The Effect of Student Loans on Entrepreneurial Firm Risk-taking and Access to Venture Capital with Implications for Firm Performance *

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Abstract

We empirically analyze the effect of student loans on entrepreneurial firm risk-taking and access to venture capital. We develop testable hypotheses assuming entrepreneurial risk-aversion declining in net wealth. Using the natural experiment of some universities' adoption of "no-loan" financial aid policies, we find the following. Students graduating under no-loan financial aid policies start more entrepreneurial ventures, that are riskier (higher IPO or failure likelihood); more likely to be VC-backed and with larger VC investment; and with greater sales, employment, innovation, and trademark numbers. Using our empirical results, we estimate the entrepreneurial benefits of the Biden Administration's student loan forgiveness program.

Keywords: Entrepreneurial Risk-Taking; No-loan Financial Aid Policy; Student Entrepreneurship; Venture Capital Access; Biden Administration's Student Loan Forgiveness Program
JEL Codes: L26; I22; G24; G51

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The Effect of Student Loans on Entrepreneurial Firm Risk-taking, Performance, and Access to Venture Capital with Implications for the Biden Administration's Student Loan Forgiveness Program

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Abstract

We empirically analyze the effect of student loans on entrepreneurial firm risk-taking and access to venture capital. We develop testable hypotheses assuming entrepreneurial risk-aversion declining in net wealth. Using the natural experiment of some universities' adoption of "no-loan" financial aid policies, we find the following. Students graduating under no-loan financial aid policies start more entrepreneurial ventures, that are riskier (higher IPO or failure likelihood); more likely to be VC-backed and with larger VC investment; and with greater sales, employment, innovation, and trademark numbers. Using our empirical results, we estimate the entrepreneurial benefits of the Biden Administration's student loan forgiveness program.

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1 Introduction

Student loans are increasingly becoming a major challenge for the United States. It is estimated that more than 43 million borrowers owe about $1.6 trillion dollars, which is a significant fraction of the U.S. GDP of around $23 trillion dollars.[1] Further, federal student loans make up a significant fraction of the student loan market. This means that a significant fraction of U.S. households are burdened with debt that is not dischargeable in bankruptcy. The student loan problem has become a significant political and economic issue with the Biden administration's original announcement forgiving federal student loans (one-time student loan debt relief) for millions of borrowers up to a maximum of $10,000 to $20,000 per borrower.[2] Significant opposition has also arisen to forgiving student loans, since such forgiveness is considered a social welfare measure and the costs involved in the Biden Administration's student loan forgiveness program to U.S. taxpayers is considerable. The cost of the above forgiveness was estimated to be around $400 billion.[3]

In this paper, we take an approach to student loan reduction different from the approach taken so far in the literature and in policy discussions. We attempt to empirically explore whether there are important economic benefits arising from student loan forgiveness, which may at least partially compensate for the costs of student loan forgiveness to U.S. tax payers. While there may be other channels through which the U.S. economy may benefit from student loan reduction, the channel we explore here is entrepreneurship. In particular, our focus in this paper is on high-value entrepreneurship, since they contribute significantly to economic growth, e.g., Decker et al. (2016). Thus, our focus is not on new business

[1]Please refer to this WSJ article for details: https://www.wsj.com/articles/college-university-student-debt-parent-grad-plus-loans-congress-school-borrowing-11638930489.

[2]The originally announced loan forgiveness plan of the Biden Administration was struck down by the Supreme court (https://www.wsj.com/us-news/law/supreme-court-strikes-down-bidens-student-loan-forgiveness-plan-54a1ca7). However, the Biden Administration has recently been using a variety of tools to forgive student loans despite the Supreme Court ruling (https://www.wsj.com/us-news/education/biden-has-canceled-about-127-billion-of-student-loans-despite-supreme-court-ruling-heres-how-ab289d75).

[3]Please refer to the following articles for more details: https://www.nytimes.com/2022/09/26/us/politics/white-house-student-loan-forgiveness.html

creation through self-employment, e.g., lawyers or plumbers, which comprise a significant portion of small business formation (which is the focus of Krishnan and Wang (2019)). In contrast, our focus is on"high-value" entrepreneurship, i.e., the type of entrepreneurship that bring new ideas to the market and create significant employment growth: see, e.g., Hurst and Pugsley (2011), who suggest that researchers and policy makers should focus on such high-value entrepreneurship to test standard theories of entrepreneurship and to test the implications of policies that promote growth and innovation, respectively. In this paper, we use the words "high-value entrepreneurship" and "entrepreneurship" interchangeably. There have been no research on the relationship between student loan reduction and its effect on high-value entrepreneurial firms, on entrepreneurial firm risk-taking, the role of venture capital investment, and on entrepreneurial firm performance, which is our focus in this paper. We further address the relationship between student loan reductions and the nature and extent of such entrepreneurial activities and entrepreneurial firm outcomes for the first time in the literature. We make use of the adoption of no-loan financial aid policies by many U.S. universities as a natural experiment to conduct this analysis.[4] We also estimate the entrepreneurial benefits of the Biden Administration's originally announced student loan forgiveness program (one-time student loan debt relief), which was subsequently struck down by the US Supreme Court. We use the above loan forgiveness plan as a proof of concept to study the entrepreneurial benefits arising from any student loan forgiveness program (with suitable modifications in the underlying assumptions).

We address the following research questions in this paper, after developing testable hypotheses based on our conjecture that a reduction in entrepreneur's student loans outstanding reduces a potential entrepreneur's risk aversion. First, how does the adoption of a no-loan financial aid policy (rather than a standard student loans policy) affects the propensity of student graduates to become entrepreneurs rather than take salaried employment? Second,

[4]The adoption by U.S. universities of no-loan financial policies is continuing at a strong pace, and is worthy of analysis in its own right: see, e.g., the following article which mentions that Dartmouth college and Emory University are eliminating student loans for undergraduate students, https://www.cnn.com/2022/06/21/us/dartmouth-undergraduate-student-loans-scholarship-grants/index.html.

how does a switch to a no-loan financial aid policy affect risk-taking by entrepreneurial firms started by students graduating under such a policy? Third, what is the propensity of entrepreneurial firms founded by students graduating under a no-loan financial aid policy to receive funding from venture capitalists (VCs) (and high-reputation VCs)? Do VCs invest large amounts in such firms and stage their investments in these firms to a lower extent, a sign that they view these firms to be of higher quality? Fourth, how do entrepreneurial firms started by students graduating under a no-loan financial aid policy perform relative to those started by students graduating under a standard student loan policy, as measured by the following variables: sales; employment generated; innovation output; and the number of trademarks (a measure of new product introduction)?

We develop our testable hypotheses by relying on the standard theory of risk-aversion. We expect that student loans will have a significant effect on the extent of risk-aversion of student (recent graduate) entrepreneurs. We assume that individuals have a degree of risk-aversion, see, e.g., Arrow (1973) and Pratt (1964), that is decreasing in their net wealth (wealth minus any debt outstanding). Given that entrepreneurial ventures are riskier (have more uncertain payoffs) than salaried employment, this means that a reduction in student loans will significantly affect the nature and quality of students' entrepreneurial ventures. We therefore expect a larger fraction of students graduating under a no-loan financial aid policy (who have smaller amount of loan outstanding on average) to start entrepreneurial ventures (in preference to salaried employment) compared to the fraction of students graduating under a standard student loan policy. Further, given their lower risk aversion, we expect ventures started by students graduating under a no-loan financial aid policy to have riskier outcomes (longer tails characterizing the probability distributions of their outcomes: a higher chance of firm success as measured by initial public offerings (IPOs) and a higher chance of firm failure as well).

Based on the above, we expect entrepreneurs with smaller amount of student loans to

undertake riskier ventures that will have higher expected payoffs.[5] Assuming that VCs are aware of the above and given that VCs can be viewed as risk neutral with the objective of investing in firms (projects) with highest expected cash flows, we also expect the entrepreneurial ventures started by students graduating under a no-loan financial aid policy to have a greater propensity to receive VC-backing (and a greater propensity to receive high-reputation VC-backing). Further, the amount invested by VCs in such ventures will be larger and the extent of staging by VCs of such investment will be smaller (i.e., the number of rounds over which the total investment amount is distributed will be smaller). Finally, we expect the entrepreneurial ventures started by students graduating under a no-loan financial aid policy to perform better than those started by students graduating under standard student loans, as measured by the following: sales, employment generated, innovation output, and the number of trademarks (new products introduced).

Finally, we develop a hypothesis to provide an additional test of the risk-aversion channel. We know that lower income students are likely to have greater risk-aversion compared to students from higher income families (given that their wealth is likely to be smaller). Therefore, we expect the effect of no-loan financial aid policies on entrepreneurship, risk-taking behavior, VC-backing, and entrepreneurial firm performance to be stronger for entrepreneurial ventures started by students graduating from universities with an above median proportion of low-income students.

There are two major hurdles in analyzing the effect of student loans on the nature and quality of entrepreneurship. The first major hurdle is finding a source of exogenous variation for student loans and the second hurdle is creating a dataset that will allow us to study the quality and nature of ventures started by student (recent graduate) entrepreneurs. As mentioned earlier, we overcome the first hurdle by using a no-loan financial aid policies set up by various schools as our source of exogenous variation for student loans. Since 1998, over 80 universities in the U.S. have replaced loans with grants in their financial aid packages,

[5]The intuition is that such entrepreneurs will be able to make their entrepreneurial firm (project) choice less affected by risk, therefore selecting projects with higher risk but also higher expected return (payoffs).

at least for certain groups of students (e.g. low income families). This lowers the student debt burden of graduating students significantly. While no-loan financial aid policies reduce the loan component of financial aid, they do not affect the total amount of loans and grants (total financial aid). This is because no-loan financial aid policies replace student loans with grants. These policies were not designed with the aim of improving entrepreneurship, but were designed to improve financial affordability of higher education for students. However, as we hypothesized, no-loan financial aid policies will reduce the risk-aversion of potential student (recent graduate) entrepreneurs by increasing their net wealth. This, in turn, will affect the nature and quality of student (recent graduate) entrepreneurship.

We ensure that our natural experiment is plausibly exogenous. In particular, we restrict our sample to students that were already enrolled in college prior to the policy change to eliminate any effect of the financial aid policy change on college choice. Thus, we rule out the selection effect due to no-loan financial aid policies. We note that such policies are implemented by a wide variety of schools, ranging from Princeton University to the College of Holy Cross, and thus are not driven by university rankings. All our regressions have university and state-year fixed effects. Finally, we use a matched control group of universities that is similar to our treated group in terms of their pre-policy level of entrepreneurial activities, bachelor degrees granted, and tuition.

The second major hurdle to our study is getting data on individual high-value entrepreneurial ventures and linking them to university loan policies of entrepreneurs' alma mater. We combine data from various sources to overcome this hurdle. First, we obtain entrepreneur and venture specific data from Crunchbase, a database that contains details of entrepreneurs (e.g., undergraduate alma mater) and their startups.[6] We obtain data on financial aid policies and other variables for the universities of entrepreneurs from the Integrated Post-Secondary Education Database System (IPEDS) provided by the Department of Education. Data on venture backing is obtained from VentureXpert, and firm-level out-

[6]Crunchbase has an extensive coverage of high-value entrepreneurship, e.g., Dalle et al. (2017). We are grateful to Crunchbase for providing us access to this data.

come variables like sales and employment are obtained from the National Establishment Time-Series (NETS) database. Our overall sample consists of 144 universities, 5,564 entrepreneurs, and 10,384 entrepreneurial firms for the years between 1987 to 2012.

We start by providing evidence that our instrument for student loans, i.e., no-loan financial aid policy, is associated with a statistically significant reduction in the fraction of students graduating from an institution with student loans. We use a difference-in-differences (DiD) analysis to establish the above result. We also show that no-loan financial aid policies does not affect the total financial aid (sum of student loans and grants) provided by an educational institution because student loans are replaced by grants. Thus, our results are consistent with no-loan financial aid policies reducing student loans without reducing total financial aid.

We use DiD analyses to test our hypotheses. We first analyze the effect of student loans on the propensity of recent graduates to start entrepreneurial ventures. We show that no-loan financial aid policies are positively related to the propensity of recent graduates to start a firm within 3 (and 5) years after graduating from college.

Next, we test the effect of student loans on the riskiness of outcomes of entrepreneurial firms started by recent graduates. We show that entrepreneurial firms founded by students graduating under a no-loan financial aid policy are more likely to exit through an IPO. However, such ventures are also more likely to fail. These results suggest that entrepreneurial firms started by students with lower levels of student loans have riskier outcomes, consistent with our hypotheses based on lower risk-aversion.

We also test the effect of student loans held by entrepreneurs on access to venture capital. We show that VCs are more likely to invest in startups started by students graduating from the universities under no-loan financial aid policy. We also show that higher reputation VCs are more likely to invest in such startups. We then show that graduates from universities with no-loan financial aid policies receive a greater amount of VC investment for their entrepreneurial ventures. We also show that students graduating under a no-loan

financial aid policy receive VC investment with a lower extent of VC staging for their entrepreneurial ventures. In other words, they receive a larger fraction of total VC investment in the first investment round itself and receive the total VC investment over a smaller number of investment rounds. The above findings are also consistent with our testable hypotheses.

We also find that entrepreneurial ventures founded by students graduating under a no-loan financial aid policy perform better, on average, compared to those founded by students graduating under standard student loan policies. This is true for a number of performance dimensions: sales, employment generated, innovation output, and the number of trademarks (as a proxy for successful new product introduction). We also find that entrepreneurial ventures started by such students (recent graduates) produce greater innovation output (number of patents) and introduce more new products (number of trademarks).

We also provide additional evidence supporting the risk-aversion channel by conducting a cross-sectional analysis based on the income levels of students. We split our sample into groups (above and below the median) based on the percentage of students at a university who are from low income families, where low income families are those whose family income is below $30,000 per year (measured over two cohorts prior to the policy year). We show that the impact of no-loan financial aid policies on the fraction of entrepreneurship, access to VC-backing, firms' sales and employment, and new product introduction are both statistically and economically stronger for the schools with a higher percentage of low income students, thus, providing additional evidence supporting the risk-aversion channel.

We also conduct a variety of robustness tests to support our main results and to rule out some alternative channels. Our results are robust to using stacked DiD regressions, which addresses some concerns regarding the use staggered DiD estimators. Further, our empirical design rules out alternative explanations based on the quality and skill types of graduates (selection effect) since we study the effect of the introduction of no-loan financial aid policies on students who were already enrolled in such universities. We also rule out explanations such as debt-overhang or the effect of no-loan financial aid on labor supply. We also conduct

dynamic DiD analysis to show the absence of pre-trends in our results, thus, validating our parallel trend assumptions.

Finally, we discuss the entrepreneurial benefits of the Biden Administration's originally announced student loan forgiveness program. We calculate the sales and employment benefits of loan forgiveness in our sample by estimating the additional sales and employment for firms started by student entrepreneurs from standard loan schools had their schools also implemented no-loan financial aid policies. Using the above estimates and assuming proportional benefits of student loan forgiveness along with some other assumptions, we estimate the entrepreneurial benefits of the Biden Administration's originally announced student loan forgiveness program. For example, assuming a growth rate of sales of 5% and a discount rate of 15% and assuming that one-third of the student loan amount outstanding is forgiven, we estimate the present value of the additional sales generated over 10 years due to the Biden Administration's loan student loan forgiveness program to be $181.6 billion. We estimate the above present value of sales to be equal to $310.3 billion using a perpetual growth model. Although this originally announced loan forgiveness plan was struck down by the Supreme Court, our approach can also be applied to other student loan forgiveness plans of the US government with modified assumptions.

The rest of the paper is organized as follows. Section 2 discusses how our paper is related to the existing literature. Section 3 develops testable hypotheses for our empirical analyses. Section 4 describes our data sources, sample selection, and the construction of variables. Section 5 describes our empirical methodology and our identification strategy. Section 6 presents our empirical tests and results. Section 7 discusses some robustness tests and rules out some alternative explanations. Section 8 discusses the entrepreneurial benefits of the Biden Administration's originally announced student loan forgiveness program. We conclude the paper in Section 9 with a discussion of policy implications.

2 Related Literature and Contribution

Our paper is related to several strands in the literature. First, our paper lies at the intersection of the literature on entrepreneurial finance and student debt. To the best of our knowledge, there are only two papers that study the relationship between student loans and business formation. However, both these papers study the effect of student loans on small business formation and not on high-value entrepreneurship. Krishnan and Wang (2019) find that student debt has a negative effect on small business entrepreneurship, i.e., businesses having between 1 to 9 employees. They measure small business entrepreneurship using data on new business formation from the Survey of Consumer Finance (SCF). Businesses in SCF data are smaller on average and do not represent high-value entrepreneurship. Further, SCF data does not distinguish between self-employment (e.g., professional practices) versus small business versus high-value entrepreneurship.[7] Ambrose et al. (2015) use county level data to show that student debt is negatively correlated with small businesses formation (business with 1 to 4 or 5 to 9 employees), but do not provide any causal evidence. In contrast to the above two papers, this is the first paper to study the effect of student loan on high-value entrepreneurship.

The other important differences between our paper and the above two papers are as follows. We explore the role of risk-aversion on the quality and on the nature of entrepreneurial ventures. This is also the first paper to show that startups founded by students graduating from universities with no-loan financial aid policies have riskier outcomes (more likelihood of IPOs or failures), have greater propensity to receive VC-backing, and have better long-run performance (better sales, innovation output, and successful new product introduction as measured by the number of trademarks) compared to startups founded by students graduating under a standard student loan policy. Finally, this is the first paper to study the

[7]The SCF survey question on the ownership of business considers farms or professional practices such as plumbers as entrepreneurial ventures. Please refer to the SCF codebook for more details: https://www.federalreserve.gov/econres/files/codebk2013.txt.

entrepreneurial benefits of the Biden Administration's student loan forgiveness program. Given the recent political and economic debates around the costs associated with the Biden Administration's student loan forgiveness program, our paper makes an important contribution to the literature by providing estimates of entrepreneurial benefits generated by this program.[8, 9]

Second, our paper contributes to the broader entrepreneurial finance and innovation literature. Prior literature has examined various factors that affect entrepreneurship such as financing (e.g., Kerr et al. (2015); Bernstein et al. (2016)), location (Delgado et al. (2010)), and human capital (e.g., Glaeser and Kerr (2009); Ewens and Marx (2017)).[10] In contrast, we show, for the first time in the literature, the effect of student loan reductions on the nature and characteristics of entrepreneurial ventures started by recent graduates and on the innovation performance of such ventures.

Finally, we also contribute to the literature dealing with investment behavior of VCs in private firms: see, e.g., Gompers (1995), who analyzes how agency costs and information asymmetry affect VC staging, and Tian (2011), who studies how the distance between VC investors and start-up firms affect the staging of VC investments. The existing literature has also studied the effect of intellectual property on VC investment (e.g., Farre-Mensa et al. (2020) and Bayar et al. (2022)). Our paper contributes to this strand in the literature by

[8]There is an extensive literature on the impact of education financing on other characteristics such as educational enrollment, attainment and other related outcomes (e.g., Armona et al. (2019); Kargar and Mann (2018); and Fos et al. (2017)). Other studies have analyzed the career effects of how higher education is financed (e.g., Herbst (2018) and Ji (2018).) Black et al. (2023) find that increase in availability of student loans leads to greater degree completion and later-life earnings but does not effect homeownership. Catherine and Yannelis (2023) study the distributional effects of student loan forgiveness policies and argue that they may be regressive. In contrast, this paper highlights the benefits of the Biden student loan forgiveness program. Rothstein and Rouse (2011) study the effect of student debt on job choices using data from only one school. In contrast, this paper analyzes the effect of student debt on high-value entrepreneurship using data on all universities that have implemented no-loan financial aid policies. In a paper written subsequent to this paper, Hampole (2022) studies the effect of staggered implementation of no-loans financial aid policies on college major choices of students. Thus, even though the above paper borrows our identification strategy, its research question is very different.

[9]In more distantly related works, Cherry et al. (2022) and Cherry et al. (2021) study the effect of CARES driven debt-relief on the debt forbearance offered by shadow banks and on household debt distress, respectively.

[10]This paper is also indirectly related to the large theoretical and empirical literature on the determinants of corporate innovation, e.g., Manso (2011) and Balsmeier, Fleming, and Manso (2017).

showing, for the first time, that entrepreneurial firms started by students graduating under a no-loan financial aid policy are more likely to receive VC-funding, are likely to receive a larger amount of VC-funding, and receive VC-funding with a lower extent of staging (smaller number of financing rounds).

3 Theory and Hypotheses Development

In this subsection, we discuss the underlying theory and develop testable hypotheses for our empirical analysis. The theoretical foundation for our analysis rests on the theory of risk bearing pioneered by Arrow (1973) and Pratt (1964). We assume that potential entrepreneurs in our setting have concave (risk-averse) utility functions, and they have absolute risk-aversion that is declining in their net wealth: i.e., their wealth minus any loans outstanding (such as student loans).[11] Since entrepreneurial ventures are riskier (have more uncertain payoffs) than salaried employment, this means that students with smaller amounts of student loans outstanding are more likely to undertake entrepreneurial ventures in preference to salaried employment. This leads to our first testable hypothesis:

H1*: Students graduating under a no-loan financial aid policy are more likely to undertake entrepreneurial ventures instead of salaried employment compared to those graduating under a standard loan policy.*

Our next testable hypothesis deals with the riskiness of the entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy rather than a standard student loan policy. Given that the former group of students are likely to have higher expected net wealth than the latter, and given the assumption that all individuals have risk aversion that is decreasing in their net wealth, we have the following testable hypothesis:

H2*: Entrepreneurial ventures undertaken by students graduating under a no-loan finan-*

[11] The degree of absolute risk aversion is defined as A(W) = -U"(W)/U'(W), where U(.) denotes an individual's utility function, and W denotes the individual's wealth. It is is used to measure the extent of an individual's propensity to take risk (see, e.g., Arrow (1973) and Pratt (1964). If an individual is characterized by a degree of absolute risk aversion that is decreasing in wealth W, it implies that as the individual's wealth W increases, he or she will invest a larger amount of wealth in risky assets.

cial aid policy will have riskier outcomes (a higher chance of success as well as a higher chance of failure) compared to those undertaken by students graduating under a standard loan policy.

Note that, by riskier venture, we mean an entrepreneurial venture characterized by riskier expected payoffs or cash flows. Thus, if we think of an entrepreneurial venture as having a payoff with a normal (bell-shaped) probability distribution, entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy will have a probability of payoff distribution with a longer left tail (i.e., higher failure probability) and a longer right tail (i.e., higher probability of success, such as having an IPO).

We now turn to developing our testable hypotheses regarding venture capitalists' propensity to invest in entrepreneurial ventures undertaken by students graduating under a no-loan financial policy aid policy compared to their propensity to invest in entrepreneurial ventures undertaken by students graduating under a standard student loan policy. In order to develop this hypothesis, it is useful to first discuss how an entrepreneur chooses the type of entrepreneurial venture to undertake, and subsequently attempts to obtain venture capital funding from for his firm. We assume, consistent with practice, that an entrepreneur first undertakes the best (highest payoff) firm consistent with his risk preferences (i.e., with a risk profile satisfying his needs). Formally, we can think of entrepreneurs as choosing their entrepreneurial firm (project) to undertake by solving the following optimization problem: they choose that project that maximizes their expected cash flow net of investment amount (i.e., expected NPV), subject to the risk of the project (firm) not exceeding a certain riskiness figure (measured, for example, by their standard deviation of their cash flows from the project). Since, the maximum risk that he is willing to bear will be greater for an entrepreneur who has a smaller student loan amount outstanding, an entrepreneur graduating under a no-loan financial aid policy will be able to make his entrepreneurial firm (project) choice in a less constrained manner (i.e., under a slacker optimisation constraint). This means that an expected NPV of a firm started by an entrepreneur graduating under a no-

loan financial aid policy will be greater (or at least equal to) than the expected NPV of the entrepreneurial firms started by a student graduating under a standard student loan policy, *ceteris paribus*.

We also assume that the entrepreneur initially undertakes his entrepreneurial venture using his personal funds, and then attempts to get additional funding from outside financiers such as venture capitalists in order to expand the scale of his firm toward its optimal scale. For the purpose of this analysis, we assume that venture capitalists are risk neutral and therefore choose to fund the best (highest expected cash flows net of investment) entrepreneurial firms available to them until their total available funding is exhausted.[12] Given our earlier discussion of an entrepreneur's choice of startup firms to undertake, venture capitalists are likely to understand that firms undertaken by entrepreneurs graduating under a no-loan financial aid policy will have a higher expected net present value than those undertaken by entrepreneurs graduating under a standard student loan policy. This is because the former category of entrepreneurial ventures are undertaken under a less restrictive optimisation constraint (in terms of limits on its total risk or standard deviation of payoff distributions) compared to the latter category of entrepreneurial ventures. This yields our next two hypotheses.

***H3**: Venture capitalists are more likely to invest in entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a standard student loan policy.*

If, as we discussed prior to hypothesis **H3**, entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy are likely to have larger expected payoff at every scale of investment than those undertaken by students graduating under a standard

[12]While we made the assumption that venture capitalists are risk neutral so that the argument here is simplified (in this case, the venture capitalist simply chooses the set of firms that maximises his expected payoff), our arguments go through in a slightly modified model as long as the venture capitalist is less risk-averse than either type of student entrepreneur (no-loan financial aid or standard student loan student). Since venture capitalists are in the business of funding very risky firms, and reduce their risks through various mechanisms such as syndication, the assumption that they are much less risk averse than entrepreneurs is consistent with practice.

student loan policy, then the equilibrium scale of investment undertaken by the former type of entrepreneur will also be larger (assuming decreasing marginal returns to scale). This is because, for any firm, the equilibrium scale is the point at which the net present value (NPV) of the next dollar of investment (marginal NPV) falls to zero. If (as is usually the case in practice), venture capitalists help the firm to expand from its initial scale (funded by the personal capital of the entrepreneur and his or her friends and relatives) to its optimal (equilibrium) scale, this yields our next hypothesis.

H4*: Conditional on choosing to invest, VCs will invest larger amounts in entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a standard student loan policy.*

It is well known that VCs "stage" their investment, i.e., provide their investment to entrepreneurial firms in stages or "rounds", since this allows them to learn more about the entrepreneurs and their firms over time, and also allows them the option to discontinue funding the firm (after providing only a fraction of their planned total investment) if the information they gather during the earlier funding years is negative (Gompers (1995); Kaplan and Strömberg (2003); Tian (2011)). However, staging, while advantageous to VCs in some respects, may be costly to the entrepreneurial firm, since it forces it to operate in a financially constrained manner over earlier funding periods. This means that the better the ex-ante assessment of the firms by VCs, the smaller the extent of staging of investment by VCs. In other words, the higher the VCs' assessment of the quality (expected cash flow) of an entrepreneurial firm, the larger the fraction of total funding provided by VCs to that firm in the first round and the smaller the number of investment rounds into which the total investment amount is split into. This leads to the next hypothesis, given our earlier argument that the expected cash flow net of investment of entrepreneurial firms undertaken by students graduating under a no-loan financial aid policy will be greater, on average, compared to those undertaken by students graduating under a standard student loan policy (and that VCs are likely to be aware of this).

H5*: The extent of staging by VCs will be lower in the case of entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a standard student loan policy.*

Finally, we argued earlier that, since entrepreneurial firms undertaken by students graduating under a no-loan financial aid policy are chosen under a less binding optimization constraint (because they can take greater risk), than those undertaken by students graduating under a standard student loan policy, we expect these ventures to have greater expected cash flows net of investment (i.e., greater NPVs). Since better expected firm performance will be associated with greater expected NPVs, our next hypothesis is as follows.

H6*: Entrepreneurial firms undertaken by students graduating under a no-loan financial aid policy will be associated with higher values of various firm performance measures on average compared to those undertaken by students graduating under a standard student loan policy.*

The measures of firm performance that we will use to test the above hypothesis are as follows: firm sales, employment, the number of patents held by the firm, and the number trademarks (proxy for new products) held by the firm. Sales and employment are standard measures of firm performance used in the entrepreneurial finance literature, see, e.g., Farre-Mensa et al. (2020). Bayar et al. (2022) show that firms trademark more successful products with a higher probability, so that the number of trademarks held by a firm is a measure of the number of successful products developed by the firm. Similarly, the number of patents held by a firm is a measure of how successful it has been in developing various innovations (see, e.g., Balsmeier et al. (2017) and Chemmanur et al. (2014)). Thus, trademarks held by an entrepreneurial firm and patents held by a firm are also measures of successful firm performance.

The final hypothesis that we test here is for an additional analysis of the risk-aversion channel. Since, we have assumed that the risk-aversion of student entrepreneurs will be decreasing in their net wealth, it can be shown that the change in risk-aversion as a result

of the policy change from the standard student loan policy to a no-loan financial aid policy will be greater for lower income students (since their risk-aversion will be higher than that of higher income students to begin with).

H7: *The effect of a change in financial aid policy from a standard student-loan to no-loan financial aid policy will be reflected to the greatest extent in entrepreneurship by lower income students and in the financing and performance of entrepreneurial ventures started by such students.*

4 Data, Sample Selection, and Variable Descriptions

Our data comes from several sources. We collect entrepreneurial data from Crunchbase, a database that provides information on entrepreneurial ventures. This database comprises company profiles (especially on startups) and information on the startup founding team. In particular, we start with an initial sample of startups with data on founding years and founders' education. We use the Crunchbase data set since it focuses on high-value entrepreneurship and has extensive coverage on companies, founders, and providers of risky-financing (Dalle et al. (2017)). Dalle et al. (2017) also show that the coverage of Crunchbase is comparable to OECD entrepreneurship data, which is obtained from national or regional Private Equity and Venture Capital Associations and is supplemented by commercial data providers. We do not focus on small traditional businesses such as plumbers or lawyers, since they neither bring new innovative ideas nor grow significantly (Hurst and Pugsley (2011)). Thus, Crunchbase data is appropriate for our study since we focus on the effect of student loans on the risk-aversion of student entrepreneurs and their propensity to start riskier high-quality ventures. We augment the Crunchbase data with internet search for data on the education of entrepreneurs. We restrict our sample to entrepreneurs who obtained their undergraduate degrees from universities within the U.S.[13]

We also utilize data from VentureXpert to gather information on venture capital invest-

[13]The existing literature on entrepreneurial finance has used the data from CrunchBase, e.g., Xu (2022).

ment in our sample firms, including the name of the VCs, VC investment amount, and VC reputation. We match the Crunchbase data with VentureXpert using fuzzy string matching algorithms on firm names augmented with additional hand cleaning. For our main analysis, we aggregate the entrepreneurs in our sample at the university-year (year of completion) level and then merge this data with university characteristics data from the Integrated Post-secondary Education Data System (IPEDS), which is a longitudinal dataset maintained by the U.S. Department of Education. The IPEDS contains university enrollment, completion, and student aid data for academic years from 1986-87 through 2011-12. Furthermore, we supplement the IPEDS with data from the College Scorecard, which provides additional information on schools and student demographics.

We then create a matched sample by selecting a group of control universities that are comparable to the treated universities that implemented no-loan financial aid policies, based on their prior entrepreneurial activities, degrees granted, and tuition. First, we select universities for which the average number of entrepreneurs graduating in the five years prior to the policy implementation is within 50% of a treated university as of the policy year.[14] From this pool of potential control universities, we select a university for which the number of bachelor degrees granted is the closest to the treated university. In case of multiple such matches, we use a control university with the closest in-state tuition to the treated university. Our final matched sample comprises 80 treated universities and 64 unique control universities spanning years between 1987 to 2012.[15] We show the list of universities (treated and control) in Table A1 in the Internet Appendix. Further, in Table A1, we also show the year of implementation of no-loan financial aid policies at treated universities and show the percentage of startups in our sample across both treated and universities. As evident from Table A1, these startups are distributed across the universities in our sample. About 69% of

[14]Here, we consider entrepreneurs who started their ventures within five years after graduation.

[15]The sector distribution of the universities in the treated and control groups are similar. In the treated sample, there are 45% public non-profit 4-year or above universities and 55% private non-profit 4-year or above universities. In the control sample, there are 45% public non-profit, 52% private non-profit, and 3% private for-profit 4-year or above universities.

startups are created by graduates from universities other than the Top 10 universities.[16] Our overall sample consists of 144 universities, 5,564 entrepreneurs, and 10,384 entrepreneurial firms for years between 1987 to 2012.

The final source of data for our study is the National Establishment Time-Series (NETS) database, which is a longitudinal database provided by Dun & Bradstreet and is widely used in research on private firms.[17] This database contains information on millions of establishments between January 1990 and January 2013, and provides firm-specific information including industry, location, employment, and sales. We match the entrepreneurial ventures in our sample to NETS based on firm name using a fuzzy string matching algorithm and restrict the NETS start year of the firm to be within 5 years after the respective entrepreneur's graduation year. For each sample firm, we also randomly select three control firms from the NETS database that is in the same industry and started in the same year as the sample firm.

In our first set of analyses, we test the impact of no-loan financial aid policies on total financial aid and the fraction of students taking student loans. We measure entrepreneurship as a fraction of graduates starting their ventures within 3 or 5 years after graduating to adjust for larger universities potentially producing more entrepreneurs due to their greater number of students. We also construct a series of measures for venture capital backed entrepreneurship. Similarly, we also create measures to capture fraction of VC-backed ventures within 3 or 5 years of graduation. We also create measures for high reputation VC-backing, total VC investment, and VC staging (fraction of aggregate VC investment in the fraction). In our individual level tests, we measure the riskiness of startups based on their likelihood initial public offerings (IPOs) or failures. All the variables are defined in the respective tables.

We use NETS data to analyze entrepreneurial firm outcomes. We measure firm performance by sales and employment in the fifth year after the founding of firms. We also obtain

[16]The top 10 universities include Ivy league universities along with Stanford and Massachusetts Institute of Technology.

[17]See Neumark et al. (2010) for a more detailed description of the NETS data set.

the patents and trademarks data from the USPTO, and we use a fuzzy name-matching algorithm (along with manual verification) to match the patents and trademarks data with our data on entrepreneurial ventures. Following the existing literature, we use quantity of patents as a proxy for innovation output (Balsmeier et al. (2017)) and quantity of trademarks as a proxy of new product introduction (Bayar et al. (2022)).

For interaction tests, we construct a variable, *Low Income Fraction of Students*, which is the percentage of students whose family income is below $30,000.[18] This variable is measured over the two cohorts graduating prior to the policy implementation, i.e., prior to the shock. Our main explanatory variable is *Policy*, which is a dummy variable that is equal to one if a university implements no-loan financial aid policy in a given year. We also create pre-trend variables. We also control for other university characteristics in our analysis like tuition, revenue, and type of degrees. All variables are defined in the respective tables.

5 Empirical Methodology and Identification

5.1 Identification Strategy: No-loan Financial Aid Policies

Over the course of the last two decades, various schools in the U.S. have established no-loan financial aid policies. These policies were implemented to increase college affordability, particularly for students from low-income (and middle-income) families, and to lower financial barriers to higher education. The initiatives are designed to reach students who would not apply or attend (if admitted) solely due to financial reasons.[19]

While the specifics of no-loan financial aid policies vary across schools, the effect of these policies is to decrease the reliance by students on debt to finance their education. No-loan policies are implemented in three ways, where schools could choose to implement more than

[18]The *Low Income Population* variable is calculated from the College Scorecard database. We have also conducted our analysis using $75,000 as our cut-off to define low income families, and our results (unreported) are qualitatively similar.

[19]See, for instance, the Harvard Gazette article "https://news.harvard.edu/gazette/story/2006/03/harvard-expands-financial-aid-for-low-and-middle-income-families/," March 30, 2006. Tufts Journal article, "http://tuftsjournal.tufts.edu/archive/2008/february/features/helping_hand.shtml," February 29, 2008.

one type of loan reduction policy. First, loans are replaced with grants. Second, parental contribution is eliminated, which reduced the need for parents to take on Federal PLUS loans for their children. Finally, schools put caps on annual individual student loan amounts. In all these cases, eliminated loans are substituted by grants. Most schools make these policies available to lower income families. Therefore, no-loan financial aid policies reduce students' need for loans to attend college.[20]

As Rothstein and Rouse (2011) point out, schools do not implement these policies with any explicit intent to impact post-graduate careers. Instead, the motivation is to lower financial barriers to higher education. The academic ranking and tuition cost of schools implementing this policy vary widely. We obtain our sample of no-loan schools and the years of implementation through hand collection of data through Internet searches. We report this information in Table A1 in the Internet Appendix.

We use a reduced form approach in our analysis, given that we do not have data on individual level student loans. We document the effect of a no-loan financial aid policy on graduates' loan taking propensity and subsequent choice to become an entrepreneur (and successfully VC-backing) at the university-year level. We directly address potential concerns with our approach. First, students may choose to go to universities that implement no-loan financial aid policies. To avoid any contamination through such selection effects, our regression models restrict the sample to cohorts that entered a university prior to the implementation of no-loan financial aid policy in that university.

Second, there may be a concern that only certain types of institutions can afford to implement such policies. We address this potential effect in various ways. First, we control for university fixed effects in all our regression models to account for time-invariant university

[20]For instance, Princeton University, which eliminates loans for all financial aid recipients since 2001, shows that 83% of its seniors graduated debt free, and the average indebtedness among those who borrowed was $6,600. (Princeton University News, March 31, 2016.) While 68% of college seniors in the U.S. who graduated with loans in 2015 and carried an average debt from $30,100 (Project on Student Debt 11th Annual Report, 2016). Some schools apply no-loan financial aid policies to state residents only. Some schools require eligible students to maintain a minimum GPA, but this requirement is not onerous for most schools (2.0 minimum GPA).

characteristics. Additionally, we control for important time-variant university characteristics, such as revenue, tuition, education-related share of expense, and degrees completion, to ensure we capture any other college changes contemporaneous to no-loan financial aid policies. Third, we create the control group of universities to ensure that there are no particular biases in the sample. Fourth, as shown in Table A1 in the Internet Appendix, no-loan financial aid policies are implemented by a wide variety of schools ranging from Princeton University to the College of Holy Cross, and so are not likely driven by university rankings.

5.2 Description of the Data and Summary Statistics

Table 1 reports the descriptive statistics of our sample at the university-year level. Panel A summarizes universities' financial aid statistics. The median total financial aid including both grants and loans is about $12 million. On average, 44% undergraduates take loans to finance their college education. Panel B shows entrepreneurship activities of students after graduation and VC investment in these ventures. The average amount invested by VCs in startups founded by entrepreneurs who start a venture within three years of graduation in a university is about $4.2 million. That amount is $6.9 million for those who start a venture within five years of graduation.

Panel C reports the entrepreneurial activities as a fraction of graduates. All numbers in this panel are multiplied by 1000 for ease of viewing. On average, entrepreneurs who found a high-value start-up within five years of graduation comprise 0.032% of the total graduating population. This fraction may seem small, but given that we focus on high-value entrepreneurship that contributes significantly to the economy, it is an economically important sample. Panel D summarizes university characteristics. The median amount of in-state tuition and fees is $14,480. At the median, universities grant 1,273 Bachelors degrees, 455 Masters degrees and 75 Doctoral degrees. Panel E reports the geographic distribution of no-loan financial aid policies.

5.3 The Effect of No-loan Financial Aid Policy on Total Financial Aids

We start by examining the effect of no-loan financial aid policy on the sum of student loans and grants (total financial aid) and on the propensity of students to take loans for education. To ensure that there is no selection effect due to the no-loan financial aid policy, we restrict our sample to students who are already enrolled in a university prior to the year it implemented a no-loan financial aid policy.[21]

The no-loan financial aid policy replaces student loans with grants. Therefore, we expect no-loan policies to reduce student loans but to increase total grants, which includes federal, state, and institutional grants, at the same time. However, we do not expect any additional increase in grants beyond the replaced amount of the student loan. Thus, we expect that the no-loan financial aid policy should not have a significant positive effect on the sum of student loans and grants (since the student loans are replaced by grants). We therefore expect that the no-loan financial aid policy affects student loan negatively, but does not affect the sum of student loans and grants. This result would also support our exclusion restriction assumption, since it would show that there are no other concurrent policies affecting total financial aid. We estimate the following difference in differences (DiD) model:

$$y_{it} = \alpha + \beta_1 Policy_{it} + \gamma X_{it} + \lambda_i + \kappa_{st} + \epsilon_{it}, \tag{1}$$

y_{it} is *Student Loan + Grant* or *Fraction of Students Taking Loans*. X_{it} are control variables, including university-year characteristics such as tuition and fees, revenue etc.[22] All the standard errors in our analyses are clustered at the university level.[23] Our analysis is at the university-year level.

The results for the DiD estimations of the above model are reported in Table 2. Column

[21]For instance, if a university implemented a no-loan financial aid policy in 1998, we only include students who enrolled in the university before 1998.

[22]In unreported tables, we also conduct regressions for total financial aid and student loan, entrepreneurship, and VC-backed entrepreneurship (corresponding to Table 2, 3, and 5, respectively) without controlling for tuition and fee and revenue, and find similar results.

[23]The main results hold when we replace state-year fixed effects with year fixed effects. The results are reported in the Online Appendix Table A5.

(1) shows that no-loan financial aid policy does not have a statistically significant relation with the sum of student loans and grants in a given school-year. This result is in line with our expectation since no-loan financial aid policy leads to the replacement of student loans with grants. This result also shows that these universities did not introduce any other concurrent polices affecting total financial aid. In Column (2), we show that the no-loan financial aid policy leads to a decrease of 4 percentage points in the percentage of students taking loans. Relative to the sample mean, this reflects a 9.1 percent decline in the fraction of students taking loans. Consistent with our expectation, no-loan financial aid policy leads to a lower fraction of students who take loans. Given that we have about 3.5 million students in our sample with student loans, this implies that around 0.35 million students did not take any student loan due to the no-loan financial aid policy.[24] Thus, the no-loan financial aid policy affects a significant number of students. Other control variables have intuitive coefficient estimates as well. Total financial aid and fraction of students taking student loans are higher for schools with higher tuition and fees.

Thus, the above results support our identification strategy of using no-loan financial aid policies as a natural experiment for our analyses. We also validate the parallel trend assumption. Figure 1a in the Internet Appendix plots the coefficients of a dynamic DiD regression. We show that there is a reduction in the fraction of students (who were already enrolled prior to introduction of no-loan Financial Aid policies) taking student loans in treated universities upon the introduction of no-loan financial aid policies. In other words, there is no pre-trend before the introduction of no-loan financial aid policies.

[24]We have around 1400 observations for the above regressions since there are missing observations for student loans and financial aids for some schools.

6 Empirical Tests and Results

6.1 The Effect of No-loan Financial Aid Policy on Entrepreneurship

In this section, we test our hypothesis **H1** that students graduating under a no-loan financial aid policy are more likely to undertake entrepreneurial ventures instead of salaried employment compared to those graduating under a standard loan policy. We use the same DiD model as before, with the dependent variable changed to *Fraction of Entrepreneurs 3 Years After Graduation* or *Fraction of Entrepreneurs 5 Years After Graduation*. All our variables are defined in respective tables.

The results of this analysis are reported in Columns (1) and (2) of Table 3. Our analysis is at the university-year level. We find that universities that implement no-loan financial aid policies produce more graduates who subsequently become entrepreneurs. This effect is statistically and economically significant. Universities that implement no-loan financial aid policies experience a 0.08 percentage point increase in the fraction of entrepreneurs out of the total number of graduating undergraduates (using Column (2)). This result is significant given that the fraction of high-value entrepreneurship is quite low in universities. We also find that college tuition and fees are negatively related to entrepreneurship.

Thus, our results supports our hypothesis **H1**. We also validate the parallel trend assumption. We conduct dynamic DiD regressions in Table A7 in the Internet Appendix. We show that there is no pre-trend before the introduction of no-loan financial aid policies. Further, Figure 1b and Figure 1c in the Internet Appendix provide support for the parallel trend assumption by plotting the coefficients of the above dynamic DiD regressions.

6.2 The Effect of No-loan Financial Aid Policy on the Riskiness of Entrepreneurial Firm Outcomes

In this section, we test our hypothesis **H2** that entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy will have riskier outcomes compared

to those undertaken by students graduating under a standard loan financial aid policy. In other words, we expect that such entrepreneurial ventures will have higher likelihood of success (IPOs) as well higher likelihood of failure.

Table 4 reports our analysis. In contrast with our previous analyses on entrepreneurship, the current analysis is at the individual (student entrepreneur) level. In other words, we consider one startup per student. We conduct our analysis at the entrepreneur-firm level because we aim to test the risk-aversion channel (our second hypothesis) by studying the likelihood of success and failures of firms. We first examine the likelihood of success of these entrepreneurial firms by using IPO as the dependent variable in Panel A of Table 4. In particular, we find that entrepreneurial firms founded by graduates of no-loan financial aid policy schools are more likely to exit through an IPO. In this analysis, IPO is a dummy variable that is equal to 1 if an entrepreneur started a venture within three (Panel A, Column 1) or five (Panel A, Column 2) years of graduation and subsequently went IPO, and 0 otherwise.[25] We control for founding year fixed effects, university fixed effects, and industry fixed effects in these regressions. As reported in Panel A, we find that entrepreneurial firms founded by graduates of no-loan financial aid policy schools have a 3.2 percentage points (Panel A, Column 1) greater likelihood to exit through an IPO.

We then address the question of whether ventures founded by graduates from no-loan policy schools have different failure rates. We show our results in Panel B of Table 4. We find consistent results using both Cox proportional hazard (Columns (1) and (2)) and logit models (Columns (3) and (4)). In both specifications, we find that start-up ventures of entrepreneurs that graduate from no-loan financial aid policy schools are more likely to fail. We use cross-sectional data in our Cox hazard model and a panel dataset in our logit model. In the logit model, a firm is in the sample until it fails (in which case the failure variable switches from 0 to 1 for the last year in the sample) or till the sample period ends (in which case the failure variable is always 0). From the logit model (Column (4) of Panel

[25]The number of observations are different in Table 4 compared to Table 3 since the analyses in Table 4 is at the individual level, while the analyses in Table 3 is at the university-year level.

B), we estimate a 14.2 percentage points higher likelihood of failure for entrepreneurs that graduate from no-loan financial aid policy schools, which shows the economic significance of our results. Thus, we show that no-loan financial aid policies increase the likelihood of failure for entrepreneurial firms. This is consistent with entrepreneurial firms founded by graduates with less loans being riskier.

Overall, the results in this section suggest that ventures founded by graduates of no-loan policy schools have a probability of payoff with a longer left tail (i.e., higher failure probability) and a longer right tail (i.e., higher probability of success, such as having an IPO) which supports our hypothesis **H2**.

6.3 The Effect of No-loan Financial Aid Policy on Access to Venture Capital

In this section, we test our hypothesis **H3** that VCs are more likely to invest in entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a standard student loan policy. We use a similar specification as before, with the dependent variable either the *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* or the *Fraction of VC-Backed Entrepreneurs 5 Years After Graduation*. Again, our analysis is at the university-year level. The results, reported in Columns (1) and (2) of Panel A of Table 5, are consistent with our hypothesis **H3**, which states that VCs are more likely to invest in startups started by students graduating from the universities with no-loan financial aid policy. Universities that implement no-loan financial aid policies experience a 0.027 percentage point increase in the fraction of VC-backed entrepreneurs out of the total number of graduating undergraduates (using Column (2)). Again, this result is significant given that the fraction of VC-backed entrepreneurship is quite low in universities. As shown in Table A5, these results are also robust to using year fixed effects instead of state-year fixed effects. In Table A7 in the Internet Appendix, we show that there is no pre-trend before the introduction of no-loan financial aid policies. Finally, Figure 1d and Figure 1e in the Internet Appendix provide support for the parallel

trend assumption by plotting the coefficients of dynamic DiD regression. We show that there is no pre-trend before the introduction of no-loan financial aid policies.[26]

We also test the impact of no-loan financial aid policies on the reputation of VCs investing in a startup. The results of this analysis are reported in Panel B of Table 5. We show a significant positive relation between no-loan financial aid policies and the fraction of entrepreneurs backed by high reputation VCs. This is consistent with our hypothesis **H3** and suggests that ventures of no-loan policy school graduates are more likely to receive investment from high-reputation VCs that invest in higher quality ventures.

6.4 The Effect of No-loan Financial Aid Policy on Total VC Investment

In this section, we test our hypothesis **H4** that, conditional on investment, VCs will invest larger amounts in entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a standard student loan policy. In Table 6, we conduct our analysis with *Total Venture Capital Invested* as the dependent variable. Again, our analysis is at the university-year level. We find that entrepreneurs from universities with no-loan financial aid policies receive greater amount of VC investment. The implementation of no-loan financial aid policies lead to an increase of 160.3 percentage points in the amount of total VC investment (Column 1). Overall, our results are consistent with our hypothesis **H4** and show a greater extent of venture capital investment in startups founded by graduates of no-loan financial aid policy schools.

6.5 The Effect of No-loan Financial Aid Policy on VC Staging

In this section, we test our hypothesis **H5**, which states that the extent of staging by VCs will be lower in the case of entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy compared to those undertaken by students graduating under a

[26] Our results are robust to restricting our sample to only treated universities as reported in Table A3 in the Internet Appendix.

standard student loan policy. VC may also invest more in the first round in firms that they expect to be of higher quality (Bayar et al. (2022)). We also control for total dollar value of VC investment in these regressions. Our analysis is at the university-year level.

Our findings are consistent with this expectation. We show our results in Table A2 in the Internet Appendix due to space constraints. We show that the fraction of investment in the first VC round is greater for entrepreneurs that graduate from no-loan policy schools (Columns (1) and (2) in Panel A of Table A2). We also analyze whether venture capital investment in ventures founded by graduates of no-loan policy schools have smaller number of rounds of financing than ventures started by graduates from control schools. In Panel B of Table A2, we find evidence of a negative and statistically significant relationship between no-loan financial aid policy and the number of venture capital rounds, which supports our hypothesis **H5**.

6.6 The Effect of No-loan Financial Aid Policy on Firm Performance: Sales, Employment, Innovation Output, and New Product Introduction

In this section, we test our hypothesis **H6**, which states that entrepreneurial ventures undertaken by students graduating under a no-loan financial aid policy will be associated with higher values of various firm performance measures, on average, compared to those undertaken by students graduating under a standard student loan policy. We use firm sales, employment, trademarks held by the firm, and the number of patents held by the firm as the measures of firm performance. We first show that firms founded by entrepreneurs who graduated from no-loan financial aid policy schools have greater levels of sales and employment. We use *ln(Sales in Year 5 after Founding)* or *ln(Employment in Year 5 after Founding)* as our dependent variable at the firm level, restricting the sample to those firms that survive for at least 5 years after founding.[27]

[27]In these regressions, we control for university, year, and industry fixed effects (obtained from NETS). We adjust for inflation to estimate additional sales in 2012 dollar terms. We note that due to hand-matching between the NETS and our Crunchbase-IPEDS-VentureXpert dataset, we end up with fewer observations because we cannot find matching observations in some cases.

Table 7 reports the results. Our analysis is at the firm level. Column (1) and (2) show the baseline regression results, and Column (3) and (4) show the results including control firm variables, *ln(Sales of Control Firms in 5 Yrs)* and *ln(Employment of Control Firms in 5 Yrs)*, respectively. Overall, we find that conditional on surviving, entrepreneurial firms' sales and employment after five years of founding are higher if its founder graduated from a university where no-loan financial aid policy was in place. The implementation of no-loan financial aid policies lead to an increase of 108.5 and 86.8 percentage points in sales and employment, respectively, five years after the founding of firms. These results provide further evidence that student debt not only hinders entrepreneurial activity, but negatively affects economic growth by impacting high performance entrepreneurship that can create significant employment.

Next, we show the effect of student loans on innovation output and successful new product introduction of entrepreneurial firms. The existing literature has used the number of patents as one of the measures of innovation output. Further, the number of trademarks is considered as a measure of the number new successful products (Bayar et al. (2022)). Table 8 shows the results for innovation output. By conducting our analyses at the university-year level, we show that firms founded by entrepreneurs graduating from universities with no-loan financial policy produce greater number of patents in next few years after their founding. Our results are statistically significant at the 10% level in Column (2). Our results are also economically significant.[28] At the university level, firms founded by entrepreneurs graduating from universities with no-loan financial policy produce 4.7 percentage point greater number of patents within five years of their founding.

Table 9 shows the results for the number of new product introduction. By conducting our analyses at the university-year level, we show that firms founded by entrepreneurs graduating from universities with no-loan financial policy produce greater number of trademarks in next few years after their founding. Our results are statistically significant at the 10% and 5%

[28]Our results on patents are slightly weaker since only a small fraction of firms file patents.

levels in Columns (1) and (2), respectively. Our results are also economically significant. At the university level, firms founded by entrepreneurs graduating from universities with no-loan financial policy produce 22.0 and 28.8 percentage point greater number of trademarks within four and five years of their founding year, respectively. Thus, our findings support our hypothesis **H6**.

6.7 Additional Tests of the Risk Aversion Channel

Students from families with lower income are likely to have greater risk-aversion compared to students from higher income families. Therefore, we expect the impact of no-loan financial aid policies on the nature and quality of entrepreneurship to be stronger for universities with a higher percentage of students from low income families (assuming that potential entrepreneurs are drawn fairly uniformly from various members of the student body of a given university). In other words, we expect our results on entrepreneurship, VC-backing, and firm-performance to stronger for universities with greater fraction of low-income students. To conduct the above analyses, we split the sample into two groups (above and below the median) based on the percentage of students at a school who are from low income families, and interact the dummy variable of each group with the policy variable (*Policy*). Here, "low income" refers to students whose family income is below $30,000 per year, measured over two cohorts prior to the policy year. Further, *below median low income student fraction* represents the group of universities with below the median fraction of lower income students across all universities in our sample, and *above median low income student fraction* represents the group of universities with above the median fraction of lower income students.

We discuss our results in Table 10. Panel A shows the results on entrepreneurship at the university-year level. Column (1) and (2) of Panel A show that the impact of no-loan financial aid policies on entrepreneurship is both statistically and economically stronger for the schools with a higher percentage of low income students, i.e., schools in above the median group. Panel B shows the results for access to venture capital at the university-year level.

Column (1) and (2) of Panel B show that the impact of no-loan financial aid policies on access to venture capital investment is both statistically and economically stronger for the schools with a higher percentage of low income students, i.e., schools in above the median group. Panel C shows the results for sales and employment at the firm level. We show that our results on sales and employment are stronger for universities with above the median fraction of low-income students, which is expected due to the risk-aversion channel. Finally, in Panel D, we show our results on trademarks at the university-year level. We show that our trademark results are stronger for universities with above the median fraction of low-income students.[29]

Overall, the results in this section are consistent with our hypothesis **H7** that lower income students will have greater degree of risk-aversion, which is decreasing in their net-wealth.[30]

7 Robustness Tests and Ruling out Alternative Explanations

In this section, we discuss some robustness tests that support our main analyses, and we also discuss and rule out other potential channels (besides risk-aversion) that may explain our findings.

7.1 Stacked DiD Regressions

It has been argued in recent literature that staggered DiD estimators may be biased, e.g., Baker, Larcker, and Wang (2022). In order to address the above concern, we also conduct our analysis using stacked DiD estimators following Gormley and Matsa (2011). Stacked DiD estimators do not suffer from the problems faced by using staggered DiD estimators (Baker, Larcker, and Wang (2022)). We construct a cohort of treated universities and control

[29] Our results on patents are in the right direction, but are weaker since only a small fraction of firms file patents.

[30] In the next section, we also explicitly address the possibility that financial constraints impact the ability of individuals to start ventures due to their inability to get initial capital.

universities using university-year observations for nine years before and three years after the introduction of no-loan Financial Aid policies by treated universities in a particular calendar year. We consider three years of post-policy observations so as to restrict our sample to students who were already enrolled in universities prior to the implementation of no-loan financial aid policies. This is because we assume that students take at least four years to graduate. For example, a student who is graduating from a university in 2005 may have joined it in 2001 or before. If the no-loan policy is implemented in 2003, the above student will not be taking any student loans in 2004 and 2005. A cohort is formed in a calendar year in which these no-loan Financial Aid policies were introduced. Thus, we have a balanced panel in this analysis.[31] In Table A6 in the Internet Appendix, we show that our main results on VC-backed entrepreneurship are robust to using stacked DiD estimators.[32]

7.2 The Effect of No-loan Financial Aid Policy on Entrepreneurship: Post-Policy Persistent Effects

To examine whether the impact of no-loan financial aid policy persists after its implementation, we relax the sample restriction on the cohorts who entered college prior to the implementation of the no-loan financial aid policy, and include all cohorts. In particular, we include post-policy year dummy variables to examine the effect each year after the policy and the aggregated effect after the third year. The results of entrepreneurship and VC-backed entrepreneurship, reported in Table A8, show that the impact of policy is persistent, and tend to get stronger over time. The tendency of stronger effect over time reflects that students who are under the policy longer are affected more.

[31] Our results are also robust to using an unbalanced panel and then running stacked DiD regressions.

[32] Our results are similar for other dependent variables such as entrepreneurship, size of VC investment, and funding from higher reputation VCs.

7.3 Quality of Students Affected by No-loan Financial Aid Policies: Selection Effect

One potential explanation for our results is that no-loan financial aid policies attract higher quality students to an institution, which in turn increases the likelihood of high quality entrepreneurship by such individuals upon graduation. Given that we restrict our sample to students who were already enrolled prior to the introduction of no-loan financial aid policies, our analyses do not suffer from the above selection effect.

We also check whether there is a difference in the composition of graduating majors across treated and control universities. For instance, it is possible that no-loan policy schools consist mostly of engineering majors, who may be more likely to become entrepreneurs. In Table A4 of the Online Appendix, we analyze the impact of policy change on specific majors (Engineering, Science, Business, and Professional). We do not find any differences in the composition of graduates graduating from a school both before and after the implementation of no-loan financial aid policies. Overall, our evidence does not support alternative explanations related to the composition of graduating majors or selection effects such as quality of students.

7.4 Graduate Degree Attainment after No-loan Policies

Another alternative explanation for our results is that the reduction in loans as a result of no-loan financial aid policies increases the propensity of undergraduate students to obtain graduate-level degrees, thus bolstering their skills and their likelihood of success as entrepreneurs.

In unreported tests, we compare the likelihood of obtaining a graduate degree for entrepreneurs graduating from our treated sample of schools relative to entrepreneurs graduating from the control sample of schools after no-loan policies are implemented at treated schools. We do not find that entrepreneurs graduating from no-loan policy schools have a higher proportion of graduate degrees compared to those graduating from control schools.

Thus, we do not find any evidence supporting the above explanation.

7.5 Financial Constraints

Another alternative explanation is that personal student debt obligations will limit individuals' ability to secure external financing to start their ventures. Two important sources of external financing for startups are VCs and angel investors. Anecdotal evidence suggests that while VCs and angel investors usually incorporate the salaries of founders in their investment calculations, they almost never utilize personal financial constraints as a diligence screen.[33]

However, VCs and angel investors usually invest once a startup has shown some traction and don't just usually invest in simply an idea, i.e., at very early stages. It is also possible that students with significant burden of student loans may be reluctant to borrow from external sources (using their personal assets as collateral) to start their risky entrepreneurial ventures.[34] While our focus in this paper is on the risk-aversion channel, it is possible that financial constraints may be a complementary channel.

7.6 Labor Supply Effects as a Driver of Entrepreneurship

Yet another explanation for our results could be that the no-loan policy shock pushes individuals to become entrepreneurs because the shock decreases the outside option (i.e., regular paid jobs) of marginal students (holding constant the quality of investment opportunities, and independent of potential wealth-effects). In particular, it is possible that the no-loan policy increases the supply of college trained workers, and reduces the regular employment prospects of recent graduates, pushing them into entrepreneurship. To alleviate any concern of such an effect driving our results, we analyze whether there is an increase in the average number of undergraduate degrees conferred by no-loan policy schools in the period after

[33]The authors of this paper have had extensive interactions with VCs and angel investors in various contexts and have had multiple conversations with them on this topic.

[34]It is possible that high-value ventures may not have collateralizable assets at the initial stages of their life-cycle.

the policy is implemented compared to untreated schools. Our results, reported in Figure 2 (in the Internet Appendix), show no significant increases in bachelors degrees conferred by treated schools. The trends in the treated and control universities are similar both before and after the policy change.

7.7 Debt Overhang

Another possibility is that student loans increase distortionary effects of debt through what is known as debt overhang.[35] Donaldson et al. (2019) argue that household debt has limited liability, in the sense that it can be discharged through personal bankruptcy with limited costs, distorts individuals' incentives to work by making them require higher wages to overcome debt payments. In our context, student debt could potentially reduce incentives of graduates to enter the labor market. These arguments, however, are driven by the limited liability of household debt because of dischargeability through personal bankruptcy. That is not an option for student loan holders, as these loans are practically not dischargeable through personal bankruptcy in the U.S. Thus, it is unlikely that debt overhang effects are driving our results.

8 The Entrepreneurial Benefits of Biden Administration's Student Loan Forgiveness Program

The Biden Administration announced its original student loan forgiveness program (one-time student loan debt relief) on August 24$^{\text{th}}$, 2022. As per the announcement, the Department of Education would have provided up to $20,000 in loan relief to borrowers with loans held by the Department of Education whose individual income is less than $125,000 ($250,000 for married couples) and who received a Pell Grant. In addition, borrowers who meet the

[35] We should distinguish between debt overhang in the household finance setting with an effect that has same name in the corporate finance setting. In particular, in corporate finance settings, debt overhang refers to underinvestment in positive NPV projects due to significant levels of corporate debt. The household finance debt overhang reflects the distortionary effect of household debt on labor market participation.

above income standards but did not receive a Pell Grant in college would have received up to $10,000 in loan relief.[36] As mentioned earlier, there has been multiple articles criticising the cost (estimated to be around $400 billion) of the above loan forgiveness program. However, it is difficult to assess the program without considering its benefits as well as its cost: we aim to estimate the entrepreneurial benefits of the Biden Administration's student loan forgiveness program in this section.[37] Although, a recent Supreme Court ruling had struck down the originally announced student loan forgiveness plan, we still use it as a proof of concept to demonstrate the potential entrepreneurial benefits of a student loan forgiveness plan. Our approach is potentially applicable to future iterations of the Biden Administration's student loan forgiveness program (with suitable modifications of our assumptions).

We have shown in our paper that the no-loan financial aid policy encourages student entrepreneurs to undertake riskier ventures which have higher chances of success (and failure). Further, since such student entrepreneurs are unburdened by student loans, their entrepreneurial ventures will be associated with higher levels of firm performance measures, e.g., sales and employment. We showed empirically in Table 7 that the implementation of no-loan financial aid policies across universities leads to higher levels of sales and employment for firms started by student entrepreneurs graduating from such schools compared to firms started by entrepreneurs graduating under a standard student loan policy. Specifically, we use the following DiD model:

$$Ln(Sales)_{i,t+5} = \alpha + \beta_1 Policy_{it} + \gamma X_{it} + \lambda_i + \kappa_{st} + \epsilon_{it}, \tag{2}$$

where we estimate the sales in the fifth year after the implementation of no-loan financial aid policy for the treated and control firms. As the first step, we estimate the additional sales that would have been generated by firms started by students graduating from standard

[36]Please refer to the White House Fact Sheet for more details: 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/.

[37]We understand that there may be other benefits associated with Biden Administration's student loan forgiveness program, e.g., social welfare. However, our focus in this section is to estimate the entrepreneurial benefits due to the loan forgiveness.

loan schools had their schools implemented no-loan financial aid policies. The additional sales is equal to the difference between the actual sales of such firms and the counterfactual sales had such firms been started by student entrepreneurs graduating from no-loan schools, estimated as follows:

$$Ln(Sales^{cf})_{i,t+5} - Ln(Sales^{act})_{i,t+5} = \beta_1, \tag{3}$$

where $Ln(Sales^{cf})_{i,t+5}$ and $Ln(Sales^{act})_{i,t+5}$ are the counterfactual and actual sales in year 5, respectively, for firms started by entrepreneurs graduating from no-loan schools. Thus, for each firm started by students graduating from standard loan schools, we estimate the additional sales as follows:

$$\Delta Sales = Sales^{act}_{i,t+5} \times (exp^{\beta_1} - 1). \tag{4}$$

We use our estimate for β_1 from Table 7, which is equal to 0.735 when the dependent variable is $Ln(Sales)_{i,t+5}$. The aggregate additional sales for the above firms in the fifth year after their founding comes out to be \$968 million. We have 1,037 such firms in our sample out of which 660 firms survived for at least 5 years. Using the above model in equation (4), we also estimate the additional sales for such firms from years 1 to 4, assuming the same value of β_1. We get aggregate values of additional sales of 783, 762, 777, and 753 million dollars from years 1 to 4. We then estimate the total present value of the above additional sales under two scenarios: assuming sales are generated over a 10-year period or assuming a perpetuity growth model for sales. We assume different values of growth rate (g) of additional sales and discount rate (r). For example, over a 10-year period and assuming a discount rate of 10% and a growth rate of 5%, we get a present value of \$5.57 billion (\$15.42 billion under a perpetuity growth model). This is only the present value of the aggregate of additional sales arising out of firms from our matched NETS sample.

As the second step, we estimate the present value of additional sales over our entire sample, where we have 8,411 firms started by entrepreneurs graduating from standard loan

schools. As mentioned earlier, due to manual matching, our matched NETS sample consists of only 1,037 firms started by entrepreneurs graduating from standard loan schools. We assume that the unmatched sample firms are similar to matched NETS sample firms in order to estimate the additional sales over our entire sample, i.e, we assume that the two groups have similar average sales. Thus, we scale up our estimates by a factor of $\frac{8,411}{1,037} = 8.11$ to estimate the additional sales that would have been generated by firms started by student entrepreneurs graduating from standard loan schools in the entire sample had these schools also implemented no-loan financial aid policies. Thus, by correspondingly scaling up the estimates shown in the previous examples (g=5% and r=10%), we get values of \$45.20 billion (\$5.57 x 8.11) and \$125.08 billion(\$15.42 x 8.11), respectively.

As the third step, we use the above estimates to calculate the additional sales that may be generated by student entrepreneurs throughout the US due to the Biden Administration's original student loan forgiveness program. To do the above calculation, we apply the per student entrepreneurial benefit of the no-loan policy to the overall population of students who will be affected by the Biden Administration's student loan forgiveness program. We estimate the additional sales that may be generated by the Biden Administration's student loan forgiveness program by scaling up the additional sales in our sample with the ratio of the total number of students affected by the Biden Administration's student loan forgiveness program to the total number of students in our sample graduating from the schools without no-loan financial aid policies (standard loan policy). As per the White House estimates, the Biden Administration's student loan forgiveness program will affect 38,589,300 students.[38] In our sample, there are 3,354,048 students who are graduating from schools without no-loan financial aid policies.[39] Thus, we scale up our estimates by a factor of $\frac{38,589,300}{3,354,048} = 11.51$.

Finally, as the fourth step, we further adjust our estimate by the average fraction of

[38]Please refer to the following White House fact sheet: https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/20/fact-sheet-the-biden-harris-administrations-plan-for-student-debt-relief-could-benefit-tens-of-millions-of-borrowers-in-all-fifty-states/

[39]We also assume uniform benefits of loan forgiveness for graduate and undergraduate students since the Biden loan forgiveness will affect both graduate and undergraduate student loans, while the no-loan financial policy is only affecting the undergraduate students.

student loan that is forgiven due to the Biden Administration's policy. We assume that the benefits of the loan forgiveness are linear, i.e., if half of the loan is forgiven on average, the average benefits will be one-half of the benefits due to a full-loan forgiveness. The Biden Administration's student loan forgiveness program stipulates loan reliefs up to $10,000 or $20,000. Given that various estimates show that the average student loan outstanding is between $28,000 to $40,000, roughly one-fourth to one-half of the average student loan outstanding will be forgiven.[40] Thus, we assume three scenarios: one-fourth of the student loan is forgiven; one-third of the student loan is forgiven; and one-half of the student loan is forgiven. Finally, we convert our estimates to 2022 dollar terms by adjusting for inflation. This adjusting factor is the ratio of Consumer Price Index (CPI) in 2022 and 2012, which is 1.2899. Therefore, assuming that one-fourth of the student loan outstanding will be forgiven, we estimate the additional sales due to the Biden Administration's student loan forgiveness program in the above examples (with g=5% and r=10%) to be $167.7 billion and $464.1 billion for the 10-year and perpetuity growth model, respectively.[41]

We present our results in Table 11. Panel A shows the estimates of additional sales generated over a period of 10-years from the entrepreneurial ventures due to the Biden Administration's student loan forgiveness program, while Panel B shows the estimates assuming a perpetuity growth model of sales. We use different values of discount rates ranging from 5% to 30% and different values of growth rates ranging from 0% to 25%. For example, assuming a discount rate of 15% and a growth rate of 5% and assuming that one-third of the student loan outstanding is forgiven, we get an estimate of present value of additional sales equal to $181.6 billion over a period of 10-years and an estimate of $310.3 billion using a perpetuity growth model, respectively.

Using the above approach, we also estimate the additional employment that is generated

[40] Please see the following link for more details: https://time.com/6172402/biden-student-debt-problem/

[41] Here are our calculations: $\$45.20 \times \frac{1}{4} \times \frac{38,589,300}{3,354,048} \times 1.2899 = \$167.7$ billion and $\$125.08 \times \frac{1}{4} \times \frac{38,589,300}{3,354,048} \times 1.2899 = \$464.1$ billion.

after five years due to the Biden Administration's student loan forgiveness program.[42] First, we estimate the additional employment in our sample by using equation (4) and by replacing sales with employment. Further, following Table 7, we use $\beta_1 = 0.625$. We find that in our NETS sample, firms started by student entrepreneurs from standard loan schools would have generated an additional employment of 5,204 at the end of five years had their schools also had no-loan financial aid policies. Second, we scale up our estimate by $\frac{8,411}{1,037} = 8.11$ to calculate the additional employment that may be generated at the end of five years for our entire sample. Finally, we scale up our estimate by the ratio of the total number of students affected by the Biden Administration's student loan forgiveness program to the number of students from standard loan schools in our entire sample. Assuming that one-third of the student loan is forgiven, we estimate that the additional employment in five-years due to the Biden Administration's student loan forgiveness program to be 161,876.[43] Further, assuming that the yearly growth rate in employment is 10%, the additional employment generated in ten-years due to the student loan forgiveness program will be 260,702, coming from the new startups created due to the loan forgiveness.

9 Policy Implications and Conclusion

Student loans can impose a significant burden on the nature and quality of entrepreneurship. We use universities' implementations of no-loan financial aid policies as a natural experiment to understand the causal impact of student loan on high-value entrepreneurship. We first show that the implementation of no-loan financial aid policies lead to a decline in the fraction of students who have taken student loans. We also show that the implementation of no-loan financial aid policies does not affect the sum of student loans and grants (total financial aid) since these loans are replaced by grants. This suggests that there are not any other concurrent

[42] We analyze additional employment after five years to focus on the long-term employment benefits of the Biden Administration's student loan forgiveness program.

[43] Here is our calculation: $5,204 \times \frac{38,589,300}{3,354,048} \times \frac{8,411}{1,037} \times \frac{1}{3} = 161,876$.

policies that affect total financial aid. Thus, the above results validate our identification strategy.

We showed that graduates of universities that implement no-loan financial aid policies are more likely to start entrepreneurial ventures and their ventures are more likely to have riskier outcomes (higher likelihood of IPOs or failures). We also showed that such entrepreneurial ventures have greater likelihood of receiving VC-backing (and backing by high reputation VCs), and raise a larger amount of VC investment. Further, VCs stage their investment to a lesser extent when funding entrepreneurs graduating from no-loan financial aid policy schools. We also showed that ventures started by graduates from no-loan policy schools have higher sales and employment in the fifth year after founding, produce greater number of patents, and introduce more successful new products. We also find that our results are stronger for universities with greater proportions of lower income students, which provides additional evidence supporting our risk-aversion channel.

Finally, we also estimated the entrepreneurial benefits arising from the Biden Administration's originally announced student loan forgiveness program, which have important implications for policymakers. The Biden Administration's student loan forgiveness program has come under considerable criticism based on the large costs involved: around $400 billion by some estimates. Our analysis suggests, however, that there are also likely to be significant benefits to the U.S. economy arising from such programs. While the precise numbers vary widely with the underlying economic assumptions, our analysis suggests that, using very conservative assumptions, the present value of additional sales generated by entrepreneurial firms started by student entrepreneurs due to the debt forgiveness program is likely to equal around $181.6 billion (considering only a ten-year horizon) and is likely to equal around $310.3 billion using a perpetual growth model (assuming a growth rate of sales of 5% and a discount rate of 15% and assuming that one-third of the student loan is forgiven). Further, the incremental employment generated by entrepreneurial firms started by student entrepreneurs (due to the program) over ten years is likely to be around 260,702 jobs. While

generating the above entrepreneurial benefits are unlikely to have been the primary goal of a student loan forgiveness program, such entrepreneurial benefits need be counted as part of the overall package of economic and welfare benefits arising from such programs. Further, the costs of a student loan forgiveness program, while substantial, need to be balanced against such economic benefits arising from the program. Although, the Supreme Court struck down the Biden Administration's originally announced student loan forgiveness plan, our approach is also applicable to evaluating future iterations of Biden Administration's student loan forgiveness program (with suitable modifications of our underlying assumptions).

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Table 1: Summary Statistics

This table reports the summary statistics for key variables. All the variables are at university-year level. Panel A show statistics of universities' financial aids and student loans. *Total Grants + Loan* is the log of aggregate of student loan, federal, state, and institutional grant (dollars in thousands). *Fraction of Students Taking Loans* is the fraction of undergraduates receiving student loans. Panel B summarizes entrepreneurship. *Entrepreneurs 3 Years after Graduation* is the number of entrepreneurs who started a venture within three years of graduation. *VC-Backed Entrepreneurs 3 Years After Graduation* is the number of entrepreneurs who started a venture within three years of graduation and has received venture capital financing (at anytime). *Total Venture Capital Invested (for Ventures Starting within 3 Years after Graduation)* is the aggregate amount (in thousands) of venture capital dollars raised across all rounds for all ventures that were started by entrepreneurs whose first ventures were started within three years after their graduation. *High Reputation VC-backed Ventures Starting within 3 Years after Graduation* is the number of entrepreneurs who started a venture within three years of graduation and has received financing by at least one high-reputation venture capitalist (at anytime). All five year variables are defined similarly for the case when an entrepreneur started a venture within five years of graduation. Panel C summarizes fraction of entrepreneurs out of the number of undergraduate degrees granted. Panel D shows university characteristics. *Tuition and Fees* is the in-state tuition and fees for full-time undergraduates (in 2012 dollars in thousands). *Bachelor*, *Master*, and *Doctoral Degrees* are the number of bachelor, master, and doctoral degrees granted respectively. Panel E shows the geographic distribution of no-loan financial aid policies.

Panel A. Financial Aid Variables

	Mean	Std.Dev.	Median	Obs
Total Grants + Loans ($ in thousands)	16,786	15,681	12,084	1667
Fraction of Students Taking Loans	0.44	0.17	0.41	1830

Panel B. Entrepreneurship after Graduation

	Mean	Std.Dev.	Median	Obs
Entrepreneurs 3 Years after Graduation	0.35	0.96	0.00	3741
Entrepreneurs 5 Years after Graduation	0.54	1.35	0.00	3741
VC-Backed Entrepreneurs 3 Years after Graduation	0.10	0.39	0.00	3741
VC-Backed Entrepreneurs 5 Years after Graduation	0.17	0.54	0.00	3741
Total Venture Capital Invested ($ in thousands) for Ventures Starting within 3 Years	4,242	51,045	0	3741
Total Venture Capital Invested ($ in thousands) for Ventures Starting within 5 Years	6,945	62,381	0	3741
High Reputation VC-backed Ventures Starting within 3 Years after Graduation	0.09	0.36	0.00	3741
High Reputation VC-backed Ventures Starting within 5 Years after Graduation	0.15	0.50	0.00	3741

Panel C. Fraction of Entrepreneurship after Graduation (multiplied by 1,000)

	Mean	Std.Dev.	Median	Obs
Fraction of Entrepreneurs 3 Years after Graduation	0.20	0.66	0.00	3737
Fraction of Entrepreneurs 5 Years after Graduation	0.32	0.91	0.00	3737
Fraction of VC-Backed Entrepreneurs 3 Years after Graduation	0.07	0.32	0.00	3737
Fraction of VC-Backed Entrepreneurs 5 Years after Graduation	0.10	0.43	0.00	3737
Fraction of High Reputation VC-backed Ventures Starting within 3 Years after Graduation	0.06	0.30	0.00	3741
Fraction of High Reputation VC-backed Ventures Starting within 5 Years after Graduation	0.09	0.40	0.00	3741
High Reputation VC-backed Ventures Starting within 3 Years after Graduation as a Fraction of VC-backed Ventures	74.33	260.66	0.00	3741
High Reputation VC-backed Ventures Starting within 5 Years after Graduation as a Fraction of VC-backed Ventures	108.64	308.84	0.00	3741

Panel D. University Variables

	Mean	Std.Dev.	Median	Obs
Tuition and Fees ($ in thousands)	17.52	13.05	14.48	3692
Bachelor Degrees	2,144	2,216	1,273	3737
Master Degrees	837	1,022	455	3630
Doctoral Degrees	168	205	75	3468

Panel E. Geographic Distribution of No-Loans Financial Aid Policies

	Frequency	Percentage	Cumulative Percentage
AZ	2	2.50	2.50
CA	12	15.00	17.50
CO	1	1.25	18.75
CT	5	6.25	25.00
FL	1	1.25	26.25
GA	2	2.50	28.75
IA	1	1.25	30.00
IL	3	3.75	33.75
IN	1	1.25	35.00
KY	1	1.25	36.25
MA	8	10.00	46.25
MD	1	1.25	47.50
ME	2	2.50	50.00
MI	2	2.50	52.50
MN	5	6.25	58.75
MO	1	1.25	60.00
NC	5	6.25	66.25
NH	1	1.25	67.50
NJ	1	1.25	68.75
NY	3	3.75	72.50
OH	4	5.00	77.50
PA	5	6.25	83.75
RI	1	1.25	85.00
TN	3	3.75	88.75
TX	4	5.00	93.75
VA	3	3.75	97.50
VT	1	1.25	98.75
WA	1	1.25	100.00
Total	80	100.00	

Table 2: The Effect of No-loan Financial Aid Policy on Total Financial Aid and on the Fraction of Students Taking Loans

This table reports the OLS regression results of the effect of no-loan financial aid policy on the total financial aid and on the fraction of students taking loans. This analysis is at the university-year level. *Student Loans + Grants* is the log of aggregate of student loan and total grants (federal, state, and institutional grants). *Fraction of Students Taking Loans* is the fraction of undergraduates receiving student loans. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1)	(2)
	Student Loans + Grants	Fraction of Students Taking Loans
Policy	0.044	-0.040***
	(0.051)	(0.015)
Tuition and Fees	0.557***	0.188**
	(0.180)	(0.078)
Total Revenue	0.015	0.020
	(0.022)	(0.014)
Educ Share	-0.035	-0.113
	(0.405)	(0.110)
Bachelor Degrees	0.233	0.068
	(0.162)	(0.053)
Master Degrees	0.002	-0.022
	(0.056)	(0.019)
Doctor Degrees	0.025	-0.002
	(0.027)	(0.017)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.977	0.884
Observations	1343	1438

Table 3: The Effect of No-loan Financial Aid Policy on Entrepreneurship

This table reports the OLS regression results of the effect of no-loan financial aid policy on entrepreneurship. This analysis is at the university-year level. *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of the total number of undergraduate degrees granted in a given university-year. *Fraction of Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation out of the total number of undergraduate degrees granted in a given university-year. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors are multiplied by 1,000 to make it easier to read. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation
Policy	0.528**	0.793**
	(0.256)	(0.354)
Tuition and Fees	-0.577***	-0.818***
	(0.181)	(0.242)
Total Revenue	-0.010	0.035
	(0.076)	(0.100)
Educ Share	0.373	0.763
	(0.647)	(1.093)
Bachelor Degrees	-0.049	-0.102
	(0.049)	(0.083)
Master Degrees	-0.002	-0.002
	(0.033)	(0.047)
Doctor Degrees	-0.046	-0.065
	(0.036)	(0.057)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.518	0.544
Observations	3292	3292

Table 4: The Effect of No-loan Financial Aid Policy on the Riskiness of Entrepreneurial Firms' Outcomes

This table reports the regression results of the effect of no-loan financial aid policy on the riskiness of entrepreneurial firms' outcomes. These analyses are at the individual entrepreneur level. We consider one startup per entrepreneur. Panel A reports the OLS regression results of the effect of no-loan financial aid policy on the likelihood of IPO. Panel B reports the OLS regression results of the the effect of no-loan financial aid policy on the likelihood of firm failure. In Panel A, *IPO Likelihood 3 Years After Graduation* is a dummy variable, which is equal to one if an entrepreneur started a venture within three years of graduation and eventually had an IPO. *IPO Likelihood 5 Years After Graduation* is a dummy variable, which is equal to one if an entrepreneur started a venture within five years of graduation and eventually had an IPO. In Panel B, Columns (1) and (2) show the results of proportional hazards model on cross-sectional establishment data. In Columns (3) and (4), we apply logistic model on transformed longitudinal establishment-level data. *Failure Likelihood* is equal to one when an establishment is out of business. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University, year of establishment, and industry fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

Panel A: The Effect of No-loan Financial Aid Policy on Entrepreneurial Firm IPO

	(1) IPO Likelihood 3 Years After Graduation	(2) IPO Likelihood 5 Years After Graduation
Policy	0.032***	0.041**
	(0.012)	(0.017)
Tuition and Fees	0.043**	0.060***
	(0.018)	(0.023)
Total Revenue	-0.004	-0.000
	(0.007)	(0.010)
Educ Share	-0.010	-0.030
	(0.076)	(0.089)
Bachelor Degrees	-0.010	0.005
	(0.025)	(0.029)
Master Degrees	0.021	0.039*
	(0.020)	(0.023)
Doctor Degrees	0.027	0.028
	(0.023)	(0.027)
Constant	-0.270	-0.651**
	(0.253)	(0.293)
University FE	Yes	Yes
Year FE	Yes	Yes
Industry FE	Yes	Yes
R^2	0.088	0.090
Observations	4171	4171

Panel B: The Effect of No-loan Financial Aid Policy on Entrepreneurial Firm Failure

	(1) Failure Likelihood (Hazard Model)	(2) Failure Likelihood (Hazard Model)	(3) Failure Likelihood (Logit Model)	(4) Failure Likelihood (Logit Model)
Policy	0.463***	0.543***	0.107*	0.133**
	(0.168)	(0.167)	(0.062)	(0.054)
Tuition and Fees	-0.439	-0.586	-0.033	-0.135
	(0.586)	(0.537)	(0.205)	(0.183)
Total Revenue	-0.120	-0.109	-0.091	-0.077
	(0.177)	(0.190)	(0.070)	(0.079)
Educ Share	-0.415	-0.806	-0.205	-0.423
	(1.252)	(1.295)	(0.417)	(0.443)
Bachelor Degrees	-0.375		-0.450	
	(0.774)		(0.302)	
Master Degrees	-0.623		-0.080	
	(0.488)		(0.207)	
Doctor Degrees	0.199		0.179	
	(0.334)		(0.115)	
University FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo-R^2	.046	0.046	0.041	0.041
Observations	1285	1297	9123	9175

Table 5: The Effect of No-loan Financial Aid Policy on Access to Venture Capital

This table shows the effect of no-loan financial aid policy on the access to venture capital using OLS regressions. These analyses are at the university-year level. Panel A reports the effect of no-loan financial aid policy on the probability of receiving VC-backing. Panel B reports the effect of no-loan financial aid policy on the probability of receiving VC-backing from high-reputation VCs. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and have received venture capital financing (at anytime) out of the total number of undergraduate degrees granted in a given university-year. *Fraction of High Reputation VC-backed Ventures Starting within 3 Years after Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and have received financing by at least one high-reputation venture capitalist (at anytime) out of the total number of undergraduate degrees granted in a given university-year. "5 Years" variables are defined similarly for the case when an entrepreneur started a venture within five years of graduation. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors except Panel B Column (3) and (4) are multiplied by 1,000 to make it easier to read. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

Panel A: The Effect of No-loan Financial Aid Policy on Access to Venture Capital

	(1) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(2) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
Policy	0.209**	0.271**
	(0.107)	(0.133)
Tuition and Fees	-0.206**	-0.265***
	(0.083)	(0.101)
Total Revenue	-0.008	0.002
	(0.031)	(0.033)
Educ Share	0.056	0.139
	(0.273)	(0.386)
Bachelor Degrees	-0.019	-0.032
	(0.014)	(0.022)
Master Degrees	-0.014	-0.012
	(0.015)	(0.020)
Doctor Degrees	-0.005	-0.002
	(0.014)	(0.020)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.439	0.428
Observations	3292	3292

Panel B: The Effect of No-loan Financial Aid Policy on Access to High-Reputation Venture Capital

	(1) Fraction of High Reputation VC-backed Ventures Starting within 3 Years after Graduation	(2) Fraction of High Reputation VC-backed Ventures Starting within 5 Years after Graduation
Policy	0.170*	0.244**
	(0.095)	(0.123)
Tuition and Fees	-0.185**	-0.240**
	(0.078)	(0.095)
Total Revenue	0.003	0.011
	(0.023)	(0.027)
Educ Share	0.075	0.112
	(0.237)	(0.345)
Bachelor Degrees	-0.018	-0.028
	(0.013)	(0.020)
Master Degrees	-0.015	-0.010
	(0.015)	(0.020)
Doctor Degrees	-0.002	0.000
	(0.013)	(0.018)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.435	0.413
Observations	3292	3292

Table 6: The Effect of No-loan Financial Aid Policy on Total Amount of Venture Capital Invested

This table reports the OLS regression results of the effect of no-loan financial aid policy on the total amount of venture capital invested. This analysis is at the university-year level. *Total Venture Capital Invested (for Ventures Starting within 3 Years after Graduation)* is the log of one plus the aggregated amount (in thousand) of venture capitalist dollars raised across all rounds for all ventures that were started by entrepreneurs whose first ventures were started within three years after their graduation. "5 Years" variable are defined similarly only if an entrepreneur started a venture within five years of graduation. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Total Venture Capital Invested (for Ventures Starting within 3 Years after Graduation)	(2) Total Venture Capital Invested (for Ventures Starting within 5 Years after Graduation)
Policy	0.957*	0.864
	(0.571)	(0.582)
Tuition and Fees	-0.896*	-0.385
	(0.487)	(0.488)
Total Revenue	0.144	0.140
	(0.206)	(0.249)
Educ Share	0.006	0.715
	(1.912)	(1.796)
Bachelor Degrees	-0.052	-0.041
	(0.149)	(0.168)
Master Degrees	-0.143	-0.154
	(0.092)	(0.133)
Doctor Degrees	-0.003	0.025
	(0.122)	(0.163)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.433	0.496
Observations	3292	3292

Table 7: The Effect of No-loan Financial Aid Policy on Entrepreneurial Firms' Long-run Sales and Employment

This table reports the OLS regression results of the effect of no-loan financial aid policy on entrepreneurial firm's sales and employment in the long-run. This analysis is conducted at the establishment level using NETS dataset. *ln(Sales in Year 5 after Founding)* is the log of one plus an entrepreneurial firm's sales in the fifth year after its start. All sales are in 2012 dollar terms, i.e., are adjusted for inflation. *ln(Employment in Year 5 after Founding)* is the log of one plus an entrepreneurial firm's number of employees in the fifth year after its start. *ln(Sales of Control Firms in Year 5)* is the log of one plus the average sales of three control firms in the fifth year after their start. Similarly, *ln(Employment of Control Firms in Year 5)* is for average number of employees for control firms in the fifth year after their start. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University, year, and industry fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) ln(Sales After 5 Years of Founding)	(2) ln(Employment After 5 Years of Founding)	(3) ln(Sales After 5 Years of Founding)	(4) ln(Employment After 5 Years of Founding)
Policy	0.735***	0.625***	0.720***	0.624***
	(0.232)	(0.214)	(0.237)	(0.214)
ln(Sales of Control Firms in 5 Yrs)			0.012	
			(0.019)	
ln(Employment of Control Firms in 5 Yrs)				0.017
				(0.078)
Tuition and Fees	-0.437	-0.465	-0.433	-0.464
	(1.152)	(0.999)	(1.148)	(1.000)
Total Revenue	0.083	0.128	0.076	0.126
	(0.228)	(0.193)	(0.233)	(0.192)
Educ Share	4.390**	3.196**	4.409**	3.188**
	(2.056)	(1.557)	(2.072)	(1.565)
Bachelor Degrees	-0.415	-0.592	-0.453	-0.594
	(1.600)	(1.156)	(1.583)	(1.157)
Master Degrees	0.079	0.019	0.070	0.013
	(1.067)	(0.822)	(1.066)	(0.828)
Doctor Degrees	-0.629	-0.239	-0.575	-0.233
	(0.605)	(0.461)	(0.606)	(0.463)
University FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	.818	.737	.776	.735
Observations	640	640	638	638

Table 8: The Effect of No-loan Financial Aid Policy on Entrepreneurial Firms' Innovation Output

This table reports the OLS regression results of the effect of no-loan financial aid policy on entrepreneurial firms' innovation output. This analysis is conducted at the university-year level. We include all firms that were founded by entrepreneurs within five years of their graduation or at least three years prior to their graduation. We measure innovation output by observing the number of patents filed by firms. *Ln(1+Patents) (4 years)* is the natural logarithm of one plus the aggregate of all the patents filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 4 years after they were founded. *Ln(1+Patents) (5 years)* is the natural logarithm of one plus the aggregate of all the patents filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 5 years after they were founded. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1)	(2)
	Firms founded within 5 years of Graduation	
	Ln(1+#Patents)	
Variables	(4 years)	(5 years)
Policy	0.039	0.046*
	(0.024)	(0.027)
Tuition and Fees	-0.015	-0.019
	(0.011)	(0.013)
Total Revenue	-0.004	-0.005
	(0.004)	(0.005)
Educ Share	-0.025	-0.034
	(0.046)	(0.056)
Bachelor Degrees	-0.002	-0.003
	(0.002)	(0.003)
Master Degrees	0.001	0.001
	(0.002)	(0.002)
Doctor Degrees	0.003	0.003
	(0.003)	(0.003)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.218	0.226
Observations	3292	3292

Table 9: The Effect of No-loan Financial Aid Policy on the Number of Trademarks Obtained by Entrepreneurial Firms

This table reports the OLS regression results of the effect of no-loan financial aid policy on the number of trademarks filed by entrepreneurial firms, which were eventually granted. This analysis is conducted at the university-year level. We include all firms that were founded by entrepreneurs within five years of their graduation or at least three years prior to their graduation. *Ln(1+Trademarks) (4 years)* is the natural logarithm of one plus the aggregate of all the trademarks filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 4 years after they were founded. *Ln(1+Trademarks) (5 years)* is the natural logarithm of one plus the aggregate of all the trademarks filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 5 years after they were founded. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1)	(2)
	Firms founded within 5 years of Graduation	
	Ln(1+#Trademarks)	
Variables	(4 years)	(5 years)
Policy	0.199*	0.253**
	(0.118)	(0.129)
Tuition and Fees	-0.162*	-0.155*
	(0.086)	(0.088)
Total Revenue	0.024	0.035
	(0.039)	(0.042)
Educ Share	-0.305	-0.178
	(0.321)	(0.330)
Bachelor Degrees	-0.018	-0.017
	(0.025)	(0.025)
Master Degrees	0.002	-0.007
	(0.015)	(0.016)
Doctor Degrees	-0.019	-0.020
	(0.031)	(0.035)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.434	0.444
Observations	3292	3292

Table 10: The Effect of No-loan Financial Aid Policy on the Nature and Quality of Entrepreneurship: Additional Tests of the Risk-Aversion Channel

This table reports the OLS cross-sectional regression results of the effect of no-loan financial aid policy on various aspects of entrepreneurship. We conduct our cross-sectional analysis on the basis of percentage of low-income students across universities in our sample. Panel A shows the cross-sectional results on entrepreneurship. Panel B shows the cross-sectional analysis on access to venture capital. Panel C shows the cross-sectional analysis on sales and employment. Panel D shows the cross-sectional analysis on new product introduction. *Low Income Fraction of Students* is the percentage of students whose family income is below $30,000, which is measured over the two cohorts prior to the policy year. *Below Median Low Income Student Fraction* and *Above Median Low Income Student Fraction* are median indicator variables based on the fraction of low income students in universities with the former consisting of the universities with below the median fraction of low income students out of all the universities in our sample, and the latter consisting of the universities with above the median fraction of low income students. *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and has received venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. "5 Years" variables are defined similarly for the case when an entrepreneur started a venture within five years of graduation. *ln(Sales in Year 5 after Founding)* is the log of one plus an entrepreneurial firm's sales in the fifth year after its start. All sales are in 2012 dollar terms, i.e., are adjusted for inflation. *ln(Employment in Year 5 after Founding)* is the log of one plus an entrepreneurial firm's number of employees in the fifth year after its start. *ln(Sales of Control Firms in 5 Yrs)* is the log of one plus the average sales of three control firms in the fifth year after their start. Similarly, *ln(Employment of Control Firms in 5 Yrs)* is for average number of employees for control firms in the fifth year after their start. *Ln(1+Trademarks) (4 years)* is the natural logarithm of one plus the aggregate of all the trademarks filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 4 years after they were founded. *Ln(1+Trademarks) (5 years)* is the natural logarithm of one plus the aggregate of all the trademarks filed (and eventually granted) by all firms founded by entrepreneurs affiliated with a particular university within 5 years after they were founded. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. In Panel A and Panel B, all the coefficients and standard errors are multiplied by 1,000 to make it easier to read. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

Panel A: The Effect of No-loan Financial Aid Policy on Entrepreneurship: By Low Income Fraction of Students

	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation
Policy x Below Median Low Income Student Fraction	0.386	0.598
	(0.406)	(0.509)
Policy x Above Median Low Income Student Fraction	0.591**	0.913**
	(0.280)	(0.418)
Tuition and Fees	-0.592***	-0.847***
	(0.184)	(0.246)
Total Revenue	-0.015	0.034
	(0.076)	(0.100)
Educ Share	0.345	0.663
	(0.740)	(1.247)
Bachelor Degrees	-0.067	-0.129
	(0.057)	(0.095)
Master Degrees	0.001	-0.003
	(0.034)	(0.049)
Doctor Degrees	-0.057	-0.086
	(0.037)	(0.058)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.518	0.544
Observations	3219	3219

Panel B: The Effect of No-loan Financial Aid Policy on Access to Venture Capital: By Low Income Fraction of Students

	(1) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(2) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
Policy x Below Median Low Income Student Fraction	0.153	0.246
	(0.164)	(0.230)
Policy x Above Median Low Income Student Fraction	0.221*	0.269**
	(0.120)	(0.134)
Tuition and Fees	-0.209**	-0.271***
	(0.084)	(0.100)
Total Revenue	-0.012	0.001
	(0.031)	(0.033)
Educ Share	0.031	0.114
	(0.309)	(0.443)
Bachelor Degrees	-0.026	-0.041
	(0.016)	(0.026)
Master Degrees	-0.011	-0.010
	(0.015)	(0.020)
Doctor Degrees	-0.008	-0.007
	(0.015)	(0.021)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.436	0.426
Observations	3219	3219

Panel C: The Effect of No-loan Financial Aid Policy on Entrepreneurial Firms' Sales and Employment: By Low Income Fraction of Students

	(1) ln(Sales After 5 Years of Founding)	(2) ln(Employment After 5 Years of Founding)	(3) ln(Sales After 5 Years of Founding)	(4) ln(Employment After 5 Years of Founding)
Policy x Below Median Low Income Student Fraction	0.447	0.581*	0.431	0.582*
	(0.414)	(0.339)	(0.420)	(0.340)
Policy x Above Median Low Income Student Fraction	0.870***	0.645**	0.856***	0.644**
	(0.274)	(0.245)	(0.278)	(0.244)
ln(Sales of Control Firms in 5 Yrs)			0.012	
			(0.019)	
ln(Employment of Control Firms in 5 Yrs)				0.017
				(0.078)
Tuition and Fees	-0.456	-0.468	-0.452	-0.467
	(1.158)	(0.999)	(1.154)	(1.000)
Total Revenue	0.109	0.132	0.102	0.130
	(0.231)	(0.194)	(0.235)	(0.193)
Educ Share	4.545**	3.220**	4.565**	3.211**
	(2.069)	(1.575)	(2.078)	(1.585)
Bachelor Degrees	-0.303	-0.575	-0.340	-0.577
	(1.604)	(1.162)	(1.587)	(1.162)
Master Degrees	-0.018	0.004	-0.027	-0.001
	(1.093)	(0.836)	(1.089)	(0.841)
Doctor Degrees	-0.627	-0.239	-0.573	-0.233
	(0.603)	(0.462)	(0.603)	(0.463)
University FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
R^2	0.818	0.737	0.777	0.734
Observations	638	638	636	636

Panel D: The Effect of No-loan Financial Aid Policy on the Number of Trademarks Obtained by Entrepreneurial Firms: By Low Income Fraction of Students

	(1)	(2)
	Firms founded within 5 years of Graduation	
	Ln(1+#Trademarks)	
Variables	(4 years)	(5 years)
Policy x Below Median Low Income Student Fraction	0.085	0.097
	(0.141)	(0.146)
Policy x Above Median Low Income Student Fraction	0.273*	0.359**
	(0.152)	(0.166)
Tuition and Fees	-0.176**	-0.169*
	(0.086)	(0.088)
Total Revenue	0.024	0.034
	(0.039)	(0.042)
Educ Share	-0.381	-0.237
	(0.396)	(0.407)
Bachelor Degrees	-0.028	-0.027
	(0.027)	(0.026)
Master Degrees	0.002	-0.008
	(0.015)	(0.017)
Doctor Degrees	-0.029	-0.028
	(0.031)	(0.035)
University FE	Yes	Yes
State-Year FE	Yes	Yes
Observations	3,219	3,219
R-squared	0.430	0.441

Table 11: The Entrepreneurial Benefits of the Biden Administration's Original Student Loan Forgiveness Program

This table reports the estimation of the entrepreneurial benefits of the Biden Administration's student loan forgiveness program. We measure entrepreneurial benefits by computing the additional sales potentially generated by firms started by student entrepreneurs, who would have experienced a forgiveness on a portion of their outstanding student loans due to the Biden Administration's policy on student loans announced on August 24, 2022. Panel A shows the estimated present value of sales (in billions of dollars) over a period of 10-years. Panel B shows the estimated present value of sales assuming a growing perpetuity. All the above estimates are based on different assumptions of growth rate (g) of additional sales and discount rate (r). All estimates are in 2022 dollars. We describe our estimation strategy in detail in Section 8.

Panel A: Present Value Estimates of Additional Sales generated over a period of 10-years from Entrepreneurial Ventures due to the effect of Biden Administration's Original Student Loan Forgiveness Program (Billion$)

	r= / g=	5%	10%	15%	20%	25%	30%
Assuming 1/4th of the loan is forgiven	**0%**	203.7	160.1	129.2	106.7	90.0	77.2
	5%		170.3	136.2	111.6	93.5	79.7
	10%			144.1	117.1	97.4	82.5
	15%				123.3	101.7	85.7
	20%					106.6	89.2
	25%						93.0

	r= / g=	5%	10%	15%	20%	25%	30%
Assuming 1/3d of the loan is forgiven	**0%**	271.6	213.4	172.2	142.3	120.0	103.0
	5%		2227.1	181.6	148.8	124.6	106.3
	10%			192.2	156.2	129.8	110.1
	15%				164.4	135.7	114.2
	20%					142.2	118.9
	25%						124.1

	r= / g=	5%	10%	15%	20%	25%	30%
Assuming 1/2 of the loan is forgiven	**0%**	407.4	320.1	258.4	213.5	180.0	154.4
	5%		340.6	272.4	223.3	187.0	159.5
	10%			288.3	234.3	194.8	165.1
	15%				246.7	203.5	171.4
	20%					213.2	178.3
	25%						186.1

Panel B: Present Value Estimates of Additional Sales generated under a Growing Perpetuity Model from Entrepreneurial Ventures due to the effect of Biden Administration's Original Student Loan Forgiveness Program (Billion$)

	g= \ r=	5%	10%	15%	20%	25%	30%
Assuming 1/4th of the loan is forgiven	**0%**	561.3	272.4	177.2	130.3	102.5	84.3
	5%		471.3	232.7	153.7	114.4	91.1
	10%			399.2	200.5	134.3	101.3
	15%				340.9	174.1	118.3
	20%					293.4	152.2
	25%						254.2

	g= \ r=	5%	10%	15%	20%	25%	30%
Assuming 1/3d of the loan is forgiven	**0%**	748.4	363.1	236.2	173.7	136.7	112.4
	5%		628.4	310.3	204.9	152.6	121.4
	10%			532.3	267.3	179.1	135.0
	15%				454.6	232.1	157.7
	20%					391.2	203.0
	25%						339.0

	g= \ r=	5%	10%	15%	20%	25%	30%
Assuming 1/2 of the loan is forgiven	**0%**	1122.7	544.7	354.4	260.5	205.0	168.5
	5%		942.6	465.4	307.3	228.9	182.1
	10%			798.4	401.0	268.6	202.5
	15%				681.9	348.2	236.5
	20%					586.8	304.5
	25%						508.5

Internet Appendix (Not to be Published)

In this section, we show some additional evidence in support of our results in the main paper. In Table A1, we provide the list of universities in our sample and the percentage of startups in our sample created by students from these universities. Some of these universities have implemented no-loan financial aid policies (treated universities), while the remaining universities did not implement no-loan financial aid policies (control universities). We show the year of implementation of no-loan financial aid policies for treated universities. In Table A2, we show the effect of student loan on the staging of VC investments in the entrepreneurial ventures of students graduating from the above universities. In Table A3, we restrict our sample to treated universities to examine the effect of student loan on entrepreneurship and on VC-backed entrepreneurship. This analysis rules out the concern that our results are driven by differences between treated and control universities. In Table A4, we analyze the effect of no-loan financial aid policies on specific majors (Engineering, Science, Business, and Professional). We do not find any changes in the composition of graduates across the above majors after some universities have implemented no-loan financial aid policies. In Table A5, we conduct additional robustness check by removing state fixed effects. The new results are consistent with our earlier results reported in the main paper. Next, in Table A6, we conduct robustness tests using stacked DiD regressions to address concerns associated with using staggered event-based DiD regressions. Our main results are robust to using the above stacked DiD regressions.

Next, in Table A7, we show the dynamic time-trends of the effect of no-loan financial aid policies on entrepreneurship and on VC-backed entrepreneurship. Our results support the parallel trend assumptions. Next, in Figure 1, we show the above results graphically. We show the parallel trend tests for our analyses on the fraction of students taking loans, on entrepreneurship, and on VC-backed entrepreneurship. There is a reduction in the fraction of students (who were already enrolled in these universities prior to introduction of no-loan financial aid policies) taking student loans in treated universities. Further, there is an increase in entrepreneurship and in VC-backed entrepreneurship for the above students in treated universities, compared to control universities, after the introduction of no-loan financial aid policies. In Figure 2, we show parallel trend tests for the number of undergraduates graduating (receiving degrees) from treated and control universities. Our parallel trend tests show that there is no difference in terms of the number of undergraduates graduating (graduation rate) from treated versus control universities.

Finally, in Table A8, we show the long-run effect of no-loan financial aid policies on entrepreneurship and on VC-backed entrepreneurship. We expand our sample to even include cohorts of students who joined these universities after the implementation of no-loan financial aid polices in these universities. Our results show long-run persistence of the effect of no-loan financial aid policies on entrepreneurship and on VC-backed entrepreneurship.

Table A1: Information on the Implementation of No-Loan Financial Aid Policies and on the Percentage of Startups across Various Universities

In this table, we show the information on the year of the introduction of no-loan financial aid policies in some of these universities, which introduced these policies, and the information on the percentage of startups in our sample that were created by students graduating across these universities, including the universities that did not implement no-loan financial aid policies. We consider all the startups created by students within five years of their graduation from these universities. Panel A shows the list of percentage of startups in our sample created by students either graduating from universities with no-loan financial aid policies (treated universities) or graduating from universities with standard student loan policies (control universities). Panel B shows the percentage of startups in our sample that were created by students graduating from top ten universities.

Panel A: List of All Universities and their Respective Percentage of Student Startups Created by Students within Five Years of their Graduation

University	% of Startups (5 years after graduation)	No Loan Policy Implemented?	Year of No Loan Policy implementation
Georgian Court University	0.00%	No	
Humboldt State University	0.00%	No	
Richard Stockton College Of New Jersey	0.00%	No	
Colorado State University-Pueblo	0.00%	Yes	2011
Indiana University-Bloomington	0.00%	Yes	2007
Kenyon College	0.00%	Yes	2008
University of Minnesota-Morris	0.00%	Yes	2005
Wellesley College	0.00%	Yes	2008
Louisiana Tech University	0.03%	No	
Maryland Institute College of Art	0.03%	No	
Mount Mercy University	0.03%	No	
Oklahoma Christian University	0.03%	No	
Southern Polytechnic State University	0.03%	No	
University of New Mexico-Main Campus	0.03%	No	
University-Buffalo	0.03%	No	
Carleton College	0.03%	Yes	2008
Connecticut College	0.03%	Yes	2006
Texas State University-San Marcos	0.03%	Yes	2009
University of Toledo	0.03%	Yes	2009
Gustavus Adolphus College	0.07%	No	
College of Holy Cross	0.07%	Yes	2008
University of Louisville	0.07%	Yes	2007
Ball State University	0.10%	No	
California State University-East Bay	0.10%	No	
Letourneau University	0.10%	No	
Sonoma State University	0.10%	No	
Stetson University	0.10%	No	
University Of Alabama-Huntsville	0.10%	No	
Vanguard University of Southern California	0.10%	No	
Wheaton College 168281	0.10%	No	
Wofford College	0.10%	No	

Appalachian State University	0.10%	Yes	2007
Bowdoin College	0.10%	Yes	2008
Fairfield University	0.10%	Yes	2008
Brooks Institute of Photography	0.13%	No	
Occidental College	0.13%	No	
Susquehanna University	0.13%	No	
University Of Nevada-Reno	0.13%	No	
Wentworth Institute of Technology	0.13%	No	
Northern Illinois University	0.13%	Yes	2009
Sacred Heart University	0.13%	Yes	2008
Swarthmore College	0.13%	Yes	2006
Texas A & M University-College Station	0.13%	Yes	2009
Vassar College	0.13%	Yes	2008
California State Polytechnic University-Pomona	0.17%	No	
California State University-Fullerton	0.17%	No	
Chapman University	0.17%	No	
Davidson College	0.17%	Yes	2007
University of Central Arkansas	0.20%	No	
College of William and Mary	0.20%	Yes	2007
University of San Diego	0.23%	No	
Claremont Mckenna College	0.23%	Yes	2008
Haverford College	0.23%	Yes	2008
Pomona College	0.23%	Yes	2008
Washington And Lee University	0.23%	Yes	2008
Amherst College	0.27%	Yes	2007
University of Kansas	0.30%	No	
Colby College	0.30%	Yes	2008
Grinnell College	0.30%	Yes	2008
Lafayette College	0.30%	Yes	2008
Oberlin College	0.30%	Yes	2008
Rice University	0.30%	Yes	2005
University of Vermont	0.33%	Yes	2008
Reed College	0.37%	No	
North Carolina State University-Raleigh	0.37%	Yes	2007
University of California-Riverside	0.37%	Yes	2009
Williams College	0.40%	Yes	2008
California Institute of Technology	0.43%	Yes	2008
Emory University	0.43%	Yes	2007
Rensselaer Polytechnic Institute	0.47%	No	
Stony Brook University	0.47%	No	
Lehigh University	0.47%	Yes	2008
Colgate University	0.50%	No	
Southern Methodist University	0.50%	No	
University of Tennessee	0.50%	Yes	2005

Brandeis University	0.57%	No	
University of California-Santa Cruz	0.57%	Yes	2009
Case Western Reserve University	0.60%	No	
University of Central Florida	0.60%	No	
Tufts University	0.60%	Yes	2007
University of Delaware	0.67%	No	
University of Michigan-Ann Arbor	0.70%	Yes	2006
Washington University-St Louis	0.70%	Yes	2008
Bentley University	0.77%	No	
Miami University-Oxford	0.80%	Yes	2007
University of California-Davis	0.80%	Yes	2009
University of Minnesota-Twin Cities	0.86%	Yes	2005
Michigan State University	0.90%	Yes	2006
University of North Carolina-Chapel Hill	0.96%	Yes	2003
Florida State University	1.00%	No	
University of Chicago	1.03%	Yes	2008
Wesleyan University	1.03%	Yes	2008
University of Notre Dame	1.10%	No	
California Polytechnic State University-San Luis Obispo	1.13%	No	
Georgetown University	1.13%	No	
Virginia Polytechnic Institute and State University	1.13%	No	
University of California-San Diego	1.13%	Yes	2009
Vanderbilt University	1.16%	Yes	2009
University of California-Irvine	1.20%	Yes	2009
Pennsylvania State University-Main Campus	1.23%	No	
Dartmouth College	1.33%	Yes	2008
University of Virginia-Main Campus	1.33%	Yes	2004
University of Maryland-College Park	1.40%	Yes	2007
University of Wisconsin-Madison	1.43%	No	
University of Arizona	1.43%	Yes	2008
Northwestern University	1.50%	Yes	2008
Arizona State University	1.53%	Yes	2007
University of Florida	1.56%	Yes	2006
Boston University	1.60%	Yes	2009
Princeton University	1.70%	Yes	1998
University of Washington-Seattle Campus	1.86%	Yes	2007
Columbia University-City of New York	1.90%	Yes	2007
Brown University	1.96%	Yes	1999
Georgia Institute of Technology-Main Campus	2.03%	Yes	2007
University of California-Santa Barbara	2.03%	Yes	2009
University of Colorado Boulder	2.06%	No	
Yale University	2.20%	Yes	2005
New York University	2.40%	No	
Duke University	2.53%	Yes	2008

Carnegie Mellon University	2.56%	No	
University of California-Los Angeles	2.79%	Yes	2009
University of Southern California	2.99%	No	
Harvard University	3.46%	Yes	2004
Cornell University	3.79%	Yes	2008
Massachusetts Institute of Technology	3.93%	Yes	2006
University of Pennsylvania	4.76%	Yes	2006
Stanford University	6.62%	Yes	2006

Panel B: Percentage of Startups Created by Students Graduating from Top Ten Universities

University	% of Startups (5 years after graduation)	No Loan Policy Implemented?	Year of No Loan Policy implementation
Brown University	1.96%	Yes	1999
Columbia University-City Of New York	1.90%	Yes	2007
Cornell University	3.79%	Yes	2008
Dartmouth College	1.33%	Yes	2008
Harvard University	3.46%	Yes	2004
Princeton University	1.70%	Yes	1998
University of Pennsylvania	4.76%	Yes	2006
Yale University	2.20%	Yes	2005
Massachusetts Institute of Technology	3.93%	Yes	2006
Stanford University	6.62%	Yes	2006
Total	31.64%		

Table A2. The Effect of No-loan Financial Aid Policy on Venture Capital Staging

This table reports the OLS regression results of the effect of no-loan financial aid policy on venture capital staging at the university-year level. Panel A uses fraction of total VC investment made in the first round as the measure of staging, while Panel B uses the number of VC-investment rounds as the measure of staging. *Fraction of Investment in 1st VC Round (for Ventures Starting within 3 Years after Graduation)* is the fraction of investment received in the first round of VC financing out of all rounds for a given firm, aggregated to the university level by taking average across all VC firms founded by graduates within 3 years after their graduations in a university. *Number of VC Rounds (for Ventures Starting within 3 Years after Graduation)* is the number of rounds of VC financing for a given firm, aggregated to the university level by taking average across all VC firms founded by graduates within 3 years after their graduations in a university. *Five years after graduation* measures are similarly defined. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *VC Investment for Ventures 3 Years After Graduation* is the log of one plus the aggregated amount (in thousand) of venture capitalist dollars raised across all rounds for all ventures that were started by entrepreneurs whose first ventures were started within three years after their graduation. "5 Years" variable is defined similarly with an entrepreneur started a venture within five years of graduation. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of the total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of the number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

Panel A: The Effect of No-loan Financial Aid Policy on the Fraction of VC Investment in the First Round

	(1) Fraction of Investment in 1st VC Round (for Ventures Starting within 3 Years After Graduation)	(2) Fraction of Investment in 1st VC Round (for Ventures Starting within 5 Years After Graduation)
Policy	0.090*	0.163***
	(0.053)	(0.057)
VC Investment for Ventures 3 Years After Graduation	0.051***	
	(0.004)	
VC Investment for Ventures 5 Years After Graduation		0.048***
		(0.003)
Tuition and Fees	0.011	0.024
	(0.027)	(0.030)
Total Revenue	0.007	0.017
	(0.016)	(0.018)
Educ Share	-0.044	-0.040
	(0.101)	(0.126)
Bachelor Degrees	-0.000	-0.004
	(0.008)	(0.009)
Master Degrees	-0.007	-0.006
	(0.006)	(0.007)
Doctor Degrees	-0.005	-0.000
	(0.009)	(0.012)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.603	0.640
Observations	3292	3292

Panel B: The Effect of No-loan Financial Aid Policy on the Number of Rounds of VC Investment

	(1) Number of VC Rounds (for Ventures Starting within 3 Years After Graduation)	(2) Number of VC Rounds (for Ventures Starting within 5 Years After Graduation)
Policy	-0.215*	-0.495***
	(0.127)	(0.178)
VC Investment for Ventures 3 Years After Graduation	0.412***	
	(0.026)	
VC Investment for Ventures 5 Years After Graduation		0.416***
		(0.023)
Tuition and Fees	0.025	0.137
	(0.124)	(0.200)
Total Revenue	0.029	0.060
	(0.056)	(0.077)
Educ Share	0.390	-0.207
	(0.464)	(0.641)
Bachelor Degrees	-0.008	0.005
	(0.035)	(0.047)
Master Degrees	0.029	0.031
	(0.024)	(0.034)
Doctor Degrees	-0.004	-0.040
	(0.029)	(0.043)
University FE	Yes	Yes
State-Year FE	Yes	Yes
R^2	0.739	0.716
Observations	3292	3292

Table A3. The Effect of No-loan Financial Aid Policy on Entrepreneurship - Treated Sample

This table reports the OLS regression results of entrepreneurship and VC-backed entrepreneurship on no-loan financial aid policy using only the treated universities as the sample. *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and has got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation and has got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors are multiplied by 1,000 to make it easier to read. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation	(3) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(4) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
Policy	0.885**	1.229**	0.356*	0.452**
	(0.409)	(0.561)	(0.188)	(0.222)
Tuition and Fees	-0.855***	-1.179***	-0.311**	-0.361**
	(0.305)	(0.385)	(0.145)	(0.181)
Total Revenue	-0.096	-0.072	-0.035	-0.020
	(0.088)	(0.125)	(0.040)	(0.044)
Educ Share	0.676	1.582	0.274	0.541
	(1.215)	(2.028)	(0.520)	(0.717)
Bachelor Degrees	-0.093	-0.157	-0.030	-0.048
	(0.078)	(0.141)	(0.024)	(0.040)
Master Degrees	0.077	0.126	0.001	-0.009
	(0.077)	(0.128)	(0.051)	(0.058)
Doctor Degrees	-0.123	-0.212*	-0.010	0.003
	(0.088)	(0.120)	(0.038)	(0.046)
University FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
R^2	0.573	0.606	0.416	0.428
Observations	1814	1814	1814	1814

Table A4. The Effect of No-loan Financial Aid Policy on Bachelor Degrees Granted by Major

This table reports the OLS regression results of bachelor degrees granted by major on no-loan financial aid policy. The dependent variables *Engineering*, *Science*, *Business*, and *Professional* correspond to the fraction of bachelor degrees granted in each major. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1)	(2)	(3)	(4)
	Engineering	Science	Business	Professional
Policy	-0.009	-0.007	-0.007	-0.001
	(0.009)	(0.007)	(0.009)	(0.005)
Tuition and Fees	0.007	-0.021	0.004	0.047**
	(0.017)	(0.014)	(0.024)	(0.020)
Total Revenue	0.003	0.002	-0.024**	0.000
	(0.006)	(0.007)	(0.010)	(0.006)
Educ Share	-0.054	-0.010	-0.082	-0.048
	(0.078)	(0.044)	(0.057)	(0.037)
Bachelor Degrees	-0.019	-0.065***	0.060***	-0.024
	(0.012)	(0.017)	(0.022)	(0.038)
Master Degrees	-0.016**	-0.010*	0.024	-0.013*
	(0.006)	(0.005)	(0.016)	(0.007)
Doctor Degrees	0.011**	0.004	-0.014**	0.008
	(0.005)	(0.005)	(0.007)	(0.008)
University FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
R^2	0.819	0.873	0.759	0.683
Observations	3174	3174	3174	3174

Table A5. The Effect of No-loan Financial Aid Policy on Entrepreneurship - No State Fixed Effects

This table reports the OLS regression results of entrepreneurship and VC-backed entrepreneurship on no-loan financial aid policy including only year fixed effects, instead of state-year fixed effects. *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University and year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors are multiplied by 1,000 to make reading easier. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation	(3) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(4) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
Policy	0.258*	0.363*	0.119**	0.139**
	(0.142)	(0.193)	(0.052)	(0.067)
Tuition and Fees	-0.432***	-0.650***	-0.152***	-0.188***
	(0.112)	(0.162)	(0.043)	(0.057)
Total Revenue	0.002	0.042	0.009	0.025
	(0.071)	(0.089)	(0.030)	(0.030)
Educ Share	0.478	0.804	0.137	0.187
	(0.482)	(0.756)	(0.196)	(0.264)
Bachelor Degrees	-0.065*	-0.115*	-0.027**	-0.038**
	(0.039)	(0.061)	(0.013)	(0.018)
Master Degrees	0.013	-0.007	-0.003	-0.007
	(0.024)	(0.028)	(0.010)	(0.013)
Doctor Degrees	-0.048*	-0.060*	-0.010	-0.011
	(0.025)	(0.035)	(0.008)	(0.010)
University FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
R^2	0.342	0.411	0.202	0.248
Observations	3292	3292	3292	3292

Table A6. The Effect of No-loan Financial Aid Policy on VC-backed Entrepreneurship - Stacked DiD Regressions

This table reports the stacked difference in differences (DiD) regression results of VC-backed entrepreneurship on no-loan financial aid policy. We construct a cohort of treated universities and control universities using university-year observations for nine years before and three years after the introduction of No-loan Financial Aid policies by treated universities in a particular calendar year. A cohort is formed in a calendar year in which these No-loan Financial Aid policies were introduced. The sample is balanced and include three years of observations after the shock and nine years prior to the shock. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Policy* is a dummy variable that is equal to one if a university has implemented no-loan financial aid policy in a given year, otherwise it is equal to zero. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University by cohort and state-year by cohort fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors are multiplied by 1,000. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(2) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
Policy	0.313*	0.414*
	(0.174)	(0.247)
Tuition and Fees	0.001	0.293
	(0.161)	(0.270)
Total Revenue	-0.020	-0.056
	(0.036)	(0.049)
Educ Share	-0.213	0.054
	(0.715)	(0.910)
Bachelor Degrees	-0.003	-0.092
	(0.097)	(0.137)
Master Degrees	-0.070	-0.078
	(0.074)	(0.101)
Doctor Degrees	-0.035	-0.041
	(0.079)	(0.098)
University by Cohort FE	Yes	Yes
State-Year by Cohort FE	Yes	Yes
R^2	0.707	0.770
Observations	1838	1838

Table A7. The Dynamic Effect of No-loan Financial Aid Policy on Entrepreneurship and VC-backed Entrepreneurship: Parallel Trend Test

This table reports the dynamic difference in differences (DiD) regression results of entrepreneurship and VC-backed entrepreneurship on no-loan financial aid policy. *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 5 Years After Graduation* is the fraction of entrepreneurs who started a venture within five years of graduation and have got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. *T=-1* and *T=-2* are indicator variables equal to one if it is one and two years, respectively, before the year of the adoption of No-loan financial aid policy by a university. *T=0* is an indicator variable equal to one if it is the year of the adoption of No-loan financial aid policy by a university. *T=+1*, *T=+2*, and *T=+3* are indicator variables equal to one if it is one, two, and three years, respectively, after the year of the adoption of No-loan financial aid policy by a university. *T= before -2* is an indicator variable that is equal to one for all years before two years prior to the adoption of No-loan financial aid policies. The above indicator variable is omitted due to multicollinearity. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

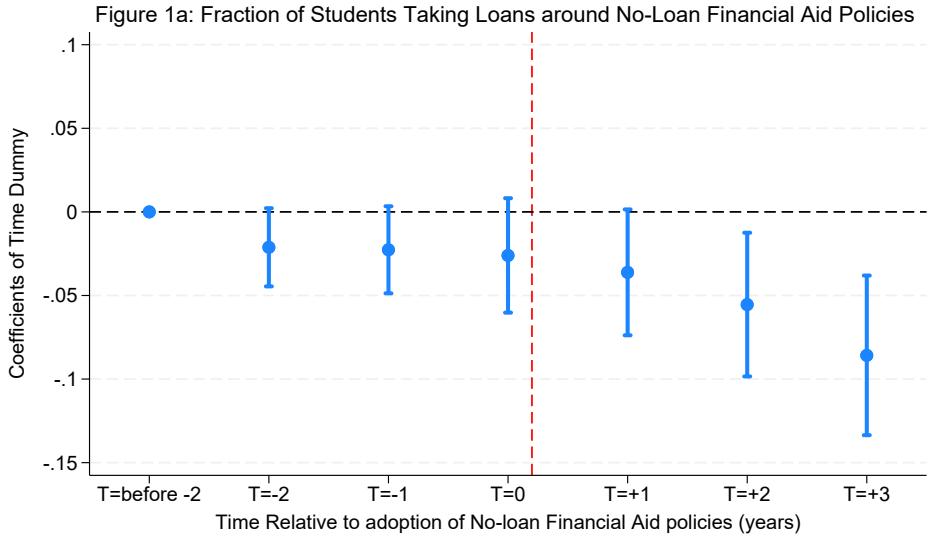
	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation	(3) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(4) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
T=-2	0.00010	0.00027	0.00009	0.00021
	(0.00013)	(0.00017)	(0.00010)	(0.00014)
T=-1	0.00014	0.00037	0.00008	0.00006
	(0.00015)	(0.00024)	(0.00007)	(0.00008)
T=0	-0.00002	0.00025	-0.00002	0.00007
	(0.00018)	(0.00022)	(0.00011)	(0.00015)
T=+1	0.00055**	0.00086**	0.00032*	0.00041**
	(0.00027)	(0.00035)	(0.00019)	(0.00020)
T=+2	0.00046**	0.00099**	0.00014	0.00028*
	(0.00021)	(0.00042)	(0.00009)	(0.00017)
T=+3	0.00069	0.00094*	0.00020	0.00022
	(0.00043)	(0.00049)	(0.00016)	(0.00017)
Tuition and Fees	-0.00058***	-0.00084***	-0.00020**	-0.00027***
	(0.00018)	(0.00025)	(0.00008)	(0.00010)
Total Revenue	-0.00002	0.00001	-0.00001	0.00000
	(0.00007)	(0.00010)	(0.00003)	(0.00003)
Educ Share	0.00037	0.00077	0.00006	0.00015
	(0.00064)	(0.00107)	(0.00027)	(0.00039)
Bachelor Degrees	-0.00005	-0.00010	-0.00002	-0.00003
	(0.00005)	(0.00008)	(0.00001)	(0.00002)
Master Degrees	0.00000	0.00001	-0.00001	-0.00001
	(0.00003)	(0.00005)	(0.00001)	(0.00002)
Doctor Degrees	-0.00005	-0.00006	-0.00001	-0.00000
	(0.00003)	(0.00005)	(0.00001)	(0.00002)
University FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
R^2	0.520	0.547	0.442	0.433
Observations	3292	3292	3292	3292

Figure 1: Parallel Trends Test

We estimate the following dynamic difference in differences (DiD) model, which is also used to show regression results in Table A7:

$$y_{it} = \alpha + \beta_1 * (T = \textit{before -2}) + \sum_{j=-2}^{+3} \beta_j (T = j) + \gamma X_{it} + \lambda_i + \kappa_{st} + \epsilon_{it}, \quad (1)$$

where *T=-1* and *T=-2* are indicator variables equal to one if it is one and two years, respectively, before the year of the adoption of No-loan financial aid policy by a university. *T=0* is an indicator variable equal to one if it is the year of the adoption of No-loan financial aid policy by a university. *T=+1*, *T=+2*, and *T=+3* are indicator variables equal to one if it is one, two, and three years, respectively, after the year of the adoption of No-loan financial aid policy by a university. *T= before -2* is an indicator variable that is equal to one for all years before two years prior to the adoption of No-loan financial aid policies. The above indicator variable is omitted due to multicollinearity. X_{it} represents control variables, including university-year characteristics such as tuition and fees, revenue etc. λ_i represents university fixed effects and κ_{st} represents state-year fixed effects.



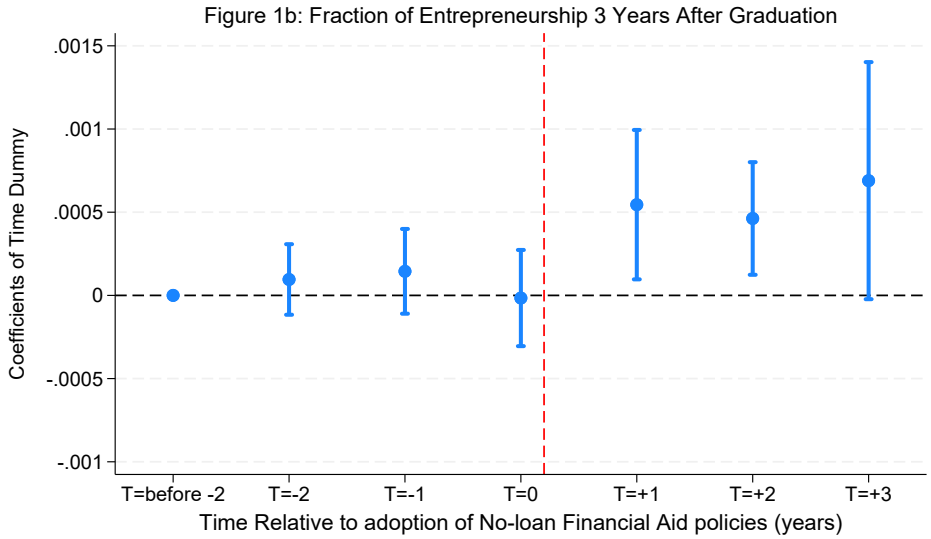


Figure 1c: Fraction of Entrepreneurship 5 Years After Graduation

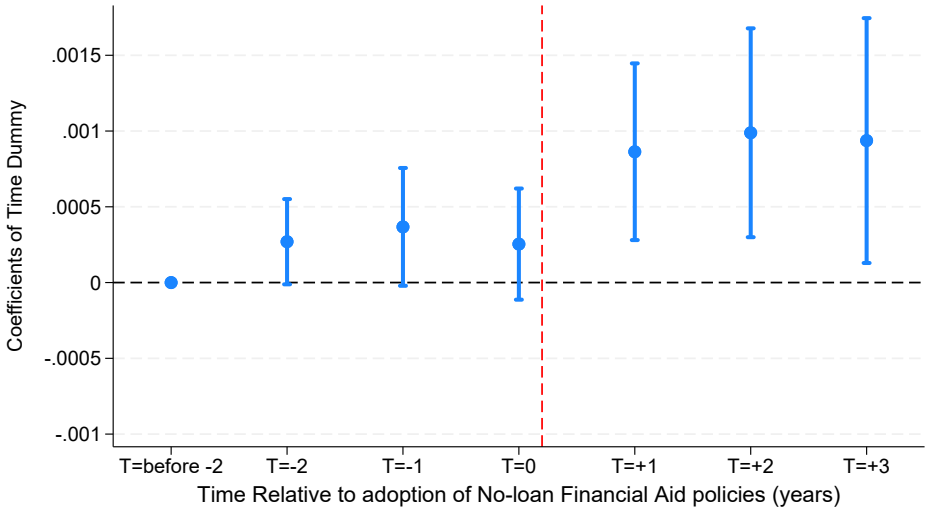


Figure 1d: Fraction of VC-backed Entrepreneurship 3 Years After Graduation

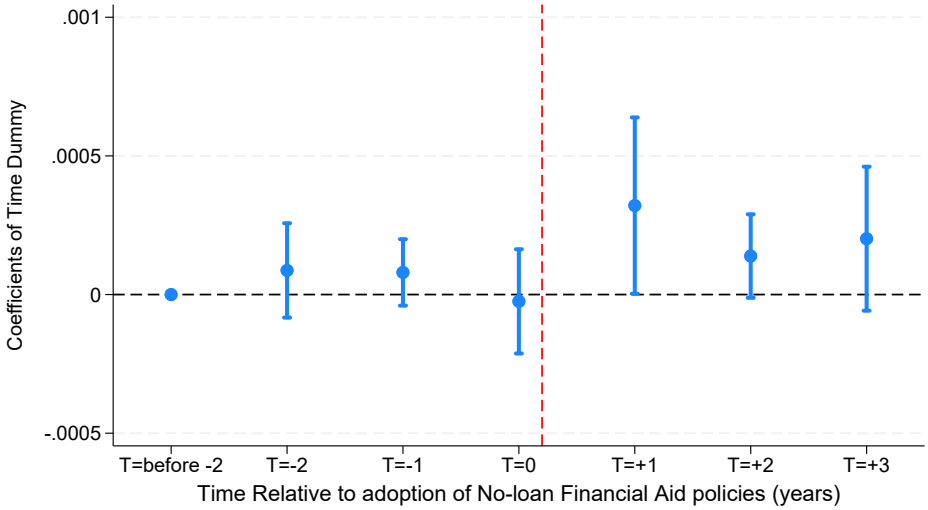


Figure 1e: Fraction of VC-backed Entrepreneurship 5 Years After Graduation

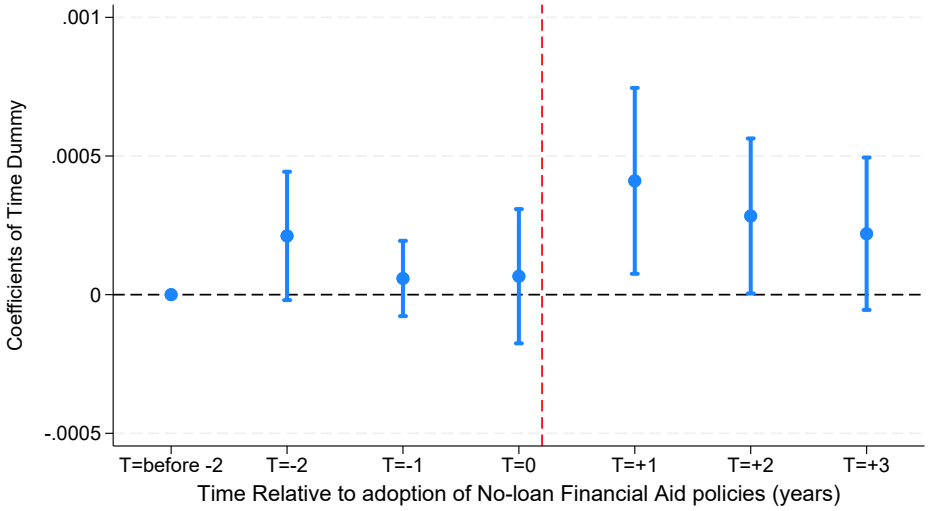


Figure 2: Trends of Number of Undergraduates Graduating

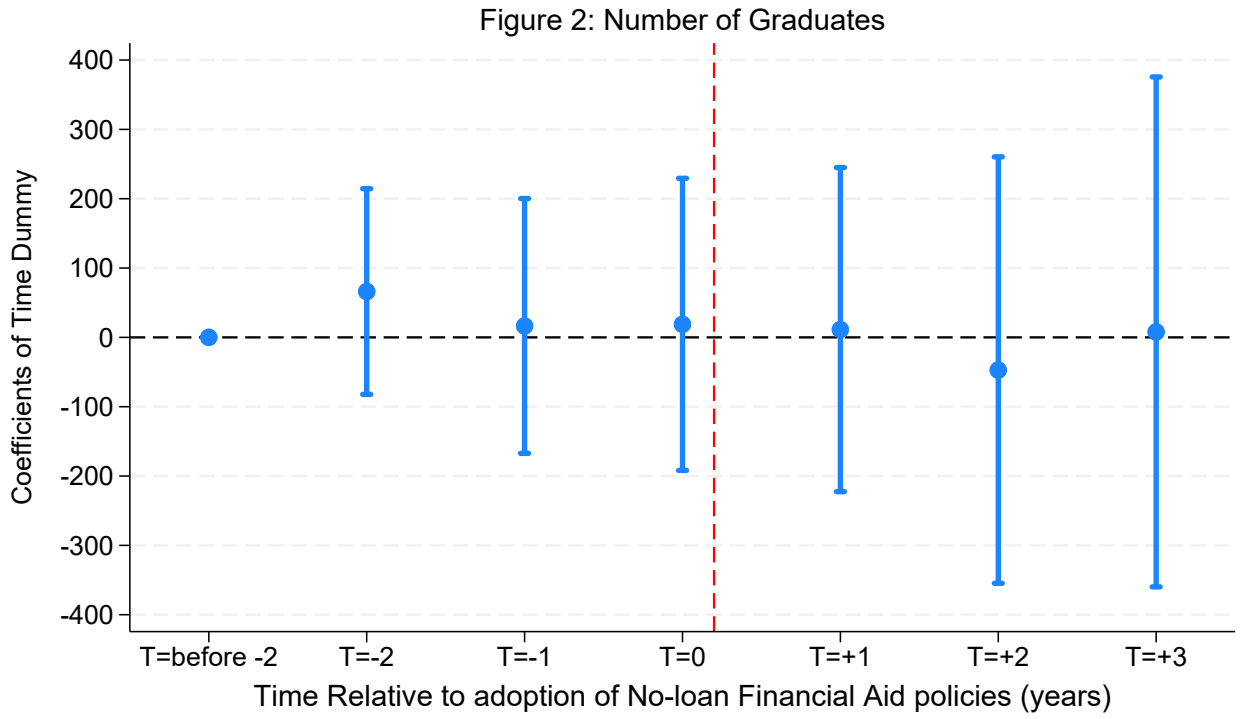


Table A8. The Effect of No-loan Financial Aid Policy on Entrepreneurship - Post-Policy Effects

This table reports the OLS regression results of entrepreneurship and VC-backed entrepreneurship on post-policy effects of no-loan financial aid policy, including all available cohorts. In other words, it also includes cohorts who joined the universities after the implementation of no-loan financial aid policies, *Fraction of Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation out of total number of undergraduate degrees granted in a given university-year. *Fraction of VC-Backed Entrepreneurs 3 Years After Graduation* is the fraction of entrepreneurs who started a venture within three years of graduation and has got venture capital financing (at anytime) out of total number of undergraduate degrees granted in a given university-year. "5 Years" variables are defined similarly with an entrepreneur started a venture within five years of graduation. *T=-1* and *T=-2* are indicator variables equal to one if it is one and two years, respectively, before the year of the adoption of No-loan financial aid policy by a university. *T=0* is an indicator variable equal to one if it is the year of the adoption of No-loan financial aid policy by a university. *T=+1*, *T=+2*, and *T=+3* are indicator variables equal to one if it is one, two, and three years, respectively, after the year of the adoption of No-loan financial aid policy by a university. *T=Beyond +3* is an indicator variable equal to one if it is beyond three years after the year of the adoption of No-loan financial aid policy by a university. *T= before -2* is an indicator variable that is equal to one for all years before two years prior to the adoption of No-loan financial aid policies. The above indicator variable is omitted due to multicollinearity. *Tuition and Fees* is the log of in-state tuition and fees for full-time undergraduates (in real 2012 dollars). *Total Revenue* is the log of total amount of university revenue (in real 2012 dollars). *Educ Share* is education-related share of expenses. *Bachelors*, *Masters*, and *Doctoral Degrees* are the log of number of Bachelors, Masters, and Doctoral degrees granted respectively. University and state-year fixed effects are included in all regressions. Standard errors are clustered at university level and reported in parentheses. All coefficients and standard errors are multiplied by 1,000 to ease reading. ***, ** and * represent statistical significance at 1%, 5%, and 10% levels respectively.

	(1) Fraction of Entrepreneurs 3 Years After Graduation	(2) Fraction of Entrepreneurs 5 Years After Graduation	(3) Fraction of VC-Backed Entrepreneurs 3 Years After Graduation	(4) Fraction of VC-Backed Entrepreneurs 5 Years After Graduation
T=-2	0.087	0.250	0.084	0.206
	(0.130)	(0.170)	(0.102)	(0.140)
T=-1	0.130	0.334	0.075	0.051
	(0.159)	(0.241)	(0.072)	(0.081)
T=0	-0.006	0.245	-0.031	0.054
	(0.172)	(0.216)	(0.113)	(0.145)
T=+1	0.420*	0.680**	0.257	0.341*
	(0.234)	(0.292)	(0.181)	(0.191)
T=+2	0.402**	0.876**	0.150*	0.302*
	(0.183)	(0.349)	(0.083)	(0.160)
T=+3	0.684	0.970**	0.224	0.272*
	(0.434)	(0.487)	(0.141)	(0.146)
T=Beyond +3	0.887**	1.029***	0.195*	0.235**
	(0.375)	(0.359)	(0.111)	(0.109)
Tuition and Fees	-0.696***	-0.907***	-0.205***	-0.265***
	(0.220)	(0.251)	(0.074)	(0.087)
Total Revenue	-0.016	0.011	-0.009	-0.005
	(0.078)	(0.103)	(0.031)	(0.037)
Educ Share	0.377	0.771	0.082	0.153
	(0.809)	(1.134)	(0.309)	(0.382)
Bachelor Degrees	-0.068	-0.109	-0.020	-0.025
	(0.060)	(0.086)	(0.015)	(0.021)
Master Degrees	-0.000	-0.006	-0.015	-0.023
	(0.032)	(0.044)	(0.013)	(0.023)
Doctor Degrees	-0.052	-0.066	-0.009	-0.013
	(0.038)	(0.051)	(0.013)	(0.018)
University FE	Yes	Yes	Yes	Yes
State-Year FE	Yes	Yes	Yes	Yes
R^2	0.533	0.564	0.446	0.446
Observations	3397	3397	3397	3397