount awarded per student and the average share of students receiving it).[51,52] Furthermore, to replicate the progressivity of need-based programs – governed by the parameter ψ_1 in the model – I target the (negative) correlation between grant aid received and students' family income bracket.[53]

Table 9 reports all the other internally fitted parameters, which I proceed to discuss. First, I pick $\beta = 0.98$ to match an average annual interest rate for the US economy of $r = 4\%$.[54] I then set the wedge between r and the interest rate on student debt such that $r^d = 0.05$, in line with the average interest rate on education loans prevailing in the last decade.[55] The college tuition parameter χ is instead calibrated to replicate the share of the adult population with a college degree, which is

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

[52] `https://www.usnews.com/education/best-colleges/paying-for-college`

[53] See the information reported for the 2015/2016 cohort at `https://professionals.collegeboard.org/pdf/trends-spotlight-family-income-net-price.pdf`. Abbott et al. (2019) adopt a similar strategy and target the progressivity in means-tested grants considering, however, data for the fiscal year 1999/2000.

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

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

considered to be around 35% over the last 10 years.[56,57] The estimated value $\chi = 1.25$ amounts to almost 30% of the median yearly income in the model (roughly \$25,000), consistent with recent US data on college costs and households' income. Accordingly, the lower bound on student loans $\underline{d}$ is set to over a third of the average yearly tuition for a 4-years college degree. Since I abstract from graduate studies, I compute an average of the maximum amount of education loans granted for undergraduate degrees across dependent and independent students, considering both subsidized and unsubsidized federal loans, which corresponds to almost \$10,000 per year.[58]

Table 9: Internally Fitted Parameters

Fitted	Value	Description	Moment	Model	Data
β	0.98	Discount factor	Interest rate	0.04	0.04
χ	1.25	College tuition	Educational rate	0.37	0.35
σ_a	3.50	Dispersion initial wealth	Top10 wealth share	0.69	0.70
ρ_{az}	0.25	Correlation initial (a, z)	Inter-generational earnings	0.31	0.28
ν	0.78	Span of control	Top10 income share	0.45	0.45
σ_ϵ	0.305	St deviation prod shocks	Top25 employment share	0.63	0.65
ρ_z	0.92	Persistence entrep prod	Serial correlation revenues	0.84	0.80
λ	3.00	Financial constraint 1	Avg. corporate debt/GDP	0.30	0.35
η	0.15	Financial constraint 2	Δ Entr rates w/ – w/o Sloans	5pp	5pp
ζ_1^c	0.0573	Trend income growth (college)	Income growth year 0 - 30	0.84	0.86
ζ_2^c	0.0012	Curv. income growth (college)	Income growth year 30 - 40	0.07	0.05
ζ_1^{nc}	0.031	Trend income growth (no coll)	Income growth year 0 - 30	0.48	0.48
ζ_2^{nc}	0.0004	Curv. income growth (no coll)	Income growth year 30 - 40	0.08	0.10

I also need to assign values to the parameters that define the initial distribution of wealth across the population and the correlation between initial assets and productivity upon birth. Assuming that the distribution of assets follows a log-normal shape, I normalize the mean to 1 and set the dispersion σ_a to match the fat right tail of the US wealth distribution, following recent estimates by Zucman (2019). Since the wealth agents are endowed with in period 1 influences college enrollment and the amount of student debt they choose, I check that the correlation between initial a and d in the model mimics the correlation between family contributions and student loans reported in Folch and Mazzone (2020).[59] Moreover, I calibrate the correlation between assets a and productivity z upon birth – denoted by ρ_{az} – to match the inter-generational persistence in

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

[57] The average tuition for 4 year degree is currently around \$112K, with the average debt at graduation being \$35K.

[58] See `https://studentaid.gov/understand-aid/types/loans/subsidized-unsubsidized`.

[59] Using US individual-level data from the Baccalaureate and Beyond Longitudinal Study, Folch and Mazzone (2020) report a correlation of 0.15 between family contributions and education loans. I compute a similarly moment in my model, and show that the correlation between initial wealth and the amount of student debt at graduation is 0.1391.

earnings documented by Chetty et al. (2014) for the US economy.[60] Since my model does not feature households' dynasties, I instead compute the correlation between individuals' average (log) income over the life-cycle and their initial (log) assets, which can be interpreted as parental wealth.

Secondly, the span of control parameter is fitted such that the income share of the top 10% 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 entrepreneurs, who are likely to belong to the top deciles of the earnings distribution. In that, I follow an extensive literature on income and wealth concentration in the US (see Batty et al. (2019) and Zucman (2019) for example), which shows that the top 10% richest Americans make up for almost 45% of aggregate earnings in the economy. My estimated value for the span of control parameter $1-\nu = 0.78$ is close to the ones obtained by several other papers on US entrepreneurship.[61] As a robustness check, I can alternatively calibrate $1-\nu$ to match the share of entrepreneurial wealth in aggregate wealth,[62] 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, computed using the 1980-2019 Business Dynamics Statistics dataset. A bigger σ_ϵ implies greater dispersion in the productivity process (by means of thicker tails in the distribution) and hence higher employment generation by large businesses.[63] My calibrated value $\sigma_\epsilon = 0.305$ is in line with the range of US estimates provided by Lee and Mukoyama (2015). In addition, I use a standard measure for the average serial correlation of revenues across US firms to identify the persistence ρ_z of the idiosyncratic entrepreneurial productivity process.[64]

Next, to calibrate the parameter λ, which governs the extent of firms' borrowing constraints, I match the average US non-financial corporate debt over GDP.[65] I focus on non-financial corporate debt because other measures of total (country's) debt merge together household and corporate liabilities, and hence cannot be mapped correctly into my theoretical framework.[66] In addition, I use the relative percentage points (p.p) difference in entrepreneurial rates across college-graduate entrepreneurs with and without education loans to discipline the parameter η, which affects by how much outstanding student debt balances reduce the collateral that can be pledged by entrepreneurs on financial markets. (Unconditional) entrepreneurial rates for university-educated

[60] A similar strategy is used in Daruich and Kozlowski (2020) to discipline inter-generational human capital.

[61] Values for the US typically range from 0.78 (see Buera and Shin (2013)) to 0.88 (see Cagetti and De Nardi (2006)).

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

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

[64] 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 $\rho_z = 0.92$ is similar to the one used by papers in this field such as Lee and Mukoyama (2015).

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

[66] To pin down λ, I do not use SCF due to the lack of a proper variable capturing firm liabilities, which makes it difficult to compute debt-to-sales ratios. SCF only reports personal or family assets used as collateral for business purposes, and the mean ratio of collateralized assets to gross sales is between 0.60 and 0.70, with the median between 0.15 and 0.20. Due to this particular skewness, I would otherwise attribute too much weight to extremely high ratios. As an alternative, one can instead use Compustat, which covers publicly listed US firms between 1980 and 2016. The ratio of current liabilities to revenues is on average 0.41, in line with estimates from FRED data. Moreover, Morazzoni and Sy (2021) document a similar debt-to-sales ratio for a sample of US startups using the Kauffman Firm Survey.

individuals with and without student loans are computed using SCF data for the last decade.

Finally, I have to calibrate 4 parameters related to the deterministic efficiency profile of agents with and without college over their life-cycle. Using SCF data, I set the values of ζ_1^c and ζ_1^{nc} to mimic the growth in the income profiles of US households with and without university degrees in the first 30 years of their working career. I then pin down ζ_2^c and ζ_2^{nc} targeting again the average growth in individuals' income profiles, but focusing instead on the last 10 years of their working life. The moments I compute for this final step of the calibration are close to those reported in Lagakos et al. (2018) across different sources of US data.[67] As shown in Table 9, the estimated values for ζ_1^c, ζ_1^{nc}, ζ_2^c and ζ_2^{nc} reflect the fact that income growth is faster at the beginning of the life-cycle of individuals, and instead slows down progressively as agents move towards retirement.

As a concluding remark to this subsection, it is relevant to mention that the tax rate τ pinned down in GE to balance government expenditures and revenues in the model economy is 0.2.[68] Moreover, the fraction of assets bequested by individuals upon their death, denoted by b, is such that the bequests of the last generation alive in T_{end} and the accidental bequests left by those who die before T_{end} cover the sum of the assets of newly-born cohorts.[69] This ensures that the new generations of young households in the model have all the same initial distribution of wealth.

4.2 Model Validation in the Cross-Section

In what follows, I discuss the quantitative fit of the model with respect to numerous dimensions of the SCF data that were not targeted during the calibration. First, I correctly predict that the share of borrowers among all college students is around 60%, as reported in recent US estimates. Secondly, the model replicates not only the general level of entrepreneurial activity in the economy, but also the relative composition of the entrepreneurial sample. It is important to stress that my estimation has only targeted the average share of educated individuals and the relative p.p. difference in entrepreneurial rates across college-educated entrepreneurs with and without student debt. The quantified model can instead match – as untargeted moments – the average US business ownership rate for the last decade,[70] as well as the average entrepreneurial rates of individuals with and without college. I also fit the fraction of entrepreneurs with and without student loans and without a college degree. For a comparison, Table 10 reports the moments computed in

[67] The values for ζ_1^c, ζ_1^{nc}, ζ_2^c and ζ_2^{nc} are consistent with the elasticities of salaries to age estimated by Daruich (2018), who documents the presence of a steeper wage-profile for college vs non-college graduates using PSID data for the US.

[68] In the US, it is estimated that the average net income tax of single and married workers is 22% and 7% respectively, in line with the value I find in GE (see `https://www.oecd.org/unitedstates/taxing-wages-united-states.pdf`).

[69] Since death may occur before T_{end}, the total sum of resources bequested in the economy corresponds to voluntary and accidental bequests. Voluntary bequests are precisely the calibrated share b of $a_{T_{end}}$ for those living till T_{end}, while accidental bequests are the assets accumulated by agents till the year $t < T_{end}$ in which they accidentally die.

[70] The average share of business owners in the 1989-2019 SCF sample is 0.13, down to 0.10 considering the last decade only. Self-employment rates are slightly higher for the same periods (0.14 and 0.12 respectively). Note that I am considering averages for individuals that are active in the labor force. Considering all survey respondents and hence computing population averages leads to an average entrepreneurial rate of 0.07. Similar statistics are reported by other sources, such as the OECD (see `https://data.oecd.org/entrepreneur/self-employed-with-employees.htm`).

the model simulation and the ones documented empirically using the last 10 years of SCF data.

Table 10: Untargeted Moments

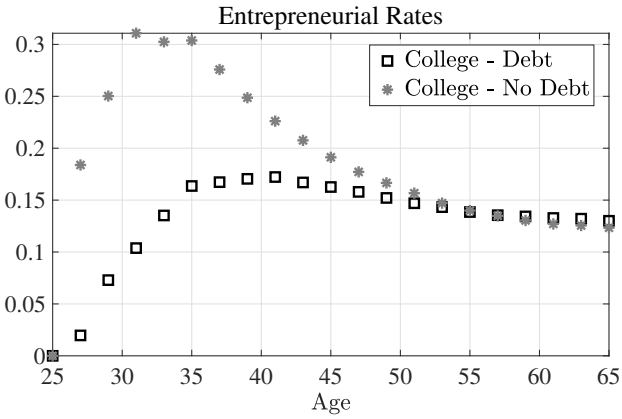
	Model	**Data**
Entrepreneurship & Education		
Share of Student Borrowers	0.55	0.60
Average Entrepreneurial Rate	0.12	0.10
Average Entrepreneurial Rate College	0.15	0.14
Average Entrepreneurial Rate Non-College	0.10	0.08
Share of Entrepreneurs with Student Debt	0.11	0.15
Share of Entrepreneurs without Student Debt	0.37	0.44
Share of Entrepreneurs without College	0.52	0.41
Model-Implied Elasticities		
Business Size (in Employees) to Student Loans	-0.641	-0.859
Business Profits to Student Loans	-0.210	-0.082
Business Sales to Student Loans	-0.169	-0.098

Considering households with a college degree and taking a life-cycle perspective, I can analyse several differences in entrepreneurial outcomes across graduates with and without education loans. In the data, having attended university predicts higher chances of becoming entrepreneurs: such association is typically attributed to higher human capital accumulation by college graduates, strong complementarities between education and labor market experience, and peer effects.[71] Similarly, in my model economy, having a university degree is positively related to undertaking entrepreneurship, due to the fact that college graduates face a higher deterministic efficiency profile throughout their life-cycle, regardless of their occupation. However, the repayment of student loans slow down the accumulation of wealth, while outstanding college debt balances lower the amount of collateral that can be pledged by entrepreneurs when renting capital on financial markets. The combination of these mechanisms can replicate the empirically estimated heterogeneities in the entrepreneurial rates of college graduates with and without education loans, as reported in Table 10. Before the debt is fully repaid, college borrowing discourages or delays entry into entrepreneurship, and, as shown in Figure 3, student borrowers see a catch up in business ownership rates between 15 and 20 years after completing college compared to graduates without loans.[72]

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

[72] The deterministic growth in individuals' efficiency profile is also responsible for the growth in entrepreneurial rates over agents' life-cycle. 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 0.0027 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.

Figure 3: Extensive Margin



Keeping the focus on college-educated business owners, my model also predicts that firms of individuals with college loans are smaller than those of owners without student debt, and can secure less external funding. Considering the number of workers employed and the total sales or profits generated, I can match between 30 and 80% of the differences across entrepreneurs with and without student debt. In particular, Table 10 collects the empirically estimated elasticities of business profits, sales and size to the amount of student debt owed by entrepreneurs.[73] Exploiting my calibrated model, I run equivalent regressions using a simulated panel of 50,000 households. A 1% increase in the amount of student debt owed decreases business profits and sales by 21% and 17% in the model, compared to the 8% and 10% elasticities computed empirically. Moreover, a 1% increase in the amount of student debt owed leads entrepreneurs in the model to hire on average 0.64 employees less, similarly to the 0.84 coefficient that has been estimated in SCF data.[74]

As a consequence of the tighter collateral frictions they face, I observe a stricter selection into entrepreneurship by college graduates with student loans. To exemplify this point, I compute the average product of capital (hereafter *arpk*) as the ratio between output and capital for entrepreneurs in the model. The *arpk* is an indicator for how capital is allocated across productive units because, absent distortions, capital should flow similarly to entrepreneurs with and without student loans, ensuring no heterogeneity in *arpk* across firms (see Hsieh and Klenow (2009)). Yet, student loans decrease the collateral that can be pledged on financial markets, which constitutes a barrier to the optimal allocation of capital across units that are more productive. Consistent with that, indebted college graduates that operate a firm have a 6% higher *arpk*, controlling for owners' assets. While I cannot compare such model-implied elasticity to any empirical counterpart due to

[73] For the comparison with the model, I estimate again the regressions of Section 2 in the 2009-2019 SCF sample controlling for age, assets and education (and business size when the outcome variable is either sales or profits). I net out survey year FE to control for heterogeneous economic conditions across the different years in the sample, as well as demographic characteristics that I do not explicitly model theoretically, such as gender, ethnicity and marital status.

[74] Model regressions on the simulated panel of households moderately overestimate the elasticities of business outcomes to student loans computed on SCF data for the last decade. A possible explanation for this result is that the model overpredicts by a third the average amount of college borrowing with which individuals graduate. Due to the non-linearities present in the model, this may imply relative higher barriers to entrepreneurship compared to the data.

the lack of data on capital in the SCF, this quantitative result implies that my calibrated economy features capital misallocation across firms run by entrepreneurs with and without student loans.

To further explore the extent of the entrepreneurial distortions generated by outstanding college debt, I analyse a counterfactual scenario in which I eliminate the difference in firm borrowing constraints across individuals with and without student loans. In practice, I set the parameter η to 0, recompute the equilibrium outcomes, and then compare the subsequent results to the baseline economy. First, whenever college debt does not contribute to tightening entrepreneurial financial frictions, the share of student borrowers increases by 1 p.p., and the average amount of debt taken for college scales up by 7%.[75] Second, indebted college graduates can leverage by more their own wealth in order to rent capital for business purposes whenever $\eta = 0$. As a result, their capital-to-labor ratio and entrepreneurial output increase by 4.96% and 5.39% respectively. Moreover, due to the improved allocative efficiency, aggregate production in the economy increases by 2.11%.

Table 11: No Difference in Entrepreneurial Constraints With and Without Student Loans

	Output (w/ Student Debt)	Business Debt (w/ Student Debt)	$\frac{\text{Capital}}{\text{Labor}}$ (w/ Student Debt)	Output Aggregate
Change wrt Baseline	+5.39%	+3.75%	+4.96%	+2.11%

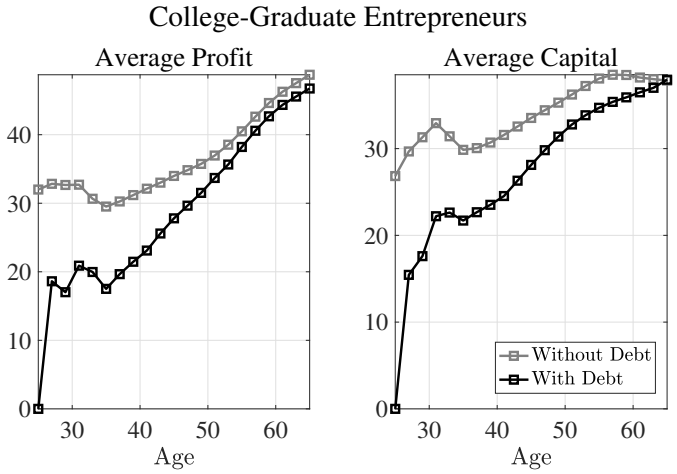
As a final remark note that, in the model economy as in the data, entrepreneurial performance changes with individuals' age, due to assets accumulation and to the deterministic growth in agents' efficiency profiles. As a consequence of that, the gap in the average profit or capital between college-educated entrepreneurs with and without student debt decreases over time, especially after indebted households finish paying off their loans (i.e: 15 years after graduating college). However, since overcoming firm financial frictions through savings takes time, the gap in the average capital rented by college graduates with or without loans is wider and persists for relatively longer compared to other dimensions of business performance, as reported in Figure 4.

4.3 The Rise in Student Loans and the Decline in Entrepreneurship

In what follows, I use the calibrated model to analyse the rise in student loans and the drop in the business ownership rate of college graduates over the last three decades. As documented by several previous contributions, US entrepreneurial rates and dynamism have steeply declined over the past 30 years (see Decker et al. (2014) for example). Using different household-level surveys, Jiang and Sohail (2017), Kozeniauskas (2018) and Salgado (2020) have also recently shown that the drop seems to have been bigger for college graduates, a phenomenon referred to as the "skill-biased entrepreneurial decline". Possible explanations for such a steeper decline in entrepreneur-

[75] The college attainment rate goes up by only 0.3 p.p. in this counterfactual economy. This suggests that, if college borrowing was not to influence entrepreneurial financial frictions, agents that choose to study would borrow more, but the increase at the borrowing margin would be relatively bigger than the increase in college enrollment itself.

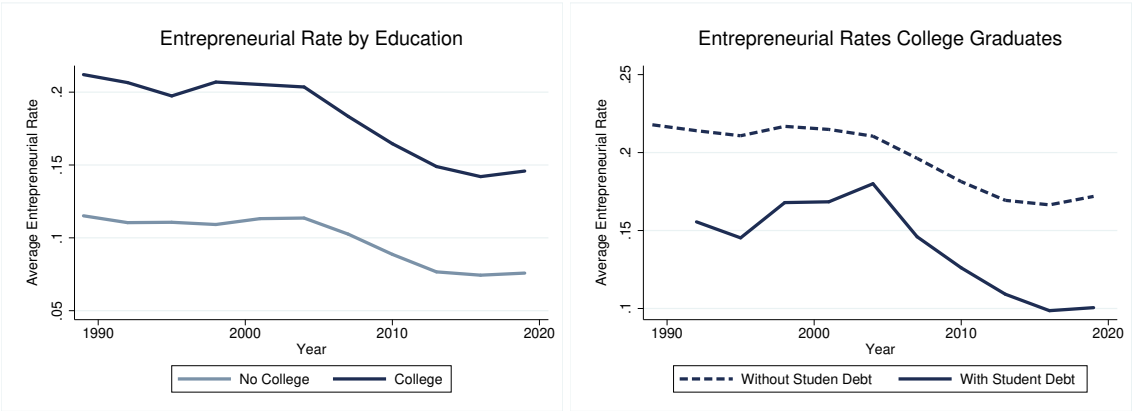
Figure 4: Intensive Margin



ship for college graduates range from the advent of a skill-biased technological change to the steady fall in the price of capital, which may have decreased skilled entrepreneurship if one assumes capital and skilled labor to be complementary in production. Both channels could have increased the ratio of wages relative to entrepreneurial returns, pushing highly-skilled agents at the margin to select out of entrepreneurship. Parallel to that, rising entry costs and outsized productivity gains by large non-entrepreneurial firms could also be responsible for part of the decline in the business ownership rate of more educated people, as observed in Kozeniauskas (2018).

In addition to the previously discussed evidence and reasoning, Figure 5 further suggests that, among highly-educated individuals, the decline in entrepreneurship over the recent years has been even steeper for college graduates with student loans. Could then the rise in student debt and the fall in entrepreneurship – especially for skilled individuals – be related, and, if so, how could their co-movement be rationalized through the lens of the model developed in Section 3?

Figure 5: Entrepreneurial Rates Over Time



A prolific literature on entrepreneurial dynamism has already investigated various potential explanations for the drop in US firm ownership rates over time. It is beyond the scope of this

section to offer an exhaustive review of previous works, and the goal of the model is not to account for all the proposed channels at once and disentangle their relative explanatory power. Based on the analysis done so far on the tighter constraints faced by firm owners with education loans, I rather aim to shed light on an alternative mechanism that could link the decline in the entrepreneurial rates of college graduates and the increase in student debt. To this end, I first observe that there are at least two important trends related to the growth in education loans over the past decades, namely the rise both in the college premium and in the tuition for college. As extensively documented in Goldin and Katz (2010), Heathcote et al. (2010) and Doepke and Gaetani (2020) for example, the gap in average salaries between college and non-college graduates has widened 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.[76] Moreover, the average price to attend either public or private universities has more than doubled since the 1980s,[77] growing faster than US inflation.[78]

Connecting together these trends, increasing returns to higher education might have boosted the demand and hence the price for college. While recent research has shown the impact of other demand factors – such as expansions in federal student aid and rising parental transfers – on college prices (see Gordon and Hedlund (2020)), several papers have specifically related the rise in university tuition to the increase in the college premium (see Jones and Yang (2016) and Fortin (2006)). Parallel to that, higher university prices have been held responsible for the soar in student debt (see Kim and Kim (2022)). In the exercise that follows, I link the expansion of student loans to the increase in the cost to attend university plausibly engineered by the rise of the college wage premium. Since, in my model, student loans affect disproportionately individuals that become entrepreneurs – especially due to the tighter financial constraints they imply – I explore what is the effect of carrying a higher student debt burden on different entrepreneurial margins.

I estimate the model to the US economy of the late 80's, using available data to inform the main parameters already summarized in Table 8 and Table 9 for the baseline economy. I then keep everything fixed and target the following adjustments: a (i) 20% growth in the college premium, induced by a 15% increase in the parameter governing the life-cycle profile of college graduates' efficiency ζ_1^c;[79] and a (ii) rise of 16 p.p. in the college attainment rate, which is accompanied by a 180% hike in the tuition for college captured by the parameter χ.[80] The former adjustment stimulates college enrollment through higher returns to education, while the latter ensures to deliver the

[76] 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.

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

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

[79] Note that the increase in ζ_1^c brings about an increase in the life-cycle profile of efficiency for both entrepreneurs and workers: this is consistent with evidence from Michelacci and Schivardi (2020) showing that the college premium seems to have increased similarly for both entrepreneurs and workers in the US over the last decades.

[80] I consider changes in the average tuition from the late 80's till today, using constant 2019-2020 dollars, as reported by the US Department of Education at `https://nces.ed.gov/programs/digest/d20/tables/dt20_330.10.asp`.

average share of adults with a college degree in the US for the last decade, which is around 35%, as discussed in the strategy for the baseline calibration. I solve and simulate the economies of the late 80's and today: through the comparison of these two steady states, I can quantify the changes in entrepreneurial rates and outcomes attributable to the increase in college demand, college prices and student debt over time. Results for this counterfactual exercise are shown in Table 12.

Table 12: Changes between the late 1980s and Today

	Data	Model
Targeted		
College Premium	+ 20.0%	+ 20.0%
College Attainment	+ 16 p.p	+ 16 p.p.
Untargeted		
Total Student Debt	+ 788.90%	+ 689.50%
Share of Student Borrowers	+ 30.0 p.p.	+ 35.9 p.p.
Entrepreneurial Rate Overall	- 4.25 p.p.	- 0.50 p.p.
Entrepreneurial Rate College Graduates With Loans	- 5.47 p.p.	- 1.82 p.p.

Raising the college premium and the price to attend university leads to a consistent increase in the share of college graduates and, importantly, in the share of student borrowers. From the late 80's to today, the fraction of individuals taking up loans to finance their degree has gone up by roughly 30 p.p. in the data, compared to an increase of 35.9 p.p. in my counterfactual exercise. Computing the total amount of education loans in the two steady states, it is clear that the size of student debt in the economy has grown almost sevenfold, and this result lines up well with estimates from the Congressional Budget Office of the US Government.[81] The model can then match 1/10 of the decline in entrepreneurial rates for the overall population since the 1980s, and 1/3 of the drop in entrepreneurial rates for college graduates with loans over the same period.

As expected, the rise in student debt engineered by soaring college demand and prices can explain a rather small share of the overall decline in entrepreneurial dynamism, suggesting that many more forces are indeed at play in the data and can in fact rationalize the drop in firm ownership rates for both college and non-college graduates, as argued for example in Decker et al. (2014). Yet, the increase in education debt and in the share of student borrowers might have played a much more important role in determining the fall in entrepreneurial dynamism for indebted highly-educated individuals over the last decades. In this, my findings complement the results in Salgado (2020) and Jiang and Sohail (2017), who focus on the relationship between the growth in the skill premium and the skill-biased entrepreneurial decline. Specifically, in the pres-

[81] https://www.cbo.gov/publication/56754.

ence of firm collateral constraints that depend on entrepreneurial pledgeable assets and are hence tightened by outstanding education loans, I highlight the role of higher college tuition and student debt in depressing business ownership rates, especially for indebted highly-skilled individuals.

5 Bankruptcy Availability

A cornerstone of US consumer credit markets are personal bankruptcy laws, which can provide loan discharge to distressed debtors under specific procedures.[82] Unlike other forms of consumer debt, student loans have become almost completely non-dischargeable in bankruptcy since 1998.[83] Exceptions regard individuals that join the public sector or the army, people affected by disabilities and debtors who can prove *undue hardships*. However, less than 0.001% of borrowers meet these standards and succeed in filing for bankruptcy (see Iuliano (2012)), while roughly 10% of outstanding student debt is currently in default.[84] As discussed by Yannelis (2016), policy makers are actively debating about re-allowing education loans discharge, and the White House has discussed reintroducing bankruptcy protections for student debt holders both in 2015 and 2018. From a macroeconomic point of view, the work by Ionescu (2011) has stressed the need to quantitatively study different bankruptcy regimes in the student loan market, and understand their implications for repayment incentives, human capital investment and aggregate welfare.

Why the availability of education loans bankruptcy could matter for entrepreneurship? Krishnan and Wang (2019) argue that student debt can reduce individuals' "tolerance for risk", including their propensity to open and run a business. By making bankruptcy unavailable, the 1998 reform could have increased the aversion of indebted college graduates to undertake entrepreneurial projects. But several other mechanisms may also apply. Before the reform took place, education loans were a type of unsecured debt that was easier to default upon, particularly if agents were facing financial hardships (see Yannelis (2016)). Student debt discharge might have then ensured households a "fresh start", especially because, in the US, credit risk scores are known to recover faster for bankrupt individuals compared to those remaining insolvent (see Albanesi and Nosal (2018)). According instead to the current legislation, borrowers who cannot repay or consolidate their education loans see their wages, income tax refunds or social security contributions garnished, and cannot abide to their student debt obligations or dismiss their outstanding balances.

Leveraging the fact that, before the 1998 Higher Education Act, student loans were dischargeable in bankruptcy after seven years in repayment, I analyse the impact of this reform on entrepreneurship in two steps. First, I establish a link between the 1998 bankruptcy reform and the outstanding student debt balances of individuals surveyed in the SCF up to a decade after. Since I

[82] In 1934, US Supreme Court stated that bankruptcy "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".

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

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

have information on the repayment year in which they were at the time of the 1998 reform,[85] I am able to further distinguish respondents who had or had not access to education loans bankruptcy. Then, an RDD allows me to study the effect of outstanding student debt balances on entrepreneurship across cohorts who started repaying their education loans right before or after 1991.[86]

Secondly, I use the model from Section 3 to estimate the macroeconomic impact of the 1998 bankruptcy reform on individuals' entrepreneurial margins over the life-cycle, as well as on capital misallocation and aggregate US output. The goal is to replicate, in my calibrated framework, the key elasticity of business ownership to outstanding student debt that can be empirically estimated in the SCF data. Note that, in the model, outstanding loans affect firm outcomes mainly because of the borrowing constraint, which can be made less binding by the dismiss of student debt through bankruptcy. Then, analysing the partial equilibrium (PE) response of entrepreneurship to education loans discharge serves as a counterfactual and further validation of the quantitative fit of the model, particularly with respect to the parameter η, which captures the severity of the financial constraint imposed by outstanding student debt on college-educated entrepreneurs.

5.1 The 1998 Reform to Student Debt Bankruptcy

Before 1998, borrowers could discharge their student debt in bankruptcy after 7 years into repayment. The advent of the bankruptcy reform is not a pure randomized treatment, but yet a plausible source of exogenous variation in the repayment options and hence in the amount of student debt owed by affected individuals early in their career. The discontinuity in the availability of student loan bankruptcy by repayment year when the 1998 reform stroke can be exploited to estimate the impact of outstanding student debt on entrepreneurship through an RDD. As argued in previous paragraphs, there are several channels that could rationalize a potential effect of student debt bankruptcy on entrepreneurial margins. What is key to highlight is that the effect of loans discharge should first be reflected in a jump in the amount of student debt owed after the 7th repayment year for individuals who had the option to declare bankruptcy. Then, through the lens of the model introduced in Section 3, lowering outstanding student debt balances could subsequently impact entrepreneurial financial constraints and the choice to become an entrepreneur.

As a first step, I focus on the amount of outstanding student debt reported at the time of the survey interview by individuals that started repaying their loans at most 10 years before the 1998 bankruptcy reform was enacted. In the regression that follows, I control for the amount of debt agents graduated with and for the repayment year they were in by 1998 to account for the extent of initial loan balances and cohort effects. I also include as regressors households' demographics,

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

[86] Through an OLS model, Krishnan and Wang (2019) find that individuals that graduated college after 1998 and took out student loans have a lower likelihood of becoming entrepreneurs. However, the bankruptcy reform also applied to graduates from previous cohorts, who graduated before 1998 but had not reached the 7th year of repayment. This motivates my different empirical strategy through an RDD based on the repayment year individuals were by 1998.

such as gender, ethnicity, marital and home-ownership status, as well as their income category by age and educational group as of the year in which they are interviewed. Focusing on the 10-years period after the introduction of the bankruptcy reform, Table B21 shows that agents that did not reach the 7th repayment year by 1998 are associated with higher outstanding student debt.

Having established some suggestive evidence on the relationship between bankruptcy availability and households' outstanding student debt balances, it is possible to investigate further the association between the 1998 reform and entrepreneurship itself. To begin with and as illustrated in Table B22, being past the 7th repayment year has a strong positive effect on the likelihood of becoming an entrepreneur for cohorts entering repayment before 1991, while it seems not to matter at all after 1991. It is important to stress that almost the totality of student debt repayment plans in the 1990s had a duration of 10 years. Accordingly, one should expect agents to have exercised the option to declare student debt bankruptcy right after reaching the 7th year into repayment, which is then the relevant cutoff to look at, as confirmed in the last 3 columns of Table B23. As such, I exploit the discontinuity in the availability of bankruptcy represented by the 7th year into repayment at the time of the 1998 reform to estimate the differential likelihood of becoming entrepreneurs for cohorts who started repaying before 1991, compared those who started at some given point between 1992 and 1997. I first run the following parametric probit regression:

$$Pr(BusOwner_{it} = 1) = F\left(\beta_0 + \beta_1 SubjectReform_i + \beta_2 \Delta_i^{cutoff} + \boldsymbol{\gamma}' \boldsymbol{\Phi}_{it} + \alpha_t + \varepsilon_{it}\right) \tag{9}$$

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 $SubjectReform_i$ is an indicator that takes a value of 1 if the respondent 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. Covariates and fixed effects are as in Equation 12. Results are shown below in Table 13 for different choices and combinations of bandwidths and control variables. Agents below the 7th repayment year cutoff by the time the reform was enacted are less likely to turn entrepreneurs later on in their life. This is true across different specifications: as reported in Table 13, widening the bandwidth around the 7th repayment year cutoff implies using more observations, which decreases the standard errors but can make the comparison across the treated and non-treated groups less accurate. The estimated β_1 coefficients range from -0.0568 to -0.0916, which corresponds to roughly a 1 p.p. decrease with respect to the average business ownership rates observed in the population.

The regression in Equation 9 is estimated parametrically, but coefficients do not qualitatively change when using the in-built Stata package from Calonico et al. (2015), which allows for more general specifications and data-driven choices of bandwidths.[87] In particular, Table 14 below shows similar results to Table 13. Individuals that were before the 7th repayment year of their student loans by the time the 1998 reform stroke are associated with a lower likelihood of becom-

[87] Such procedures optimize the bias-variance trade-off given the data in my sample.

Table 13: RDD Estimates of Likelihood of Business Ownership (Parametric)

	(2Yrs Bandwidth)	(2Yrs Bandwidth)	(3Yrs Bandwidth)	(4Yrs Bandwidth)	(4Yrs Bandwidth)
Subject to Reform	-0.0916***	-0.0901***	-0.0731**	-0.0772**	-0.0568**
	(0.0369)	(0.0369)	(0.0296)	(0.0261)	(0.0262)
Pre-Coll Controls	Y	Y	Y	Y	Y
General Controls	N	Y	Y	Y	N
Personal Wealth	N	Y	Y	Y	N
Survey Year FE	N	Y	Y	Y	N
Observations	1,565	1,565	2,168	2,887	2,887
R^2	0.0294	0.0472	0.0634	0.0487	0.0113
Avg Bus.Owners	0.1284	0.1284	0.1284	0.1284	0.1284

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, initial student debt amount and income or wealth category.

ing entrepreneurs.[88] Note that, across the different specifications, the algorithm optimally chooses regression bandwidths which span 4 time units above and below the 7th repayment year cutoff. In the baseline specification of Column (1), I use a linear polynomial to fit the regression. Estimates are stable when using a second order polynomial, when applying a uniform kernel function to weight the regressions (as opposed to the default triangular one),[89] when clustering standard errors at the repayment-year level and when introducing the same covariates as in Table 13.

Table 14: RDD Estimates of Likelihood of Business Ownership (Non-Parametric)

	Baseline	2nd Order Poly	Kernel(uni)	Clustered St.Errs	Covariates
Subject to Reform	-0.0632**	-0.0694**	-0.0691**	-0.0672***	-0.0657**
	(0.0316)	(0.0339)	(0.0305)	(0.0153)	(0.0313)
Observations	4,782	4,782	4,782	4,782	4,782

Notes: 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. *Covariates* refer to agent's gender and ethnicity, age, marital and home-ownership status, assets and loan amount. Robust to include spousal income and the leverage ratio of the households instead of their asset positions.

As an additional robustness check, Figure B.1 illustrates graphically the discontinuity at the 7th year of student debt repayment and its relationship with the likelihood of business ownership later on in individuals' life. The relatively small sample size leads to modest jumps in the estimated coefficients at different repayment years, but Figure B.1 shows that the only signifi-

[88] For roughly 700 individuals in the treated and control groups considered in Table 14 I have also information on the year in which they funded their business. Controlling for the initial amount of the student loan, the repayment year by 1998 and demographic characteristics such as gender, ethnicity, marital and home-ownership status and income category (by education and age group), the treated sample is associated with a 1.7 delay in their business funding year. Yet, the treated sample is also associated with higher sales and profits and bigger business size. This is consistent with selection into entrepreneurship becoming stricter across neighboring cohorts due to the removal of student debt bankruptcy provisions, which could have entailed lower net worth and a tightening of financial constraints.

[89] The uniform kernel function gives the same weight to all observations.

cant discontinuity is represented by the 7th repayment year cutoff value. It is important to stress that the variable used to define the treatment and cutoff groups (e.g: the distance from the 7th repayment year by 1998) does not present jumps in its density around the relevant cutoff, suggesting little role for any confounding strategic behavior of individuals when approaching the 7th repayment year of their student loans.[90] Table B24 also illustrates the absence of any correlation between being in the treated group and the main covariates included in the estimation of Equation 9, which discards selection into the treated group. Finally, Table B25 contains and discuss standard placebos tests that strengthen and confirm the empirical validity of my RDD estimates.[91]

5.2 Macroeconomic Impact

The next step is to evaluate the impact of bankruptcy availability on entrepreneurship in my model economy. As in Kaboski and Townsend (2011), Lagakos et al. (2018) and Buera et al. (2021a), this counterfactual exercise is carried out in a PE setting, namely without recomputing aggregate prices. To remain close to the spirit of the RDD specifications presented above, my goal is to estimate the elasticities of the extensive and intensive entrepreneurial margins to the provision of a bankruptcy scheme, without letting the surrounding economic environment change at the same time. Nevertheless, it is also plausible to assume that the general equilibrium effects of the 1998 reform might have not been sizable. This is due to the fact that bankrupt individuals were a low share of all student debt borrowers back in the 1990's, and college graduates used to carry smaller balances than today: in particular, the average size of education loans upon graduation was $10K for the 1992-1993 cohort, which is less than a third of what is computed for recent cohorts.

I hence fix the model parameters to the estimates discussed in Table 8 and Table 9, keeping input prices and the tax rate to their baseline values. Secondly, I simulate an alternative economy where I allow for student debt discharge after 7 years into repayment – the same way the option of bankruptcy on education loans was implemented before the 1998 reform. Moreover, when households in the model liquidate their student debt, they are required to use any available assets to cover for as much as possible the amount of defaulted college borrowing. This means that bankrupt individuals have to pay a sum equal to $\max\{a_t - d_t, 0\}$ in the year $t \geq 7$ in which they discharge their student debt. After that, they become free of obligations on all remaining balances and are no longer responsible for loan repayments. Note that, to get correctly the overall impact, I have to carefully replicate in the model economy the average share of student debt that used to be discharged before the 1998 reform. As mentioned in the previous paragraph, roughly 1-1.5%

[90] That would have been the case if households were to rush to open a firm right before the 7th repayment year of their student loans to be able to strategically discharge that debt as opposed to other loans, including business ones. The test run with the - rddensity - package in Stata returns a T-statistics of 7.5009, with a p-value of 0.0000.

[91] As an additional check, I run similar RDD specifications to investigate whether the availability of student debt bankruptcy potentially affects other individuals' outcomes, such as their likelihood of marrying and/or being homeowners. Consistent with the discussions in Folch and Mazzone (2020) and Ji (2021), I overall find that outstanding student loans reduce the likelihood of buying a house and marry. All results are available upon request.

of education loans were dismissed in bankruptcy per cohort before 1998 (see Yannelis (2016)).

Two clear effects of student debt bankruptcy are worth discussing: on the one hand, college graduates who discharge their education 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 extra cost,[92] entrepreneurs' borrowing constraint may become less tight, leading them to rent higher levels of business capital. Both mechanisms are expected to boost the entrepreneurial rate of households with a college degree and who took out education loans to finance it, and to increase the amount of capital they rent for their business. The impact of bankruptcy availability on different entrepreneurial margins is reported in Table 15.

Table 15: Effect of Bankruptcy Availability on Entrepreneurship

Outcome	Change wrt to Baseline
Entrepreneurial Rate of college graduates w/ Student Loans	+ 7.64%
Data	*[6.32 – 9.16%]*
Entrepreneurial Debt of college graduates w/ Student Loans	+ 16.97%
Total Entrepreneurial Output	+ 0.60%

Bankruptcy availability boosts the entrepreneurial rate of college graduates with loans. Exploiting the 1998 reform, RDD regressions have found an elasticity of business ownership to student debt discharge between 6 and 9%. The model delivers a 7.64% coefficient, fitting more than 70% of the empirical estimates. The effect in the simulated economy is larger than in the data, consistent with the fact that bankruptcy availability is assigned randomly in my counterfactual, and I do not allow selection into student debt discharge along relevant individuals' characteristics. Moreover, bankruptcy availability increases business funding for college-educated entrepreneurs with student loans by 16.97%. By loosening their collateral constraints and expanding their capital rental capacity, the option of discharging outstanding student loans after 7 years into repayment reduces capital misallocation in the economy. Finally, the counterfactual exercise shows an increase in aggregate entrepreneurial output and welfare of +0.60% and +0.05% respectively.[93]

[92] 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 for bankruptcy.

[93] The amount of student debt discharged in bankruptcy should in principle become a financial burden for the government in my framework, who would have to increase taxation to cover bankrupt student loans and meet its budget constraint. In turns, higher taxes would decrease consumption and savings, while higher entrepreneurial rates would raise the demand and price of capital and labor. The resulting impact on output and welfare could be ambiguous but can be quantitatively estimated allowing for the GE response. Without endogenizing the decision to declare bankruptcy, exogenous student debt discharge would increase the tax rate by 0.5 p.p., while the entrepreneurial rate of graduates and the amount of business debt they can secure would increase by less compared to the PE case (+7.63% and +15.28% with respect to the baseline economy). Note that college-graduate entrepreneurs have a higher efficiency profile and marginally crowd out non-college graduates from the entrepreneurial pool. Yet, the increase in entrepreneurial entry for college graduates would boost the demand for both capital and labor, raising equilibrium prices and depressing

6 Policy Counterfactuals

In what follows, I analyse four policy experiments to further investigate the interplay between the sources and characteristics of college financial aid and the extensive and intensive margins of entrepreneurship. I first study the effect of increasing the provision of college grants – considering need and merit-based ones – which represents a shift in the composition of total aid awarded to students. Second, I raise the borrowing limit on education loans. In the third experiment, I instead compare the baseline economy – where student debt repayment plans are *fixed* – to a counterfactual scenario where they become *income-driven*. In this case, indebted graduates pay the minimum between the fixed amount and a given share of their income. This different scheme makes payments less binding in bad times, and also implies that remaining student debt balances are forgiven and covered by public expenditure after their repayment term expires. Note that all interventions are supported through potentially higher taxation by the government, whose budget constraint must balance in every period. Moreover, by fostering college enrollment, all three policy experiments could in principle increase the amount of student debt per borrower and the size of the market for education loans, which makes their aggregate effects a priori unclear.

Finally, I conduct a preliminary assessment of US President Biden's proposal to cancel part of outstanding student loans. Following the plan recently outlined by the White House, I simulate the introduction of debt relief in my baseline economy, and compute the impact that this one-time intervention could have on entrepreneurial margins and on the fiscal burden of affected taxpayers.

6.1 Expansion of Grants and Borrowing Limits

As a first remark to these policy counterfactuals, recall that my baseline model is characterized by missing markets for insuring against being born from a poor family (eg: having low initial wealth a). Moreover, neither the maximum amount of student debt individuals can borrow, nor the grants provided by the government can fully cover the tuition for college. As noted in Abbott et al. (2019), government interventions that guarantee an easier access to student loans or increase university subsidies can partially address such under-investment in higher education. In particular, they can ensure that a larger share of the population, especially highly-productive constrained individuals, benefits from higher income growth over their life-cycle. In turn, their higher income tax contributions can in principle compensate for the resulting increase in public expenditure.

I begin by analysing the effects of a potential expansion of grants schemes, noting that the scholarship term s in the baseline economy has two components, given by s_1 and s_2. The former is means-tested and depends on one's family available resources, while the latter is proportional to students' merit. In particular, I assumed the first grant to be inversely related to initial wealth and given by: $s_1 = \phi_1 a^{-\psi_1}$, while the second one to increase with individuals' initial productivity according to: $s_2 = \phi_2 z$. Together, these two scholarships account on average for 25% of the yearly

production. Combined with the increase in the tax rate, this would still decrease entrepreneurial output by 0.5%.

cost of attending college. In the next counterfactuals, I follow the spirit of the policy exercise carried out in Abbott et al. (2019) and double the share of tuition covered by grants (from 20 to 40%).[94] Then, I examine the subsequent changes on education choices, entrepreneurial margins, aggregate output and welfare.[95] Both exercises are performed in GE, by recomputing r, w and τ.

Table 16: Expansion of Means-Tested Grants

	Entrepreneurship (w/ Stud. Debt)	Output (w/ Stud. Debt)	Business Debt (w/ Stud. Debt)	Output Aggregate	College Attainment	Welfare Aggregate
Change wrt Baseline	+6.00%	-0.8%	-1.24%	+0.14%	+6.02%	0.72%

First, I expand need-based scholarships by raising the parameter ϕ_1 from 2.20 to 2.25 and keeping instead fixed the progressivity of the subsidy with respect to students' wealth, captured by ψ_1. In so doing, the share of college tuition covered by need-based grants goes up from 12.5% to 25%. Second, I analyse an increment of merit-based scholarships by increasing the parameter ϕ_2 from 0.04 to 0.06, which raises the fraction of college tuition covered by merit-based grants from 10% to 15%. In both cases, the government has to meet the rise in public expenditure with larger fiscal revenues. However, the model economy is characterized by a higher income profile for college graduates and by a proportional income tax. Therefore, the increase in the share of college-educated individuals induced by a more generous provision of educational grants enlarges the amount of fiscal revenues collected by the government as well. Both policy changes analysed here are in fact fiscally self-sustained and do not lead to a higher equilibrium tax rate with respect to the baseline economy. Results from these counterfactuals are shown in Table 16 and Table 17.

Table 17: Expansion of Merit-Based Grants

	Entrepreneurship (w/ Stud. Debt)	Output (w/ Stud. Debt)	Business Debt (w/ Stud. Debt)	Output Aggregate	College Attainment	Welfare Aggregate
Change wrt Baseline	+8.97%	+12.29%	+0.86%	+2.30%	+9.84%	+1.82%

Expanding need and merit-based aid raises by 6% and 10% the college attainment rate in the counterfactual economies, and by 19% and 25% the average amount of student debt per person. Increasing merit-based grants induces relatively productive but constrained students to substitute education loans with publicly-provided financial aid (note that the share of student borrowers decreases by 4.9%), and allows a larger fraction of young adults to secure a high efficiency life-cycle profile through college education. Both mechanisms raise entry into entrepreneurship and the output of indebted college-educated business owners. Due to a higher share of college graduates

[94] Also, note that my framework does not include any disutility or psychic costs of attending university. An excessive increase in the provision of grants could produce a counterfactual and unrealistic rise in college enrollment.

[95] I define aggregate welfare as the sum of utilities over consumption across the distribution of all individuals.

within the entrepreneurial sample, the productivity cutoff to open a firm shifts rightwards: together with the aforementioned effects, the crowding out of marginally less productive owners increases aggregate output by 2.3%, and contributes to a 1.8% increment in aggregate welfare.

On the contrary, doubling the size of need-based grants does not equally succeed in attracting potentially constrained but productive students into college, and has in fact the downside effect of marginally increasing by 5.3% the share of indebted graduates. Overall, the larger fraction of borrowers and the higher student debt burden worsen – instead of improving – the entrepreneurial performance of college-educated agents with loans. As a consequence, the counterfactual economy under higher means-tested grants does not register substantial positive compositional effects within the entrepreneurial sample, which limits the gains in aggregate output and welfare.

In a third exercise, I examine the effect of loosening college borrowing limits and allowing students to take out larger loans to finance their degree. In the baseline economy, the lower bound on student loans $\underline{d}$ was set to a third of the average yearly tuition for a 4-years college degree. Since the model abstracts from enrollment in graduate studies, I considered an average of the maximum amount of loans granted for undergraduate degrees across dependent and independent students, including subsidized and non-subsidized federal loans, which corresponds to roughly $10,000 per year. In the following experiment, I increase by 25% the maximum amount students can borrow to finance college, and assess the impact of this reform on education choices, entrepreneurial margins, aggregate output and welfare. Differently from the counterfactual in Abbott et al. (2019), I do not assume student loans to fully cover the tuition, but rather look at a middle-ground case.

Table 18: Expansion of Borrowing Limits

	Entrepreneurship (w/ Stud. Debt)	Output (w/ Stud. Debt)	Business Debt (w/ Stud. Debt)	Output Aggregate	College Attainment	Welfare Aggregate
Change wrt Baseline	- 9.38%	-3.09%	-4.98%	+0.82%	+16.67%	+1.89%

As shown in Table 18, the expansion of the borrowing limit on student debt results in a 17% rise in the educational attainment of young adults, and in a 58% increase in the average amount of borrowing per student. However, the share of borrowers among college graduates does barely move: this indicates that some prospective students are credit constrained, but the maximum amount of education loans granted does not affect one to one their discrete choice of taking out loans. Moreover, in line with the fact that student loans affects entrepreneurial margins in my model, a higher debt burden decreases business ownership for agents with student loans, limits the amount of business credit they get to finance capital acquisition, and reduces their entrepreneurial output. As a consequence of that, allocative efficiency – measured by college-educated entrepreneurs' $arpk$ – worsens in the economy by 6%. Yet, the economy now features a larger share of highly-educated entrepreneurs, who enjoy a higher efficiency profile and income growth over the life-cycle. De-

spite a 0.3 p.p. increase in the GE tax rate to support the expansion of student debt limits, and the negative effects registered in the early stage of indebted graduates' entrepreneurial careers, this policy change still results in almost 1 p.p. higher aggregate welfare and output.[96]

As a final remark to these exercises, I want to stress two key limitations of my framework: on the one hand, I have modelled the college premium as an exogenous factor. Specifically, I have assumed that university-educated individuals enjoy a given higher efficiency profile over the life-cycle, which is not affected by the increased supply of college graduates induced by the policy changes explored above. On the other hand, the price to get a degree – denoted by χ in the model – does not move either throughout these counterfactuals, despite the fact that expanding the provision of grants or the borrowing limit on student debt causes a rise in college demand.

In future work, a possible solution to tackle these issues would be to endogenize the supply-side of higher education or to include a college market, as in Cai and Heathcote (2022). At the same time, I could also microfound further the presence and extent of the college premium by assuming skilled and unskilled labor to have a different degree of complementarity to the technology in the production function of entrepreneurs, as in Salgado (2020). This would in principle allow the premium and the price for college to react to changes in the supply of highly-educated agents and in the demand for higher education itself, which in turn could affect the quantitative results of the policy experiments I have studied. For now, I follow Abbott et al. (2019), and keep the price and the higher efficiency profile induced by college education fixed when assessing the impact of reforms to university financial aid, observing that the share of college graduates does not in fact increase exponentially or unrealistically in the counterfactual policy scenarios that I analyse.

6.2 Income-Based Repayment Plan

The second type of policy exercises I perform is a change to the repayment structure of student loans, by making their repayment tied to the income of borrowers in any given year. In the US, there are currently four different types of income-driven plans, which include the Revised Pay As You Earn (REPAYE), the Pay As You Earn (PAYE), the Income-Based Repayment (IBR) and the Income-Contingent Repayment (ICR).[97] All of them entail a repayment that varies between 10% and 20% of agents' discretionary income.[98] Moreover, if the original loan is not paid off entirely after 20 or 25 years, depending on the plan, outstanding balances are forgiven. Interestingly, despite the fact that the US administration has passed actions requiring matriculating students to be informed about income-driven repayment options, these represent less than 15% of the plans subscribed in the last years. Similarly to Luo and Mongey (2019), I introduce in my model an IBR

[96] The gain in individuals' efficiency induced by attending university is such that college-educated entrepreneurs, especially those without student debt, are relatively more productive than in the baseline economy, which raises both output and capital and labor demand. Higher input prices induce a mechanism of churning within the entrepreneurial sample, and make it harder for non-college individuals and college-graduates with student debt to open and run a firm.

[97] See information at: `https://studentaid.gov/manage-loans/repayment/plans/income-driven`

[98] See `https://www.census.gov/library/publications/2021/demo/p60-273.html`

program, which was first launched in 2009, and assess its effects on macroeconomic outcomes.

Recall that, in my baseline economy, the initial loan balance due in repayment is divided into fixed tranches, which individuals pay along with interest rates on top of their outstanding debt until the end of their repayment term $T_{repayFIX} = 15$. Next, I assume instead that student loans get repaid through an IBR plan, under which agents have to disburse the minimum between the fixed repayment amount and 15% of their current income, as long as it exceeds 150% of the poverty line established by the government. If the latter condition is not met, the repayment due is zero. Moreover, borrowers have to pay interests on their outstanding loan balances, as for the standard repayment plan, provided that these do not exceed the amount of the principal payment. For now, I do not allow either for the endogenous choice of repayment plan upon graduation, or for the option to switch between plans. As for the previous exercises, this counterfactual is carried out in GE, and the government covers with fiscal revenues any higher public expenditure caused by unpaid interests and debt forgiveness after 25 years into repayment (recall that $T_{repayIBR} = 25$).

As noted by Luo and Mongey (2019), individuals that carry low amounts of student debt may benefit from the standard repayment plan, which enables them to run down quickly their small balances without bearing the burden of large interest rate payments that is involved in longer IBR plans. On the contrary, the IBR program is preferred at moderately higher debt levels, as it ensures higher consumption early on in agents' careers, when income is lower and the marginal utility of consumption is higher. The effect on aggregate outcomes is hence hard to assess a priori, as it depends on the endogenous selection of individuals into education and student debt, and is potentially interlinked to their consumption-saving and occupational decisions over the life-cycle.

Table 19: Income-Based Repayment Plan

	Entrepreneurship (w/ Stud. Debt)	Output (w/ Stud. Debt)	Business Debt (w/ Stud. Debt)	Output Aggregate	College Attainment	Welfare Aggregate
Change wrt Baseline	-12.32%	+11.60%	+9.97%	+2.65%	+8.33%	19.29%

Table 19 shows that, if all prospective students were enrolled in IBR plans, the college attainment rate would increase by more than 8%, the share of borrowers would raise by 35 p.p. and the average amount of student debt per person would double. Since the government would have to cover unpaid interest rates and guarantee debt forgiveness after 25 years of repayment, the average GE tax rate would increase by 1 p.p. for all agents.[99] Results from this counterfactual exercise show that switching completely to IBR plans might not foster entrepreneurial entry, but may reduce the gaps in entrepreneurial outcomes across college graduates with and without loans. This is due to strong income effects, stemming from the fact that a longer repayment period and larger

[99] As noted in Abbott et al. (2019), policy reforms may have upfront costs for longer term benefits to future generations. In particular, this could imply that some of these policies would be better financed using long term government debt, instead of taxes falling on current generations. I leave the consideration of transitional effects for future work.

payments towards the middle-end of individuals' working careers reduce wealth accumulation, and discourage undertaking risky entrepreneurial activities. However, since student debt payments can effectively be delayed in bad times without increasing outstanding balances, adopting an IBR allows indebted college-educated entrepreneurs to rent higher capital and produce more on average.[100] The increase in business earnings and wages for all individuals in the economy more than compensate the higher fiscal pressure, and result in a 19% increase in welfare overall.

6.3 Student Debt Relief

In the last exercise of this section, I conduct a preliminary assessment of President Biden's recent plan to cancel off part of outstanding student loans, which was formalized and released by the White House on August 24th, 2022. While the proposal for a potential student debt relief has been discussed at least since the last US presidential campaign, the debate recently re-gained momentum, as America's working families are starting to recover from the strains associated with the COVID-19 pandemic. Behind this intervention lies the belief that the cost of college borrowing has become a burden preventing most student debt holders from enjoying the advantages post-high school education should grant. In particular, Biden's Administration has stressed how middle-class borrowers struggle with high monthly payments and ballooning balances, which make it harder – in their words – to build wealth, buy a house, open a business or save for retirement.[101]

President Biden's proposal entails up to $20,000 in debt cancellation for Pell Grant recipients with loans held by the Department of Education, and up to $10,000 in debt cancellation for non-Pell Grant recipients, provided that they do not belong to the top 5% income earners. Since it is estimated that nearly every Pell Grant recipient came from a family that made less than $60,000 a year,[102] student debt cancellation should specifically target low and middle-income debt holders, and would provide relief to 43 million individuals, including forgiving the remaining balance for roughly 40% of the borrowers. Yet, President Biden's forgiveness plan will lead the government to cover the $400 billions cost through tax increases, spending cuts, borrowing or a combination of these tools. This has spurred a debate over the redistributional consequences of the proposed intervention, and part of the public opinion argues that this measure does not address the root cause of why students graduate from college with such huge debt burdens in the first place.[103]

In the counterfactual that follows, I simulate the introduction of President Biden's student debt relief in my baseline economy. Rather than offering a comprehensive discussion over whether and how to optimally conduct education loans cancellation, this exercise aims to study the impact that this particular intervention would have on specific aggregate outcomes. In practice, I take the

[100] My results are in line with the analysis of Ionescu (2009), who shows that student debt repayment flexibility increases enrollment, decreases default rates, and lead to redistributional effects that benefit low-income households.

[101] `https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/24/fact-sheet-president-biden-announces-student-loan-relief-for-borrowers-who-need-it-most/`

[102] See: `studentaid.gov/data-center/student/title-iv`.

[103] See for example: `www.forbes.com/advisor/personal-finance/who-pays-for-student-loan-forgiveness/`.

calibrated steady state of my model and shock every cohort alive with a one-time student debt relief that mimics President Biden's proposal, and that affects individuals who are repaying their college borrowing. The set up of my framework allows me to closely replicate President Biden's plan, as Pell Grants are proxied by the need-based scholarship s_1, income is computed from either labor or entrepreneurial earnings, and a $10,000 debt cancellation corresponds to roughly a third of the average education loans balances at graduation. Since, at the moment of writing, there is still uncertainty over the steps that will follow this initial relief, I describe and focus only on the choices and outcomes of affected cohorts. In particular, I analyse how the extensive and intensive margins of entrepreneurship may react, and what the resulting fiscal pressure from this measure would be, without recomputing market clearing conditions. Results are shown in Table 20.

Table 20: Student Debt Relief

	Entrepreneurship (w/ Stud. Debt)	Capital-to-Labor (w/ Stud. Debt)	Interest Rate (Estimated Increase)	Avg Tax Rate (Estimated Increase)
Change wrt Baseline	+2.11%	+0.78%	+4.23%	+0.66 p.p.

Introducing a one-time student debt relief in the steady state of my economy would wipe out outstanding college loans for 52% of the borrowers (compared to the White House projection of 40% previously mentioned). In the cross-section, I also observe an increase of 2.11% in the entrepreneurial rate of college graduates, and a rise of 0.78% in the capital-over-labor ratio of firms run by college-educated entrepreneurs. Both effects may in principle represent improvements along the extensive and the intensive margins of entrepreneurship for indebted college graduates.

It is important to stress that these figures constitute an upper bound to the potential entrepreneurial gains that the current student debt relief proposal could obtain. Specifically, my preliminary assessment does not consider any feedback effect generated by subsequent changes in GE prices. Lower college debt repayments would free up more resources for all individuals and raise capital supply, but a higher entrepreneurial participation by graduates with loans would boost the demand for capital. On average, this could in fact increase the equilibrium interest rate by roughly 4%. Moreover, student loans forgiveness has to be covered exclusively with taxes, since the government in my model cannot issue public debt and uses only fiscal revenues to balance its budget constraint. As such, I estimate that college debt relief could increase the average fiscal pressure for all agents by almost 1 p.p., but nonetheless leave for future research a more thorough analysis of the full equilibrium response of the economy to President Biden's proposal.

7 Conclusion

In this paper, I have investigated the interplay of education and occupational choices over the life-cycle of households, focusing on the effect of student debt on entrepreneurship. Using micro-level data from the US Survey of Consumer Finances 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 in size and to generate less revenues and profits, but they do present better profitability margins.

I have rationalized my findings into a GE heterogeneous agents model, where individuals differ by wealth, productivity, age, education and student debt. During youth, households decide whether to attend college and how much to take out in education loans. College gives them a income premium through higher (deterministic) efficiency growth, and 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, education loans slow down the accumulation of wealth of college graduates, and tighten the borrowing constraint of indebted entrepreneurs. Calibrated to the US, my model replicates between 30 and 80% of the empirical differences across entrepreneurs with and without education, and with or without student debt.

Secondly, I used the 1998 reform to education loans bankruptcy to establish a causal link between student debt and entrepreneurship. Using SCF data and an RDD, I have estimated an elasticity of business ownership rates to education loans between 6 and 9%. I have then expanded my quantitative framework to include and allow for student loans bankruptcy under the legal terms in order before 1998. I found a 7.64% PE elasticity of entrepreneurship to student debt bankruptcy, which replicates closely its empirical counterpart. In such counterfactual scenario, capital misallocation would decrease, and entrepreneurial credit and output in the US would increase.

Finally, I have also used to model to investigate the relationship between the rise in college costs and student debt and the decline in entrepreneurship over the past 40 years. Specifically, I have shown that the boom in college demand and prices engineered by the rise in the college wage premium can account for the exponential increase in the amount of student debt per person and in the share of borrowers. In turns, higher student debt levels are responsible for 1/10 of the overall decline in entrepreneurship in the US, and for 1/3 of the decrease in business ownership rates for college graduates with loans. The model has also served as a quantitative laboratory to assess the effect of specific public policies on individuals' choices and aggregate outcomes. In particular, I have studied the impact of college aid expansions and income-based student debt repayment plans on entrepreneurship, capital allocation and aggregate productivity in the US. In future works, I believe it would be important to endogenize the supply-side of education and the college premium in the model. This would allow to analyse the equilibrium response of university demand and prices to shocks affecting the technology of the firms, or investigate how changes in

the educational system manage to propagate and influence individuals' labor market outcomes.

Appendix

A Data Appendix

A.1 Variable Definition and Datasets Comparison

Table A1: Description of Demographic Controls

Variable	*Description*
Age	Age of the household (25 to 65 years old).
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 equal to 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, and to 0 otherwise.
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 Table A1, I describe the variables used in the main regressions of the paper, which refer to individuals' demographic characteristics, their average income or financial position. Note that Table A2 and Table A3 define instead the variables related to the businesses run by respondents and to their student loans. In Table A4, I also offer a comparison between the SCF and other datasets used to investigate trends and patterns in US college borrowing over time and within student cohorts. In particular, aggregate statistics from SCF related to the share of borrowers within college recipients and to the civilian population are compared to those obtained with data

from (i) the National Center of Education Statistics (NCES), which includes surveys such as the National Postsecondary Aid Study (NPSAS) and the Baccalaureate and Beyond (BB); (ii) the US Department of Education, and (iii) the Federal Reserve of New York, which runs the Consumer Credit Panel (CCP) jointly with Equifax and collects information for over 40 million agents.

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 education loans. Possible range: 0 to 6. However, 99% of the sample considered has between 0 and 3 education 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

Table A5 reports figures related to the average and median amount of student debt, considering all borrowers. The average amount of student debt upon graduation and per graduate (as opposed to per borrower) was $18,650 in 2004 and $24,200 in 2011 according to NPSAS, similarly to estimates from SCF. In 1992, the average debt at graduation was 13,500 according to NPSAS, and 12,538 according to SCF. As of 2019, the total amount of student loans is reported to be worth 1.4 trillions of dollars in SCF, 1.6 trillions of dollars in NCES and 1.7 trillions of dollars in FRED.

Table A4: Student Loans in SCF and Other Sources: Part 1

	1989 – 1992		2007 – 2010	
	SCF	NPSAS	SCF	NPSAS (NCES)
% Borrowers in College Recipients	53%	55%	63%	68% (62%)
	2007 – 2010		2016 – 2019	
	SCF	Census	SCF	Census
% Borrowers in Civilian Population	11%	12%	14%	16%
% Borrowers in College Educated Households	30%	33%	36%	37%

Notes: When computing estimates in SCF, survey weights are used. Number of borrowers are from `https://educationdata.org/student-loan-debt-statistics`. Share of college educated households can be found at `https://www.statista.com/statistics/184260/educational-attainment-in-the-us/`. Civilian noninstitutional population is from `https://www.bls.gov/emp/tables/civilian-noninstitutional-population.htm`. Estimates from the National Postsecondary Aid Study (NPSAS) are from Hershbein and Hollenbeck (2015). Estimates from National Center Education Statistics (NCES) can be found at `https://nces.ed.gov/programs/digest/d20/`.

One can also compare the SCF to other datasets under different dimensions, such as patterns in loan repayments and the distribution of loan balances. First, according to NCES, the cohort that entered student debt repayments in 2014 has shown a 12% default rate, compared to a 15% default rate computed using SCF and focusing on agents declaring that their student loan payments are "behind schedule". As reported by Brown et al. (2015) using CCP data on 40 millions individuals, 20% of borrowers still in repayment by 2004 were 90+ days late on their payments, against a 18% computed in SCF for the same year. Secondly, in 2014, the National Student Loan Data System (NSLDS) estimated that among all borrowers, 42% of them had balances in excess of $25K, 17% of them had more than $50K and 5% of them had more than $100K. Using SCF data, I can compute those shares to be 48%, 24% and 5% respectively in 2014. Going back in time instead, in 1992 only 8% and 2% of borrowers had more than $25K and $50K student debt balances respectively according to NSLDS, and such figures line up with those estimated in SCF (9% and 2%).

On the negative side, it has been argued that, in 2013, the SCF underestimated the share of debt held by the top quintile of the income distribution compared to what administrative data merged with sources from the US Department of Education seem to suggest (27% against 35%).[1]

[1]See the full comparison here: `https://www.brookings.edu/blog/up-front/2019/06/28/who-owes-the-most-student-debt/`.

Table A5: Student Loans in SCF and Other Sources: Part 2

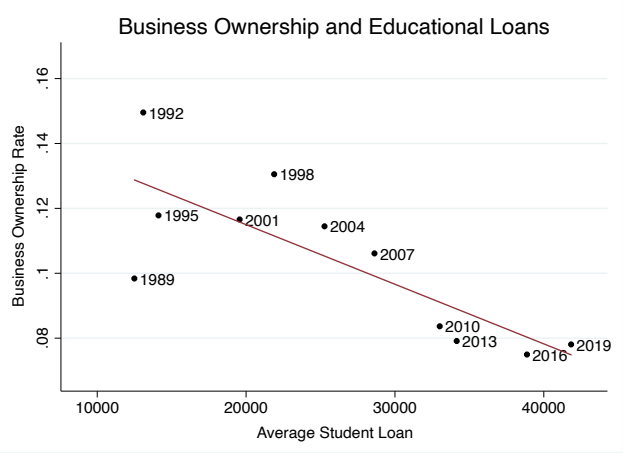
	2004			2010			2019		
	SCF	NPSAS	CCP	SCF	NPSAS	CCP	SCF	NCES	FRED
Avg. Amount	16,908	18,650	15,308	21,745	24,200	21,842	29,488	29,500	–
Median Amount	11,800	11,600	12,332	15,000	14,083	–	25,000	–	–

Notes: When computing estimates in SCF, survey weights are used and I winsorize data at the 99th percentile to exclude possible outliers and most likely misreported figures. Recent data on the total value of student debt is from the Federal Reserve Bank of St. Louis at `https://fred.stlouisfed.org/series/SLOAS`. Estimates from the National Postsecondary Aid Study (NPSAS) are from Hershbein and Hollenbeck (2015). For the *median amount* of 2010, I impute the value based on the growth rate of the median amount in NPSAS data over the 2004-2008 period. Estimates from National Center Education Statistics (NCES) can be found at `https://nces.ed.gov/programs/digest/d20/`.

A.2 Descriptive Statistics

In Figure A.1, I report the negative correlation between the average business ownership rate and the average student debt per person over time, considering loans with balances greater than 0 at the time of the interview for the sake of the computation. The graph controls for demographic characteristics such as gender, age, educational level, marital status, ethnicity and assets, and uses survey weights to ensure representativeness. Then, 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.

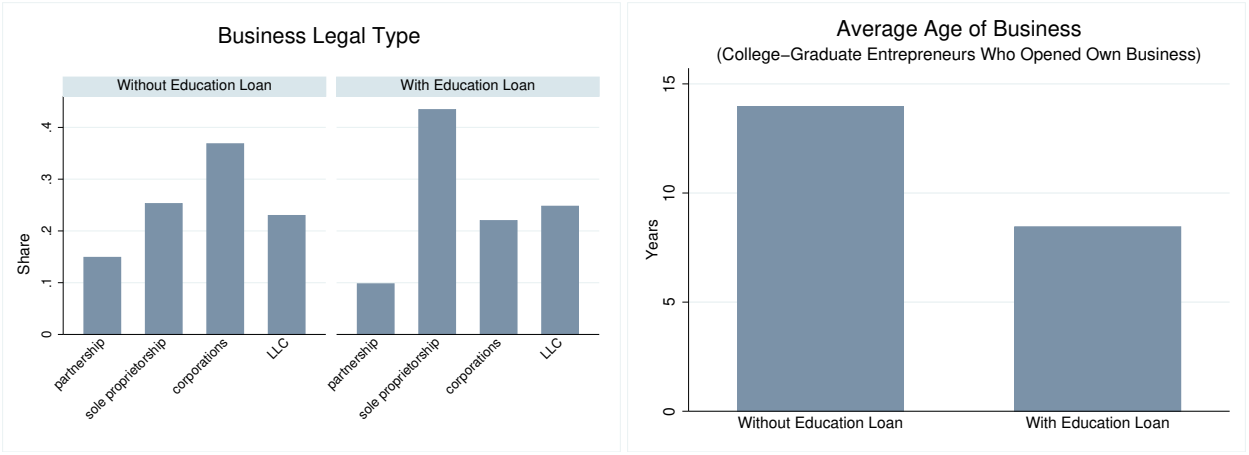
Figure A.1: Comparison over Time: 1989-2019



Moreover, in the right panel of Figure A.2, I report the average age (in years) of the firms started by entrepreneurs that have a college degree, distinguishing for whether they had to take

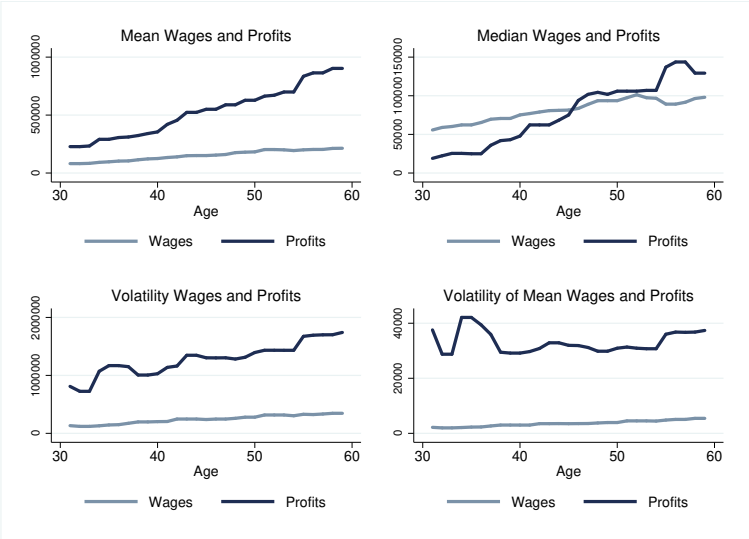
student loans or not (I could alternatively focus as well on those still repaying their loans at the time of the survey interview). In the SCF, individuals can indicate whether the business they own and actively manage was either "bought", "started", "inherited" or "joined". In the right panel of Figure A.2, I consider entrepreneurs that started their own business and have the same educational attainment, and I find that owners who had to borrow for college run firms that are on average 5 years younger, suggesting a delay in the business funding year.

Figure A.2: Legal Status and Business Age



Finally, I analyse distributional properties of wages and profits for workers and entrepreneurs in the SCF data, pooling together all sample years and without conditioning on any control variable. Figure A.3 shows that, while the average and median values of wages and profits follow different patterns and growth trajectories over individuals' life-cycle, measures of relative volatilities stay virtually unchanged and stable, which justifies my modeling choices.

Figure A.3: Distributional Properties of Wages and Profits over the Life-Cycle



A.3 Additional Regression Results

To start, Table A6 reports that 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 interview) employ more personal collateral for their firms, comparing enterprises and owners of similar characteristics.

Table A6: Collateral

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0018	0.0168*		
	(0.0086)	(0.0088)		
Dummy(Have Loan)			0.1672*	
			(0.0873)	
log(Student Debt 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: 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.

In Table A7, I provide a robustness check for the regressions estimated in Table 2, in which I control for respondents' net worth and isolate the correlation between student debt and business ownership beyond the impact that wealth and other outstanding loans can have on entrepreneurial entry. Note that, for this specific exercise, I use a different version of the SCF dataset, which contains summary variables for individuals' assets and liabilities. In particular, the website of the Federal Reserve provides access to an online tool called Summary Extract Public Data Files (SDA), from which I am able to construct a net worth variable defined as *Total Assets – Total Liabilities* and that excludes student loans. For instance, "total assets" merge together financial and non-financial wealth, including residences, vehicles, saving accounts, and any amount invested in mutual funds, stocks, pensions and bonds, among others. On the contrary, "total debt" includes principal residence debt (mortgages and HELOCs), lines of credit, debt for other residential property, credit card debt and installment loans, among others. Liabilities are to be considered as outstanding loans, including the amount of student debt reported (up to six education loans).

The SDA dataset differs from the one used in my main analysis insofar as it does not contain all the variables from the SCF questionnaire. For this reason, here I define as a business owner any respondent that actively manages a business, and then estimate again Equation 1 with outstanding student debt and individuals' net worth as main regressors. I also control for both pre-determined variables (eg: gender and ethnicity) and contemporaneous ones (eg: age, educational attainment,

number of kids, marital status). Finally, I include survey year FE and apply survey weights.

Table A7: Business Ownership (Summary Extract Public Data Files)

	(1)	(2)
log(Student Debt Still Owed)	-0.0034***	-0.0018***
	(0.0002)	(0.0002)
Pre-College Controls	Y	Y
General Controls	N	Y
Survey Year FE	N	Y
Observations	170,357	170,357
Pseudo-R^2	0.0218	0.0641

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. Pre-College controls refer to agent's gender and ethnicity. General controls are agents' net worth, education, age, marital status and number of kids. Robust to including individual and spousal income.

Back to the dataset used for the main analysis, Table A8 reports the same regression as in Columns (1)-(2) of Table 2 and Table 5 controlling for parental education, which is available only for the 2016 and 2019 surveys. In Table A9, I instead conduct a robustness check for the results in Table 2 without restricting the firm ownership share to be 100% in order for individuals 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 a 50% share of their business. The share of entrepreneurs owning less than 50% of their firm is hence smaller than 1%, and it is not likely to change the quality and extent of my results. Finally, Table A10 carries out again the analysis in Table 2 but focusing only on the largest education loan reported by survey respondents.

Table A8: Entrepreneurial Margins (Controlling for Parental Education)

	Ownership	Ownership	Loan Approval	Loan Approval
log(Original Student Debt Taken)	-0.0031***	-0.0013**	-0.0180***	-0.0138***
	(0.0004)	(0.0004)	(0.0051)	(0.0033)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	N	Y
Firm Controls	N	N	N	Y
Survey Year FE	N	Y	Y	Y
Observations	31,652	31,004	1,422	1,422
R^2	0.0475	0.0641	0.2164	0.6311

Notes: Estimates are average marginal effects. Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. In Columns (1)-(2), the dependent variable is a binary indicator = 1 if the individual is a business owner. In Columns (3)-(4), the dependent variable is a binary indicator = 1 if the business owner received a business loan over the 12 months previous to the survey interview. *Pre-College Controls* refer to agent's gender, ethnicity and parental education. *General Control* variables include agents' education level, age, marital status and home-ownership status, and income. Firm controls include size, business age, legal type and individuals working hours. Robust to including spousal income, the leverage or the assets of the households, and to using an income or wealth category by age and education instead of their personal income.

To complement the analysis conducted in Table 4, Table A11 shows how outstanding student debt

Table A9: Entrepreneurial Rates (No Ownership Share Restriction)

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0028***	-0.0017***		
	(0.0002)	(0.0003)		
Dummy(Have Loan)			-0.0188***	
			(0.0024)	
log(Student Debt 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. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, available only for the years 2016/2019). General control variables are agents' years, age, marital and home-ownership status and income. Robust to including spousal income, the leverage or the assets of the households, and to using an income or wealth category by age and education instead of their personal income.

Table A10: Business Ownership, Largest Education Loan Only

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0030***	-0.0019***		
	(0.0002)	(0.0002)		
Dummy(Have Loan)			-0.0166***	
			(0.0025)	
log(Student Debt Still Owed)				-0.0021***
				(0.0002)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Survey Year FE	N	Y	Y	Y
Observations	170,302	170,302	170,302	170,302
Pseudo-R^2	0.0279	0.0554	0.0552	0.0594

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. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of agents' personal income, and to considering owners with any given equity share.

balances correlate with the likelihood of business ownership for individuals of different age categories. I control for both pre-determined variables (eg: gender and ethnicity) and contemporaneous ones in a sequential way (eg: income, educational attainment, marital and home-ownership status). Finally, I include survey year FE and apply survey weights. Note that the regression is estimated non-parametrically and shows that the negative correlation between the amount of student debt owed at the time of the survey and business ownership decreases as individuals age. This is in line with the economic intuition that the repayment of college borrowing should have a

stronger impact on entrepreneurial margins at the beginning of individuals' working career.

Table A11: Business Ownership (Interaction Student Debt and Age)

	(1)	(2)
log(Student Debt Still Owed)	-0.0202***	-0.0303***
	(0.0039)	(0.0040)
log(Student Debt Still Owed) × 31-40yo	+0.0045	+0.0088**
	(0.0036)	(0.0035)
log(Student Debt Still Owed) × 41-50yo	+0.0078***	+0.0148***
	(0.0041)	(0.0039)
log(Student Debt Still Owed) × >50yo	+0.0180***	+0.0275***
	(0.0042)	(0.0040)
Pre-College Controls	Y	Y
General Controls	N	Y
Survey Year FE	N	Y
Observations	27,587	27,330
Pseudo-R^2	0.0290	0.0919

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. Pre-College controls refer to agent's gender and ethnicity. General controls are agents' income, education, marital and home-ownership status, and the (log) original amount of student loan individuals graduated with.

In Table A12, I report the estimates for the likelihood of applying for a firm loan, given a set of control variables and 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:

$$Pr(Apply_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_{it} + \boldsymbol{\delta}'\boldsymbol{\Gamma}_i + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \tag{10}$$

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 5. 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 A13, I run alternative specifications for the regressions included in Table 6, where I have analysed the association between student loans and business outcomes such as size and gross sales. Differently from the specifications in the main text, here I use 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 A14, I report instead the results from the regression in Equation 3, focusing on profits and business net

Table A12: Business Loan Applications

	(1)	(2)	(3)	(4)
log(Original Student Debt Taken)	-0.0006	0.0014		
	(0.0009)	(0.0009)		
Dummy(Have Loan)			0.0098	
			(0.0093)	
log(Student Debt 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.

worth. Then, in Table A15, I conduct robustness checks on these very same specifications 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. All the results are consistent with the baseline regressions in the main text.

Table A13: Business Outcomes: Size and Gross Sales

	Employees	Employees	Sales	Sales
Dummy(Have Loan)	-18.5950***		-0.4475***	
	(1.7959)		(0.0474)	
log(Student Debt 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: 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 A16, I run alternative specifications for the regressions on firms' profitability included in Table 7, 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 specification. Furthermore, an increase of 1000$ in the amount of student debt still to be paid is associated with 4% to 9% higher business profitability.

Table A14: Business Outcomes: Profits and Net Worth

	Profits	Profits	Net Worth	Net Worth
log(Original Student Debt 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: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are the log(*Profits*) and log(*Net Worth*) of businesses, as reported by entrepreneurs in the sample. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include business size, age, legal type and individuals working hours. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of personal income, and to considering owners with any given equity share.

Table A15: Business Outcomes: Profits and Net Worth

	Profits	Profits	Net Worth	Net Worth
Dummy(Have Loan)	-0.3314***		-0.5395***	
	(0.0504)		(0.0356)	
log(Student Debt 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: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used. The dependent variables are the log(*Profits*) and log(*Net Worth*) of businesses, as reported by entrepreneurs in the sample. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include business size, age, legal type and individuals working hours. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of personal income, and to considering owners with any given equity share.

In Table A17, I show that individuals' cognitive abilities are correlated with both higher amounts of grants and education 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

Table A16: 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)	
log(Student Debt 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. Pre-College controls refer to agent's gender and ethnicity (robust to including parental education, only available in 2016/2019). General controls are agents' education, age, marital and home-ownership status and income. Firm controls include business age, legal type and individuals working hours. Robust to including spousal income, households' leverage or assets, to using either an income or wealth category by age and educational level instead of personal income, and to considering owners with any given equity share.

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. The resulting estimates summarize the respondent's performance on each subtest on a scale that can be compared across respondents: a lower score indicates poorer performance, and a higher score indicates better performance 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)). In the regressions that follow, I hence use the scores of respondents as a measure of cognitive abilities.

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 higher amounts of grants, which are likely to capture students' access to merit-based aid, whereas they do not relate to the total amount of loans take out by respondents to finance college education. Moreover, I can check that higher cognitive skills do not predict a higher amount of grants compared to loans. This is consistent with the fact that grants for US universities typically cover a fifth of the total university tuition and are available only to individuals meeting specific background characteristics. Moreover, grants tend to be complemented by either borrowing or out-of-pocket contributions.

Using again the panel of respondents from the NLSY97, Table A18 shows that student debt is

Table A17: 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.

negatively associated with the likelihood of owning a firm even after controlling for individuals' cognitive skills. This strengthens the idea that the negative correlation between student debt and entrepreneurial outcomes found in the SCF is not driven by a group of particularly low-skilled households who happen to have taken out large amounts of education loans. In particular, I run the following set of probit regressions:

$$Pr(BusOwn_{it} = 1) = F\left(\beta_0 + \beta_1 Student\ Loan_i * Cognitive\ Skills_i + \boldsymbol{\delta}'\boldsymbol{\Gamma}_i + \boldsymbol{\gamma}'\boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \quad (11)$$

Table A18: Business Outcomes in NSLY97

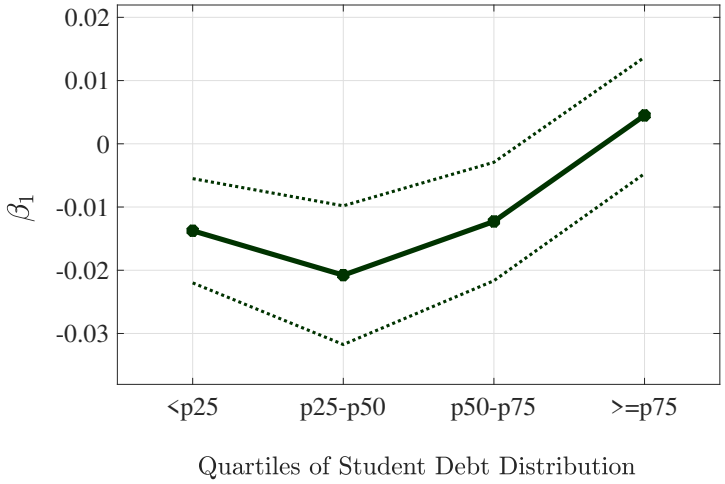
	Ownership	Ownership	Ownership	Ownership
Dummy(Have Loan)	-0.0231***	-0.0279***		
	(0.0053)	(0.0072)		
Amount Taken			-0.0189***	-0.0189
			(0.0061)	(0.0122)
Pre-College Controls	Y	Y	Y	Y
General Controls	N	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	48,345	28,688	8,354	8,354
R^2	0.0225	0.0242	0.0411	0.0411

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 self-employed individuals as I cannot define firm owners in the exact same way I did for SCF, namely focusing on ownership shares and presence of salaried workers. I include both controls that were pre-determined to the choice of education, as in Table A17, and contemporaneous control variables such as their region, marital status and wealth. Results are shown in Table A18 for the main regressors of interest, which are (i) an indicator for whether the household took out student debt, and (ii) the original amount of education loans contracted.

Finally, Figure A.4 shows the different elasticities of business ownership to outstanding stu-

Figure A.4: Elasticity of Business Ownership to Student Loans



dent loans by quartiles in the distribution of total student debt taken out for college purposes (in dashed are the 95% confidence intervals). Regressions include controls as in Column (4) of Table 2 and survey weights, but condition on individuals that contracted education loans, as opposed to use the entire sample of SCF respondents. The purpose is to illustrate heterogeneity in the negative association between college debt and the extensive margin of entrepreneurship, and to show that results are not driven by individuals in the top percentiles of the student debt distribution.

B Bankruptcy Reform

Instead of an RDD, to quantify the impact of the 1998 bankruptcy reform on the extensive margin of entrepreneurship I can estimate a diff-in-diff probit regression of the following form:

$$Pr(BusOwner_{it} = 1) = F\left(\beta_0 + \beta_1 Post_{it} + \beta_2 Reform_{it} + \beta_3 Post_{it} \times Treated_{it} + \boldsymbol{\gamma}' \boldsymbol{\Phi}_{it} + \alpha_t + \epsilon_{it}\right) \tag{12}$$

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 or before 1991 but had still not finished repaying their education loans, while the control group contains households that had finished their repayment period by the time the reform stroke. Finally, a third set of regressions compares individuals who started repaying their loans between 1992 and

1997 to a control group composed of those who started repaying after the 1998 reform took place.

Table B19: 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 and 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.

Table B20: 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.

Columns (1) to (2) in Table B19 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 B20, being subject to the reform and hence not being able 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.

Table B21: Outstanding Student Debt and Bankruptcy

	(1)	(2)
Past 7th Repayment Year by 1998	0.0997**	0.0788*
	(0.0449)	(0.0446)
Pre-College Controls	Y	Y
General Controls	N	Y
Survey Year FE	Y	Y
Observations	2,167	2,142
R^2	0.5374	0.5533
F-Statistic	477.70	266.10

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 the outstanding student debt balances reported by individuals interviewed up to 10 years after the 1998 reform that were within 10 years into their loans repayment by 1998. 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, income and age. Robust to include also spousal income and the leverage ratio of the households instead of their asset positions.

In Table B21, RDD regressions show that being past the 7th year of education loan repayment correlates with lower outstanding student debt balances 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. To avoid the confounding effect of few outliers that repaid their loans for more than 2 decades, I consider respondents that started repaying before 1998 are were surveyed at most 10 years after the 1998 bankruptcy reform was passed (i.e. up to the 2009 survey). In particular, after controlling for age effects (including interactions as well), being past the 7th year of repayment is shown to be associated with a lower amount of outstanding student debt balances.

In Table B22, 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 B22: 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 B23, I run a similar set of regressions as in Table B22 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 (all results available upon request).

Figure B.1 shows the discontinuity in the likelihood of becoming an entrepreneur by repayment year, considering individuals that were repaying their student loans around the time of the 1998 bankruptcy reform. The underlying regression is estimated using the - rdplot - package from Calonico et al. (2015), using a polynomial fit of order 1, survey weights, no covariates and the default triangular kernel function to smooth observations.

Furthermore, Table B24 checks that the main covariates included in Table 13 and Table 14 do not correlate with being in the treated or control group. To do that, I perform simple OLS regressions to assess the correlation between the covariates and the indicator function for whether households are in the treated group, considering individuals that were in a window of 3 years from the 7th repayment year cutoff. Note that Columns (3)-(6) also include the running variable

Table B23: 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.

Figure B.1: RDD Estimates

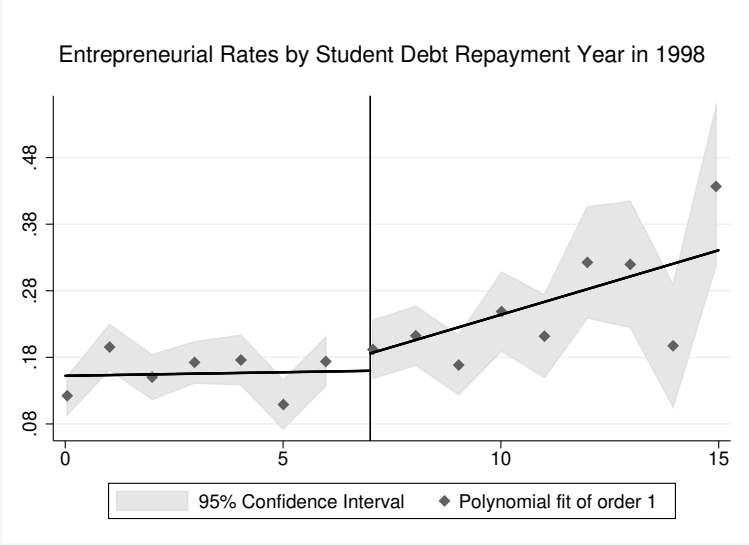


Table B24: Covariates and Treatment Effect

	Gender	Ethnicity	Marital Status	Assets	Amt Ed.Loan	Age
Subject to Reform	-0.0206	0.0486	0.0239	0.3265	-0.0811	0.3313
	(0.0175)	(0.0313)	(0.0221)	(0.3283)	(0.0924)	(0.7850)

Notes: Robust standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1. Survey weights are used.

as in Equation 9 to control for time (or cohort) effects that could otherwise confound the estimates.[2]

Finally, Table B25 conducts placebo tests to assess the validity of the RDD regressions in Ta-

[2]Within a window around the cutoff point, individuals belong to different cohorts. What this means is that, for example, they would be likely to have accumulated more or less assets, or to be a couple of years younger or older.

Table B25: 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.

ble 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) 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).

C Model Specifications

C.1 Time Transformation: the Education Stage

In Section 3, I have developed a life-cycle model of education and occupational choices, where the reference period for calibration purposes is a year. Since my framework has abstracted from other dynamic choices during the education stage of individuals' life after they decide to enroll in university (eg: college dropout), and there is full commitment to graduate, I have assumed that agents spend only 1 period in college to save on notation and simplify the analysis. Yet, I have to ensure the time-consistency across all three stages in life (i.e: education, working life and retirement) for the correct quantification and calibration of the model. In particular, since in real-

life agents spend 4 years in college, the value function for young adults that decide to enroll in university in their first year of their life $t = 1$ (or T_{edu}) is given by:

$$V^c(a_t, z_t, age_t) = \max_{a_{t+4}, d_{edu,t}, c_t} \left\{ \sum_{t=1}^{4} \beta^{t-1} u(c_t) + (\beta\theta_{age_t})^4 \int W^c(a_{t+4}, z_{t+4}, d_{t+4}, age_{t+4}) d\Xi(z_{t+4}|z_t) \right\}$$
$$\text{s.t.} : 4 * c_t + a_{t+4} = (1 + r_t)^4 a_t + 4 * (d_{edu,t} - \chi_t)$$
$$\text{and} : a_{t+4} \geq 0, \quad c_t \geq 0, \quad 0 \leq d_{edu,t} \leq \underline{d}$$

where I assume that individuals maintain the same profile of consumption across the 4 years spent in university, they pay the same yearly tuition – net of grants, as explained in previous sections – and choose the same yearly amount of college loans to pay for it. Their assets a_t are capitalized for 4 periods, and their future value W^c is discounted at the rate β^4. In a similar spirit, the value function for young adults that do not enroll in college in their first year of their life $t = 1$ (or T_{edu}), enter directly the labor markets and choose between being workers or entrepreneurs is given by:

$$V^{nc}(a_t, z_t, age_t) = \max_{a_{t+4}, c_t} \left\{ \sum_{t=1}^{4} \beta^{t-1} u(c_t) + (\beta\theta_{age_t})^4 \int W^{nc}(a_{t+4}, z_{t+4}, age_{t+4}) d\Xi(z_{t+4}|z_t) \right\}$$
$$\text{s.t.} : c_t + a_{t+4} = (1 + r_t)^4 a_t + (1 - \tau) \max\{\pi(a_t, z_t, age_t; r_t, w_t); \tilde{w}_{age_t}\}$$
$$\text{and} : a_{t+4} \geq 0, \quad c_t \geq 0, \quad k_t \leq \lambda a_t$$

C.2 Introducing a Corporate Sector

In an alternative version of the model, I include an unconstrained sector that contributes to total production in equilibrium. I do this to check that my results are not driven by the fact that my baseline economy has only one productive sector, in which entrepreneurs are constrained and in which outstanding student loans reduce the collateral that can be pledged to rent capital. Note that, in models à la Cagetti and De Nardi (2006) that include both entrepreneurial and non-entrepreneurial firms, it is often assumed that entrepreneurs produce using only capital, so that the size of the non-entrepreneurial sector is pinned down by the measure of workers in equilibrium (i.e: the share of the population who is not entrepreneurs). To remain close to the assumptions of the framework laid down in Section 3, I augment my economy with a corporate sector where unconstrained firms have all the same productivity and produce using capital and labor. Since corporate firms rent capital and labor as well, to obtain a well-defined measure of the unconstrained sector I have to assume that corporate firms operate according to a decreasing returns to scale technology with span of control parameter ν. Their production function is given by:

$$f(k, l) = A(k^\alpha l^{1-\alpha})^{1-\nu}, \quad \text{with} \qquad 0 < 1 - \nu < 1$$

In each period t, corporate firms rent capital and hire labor at the equilibrium input prices $r_t + \delta$

Table C26: Alternative Calibration w/ a Corporate Sector

Fitted	Value	Description	Moment	Model	Data
β	0.99	Discount factor	Interest rate	0.05	0.04
χ	1.00	College tuition	Educational rate	0.31	0.35
σ_a	3.50	Dispersion initial wealth	Top10 wealth share	0.69	0.70
ρ_{az}	0.25	Correlation initial (a, z)	Inter-generational earnings	0.30	0.28
ν	0.78	Entrepreneurs span of control	Top10 income share	0.43	0.45
A	1.475	Corporate productivity	Share corporate employment	0.30	0.30
σ_ϵ	0.305	St deviation prod shocks	Top25 employment share	0.57	0.65
ρ_z	0.92	Persistence entrep prod	Serial correlation revenues	0.84	0.80
λ	1.65	Financial constraint 1	Avg. corporate debt/GDP	0.27	0.35
η	0.125	Financial constraint 2	Δ Entr rates w/ – w/o Sloans	5pp	5pp
ζ_1^c	0.0573	Trend income growth (college)	Income growth year 0 - 30	0.84	0.86
ζ_2^c	0.0012	Curv. income growth (college)	Income growth year 30 - 40	0.07	0.05
ζ_1^{nc}	0.0310	Trend income growth (no coll)	Income growth year 0 - 30	0.48	0.48
ζ_2^{nc}	0.0004	Curv. income growth (no coll)	Income growth year 30 - 40	0.08	0.10

and w_t, always determined in GE. Their profits are then distributed lump-sum to all households in the economy. In essence, corporate firms will differ from entrepreneurial businesses in two dimensions. First, their productivity A will be allowed to differ from the one of the entrepreneurial sector to reflect size differences across entrepreneurial businesses and corporations. Second, corporate firms will not face a borrowing limit when renting capital using financial markets. Thus, I modify my calibration strategy to be so that the value assigned to A imply that the share of employment of the corporate sector is 30%, as estimated for the US based on Compustat firms (see Davis et al. (2006)). Results from the estimation are presented in Table C26.

There are three main differences in the calibrated values of this extended model version with respect to the baseline case. The first one, is a 20% decrease in the parameter η that governs the student debt-related entrepreneurial borrowing constraint. Since the presence of another productive sector increases the demand for capital and labor, the GE wage and interest rate increase, further discouraging indebted college graduates from entering entrepreneurship. Secondly, the discount factor β has to rise to compensate for the upwards pressure on the equilibrium interest rate caused by the increase in the demand for capital in the economy. Moreover, a higher GE wage induces young adults at the margin to select out of college, which implies a slightly lower calibrated value for the college tuition κ in order to match the average college attainment rate in the US over the last decade (parallel to that, the value for the parameter ϕ_1 governing the extent of need-based grants increases by more than 20% to match the average share of tuition covered by means-tested scholarship). Finally, the fit of untargeted moments is close to the one of the baseline model: yet,

since the presence of another productive sector increases the demand for capital and labor, the GE wage and interest rate increases, which lowers entrepreneurship by roughly 1 p.p. with respect to the baseline economy for both college and non-college graduates, with and without loans. Their respective share within the entrepreneurial sample stays instead relatively the same.

C.3 Introducing Student Debt Forbearance

As of today, roughly 20% of outstanding education loans are reported to be in deferment or forbearance, two available options for borrowers who are (currently) unable to pay back their debt, but intend to in the future.[3] The main differences between these two options for pausing student debt payments regard the average length of the programs, their qualifying requirements and the accrue of interest rates. In particular, deferment typically can last three years, while forbearance is granted for maximum 12 months for at most 3 times. To qualify for deferment, agents have to prove they are enrolled in school at least half time, or they are facing financial hardships, such as being unemployed or undergoing medical treatment for example. Instead, a specific qualifying event is usually not necessary to file for forbearance. Finally, under deferment, interest does not accrue on subsidized federal student loans and Perkins loans, while interest accrues on all types of loans under forbearance. Since 90% of borrowers in deferment are those who enroll in post-graduate schools, not included in my model, I keep my focus on student debt forbearance, especially given the relevance that forbearance has played in the recent pandemic years.[4]

I introduce forbearance in the baseline model in a stylized way, by assuming that college borrowers are subject to a "forbearance" shock with probability μ, which allows them to stop repayments for a year. Although the decision to apply for forbearance is surely an endogenous choice, such simplifying assumption keeps the model tractable and allows me to qualitatively study the implications of student debt forbearance for my framework. Since, according to the current US legislation, student debt forbearance doe not impact individuals' credit scores, I assume that the only cost of forbearance is the interest rate accrued during the pause from repayment, which is capitalized on top of individuals' outstanding balances. Note that, since payments are suspended and interest is capitalized during the period spent in forbearance, the subsequent amount individuals have to pay by the end of their repayment term increases after (any) episode of forbearance. Finally, I calibrate μ such that the average time individuals spend in forbearance is 1.75 years.[5] Results from the calibration exercise for the internally fitted parameters are reported in Table C27.

Externally fixed parameters are by default kept at their baseline values. The main difference in the quantification of this model extension is that the value of η – the student debt-related entrepreneurial borrowing constraint – inferred through the calibration procedure is roughly 25% lower than in the baseline economy. This is consistent with the fact that, under forbearance, agents

[3] See `https://www.experian.com/blogs/ask-experian/research/student-loan-debt-and-repayment/`.
[4] For more information see `https://educationdata.org/deferment-vs-forbearance-student-loan`.
[5] See the report at `https://www.gao.gov/products/gao-18-163`.

Table C27: Alternative Calibration w/ a Student Debt Forbearance

Fitted	Value	Description	Moment	Model	Data
β	0.98	Discount factor	Interest rate	0.04	0.04
χ	1.25	College tuition	Educational rate	0.37	0.35
σ_a	3.50	Dispersion initial wealth	Top10 wealth share	0.69	0.70
ρ_{az}	0.25	Correlation initial (a, z)	Inter-generational earnings	0.31	0.28
ν	0.79	Entrepreneurs span of control	Top10 income share	0.45	0.45
μ	0.875	Prob delaying payments	Share Sdebt in forbearance	0.20	0.20
σ_ϵ	0.305	St deviation prod shocks	Top25 employment share	0.63	0.65
ρ_z	0.92	Persistence entrep prod	Serial correlation revenues	0.84	0.80
λ	1.65	Financial constraint 1	Avg. corporate debt/GDP	0.30	0.35
η	0.11	Financial constraint 2	Δ Entr rates w/ – w/o Sloans	5pp	5pp
ζ_1^c	0.0573	Trend income growth (college)	Income growth year 0 - 30	0.84	0.86
ζ_2^c	0.0012	Curv. income growth (college)	Income growth year 30 - 40	0.07	0.05
ζ_1^{nc}	0.031	Trend income growth (no coll)	Income growth year 0 - 30	0.48	0.48
ζ_2^{nc}	0.0004	Curv. income growth (no coll)	Income growth year 30 - 40	0.08	0.10

can pause their yearly payments and hence do not have to serve on their student debt obligations, which may increase the amount of capital they are able to rent as entrepreneurs through collateral pledgeability.[6] No other cost or credit reduction is in place after forbearance, and the higher repayment amounts individuals have to disburse after an episode of forbearance on average hit them later on in their life-cycle, when they have already accumulated savings as a buffer. As a final remark, note that the estimation of the model predicts a slightly higher value for the span of control parameter: this may indicative of the fact that, as forbearance allows entrepreneurs to rent higher capital, this counterfactual economy may in principle register an increase in entrepreneurship, which hence is partially counterbalanced by a decrease in the extent of entrepreneurial profits.

[6]Interestingly, while almost all untargeted moments stay roughly the same in this model extension, the share of student borrowers decreases by 15 p.p. with respect to the baseline model (the education rate is instead targeted). This suggests that, the higher expected cost of taking out loans to finance college, given by the probability of pausing repayments and accumulate higher interest rates, discourage some borrowers at the margin from getting student debt.

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