Scarred Young Entrepreneurs: the effects of education policies*

Lisa Kerdelhué†

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Abstract

This paper examines the impact of education financial aid for education on entrepreneurship entry and hence on consumption and welfare. In this objective, I build a quantitative general equilibrium life-cycle model with entrepreneurial choice, in which individuals are heterogeneous in their ability, productivity and wealth. The model shows that relaxing the student borrowing constraint leads to a drop in the entrepreneurship rate, while expanding access to scholarship grants increases the entrepreneurship rate. As risk and inequalities increases with the share of self-employed, the expansion of scholarship grants has a negative impact on average welfare, while the extension of the student loan amount has a positive effect on average welfare.

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†Aix-Marseille University, CNRS, EHESS, Centrale Marseille, AMSE. E-mail: lisa.kerdelhue@gmail.com

1 Introduction

Since the 1990s, the share of self-employed among tertiary educated individuals has been decreasing in the United States (see figure 1). The 21 percent drop recorded between 2000 and 2018 for the tertiary educated is larger than the 15 percent drop in the share of self-employed among all employed. In the same period, the number of US individuals with tertiary education has increased, as figure 1 suggests. The startup rate, measured as the share of new employer firms out of all employer firms, has also been declining[1]. As entrepreneurship and start-ups in particular are responsible for an important share of job creation and productivity growth gains, explaining this lack of business dynamism is a key issue[2]. Entrepreneurs with higher education are more productive as suggested by the higher income (Poschke (2013) and Michelacci and Schivardi (2017)) or number of patents they generate (Aghion et al. (2017)). Training helps to generate new ideas. The lack of social mobility may alter business dynamism if access to those trainings is limited for young with high ability but low-income parents.

The expansion in the number of young adults with tertiary education has been accompanied by an increase in the amount of students' debt. This is shown in Figure 2, which depicts the evolution of total student debt together with that of the share of self-employed in tertiary educated individuals. The amount of student debt in the US has more than doubled since 1990s [3]. Since the initial collateral is important to start a business (Evans and Jovanovic (1989)), the presence of financial constraints due to student debt can be detrimental to business creation. This may be a major issue in explaining decline in self-employment among the tertiary educated during the last decades.

[1] see figure A.12 in the appendix

[2] Several potential factors have been suggested as causes of the decline of firm entry, including changes in the demographic structures of the population (Karahan et al. (2019)), increased regulations (Gutiérrez and Philippon (2019)) and slowdown in knowledge diffusion Akcigit and Ates (2019).

[3] In the appendix, I also show the evolution of the start-up share compared to enrollment for young adults, the total amount of student debt and the average student debt.

Figure 1: **Enrollment and share of self-employed among tertiary educated**

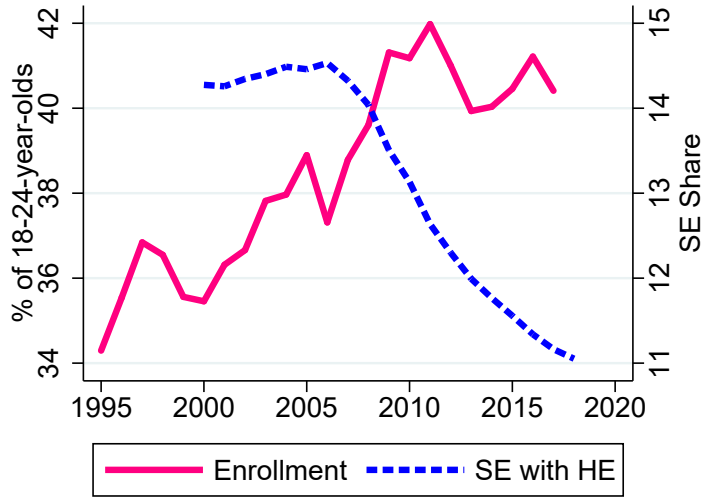
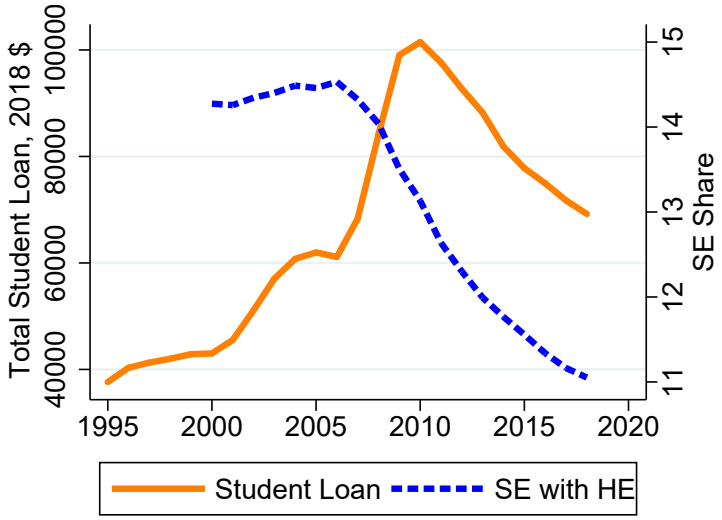


Figure 2: **Total Student Debt and share of self-employed among tertiary educated**



Motivated by these empirical facts, in this paper I study how accessibility to student loans affects entrepreneurship. Scholarships and grants are a potential alternative to student loans as means to finance tertiary education. I thus ask in the paper what would be the implications for efficiency and welfare of replacing students loans with grants.

As a first step of the analysis, I document the empirical relationship between higher education financing and self-employment in the United-States. Using individual survey data, I show that indebted young adults who have been to college have a lower probability to be self-employed than those who never accessed a student loan. Importantly, this effect lasts over the life-cycle. In my empirical strategy, I exploit the Higher Education Reconciliation Act (HERA) of 2006, which increased the yearly borrowing caps for student loans [4] and I find that expanding the amount of student loan reduces the probability to become self-employed.

These empirical results motivate a theoretical model with detailed life-cycle behavior, which can be used to assess the effects of different financial aid policies in education on self-employment and macroeconomic aggregates. In a second step, I thus build a life-cycle model with entrepreneurship choice and financial constraints, which predicts that increasing the maximum borrowing amount for students leads to a lower rate of self-employed among adults. I compare the effects of this credit policy to a policy that increases access to grants for higher education, which are financed by adjustment of progressive taxation in the long run. I find that contrary to the effect of higher borrowing, providing grants increases the self-employment rate. When the self-employment rate is reduced, the higher educated work for the corporate sector. With the credit expansion, the corporate sector production increases and dominates the reduction of the entrepreneurial production in the long run. Therefore, the credit expansion for student increases total production and aggregate consumption. The grants policy leads to opposite results as total production and consumption are reduced. Those policies also have different effects on the long run average welfare. The rise of the entrepreneurial sector increases consumption risks and inequality. As a result, availability of student loans has a positive average welfare effect because self-employment is reduced and average consumption increases. However, increasing the student grants amount has a small negative impact on welfare because there is more risk and inequality in this economy.

[4] They were unchanged since 1992

This paper relates to the literature that studies the aggregate effect of the financing of higher education (Abbott et al. (2019), Krueger and Ludwig (2013)). In this line of work, entrepreneurship choices are not included. My contribution is thus to consider entrepreneurship choices and their interaction with financial policies for higher education.

My work is also related to the literature evaluating the extent to which initial conditions have strong effects on firm dynamics. Pugsley et al. (2019) estimates that firm survival is mostly determined by ex-ante heterogeneity rather than persistent ex-post shocks. In my framework, I include ex-ante heterogeneity in the education level of the entrepreneur and financing condition to access higher education and I also consider ex-post shocks that generate reasonable saving behavior for entrepreneurs.

This paper also relates to the literature that identifies factors affecting firm entry. Karahan et al. (2019) shows that the slowdown in labor supply growth explains the decline in the startup rate. Besides, the literature has documented that the share of start-up has declined in the past decades, particularly among skilled entrepreneurs (Decker et al. (2014)). The lower supply of skilled entrepreneurs may explain why the skills premium is higher for entrepreneurs than workers (Michelacci and Schivardi (2017), Poschke (2013)).

My analysis also builds on recent empirical studies which have shown that the probability to become an inventor is highly correlated with parent's earnings (Bell et al. (2015)) but that this effect is driven by parents' education (Aghion et al. (2017)). Therefore, financing access to education is a key in determining high skilled entrepreneurship. This paper is also based on Devaraj and Patel (2020), which finds that having student loan reduces the odds of self-employment by 1.3 percentage points. They also find that access to income based repayment increases the odds for self-employment. I extend their analyses by studying the effects of student loan on the life cycle. If the student indebtedness only affects the decision of young workers its impact may be negligible for the economy. However, if young indebtedness has long lasting effects throughout the adult's life, it may have an important impact also at the macroeconomic level.

The remainder of the paper is organised as follows. Section 2 empirically analyzes the effect of student loan on entrepreneurship choice. Section 3 describes the theoretical model. Section 4 focuses on the calibration. Section 5 evaluates the model. Section 6 uses the model to make some quantitative experiments. Section 7 evaluates the welfare impacts of those experiments.

2 Empirical Evidence

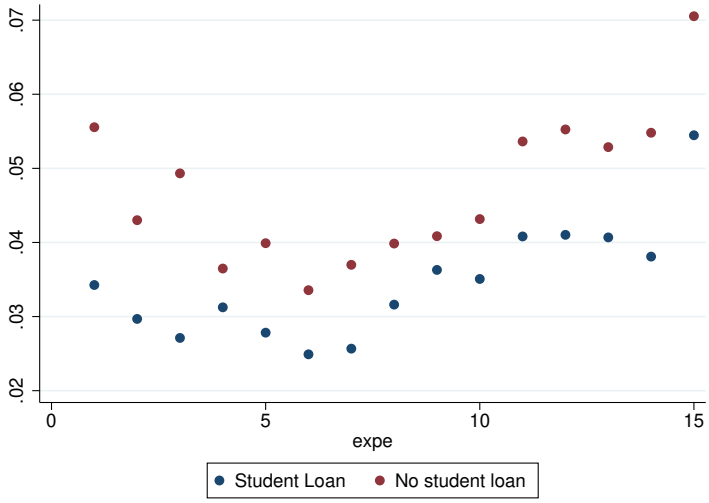
First, I compare the evolution of occupational decisions for individuals with some college education who had a student loan and their counterparts with some college education who had no student loan. I then turn to an econometric framework to discuss the short and long run effects of student loans. My empirical analysis relies on the NLSY97 data. The NLSY97 is an extensive panel that follows individuals from when they were 12 to 16 to 32 to 38 when interviewed for the 18th round in 2017-2018. Thus, I can follow an important part of the career of individuals. Second, individuals born at the end of the 1990s were directly concerned by the rising cost of college and the rise of student indebtedness. Third, this survey provides detailed information about individuals and family factors that can influence education and occupational choice.[5]

2.1 Descriptive Statistics

Figure 3 shows the probability to be self-employed for a certain number of years of experience for individuals with college education, separating those who had a student loan when entering the labor market and those who had not. The probability to become self-employed is higher for those who had no student loan for any level of experience. The first intuition would be that a student loan only affects individuals at the beginning of their career. Interestingly, the effect of student loan on self-employment decision seems to last over the life cycle and even to increase over time.

[5]See the appendix for a more comprehensive database description

Figure 3: **Probability to be self-employed, depending on having a student loan**



Note: The blue dot represents the probability of self-employment for individuals with some college education who had a student loan. The red dot represents the probability of self-employment for those who had no student loan. Sample: individuals who are more than 20 years old and are in the labor force. Sources: NLSY97

2.2 Baseline Regression

In this section, I assess how the pre-labor market characteristics account for the self-employment choices and in particular how student loan before market entry affects these choices. I estimate a logit model assuming that the log-odds of each response follow this model:

$$\log \frac{P_{iet}}{P_{ist}} = \alpha + \beta_D D_{i1} + X_{it} + \varepsilon_{it} \tag{1}$$

The dependent variable is the log-odds ratio of being self-employed rather than salaried, where P_{iet} is the probability that individual i is self-employed at time t and P_{ist} the probability that the individual i is salaried at time t. I observe the coefficient on D_{i1}, a binary variable which takes the value one if the individual had a student loan at labor market entry. I only include individuals who had entered the labor market and have been to college. All specifications control for gender, race, year-of-birth, student performance,

risky behavior and experience. I control for risky behavior because Levine and Rubinstein (2018) has shown that the probability to be self-employed is correlated to the risky behavior when young. The risk variable is a categorical variable corresponding to the self-assessment of risky behavior[6]. Since student borrowing may be endogenous to family characteristics as self-employment choices, I also control for Father's Education, Mother's education and wealth in 1997. I chose to focus on family wealth instead of family income because it is a better proxy of credit constraint than family income. By focusing on person-year observations, each person employment choice is defined by the number of years spent as self-employed and salaried.

Table 1 reports the results of the first estimation in column (1). Holding other things constant, the odds of an individual who had a student loan becoming a self-employed are 77% (i.e. $\exp(-0.26) = 77$) of those similar without a student loan. The odds are also lower for women, non-white people and higher for those with a higher level of experience. In column (2), I include family characteristics[7] and find almost the same odds of self-employment for those having a student loan relative to those similar without a student loan. The odds of becoming self-employed is higher for those with a mother with higher education and those with parents with a higher wealth level.

[6]This is the answer to the question Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Individuals have to rate themselves between 0 and 10, where 10 corresponds to someone "fully prepared to take risks"

[7]Individuals for whom there is no information on family wealth drop from the sample in the second estimation.

Table 1: **Effect of student loan on self-employment**

	(1)	(2)
	Coef./se	Coef./se
Student Loan	-0.258***	-0.246***
	(0.054)	(0.065)
Woman	-0.575***	-0.597***
	(0.052)	(0.063)
Hispanic	-0.415***	-0.285**
	(0.079)	(0.100)
Black	-0.299***	-0.405***
	(0.073)	(0.103)
Log of ASVAB score	0.061	0.045
	(0.042)	(0.055)
Risk	0.047	0.058*
	(0.029)	(0.034)
Experience years	0.081***	0.079***
	(0.007)	(0.008)
Mother's education		0.018***
		(0.006)
Father's education		-0.005
		(0.006)
Log of family wealth		0.111***
		(0.024)
N	43895	31589
Pseudo R-squared	0.0303	0.0387

[1] Notes: The symbols ***, ** and * mean significant at the 1%, 5 % and 10 % levels.

In this section, I use self-employment as a proxy for entrepreneurs. Some may argue that this is not a good proxy for entrepreneurs since it gathers "opportunity" and "out of necessity" self-employment. In the appendix, I

also estimate the relationship between student loan and another proxy for entrepreneur. I follow Levine and Rubinstein (2018) in defining entrepreneurs as individuals who run an incorporated business. An incorporated business implies the creation of a legal entity, contrary to an unincorporated business. Incorporation means more fees and regulations but also lower financial and legal risks. Levine and Rubinstein (2018) finds that incorporated have a higher level of education, have activities demanding higher skills and needed for running a productive business. They also find that self-employed rarely switch from one corporation status from another. I find that the results are similar when I use only incorporated self-employed as entrepreneurs (as shown in the appendix). In the next sections, I keep self-employment as a proxy to keep the sample of entrepreneurs larger.

2.3 Experience and student loan

In order to assess if student loans have persistent effects on occupational choice and earnings, I use the following panel regression:

$$y_{it} = \alpha + \beta_D D_e + \beta_E \text{expe}_{it} + \beta_{DE} D_e.\text{expe}_{it} + X_{it} + \varepsilon_{it} \tag{2}$$

The outcome y is self-employment status that is a binary variable for individual i at calendar year t. I focus on having a student loan at labor market entry D_e and the categorical variable for experience $expe_{it}$ of an individual i at time t. I also include an interaction between student loan at labor market entry and experience. X_{it} is a list of control. ε_{it} is the error term and can be decomposed into time invariant fixed effect θ_i and time varying error μ_{it}:

$$\varepsilon_{it} = \theta_i + \mu_{it} \tag{3}$$

The coefficient β_{DE} on $D_e.\text{expe}_{it}$ captures deviations in the probability to be self-employed from the typical experience profile at each experience year and hence the shift due to the initial student borrowing. Figure 3 suggests that the gap self-employment probability between those with a initial student debt and those without is high at the beginning of the career, is lower between 5 and 10 years of experience and higher after 10 years

of experience. Therefore, I decompose experience in low experienced ($<$ 5years), middle experienced (between 5 and 10 years of experience) and high experienced ($>$ 10 years).

Student borrowing is endogenous and can be correlated with unobservable cofounders such as risk aversion, liquidity constraint or taste for a specific occupation. Most of those cofounders are pre-labor market entry characteristics. Therefore, in a first estimation, I include individual fixed effects. Time invariant pre-labor market characteristics such as ability, gender, race and log family wealth are included in the fixed effects. In a second estimation, I control for time variant characteristics which can affect self-employment decision. I include individual's age to disentangle the effects of age and working experience, the education level[8] since it can affect the probability to be self-employed (as shown by Poschke (2013)) and the calendar year to control for the business cycle. The sample contains individuals who have been to college and are older than 21.

Table 2 shows the results of the regression assessing if the student loan effect lasts over time. First, I find that, for those without a student loan, the probability to be self-employed increases with the level of experience. The odds to be self-employed for those with a low level of experience is 1.0397 (i.e. $\exp(0.038)$) of those similar without experience (respectively $\exp(0.083) = 1.086$ for those with a high level of experience). For those with a student loan, the self-employment probability is reduced by 1.8 percentage points for below 5 experience years ($\exp(-0.018) = 0.982$) and by 2.8 percentage points above 10 experience years ($\exp(-0.028) = 0.972$) compared to individuals with the same level of experience. For those who had a student loan, experience still has a positive effect on the probability to be self-employed. Indeed, among those who had a student loan, the odds to be self-employed for those with a low level of experience is 1.020% (i.e. $\exp(0.038) * \exp(-0.018) = 1.020$) of those similar without experience (respectively $\exp(0.083) * \exp(-0.028) = 1.056$ for those with a high level of experience) One mechanism that explains the persistence of the effect of student loan on self-employment is the accumulation of net worth. Student

[8]The reference variable for the categorical variable is Associate/Junior College

indebtedness causes a gap between the wealth of individuals which persists with age. In graphs 4 and 5, I show that when individuals are older, there is still a high difference in the amount of individuals which have a negative net worth between those who had a student loan and those who had not. A low net worth indicates that the individual can be borrowing constrained. Among those who are 35 years old, there is a lower share of individual potentially borrowing constrained for those who have a high level compared to a low level of experience. Therefore, the borrowing constraint following a student loan seems to persist over time.

When I add the control variables, the effects of student loan for different levels of experience is close. The coefficient on student loan represents the effect of having a student loan after market entry and it is not significant.

Table 2: **Effect of student loan on self-employment, by experience**

	Self-Employed	Self-Employed
Student Loan and low experienced	-0.018***	-0.016**
	(0.007)	(0.007)
Student Loan and middle experienced	-0.015**	-0.014 *
	(0.01)	(.0070481)
Student Loan and high experienced	-0.028***	-0.025***
	(0.007)	(0.008)
Low experienced	0.038***	0.016***
	(0.004)	(0.006)
Middle experienced	0.054***	0.011
	(0.004)	(0.008)
High experienced	0.083***	0.016
	(0.005)	(0.011)
Student Loan	0.008	-0.000
	(0.007)	(0.007)
Age		.0031584
		(.0034883)
Bachelor Degree		0.004
		(0.003)
Master Degree		-0.001
		(0.006)
PhD		-0.019
		(0.017)
Professional Degree		0.006
		(0.011)
Individual Fixed Effects	Yes	Yes
Controls	No	Yes
Observations	32887	32887
Individuals	2553	2553

Notes:

[1] The symbols ***, ** and * mean significant at the 1%, 5 % and 10 % levels.

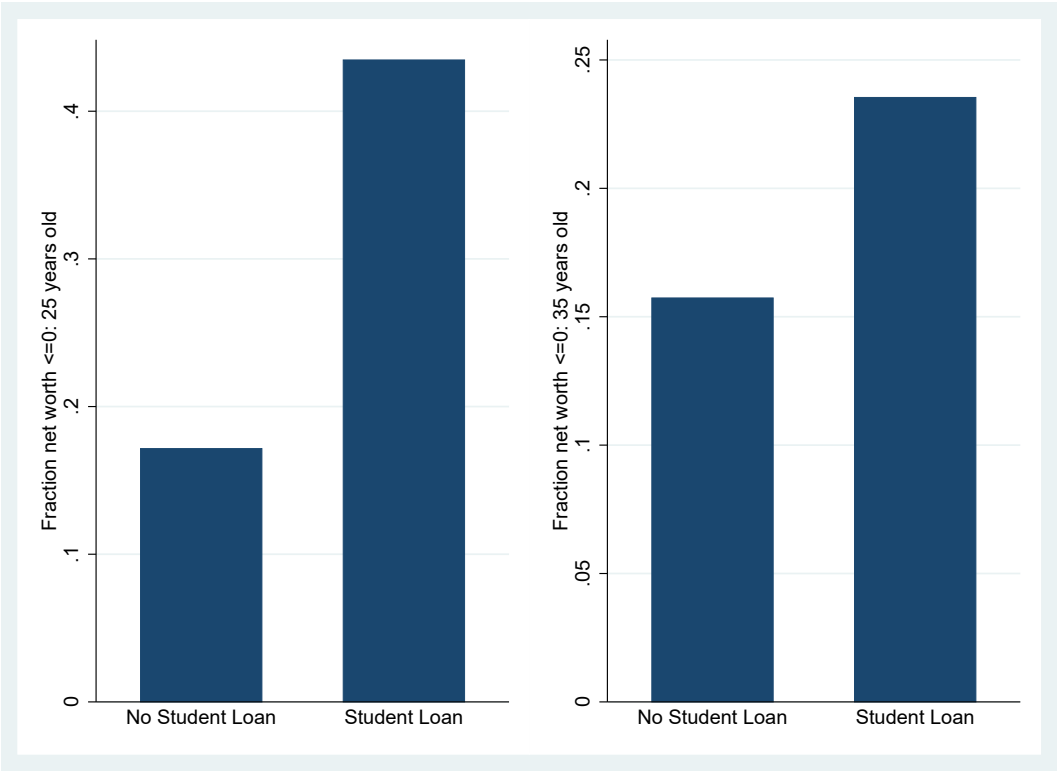


Figure 4: **Proportion of individuals with negative net wealth, by age**

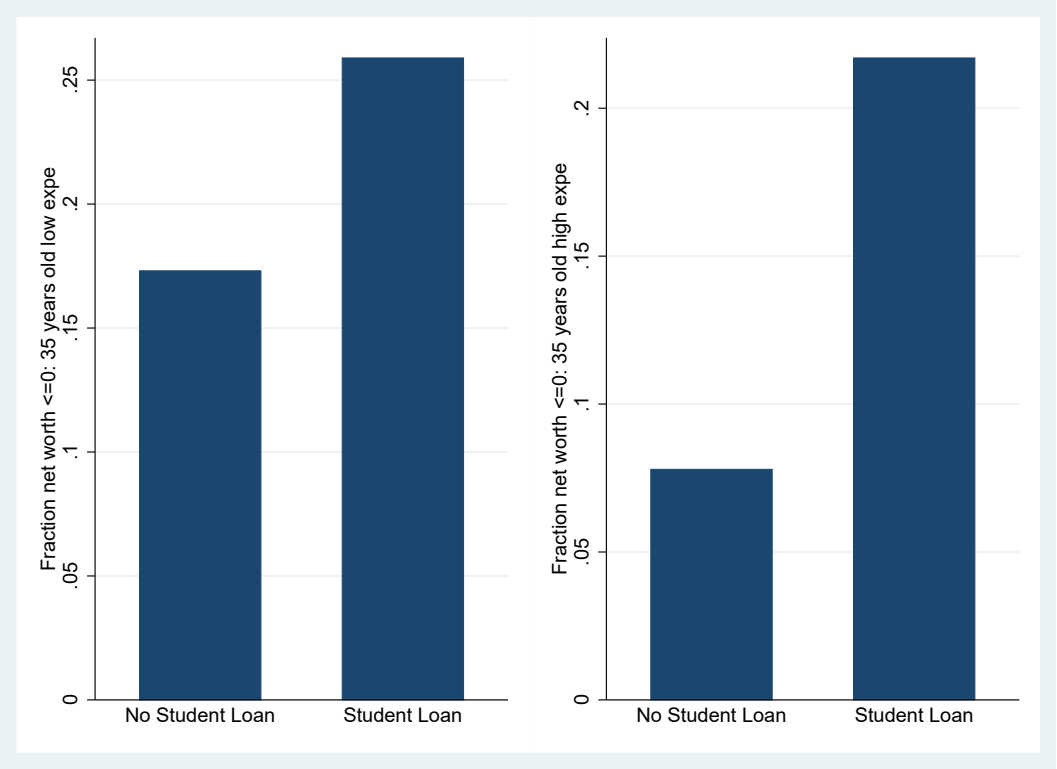


Figure 5: **Proportion of individuals with negative net wealth among 35 years old, by experience**

2.4 Legislative Change

To address reverse causality issues, I also focus on an exogenous legislative change in federal student loan maximums resulting from the Higher Education Reconciliation Act (HERA) of 2006. From July 2007, it increased the yearly borrowing limit for graduate federal loans from 18500$ to 20500$ (taking into account subsidized and unsubsidized federal loans).

As shown in figure 2 and A.11, the years 2007-2008 are followed by a peak in the average and total amounts of student loan. The cumulative average student debt for graduate school completers increased from 43900 to 60000 $ between 2007-2008 and 2011-2012 (National Center For Education Statistics).

Individuals born in 1984 were 22 in 2006. They were finishing 4-years college and had the typical age to take decisions about their graduate studies

and how to finance them. Figure 6 shows the distribution of accumulated student loan for individuals born in 1984 and those born in 1983 in 2017. The distribution moves to the right between those born in 1983 and those born in 1984. Students born in 1984 had accumulated higher student debt at the end in 2017 than those born before.

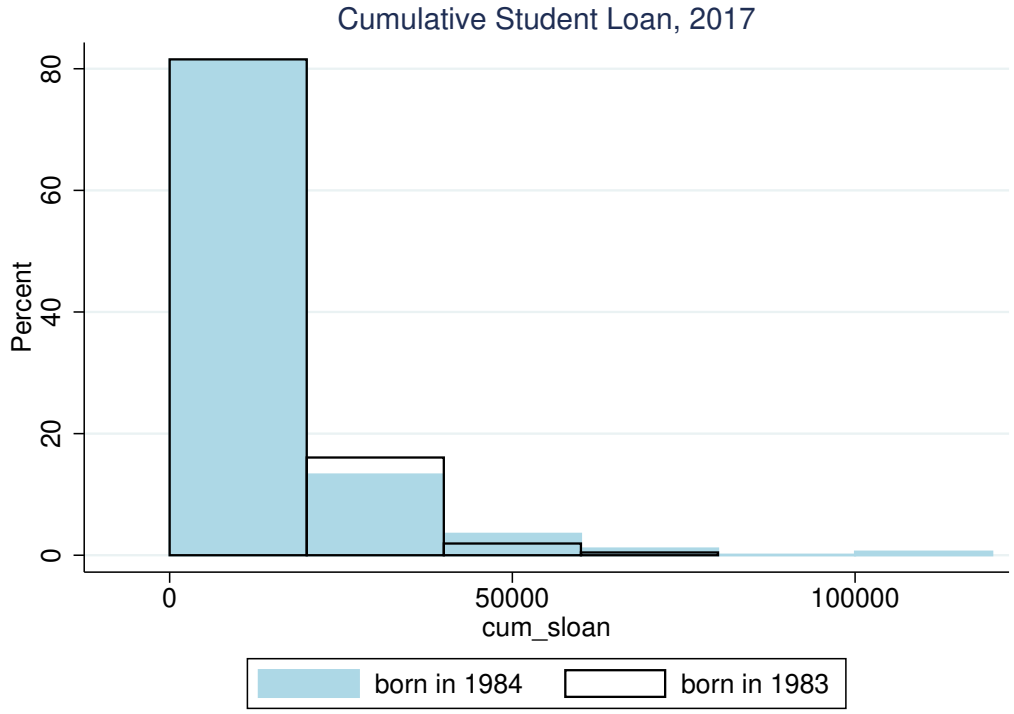


Figure 6: Distribution of cumulative student loan, by year of birth

Figure 7 shows the probability to be self-employed, depending on having a student loan and the year of birth. The effect of student loan on the probability to be self-employed seems more important for those born in 1984.

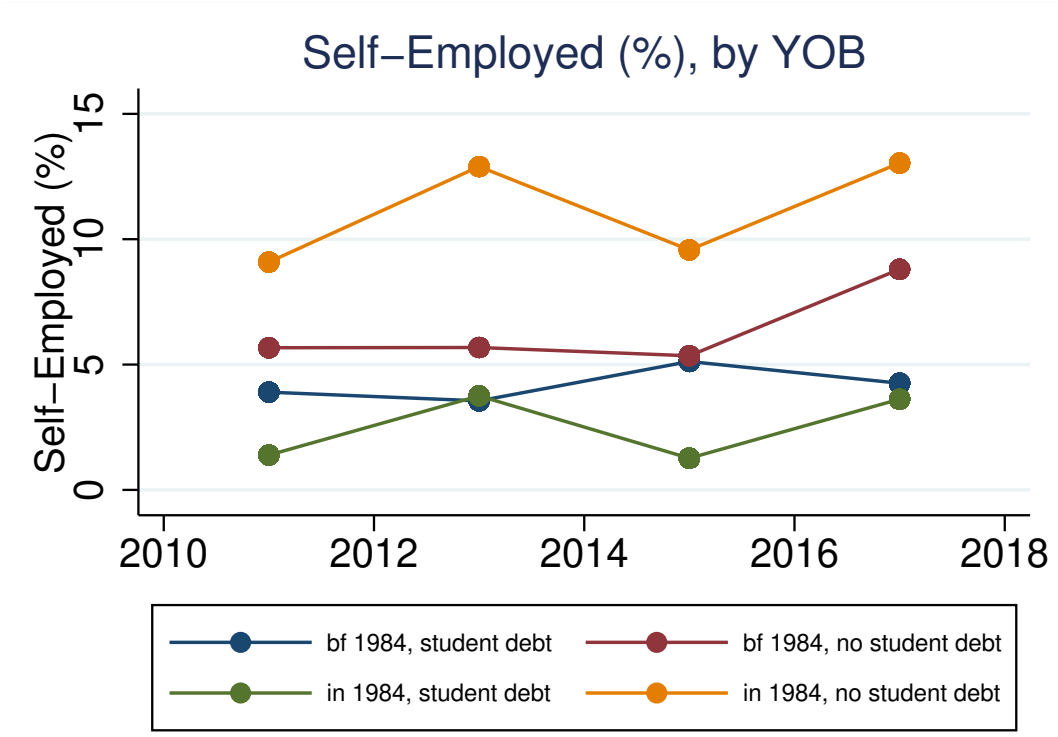


Figure 7: Self-Employment, depending on having a student loan and year of birth

I estimate a logit model assuming that the log-odds of each response follows this model:

$$\log \frac{P_{iet}}{P_{ist}} = \alpha + \beta D_i.T_i + \delta D_i + \theta T_i + X_{it} + \varepsilon_{it} \tag{4}$$

The dependent variable is the log-odds ratio of being self-employed rather than salaried, where P_{iet} is the probability that individual i is self-employed at time t and P_{ist} the probability that the individual i is salaried at time t. D_i is a binary variable set to 1 if the individual had student loan and T_i is a binary set to 1 if the individuals is from the cohort born in 1984 (which has been affected by the exogenous rise in federal loan limit). $D_i.T_i$ is an interaction. I run the estimation from 2010 in order to exclude the Great Financial Crisis and to have individuals old enough. I control for the log of family wealth, log of ASVAB score, gender, race and age.

Table 3 shows the results of this regression about the effect of having a student loan after HERA reform. Among individuals without student loan, those that could have benefited from the HERA reform do not have a significant higher probability to be self-employed. The odds of an individual who had a student loan becoming a self-employed are 81 % of those similar without a student loan. The odds of an individual who had a student loan and were affected by the HERA reform are 65 % of those with student loan not affected by the HERA reform. Therefore, relaxing the borrowing constraint of students seems to reduce the probability to become self-employed.

Table 3: **Self-employment status and HERA**

	Self-Employment
HERA	0.183
	(0.149)
Student Loan	-0.213**
	(0.095)
HERA.Student Loan	-0.452**
	(0.223)
Log of family wealth	0.166***
	(0.033)
Log of ASVAB	0.196**
	(0.082)
Woman	-0.426***
	(0.085)
Hispanic	-0.394***
	(0.143)
Black	-0.415***
	(0.143)
Age	0.071***
	(0.015)
Observations	12,840

Notes:

[1] The symbols ***, ** and * mean significant at the 1%, 5 % and 10 % levels.

3 The Model

This section introduces a dynamic general equilibrium model with endogenous education and entrepreneurial choice. The economy consists of a corporate sector and a unit measure of ex post heterogeneous agents. Those agents are heterogeneous in age, wealth, studying ability, education, entrepreneurial ability and labor productivity. The key innovation of the model is to include an education choice that affects the entrepreneurial decisions at the individual level over the next lifetime periods. I replicate the stylized facts documented above whereby debt among young people hinders their entrepreneurship decision even when they get older. The youngest households decide whether to get a college degree, based on their studying ability and initial wealth. If they do not go to college, they are full-time employee and if they study they work part-time. When the individual is older, at each age, she decides whether to start a business, based on her entrepreneurial ability and wealth (as in Cagetti and De Nardi (2006)). Therefore, the economy is composed of entrepreneurs who receive profit from small and medium businesses and employees who receive a wage by working for the corporate sector and entrepreneurs.

3.1 Demographics

I use a life-cycle model with intergenerational altruism. Time is discrete and indexed by $t = 1, ..., T$. At each time period, the total population of unit mass is divided among J generations indexed by $j = 1, ..., J$. Individuals go through these J stages of life and move from group j to group $j + 1$ with the probability of aging π_d. Retirees die with a probability π_d. When they die, they are replaced by a descendant who inherits their estate. Households enter the first generation with this same probability π_d. When a old person dies, she bequeathed her assets to its offsprings entering the model. For simplification, I assume that the total population and the survival rates are time-invariant. Therefore, the relative share of each age cohort in the

population is constant over time. [9]

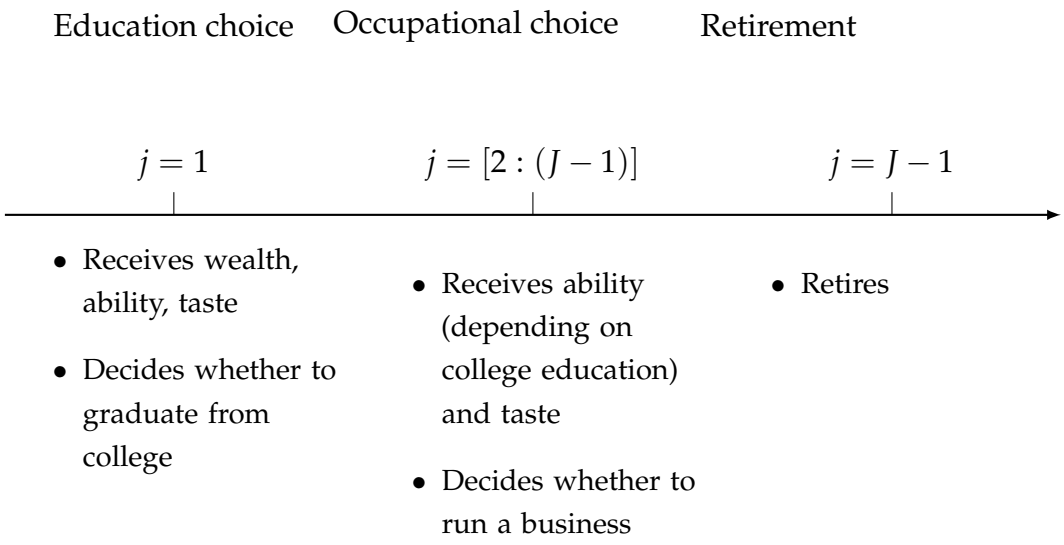


Figure 8: **Timeline of individual's decisions**

3.2 Timing

Figure 8 describes the timeline of individual's decisions. Agents make decisions that depend on their age j. Individuals enter the economy as young at age 1. They receive initial wealth from their parents, ability and taste shocks. They decide to graduate or not based on these characteristics. After their education choice decision, they observe their labor market productivity and consume, supply labor and save. Higher education graduates pay an education cost and can borrow to finance it. From age 2 to age $J - 2$, individual's can be self-employed and run a business or be an employee. At the beginning of each age j, they draw an entrepreneurial ability that depends on their higher education level and taste. They have a certain wealth level and face a collateral constraint. They decide whether to start a business based on this information. At age J, they retire.

[9] Because the total population is of unit mass, each age contains 1/J of the total population.

3.3 Preferences

The households value consumption. The household's utility is given by:

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma} \tag{5}$$

and discount the future at rate β. They are perfectly altruistic toward their offsprings.

3.4 Production

Each individual has two types of productivity. The entrepreneurial productivity θ_t is the ability to invest in capital and labor more or less productively using the personal production function. Working ability (z_t) is the ability to produce by supplying working hours to others. Each individual knows its quantity of assets a_t, entrepreneurial productivity θ_t and employee productivity z_t at the beginning of the period and chooses whether to be an entrepreneur or an employee during the current period. The entrepreneur can borrow, invest in capital k_t, hire labor n_t and run a technology depending on their entrepreneurial productivity θ_t . The production of the entrepreneur is given by:

$$f(k_t, n_t) = \theta_t \left(k_t^{\gamma} (1+n_t)^{1-\gamma}\right)^{\nu} \tag{6}$$

where ν is the return to scale and γ entrepreneurial capital income share. Entrepreneurs face decreasing returns to scale because their management of bigger projects is more complex (Lucas Jr (1978)).

Numerous firms are not managed by a single entrepreneur and are not likely to face the same financing restrictions as entrepreneurial firms. I model another sector of production as in Quadrini (2000): the non-entrepreneurial sector which represented by a standard Cobb-Douglas production function:

$$F(K_{c,t}, N_{c,t}) = A (K_{c,t})^{\alpha} (L_{c,t})^{1-\alpha} \tag{7}$$

where K_t^c and L_t^c are the total capital and labor inputs in the non entrepreneurial sector and A is constant. In both sectors, the depreciation rate is δ.

I follow Katz and Murphy (1992) and Heckman et al. (1998) to model aggregate labor L_t as a constant elasticity of substitution aggregator of two types: those with with a college degree G and those with a high-school degree H. Labor is aggregated following a CES function:

$$L_t = \left(\theta_H L_{t,H}^{\varepsilon_{HG}} + (1-\theta_H) L_{t,G}^{\varepsilon_{HG}}\right)^{1/\varepsilon_{HG}} \tag{8}$$

where ε_{HG} is the elasticity of substitution between the two types and θ_H is the CES weight parameters for the high-school type. Labor markets for both high-school graduates H and college graduate are assumed to be competitive.

3.5 Financial Markets

Agents trade claims to physical capital and risk-free government bonds. Market are incomplete such that agents cannot buy state-contingent insurance against individual risk. Competitive financial intermediaries transact all financial contracts. Returns on capital and government bonds are the same because of no arbitrage. Individuals with positive savings receive an interest rate r_t, while others borrow at the same rate r_t.

3.6 Government

The government levies taxes and can issue public debt. The government has to finance spending G_t, to finance the education subsidies and retirement system and to pay interest payments on its accumulated debt $r_t B_t$.

As in Heathcote et al. (2017), taxes follow the function:

$$T(Y_t) = Y_t - (1-\tau_t)\frac{Y_t^{1-\xi}}{1-\xi} \tag{9}$$

where Y_t represents income, ξ represents the taxation progressivity and τ_t is the level of taxes allowed to adjust to meet the government budget

constraint. Total tax is denoted T_t. The government gives a transfer T_t^g to the share individuals that graduates from college L_t^g.

L_t^g The government also gives a pension benefit T_t^R to the share of retiree R_t. The pension benefit is set to a proportional share average life-income. Then the government budget constraint is :

$$G_t + (1 + r_t B_t) + T_t^g L_t^g + T_t^R R_t = T_t + B_{t+1} \tag{10}$$

3.7 Households

3.7.1 Decisions at age $j = 1$

On the first period, agents choose whether to attend college or enter the labor market. Since there is no uncertainty in college completion, those who go to college graduate. Before the consumption choice, the individual receives an initial wealth a_t, draws ability to get a college degree θ_t and taste for higher education $\sigma_{\varepsilon_C}\varepsilon_C$.

As argued by Cunha et al. (2005), Heckman et al. (2006) and Abbott et al. (2019), taste for education is an important component of schooling decisions. The taste for education is a preference shock which is i.i.d. Extreme Value type I distributed with scale parameter σ_{ε_C} following the seminal paper of McFadden et al. (1973).

This decision implies a comparison of lifetime values. Let V^C be the value of an individual who decides to graduate from college and V^H the value of an individual who enters the labor force without going to college. At the time of the first decision, the value of an individual can be written as:

$$V_j\left(a_j, z_j, \theta_j\right) = \max\left(V_j^H\left(a_j, z_j, \theta_j\right) + \sigma_{\epsilon_C}\varepsilon_C(0), V_j^C\left(a_j, z_j, \theta_j\right) + \sigma_{\varepsilon_C}\varepsilon_C\right) \tag{11}$$

Individuals who enters the labor force without going to college choose consumption c and financial assets next period a' solve the following problem:

$$V_j^H\left(a, z_j, \theta_j\right)) = \max_{c,a'}\left(u\left(c\right) + \beta \mathbb{E}_j V_j\left(a_{j+1}, z_{j+1}, \theta_{j+1}\right)\right) \tag{12}$$

subject to

$$Y^H = z_j w^H + ra \tag{13}$$

$$a' = Y^H - T(Y^H) + a - c \tag{14}$$

$$a > \underline{a} \tag{15}$$

where $\mathbb{E}_j$ is the expectation operator conditional on the information set at age j, w is the general equilibrium labor earnings and $T(Y^H)$ the tax amount.

Individuals who graduate from college solve the following problem:

$$V_j^C\left(a, z_j, \theta_j\right)) = \max_{c,a'}\left(u\left(c\right) + \beta \mathbb{E}_j V_j\left(a_{j+1}, z_{j+1}, \theta_{j+1}\right)\right) \tag{16}$$

subject to

$$Y^C = z_j \frac{w^H}{2} + ra \tag{17}$$

$$a' = Y^C - T^C(Y^H) + a - c - (1 - T_t^g)\kappa_C \tag{18}$$

$$a > \underline{a} \tag{19}$$

where $\mathbb{E}_j$ is the expectation operator conditional on the information set at age j, w is the general equilibrium labor earnings, κ_C is the education cost and T_t^g is the fraction of that cost born by the government. κ_C refers to tuition costs net of grants. Students can borrow up to $\underline{a}$ and receive the same hourly wage as high school graduates (because they did not graduate yet).

3.7.2 Decisions at age $j > 1$ and $j < J$

From the period $j = 2$, individuals have a new state which is education level S and face occupational choices decisions. They need to decide whether to be an entrepreneur or an employee at each age j.

As argued by Hurst and Pugsley (2011) and Hurst and Pugsley (2015), taste for entrepreneurship is an important component of entrepreneurship decisions. The taste for entrepreneurship is also a preference shock which

is i.i.d. Extreme Value type I distributed with scale parameter σ_{ε_E} following the seminal paper of McFadden et al. (1973).

Let V^E be the value of an individual who decides to manage a business, V^{WC} the value of an individual who is college degree employee and V^{WH} the value of an individual who is high school degree employee . The value of an individual can be written as:

$$V_j\left(a_j, z_{j,S}, \theta_{j,S}, S\right) = \max\left(V_j^W\left(a_j, z_{j,S}, \theta_{j,S}, S\right) + \sigma_{\epsilon_E}\varepsilon_E(0), V_j^E\left(a_j, z_{j,S}, \theta_{j,S}, S\right) + \sigma_{\varepsilon_E}\varepsilon_E\right) \tag{20}$$

Individuals who are in the labor force with a high school degree face the same problem described from equation 29 to 32.

Individuals who enters the labor force with a college degree choose consumption c and financial assets next period a' solve the following problem:

$$V_j^C\left(a, z_j, \theta_j\right), C) = \max_{c,a'}\left(u\left(c\right) + \beta\mathbb{E}_j V_j\left(a_{j+1}, z_{j+1}, \theta_{j+1}, C\right)\right) \tag{21}$$

subject to

$$Y^C = z_j w^C + ra \tag{22}$$

$$a' = Y^C - T(Y^C) + a - c \tag{23}$$

$$a > \underline{a} \tag{24}$$

where $\mathbb{E}_j$ is the expectation operator conditional on the information set at age j, w is the general equilibrium labor earnings and $T(Y^C)$ the tax amount.

The value function if the household chooses to be an entrepreneur is:

$$V_j^E\left(a, z_j, \theta_j\right)) = \max_{c,k,n,a'}\left(u\left(c\right) + \beta\mathbb{E}_j V_j\left(a', z_j', \theta'\right)\right) \tag{25}$$

subject to

$$Y^E = \theta\left(k^\gamma\left(1+n\right)^{1-\gamma}\right)^\nu - (r+\delta)k - wn + ra \tag{26}$$

$$a' = Y^E - T(Y^E) + a - c \tag{27}$$

$$k \leq \lambda a \tag{28}$$

The entrepreneur invest k production and hire n labor, for which she pays respectively r and w. Equation 28 describes the borrowing constraint. I assume that the capital value of an individual must be less than or equal to a multiple of their wealth $\lambda \geq 1$. If the wealth exceeds the amount necessary to finance the business, the rest is financial assets a and is invested at a rate r_t.

3.7.3 Decisions at age j=J-1

At age of retirement J, individuals receive a pension transfers that is proportional to the average labor earnings for their education level S. They make consumption and savings decisions using their past savings. They solve the following problem:

$$V_j^S\left(a, z_j, \theta_j\right)) = \max_{c,a'} \left(u\left(c\right) + \beta \mathbb{E}_j \pi_{d,j+1} V_j\left(a_{j+1}, z_{j+1}, \theta_{j+1}, S\right)\right) \tag{29}$$

subject to

$$Y^{R,S} = T^{r,S} + ra \tag{30}$$

$$a' = Y^S - T(Y^{R,S}) + a - c \tag{31}$$

$$a > 0 \tag{32}$$

where $\mathbb{E}_j$ is the expectation operator conditional on the information set at age j, $T^{r,S}$ the pension benefit and $T(Y^{R,S})$ the tax amount. At age J, the oldest individuals die and I assume terminal condition for liquid assets to be equal to zero. This allows to have an identical share of individuals who die and leave bequest as individuals who enter the economy with bequest.

3.8 Equilibrium definition

Let $x = (a, z, \theta, S)$ be the individual state vector. We can derive a transition function $M_t(x_t, .)$ from the decision rules that solve the maximization problem and the exogenous Markov process for labor and entrepreneurial productivity. The transition function gives the probability distribution g_t

of x_{t+1}, given x_t. A stationary recursive equilibrium for this economy is a

collection of:

- factor prices r and w
- taxes (T), transfers to student T^g and retirement payment T^R
- policies for households $c(x)$ and education and occupational choices $o(x)$
- entrepreneurial labor hiring $n(x)$ and investment $k(x)$
- a distribution of people g over the state variable x

such that given prices, taxes and transfers:

- households policies c, a, k and n solve the maximization problems
- the capital market clears: $K_c + K_e = \int adg(x)$
- the labor market clears: $L_c + L_e = \bar{L}$
- the corporate sector maximize its profit
- the government budget is satisfied
- the distribution of people g is given by the transition matrix of the system as follows:

$$m'_{j+1} = M(x, .)' m'_j \tag{33}$$

In the steady state, $g = m'$ is the invariant distribution for the economy:debt and prices are constant and the individual's decision rules are time-independent.

4 Calibration

The model is calibrated yearly to be consistent with key features on education attainment, entrepreneurship and the wealth distribution. Table 1 summarizes the parameters that I take as given. Table 2 lists the parameters choices in order to match long-run features of the US economy.

4.1 Fixed parameters

Demography and preferences: Individuals enter the economy at age 18. Then, they go through $J = 9$ stages of life, of 5 years each. Individuals retire at 62. The probability to move from one stage of life to another π_d is set to 5.39 % such that life expectancy is 74 years old and is the same for each j for simplification. I set the coefficient of relative risk aversion σ to 1.5 as estimated by Attanasio et al. (1999).

Production: I choose a standard value 0.33 for α , the share of capital in total production for the non entrepreneurial corporate sector, and 0.1 for the annual depreciation rate δ. I follow Kitao (2008) to set the borrowing constraint parameter λ to 1.5. Total factor productivity A is normalized to 1.

Earnings: The logarithm of labor productivity process is assumed to follow an AR(1) as follows:

$$\log(y_{i,t}) = \rho \log(y_{i,t-1}) + \varepsilon_{i,t} \tag{34}$$

$$\varepsilon_{i,t} \sim \mathcal{N}(0, \sigma_z^2) \tag{35}$$

Labor earnings is then defined as:

$$\log z_{i,t} = \log(y_{i,t}) + \log(h_{i,t,j,s}) \tag{36}$$

The component $h_{i,t,j,s}$ is chosen in order to replicate the average lifetime labor earnings profile depending on the education level which is h high school graduate or c college graduate. The pension benefit is set to 50% of the average life-income.
I set the persistence ρ to 0.95 as it is standard in the literature. The variance is chosen to match the pre tax Gini coefficient of earnings of 0.55 at the beginning of the 1990s. Then I approximate the AR(1) process for the evolution of y as a two-state Markov chain using the Tauchen (1986) method. I use the estimates of the income tax function from Boar and Midrigan (2020).

Taste Shocks I set the parameters for the taste shocks σ_e and σ_s to the small value of 0.01.

Table 4: **Fixed Parameters**

Parameter	Value	Source
σ	1.5	Attanasio et al. (1999)
Capital income Share (C) α	0.33	Gollin (2002)
Depreciation rate δ	0.1	Stokey and Rebelo (1995)
Maximum leverage ratio λ	1.5	Kitao (2008)
Total factor productivity A	1	Normalization
Tax level τ	0.259	Boar and Midrigan (2020)
Progressivity ξ	0.073	Boar and Midrigan (2020)
Elasticity of substitution ϵ_{HG}	0.69	Card (2009)

4.2 Joint Parametrization

The remaining parameters are pinned down jointly so that the model matches seven moments of the U.S. economy. Table 5 shows the calibrated parameters, the moments targeted and the resulting values. The annual discount factor β is set to 0.95 in order to match the capital to output ratio of 3. The return to scale ν is selected to match the wealth Gini coefficient of 0.78 (WID). The share of income going to entrepreneurial working capital γ helps to match the fraction of entrepreneurs in the economy. We target a fraction of entrepreneurs of 7 % as in (Cagetti and De Nardi (2006)), but the value in the data can reach up to 12 % depending on the definition and the data sources. I also follow (Cagetti and De Nardi (2006)) to define the entrepreneurial ability process. I assume that the income process and the entrepreneurial ability process evolve independently. I make the hypothesis that the entrepreneurial ability θ is related to higher education attainment. Entrepreneurial ability corresponds to skills that you get with a college education. The value is zero if the young had no higher education. The second value is positive for those who have higher education and is set to target the ratio of net worth ratio of the median net worth between entrepreneurs and employees of 7.0

(SCF data). At each period, individuals with a college degree receive entrepreneurial ability with a certain probability. When young, the individuals have 30 % probability to get a higher education ability. This helps to match entrepreneurs entry. The probability to lose to skills is set to 5 % to target the share of self-employment exit. The education cost is set to target the share of adults with some college education of 60 %. I also pick the level of debt such that the government debt represents 90 % of GDP. The model is exactly identified, with eight moments pinned down by eight parameters.

Table 5: **Calibrated Parameters**

Parameter	Value	Data	Model	Targeted Moment
Discount factor β	0.95	3	3.16	Capital-output ratio
Return to scale ν	0.88	0.80	0.78	Wealth Gini Coefficient
Entrep. capital income share γ	0.84	7%	8 %	Entrepreneur share
Entrep. productivity θ	$[0, 1.35]$	9.6	8	Ratio of net worth E/W
Entrep. skills gain prob.	0.3	2.3 %	2.7 %	New entrepreneurs
Entrep. skills loss prob.	0.05	15 %	15 %	Self-employment exit
Education cost	50 % wage	60 %	58 %	Adults with some college
Labor parameter θ_H	0.8	50 %	53 %	Share of adults working for SME

[1] The whole equilibrium may be affected by the change of only one endogenous parameter.

5 Properties of the model

Before presenting the main results of the paper, I show that the model performs well along dimensions that were not targeted in the calibration.

5.1 College education choice

Figure 9 explains the decision to get a college degree in partial equilibrium. The graph above explains the consequences of an extension of the borrowing limit and the graph below the effects of an increase in the grants amount. The blue curve represents the wealth distribution of young individuals with

high ability to study. The vertical red line is the wealth threshold above which young can access college. In the initial economy, they need to come from a family with a positive level of wealth (above 25000$) to access college.

After the extension of the borrowing limit $\underline{a}$ for the youngest generation, the yellow dashed curve is the new distribution of those with a high ability and the dashed vertical line is the new threshold. Since the borrowing limit is higher, the level of wealth necessary to access college is lower. As the wealth distribution moves to the left side, young individuals are poorer.

After the increase of the grants amount, the level of wealth necessary to access college is also lower but contrary to the previous policy, young individuals are richer as the distribution moves to the right side.

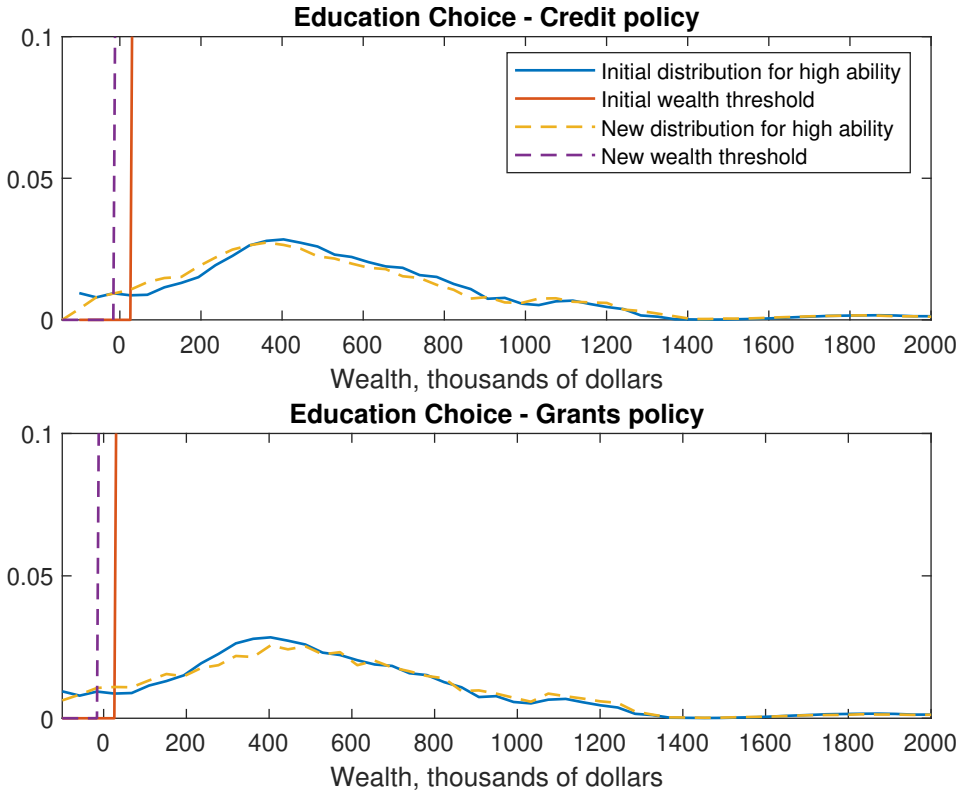


Figure 9: **Distributions of wealth for different education financial aid policies, conditional on wealth being positive for individuals with a high ability. Vertical bar: threshold for going to college**

5.2 Entry in entrepreneurship

The choice to become an entrepreneur depends on the entrepreneurial ability and the wealth. Figure 10 shows the wealth distribution of individuals with higher education and entrepreneurial skills and the threshold at which those individuals decide to become an entrepreneur. Conditional on having an entrepreneurial ability and a college degree, individuals that have a wealth level above this threshold decide to become entrepreneurs. This determines the amount of entrepreneurs in the economy. Since we are in partial equilibrium and we have changed parameters that only affect the youngest generation, the threshold for the entrepreneurial choice does not move. However, the wealth distribution of individuals entering the labor market at age j=2 depends on the education financial aid policies. After the credit policy, the young households are poorer and a lower share of them can become entrepreneurs. On the contrary, after the grants policy, those young are less constrained and a higher share of them can start a business.

The previous graph explained the probability to become an entrepreneur among individuals with a college education. The share of entrepreneur in the economy also depends on the share of individuals with a college degree. With the credit policy, the share of college graduate increases while the share of entrepreneurs among them decreases. Therefore, the overall effect on the entrepreneur share depends on which effect dominates.

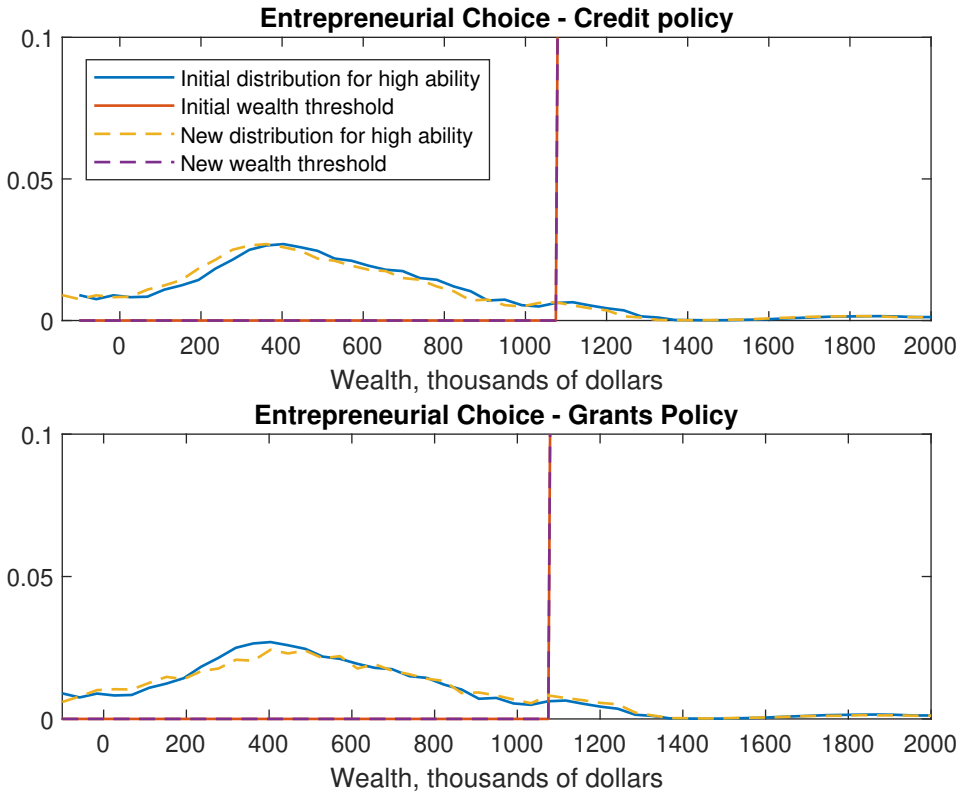


Figure 10: **Distribution of wealth, conditional on wealth being positive for the whole population. Vertical bar: threshold for entry in entrepreneurship**

5.3 Model Validation

While targeting the share of tertiary students, we calibrate education cost to be 50 % of young wage. This matches the data as annual education cost, including tuition fees plus the cost of books and other academic material net of institutional and private grants, in the 2000 was 6700 $ (Abbott et al. (2019) and the mean annual earnings for 15-24 years old were 12000 $ (CPS, 2000)

The entrepreneurial sector capital represents 35 % of total capital which is slightly lower than the 40 % reported in Quadrini (2000). The fraction of agents with zero net worth in the population is 13 %, while it is 12% in Quadrini (2000). The entrepreneurial sector 1.8 times more productive than the corporate sector. This is close to the ratio of earnings from the

entrepreneurial sector to earnings from the salaried sector in the NSLY97 date which is 1.5.

In table 6, I compare the wealth income distribution with US data (as described in Cagetti and De Nardi (2006)). The presence of entrepreneurs helps to match better the wealth distribution. Since the model includes a progressive tax system, I can also assess that both the pre-tax and after-tax income distribution are close to the data.

Table 6: **Distribution of income and wealth**

	Gini	1 percent	10 percent	20 percent
Wealth (Data)	0.78	28	64	80
Wealth (Model)	0.75	39	52	76
Income (Data)	0.55	14	38	54
Income (Model)	0.62	12	35	50
After-tax Income (Data)	0.50	13	37	53
After-tax Income (Model)	0.60	10	33	48

[1] Sources: WID

6 Quantitative exercise: The effect of college education financial aid on entrepreneurship

This model features education and entrepreneurship choice in a life-cycle model. This section presents the effect of increasing debt among young students on occupational choice over the life-cycle and compared with an increase in the average student grant amount.

The main take-away is that easing student borrowing leads to a drop in the entrepreneurship rate, while increasing access to scholarship grants increases the entrepreneurship rate. Even if the impact on corporate and entrepreneurial sectors change with both policies, they both lead to an increase in aggregate consumption.

6.1 Overview of counterfactual exercises

I explore the response of the economy to an *easy credit policy* for young student. The borrowing limit ϕ_t is permanently increased for the amount of student debt to double.[10] We consider that this policy has no immediate effect on public finance.

I compare this easy credit policy with an increase in the college grants amount, which are subsidies that reduce the cost of college. The average student grant was around 5000 $ between 2000 and 2006 [11] and increased to reach around 8000 % in 2010-2011. Therefore, I choose an expansion of the subsidy by 3000 $. [12]

As in Abbott et al. (2019), the reform are financed by variation in long run taxes.

[10] I simulate it as an opposite experiment as a credit crunch policy that we can find in Guerrieri and Lorenzoni (2017).

[11] Research College Board

[12] There was 15 million of students in 2000. The cost of the policy is 45 million$. Total government spending in the United States was 3 trillion. Therefore, the policy corresponds to an expansion of public spending by 0.0015 %

6.2 Macroeconomic Aggregates

Easy credit policy: The credit policy has a negative impact on entrepreneurship investment on the intensive and extensive margin. While entering the labor market, young graduates have a lower collateral and are more constrained. Therefore, they are less numerous to start a business and they are more constrained in the amount of capital they can invest. As shown in Table 7, the self-employment rate decreases by 3.7 %. This results in a reduction of entrepreneurial output by -4.6 %. There is also higher supply of capital from more productive employees. In parallel, the corporate sector increases its output. In the economy, total GDP increases, while consumption and investment increase. Overall, GDP increases by 1.39 % and consumption increases by 0.77 %. Consumption increases by a lower amount than production because productive households are more numerous and they have a higher saving rate. Concerning the public sector, taxes revenues increase. Taxes revenues are higher because the higher share of productive employees with higher wage dominates the effect of the reduction of entrepreneurs.

Grant policy: Compared to the credit policy, the grant policy leads to opposite effects on the entrepreneurial sector with a higher share of entrepreneurs, higher entrepreneurial capital and labor that result in a higher output. The effects are also flipped in the corporate sector with lower working hours, capital and corporate output. The wage rate which balances the labor market is a result of the lower demand of labor in the corporate sector and the higher demand of labor in the entrepreneurial sector. The corporate sector effect dominates and decreases the wage rate. GDP decreases by -1.71 %. Consumption decreases by 0.02 % because the new productive households have a higher saving rate and a lower marginal propensity to consume. The tax revenues decreases because the increase of income in the entrepreneurial sector does not compensate the drop of income in the corporate sector.

Table 7: **Easy credit vs grants policy**

	Credit	Grants
ENTREPRENEURSHIP ACTIVITY		
Output	-4.64%	38.88%
Entrepreneurs share	-3.69 %	10.55 %
Hours	-2.71 %	6.21 %
Capital	-1.16 %	63.60 %
CORPORATE ACTIVITY		
Output	1.40 %	-5.18 %
Hours	1.43 %	-3.27%
Capital	4.15 %	-6.95 %
AGGREGATES		
Wage rate	0.79 %	-1.17%
Interest rate	-0.26 pp	0.39 pp
GDP	1.39 %	-1.71 %
Consumption	0.77 %	-0.02 %
Taxes revenues	1.35%	-0.49 %
Public Debt	0 %	0 %

6.3 Distributions of consumption, income and wealth

Table 8 shows measures of dispersion for after tax income and consumption for different financial aid policies.

Credit policy: As shown in table 8, the credit policy reduces slightly inequality in after-tax income. Since the high concentration in the top of the distribution comes from the presence of entrepreneurs, the reduction of their profit reduces the after-tax income concentration in the top 1%. However, individuals renouncing entrepreneurship have on average a higher productivity and stay in the top 10 % in which the concentration stays high. This translates into lower consumption inequality. The income and consumption change trigger an reduction in wealth inequality with a reduction of the top

1%, top 10% and top 20% wealth share.

Grants policy: The grants policy increases after-tax income inequality and increases the consumption inequality, as the consumption share of the top 10 % increases.

Table 8: **Distribution of consumption, income and wealth**

	1 percent	10 percent	20 percent
After-tax Income (Initial)	10	33	48
After-tax Income (Credit)	9	31	47
After-tax Income (Grants)	13	39	55
Consumption (Initial)	26	67	78
Consumption (Credit)	24	66	77
Consumption (Grants)	23	69	74
Wealth (Initial)	39	53	75
Wealth (Credit)	37	51	75
Wealth (Grants)	35	48	75

6.4 Welfare

This section analyze the long-run welfare effects of the credit and grants policy.

Average Welfare Gain

Life-time utility, W, is:

$$W\left(\{c\}_{s=t}^{\infty}\right) = \sum_{s=t}^{\infty} \beta^{s-t} u\left(c_s\right) \tag{37}$$

A certainty equivalent consumption $\bar{c}$ follows:

$$W\left(\{\bar{c}\}_{s=t}^{\infty}\right) = \mathbb{E}_t W\left(\{c\}_{s=t}^{\infty}\right) \tag{38}$$

The utilitarian social welfare, U, is

$$U = \int \mathbb{E}_t W\left(\{c\}_{s=t}^{\infty}\right) dg \tag{39}$$

Utilitarian welfare rises if consumption increases, if inequality is reduced (since the utility function is concave), or if uncertainty is reduced (since agents are risk averse).

The utilitarian welfare gain of policy change, Δ_u, is defined by

$$\int \mathbb{E}_t W_{NR}\left(1+\Delta_u\right)\left(\{c\}_{s=t}^{\infty}\right) dg = \int \mathbb{E}_t W_R\left(\{c\}_{s=t}^{\infty}\right) dg \tag{40}$$

Δ_u is the percent of life-time consumption agents in non-reformed economy NR are prepared to give up to get the policy change R.

Components of Welfare

Floden (2001) has shown that even if the utilitarian welfare are small, important gains and losses due to level effects, changes in uncertainty and in inequality can occur. Uncertainty rises when consumption becomes more volatile and inequality when consumption is more inequally distributed across agents. Therefore, I decompose the utilitarian welfare effect into those three components following Benabou (2002) and Floden (2001). Inequality is measured from the distribution of certainty-equivalent consumption while uncertainty is measured by comparing the differences in actual and certainty-equivalent consumption. The cost of uncertainty is defined by:

$$1+\Delta_I \equiv \frac{1-p_{risk}^{R}}{1-p_{risk}^{NR}} \tag{41}$$

such that the cost of riskiness p_{risk}^{j} solves:

$$U\left(\left(1-p_{risk}^{j}\right)\{C\}_{s=t}^{\infty}\right) = U\left(\{\bar{C}\}_{s=t}^{\infty}\right), j = R, NR \tag{42}$$

The redistribution effect is defined by:

$$1+\Delta_R \equiv \frac{1-p_{ineq}^{R}}{1-p_{ineq}^{NR}} \tag{43}$$

such that the cost of riskiness p_{ineq}^{j} solves:

$$U\left(\left(1-p_{ineq}^{j}\right)\{\bar{C}\}_{s=t}^{\infty}\right) = \int U(\{\bar{c}\}_{s=t}^{\infty}) dg_0^j\left(a_0, e_t\right), j = R, NR \tag{44}$$

The cost of uncertainty is measured in percent of consumption and is calculated from the difference between average consumption on the one hand, and the average certainty equivalents on the other hand. The cost of inequality is measured (again in percent of consumption) from the difference between the utility of consuming certainty-equivalent averages and the average of utilities.

If uncertainty increases, certainty-equivalent consumption decreases. C change together with c; thus the cost of inequality is (approximately) unaffected by a change in uncertainty.

Considering redistribution, taking consumption from a 'rich' agent and giving to a 'poor' agent leaves aggregate certainty equivalent consumption constant but the sum of the distribution of certainty equivalent individual consumption increases because of the concavity of the utility function. The cost of inequality is therefore reduced but uncertainty is not affected. The level effect Δ_L solves the following equations:

$$U\left(\left(1+\Delta_L\right)C^{NR}\right) = U\left(C^{R}\right) \tag{45}$$

Table 9 shows the average effects Δ, the level effect Δ_L, the insurance effect Δ_I and the inequality effect Δ_R.

The credit policy has a positive impact on average welfare, through all the components of welfare. It increases the level of consumption by around (0.77%), reduces uncertainty and inequalities in consumption. This policy relaxes the borrowing constraint of the youngest households and reduces the share of entrepreneurs in the economy. Consumption and saving behavior of entrepreneurs and employees are different (see Cagetti and De Nardi (2006))). If the probability to switch from employee to entrepreneur is higher, the consumption volatility increases. With the credit policy, consumption volatility is lower and entrepreneurial opportunities are less numerous. This has a positive effect of the insurance components. Since the entrepreneurial production is lower and wage higher, the consumption inequality between entrepreneurs and employees is also lower.

The grants have a negative effect on the average welfare. The level effect is negative but close to zero (around 0.02 %). The difference in the average

effect is led by the insurance and redistributive effects. Contrary to the previous policy, the uncertainty and inequalities components increase. In a standard Aiyagari (1994) model, public transfers (as lump-sum transfers) reduces individual income risk and inequality by diminishing the income gap between agents with temporary high income and those with temporary low. However, in our economy, the grants are targeted transfers which imply a shift of income from the corporate to the entrepreneurial sector. This leads to a higher level of inequalities. Besides, entrepreneurs face higher uncertainty level than households. The higher share of entrepreneurs increases the level of uncertainty in the economy.

Table 9: **Welfare Decomposition (%)**

Policy Change	Δ	Δ_L	Δ_I	Δ_R
Credit policy	2.04	0.77	0.71	0.55
Grants policy	- 1.66	-0.02	-1.12	-0.53

7 Conclusion

This paper examines the impact of student loans and grants on consumption and welfare taking into account entrepreneurship. Using the NLSY97 data, I find that having a student loan is negatively correlated with the probability to become an entrepreneur and that this effect lasts over the life-cycle. Therefore, I build in a life-cycle model with entrepreneurship choice and financial constraints and find that increasing the maximum borrowing amount for students leads to a lower rate of self-employed among adults. I compare the effects of relaxing the borrowing constraint for students to a policy that increases the education grants amount. I find that easing credit policies toward young students reduces the share of self-employed but increases the amount of consumption in the economy, while providing grants increases aggregate consumption by almost the same amount. Consumption choices are related to occupational choice. If entrepreneurship opportunities are more important, inequality and risk are higher. As a result, rising the student loan amount has a positive average welfare effect, while reducing the student

grants has a negative impact on welfare.

Ionescu and Simpson (2016) and Lochner and Monge-Naranjo (2011) focus on the expansion of the expansion of private credit instead of federal student loan. Ionescu and Simpson (2016) explains that private credit student loan are sensitive to credit risk contrary to federal student loan. They build a model in which higher borrowing limit for federal student increases the default risk while grants will reduce the default risk. Since the model is already complex, I focus on a unique type of loan. I also leave the heterogeneity of student loans for future research as well as the evaluation of the transitional cost of the reform.

A Additional figures

Figure A.11: **Average Student Debt and share of self-employed among tertiary educated**

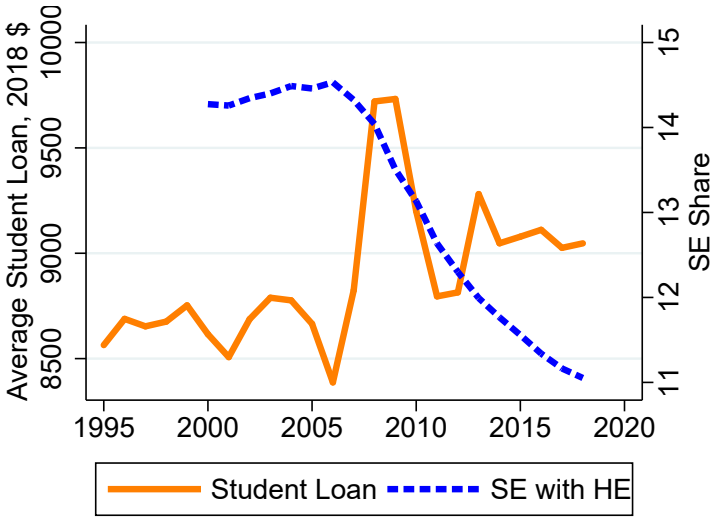
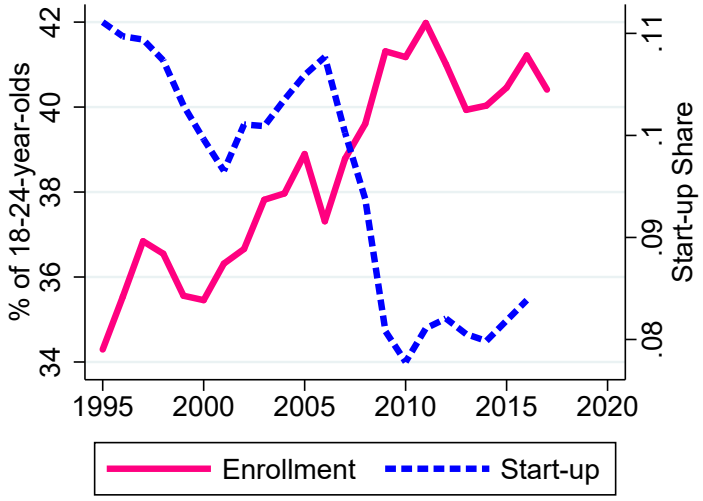


Figure A.12: **Enrollment and start-up share**



Note: The start-up share is the number of new employers as share of the total number of employers within a year

Figure A.13: **Total Student Debt and start-up share**

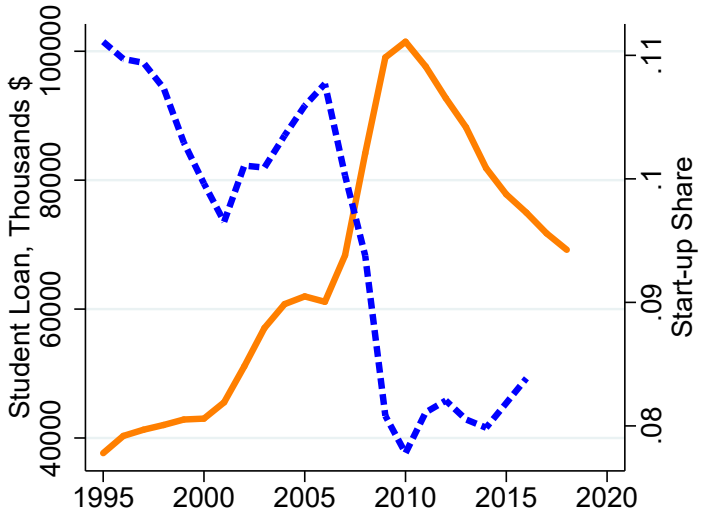
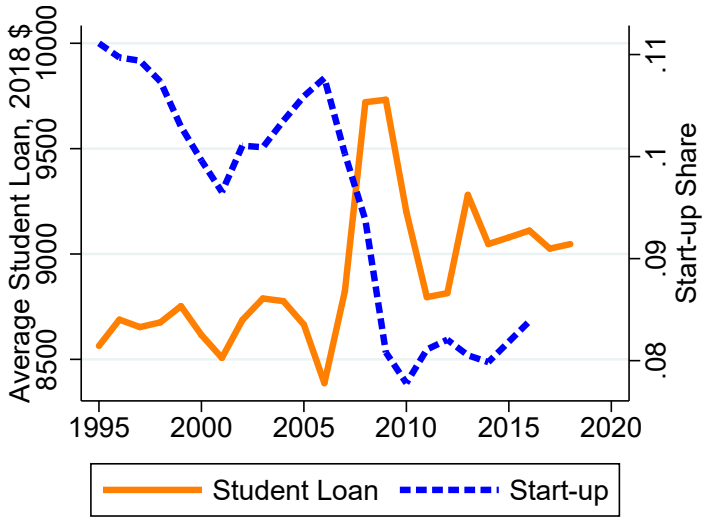


Figure A.14: **Average Student Debt and start-up share**



B NSLY97 Data

My empirical analysis relies on NSLY97 data produced by the U.S. Bureau of Labor Statistics. NSLY97 is a representative survey of the United States

within the eligible age range – 12 to 16 years of age as of December 31, 1996. At the time of initial survey in 1997, 8,984 respondents were interviewed. Between 1997 and 2011, individuals are interviewed annually and every two years from 2011. 6734 of those who responded to both the survey in Round 1 and in the latest Round 18.

Compared to other studies that uses the CPS (Krishnan and Wang (2019)), the NLSY97 allows us to control for family wealth. Devaraj and Patel (2019) also uses the NLSY97 to investigate the effect of student debt on entrepreneurship. However, they use the data between 1998 and 2011. Therefore, the maximum age in their study is 31, while the maximum age in my sample is 38.

In the NLSY79, respondents give the amount of financial aid that they get at each first semester of each year. Total student loan is the sum what they get each semester. Some values are missing for the ASVAB score. I drop these individuals with missing observations to this test.

C Solution Method

C.1 Discrete-continuous model with the endogenous grid method (DC-EGM) with taste shocks

In order to solve the discrete occupational choice model with the continuous consumption choice, I use the method of Iskhakov et al. (2017). This method is based on the endogenous grid method developed by Carroll (2006). In the model, taste shocks are used to approximate the non-pecuniary benefits (Hurst and Pugsley (2015)) of self-employment choice. As shown by Iskhakov et al. (2017), they also allow to smooth the value functions when applying the DC-EGM algorithm.

C.2 Taste Shocks

Following Iskhakov et al. (2017) and Hurst and Pugsley (2011), I include taste shocks to consider non pecuniary benefits and to avoid kinks in the value function. With taste shocks, individuals can decide to stay an employee even

if self-employment would allow them to earn more. The value function is rewritten such that:

$$v_t(a, \mu_o) = \max\{V_t(a, e) + \sigma_{\mu_e}\mu_e(1), V_t(a, w) + \sigma_{\mu_e}\mu_e(0)\} \tag{46}$$

The value function conditional on the choice to remain working $V_t(a, w)$ is modified such that

$$V_t(a, w) = \max\{u(c) - \delta_e + \beta \int EV_{t+1}(y\eta_e + a_{t+1} = Y_t^e - T_t^e(Y_t^e) + a_t - c_t)d(d\eta_e)\} \tag{47}$$

The taste shocks are independent extreme value distributed random variables. Therefore, the expected value function is given by the log-sum formula:

$$EV_{t+1}(a, e) = E\left[max\{V_t(a, e) + \sigma_{\mu_e}\mu_e(1), V_t(a, w) + \sigma_{\mu_e}\mu_e(0)\}\right] \tag{48}$$

$$EV_{t+1}(a, e) = \sigma_{\mu_e} \log\left(\exp\frac{V_t(a, e)}{\sigma_{\mu_e}} + \log\left(\exp\frac{V_t(a, e)}{\sigma_{\mu_e}}\right)\right) \tag{49}$$

D Tables

Table D.10: **Effect of student loan on annual earnings, by experience**

Annual Earnings		
	Self-Employed	All
Self-Employed	14651***	7810***
	(1106)	(1156)
Student Loan	-3189***	-6872***
	(342)	(620)
Self-Employed.Student Loan_2	-18541***	-9853***
	(1681)	(1695)
Log of ASVAB score	2514***	
	(307)	
Female	-8663***	
	(322)	
Hispanic	-1812***	
	(548)	
Black	-2356***	
	(538)	
Bachelor Degree	8860***	7509***
	(392)	(518)
Master Degree	14243***	16250***
	(681)	(831)
PhD	22424***	25887***
	(2617)	(2578)
Professional Degree	47040***	53757***
	(1403)	(1735)
N	25693	25693
Individuals		2538
Controls	Yes	Yes
Individual fixed effects	No	Yes

[1] Note: The symbols ***, ** and * mean significant at the 1%, 5 % and 10 % levels.

E Empirical Robustness - Baseline Regression with Incorporated Status

In this section, I assess how the pre-labor market characteristics account for the incorporation choices and in particular how student loan before market entry affects these choices. I estimate the same logit model as in the main section of the paper assuming that the log-odds of each response follow this model. The dependent variable becomes the log-odds ratio of being incorporated rather than unincorporated or salaried:

$$\log \frac{P_{iinct}}{P_{ininct}} = \alpha + \beta_D D_{i1} + X_{it} + \varepsilon_{it} \tag{50}$$

Table E.11 reports the results of the first estimation in column (1). Holding other things constant, the odds of an individual who had a student loan becoming a self-employed are 70% (i.e. $\exp(-0.35) = 70$) of those similar without a student loan. The odds are also lower for women, non-white people and higher for those with a higher level of experience. In column (2), I include family characteristics[13] and find almost the same odds of self-employment for those having a student loan relative to those similar without a student loan. The odds of becoming self-employed is higher for those with a mother with higher education and those with parents with a higher wealth level.

[13]Individuals for whom there is no information on family wealth drop from the sample in the second estimation.

Table E.11: **Effect of student loan on incorporation status**

	(1)	(2)	(3)	(4)
	Coef./se	Coef./se	Coef./se	Coef./se
Student Loan	-0.258***	-0.246***	-0.346***	-0.325**
	(0.054)	(0.065)	(0.098)	(0.124)
Woman	-0.575***	-0.597***	-1.184***	-1.350***
	(0.052)	(0.063)	(0.105)	(0.138)
Hispanic	-0.415***	-0.285**	-0.256	-0.229
	(0.079)	(0.100)	(0.143)	(0.196)
Black	-0.299***	-0.405***	-0.001	-0.061
	(0.073)	(0.103)	(0.130)	(0.192)
Log of ASVAB score	0.061	0.045	0.294***	0.137
	(0.042)	(0.055)	(0.085)	(0.110)
Risk	0.047	0.058	0.018	0.061
	(0.029)	(0.034)	(0.056)	(0.063)
Experience years	0.081***	0.079***	0.097***	0.078***
	(0.007)	(0.008)	(0.013)	(0.016)
Mother's education		0.018***		-0.005
		(0.006)		(0.014)
Father's education		-0.005		0.014
		(0.006)		(0.013)
Log of family wealth		0.111***		0.195***
		(0.024)		(0.048)
N	43895	31589	43895	31589
Pseudo R-squared	0.0303	0.0387	0.0517	0.0679

[1] Notes: The symbols ***, ** and * mean significant at the 1%, 5 % and 10 % levels. Columns (1) and (2) show the results with self-employment as dependent variable and columns (3) and (4) the results with the incorporated status as dependent variable.

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