Does Student Debt Reduce Earnings?*

Justin Weidner†

November 11, 2016

Please download the latest version here.

Abstract

I use the Baccalaureate and Beyond and the 1997 National Longitudinal Survey of Youth, together with an estimated model of occupational choice to asses the impact of rising student debt on college graduates' earnings. Using these datasets, I document an empirical relationship between debt, occupational choice, and income. I find that graduates with an additional ten thousand dollars of debt have 1-2% lower income one year after graduation. This result is not being driven by joint determinants of income and debt, such as ability, family income, and college characteristics. Student debt is permanently scarring, as graduates with debt experience no faster income growth than their unburdened peers. Debt induces graduates to enter employment faster and select jobs in unrelated fields, leading to lower income levels and growth rates. My results are driven by a subgroup of graduates who report that debt has constrained their labor market decisions. Using the model, I demonstrate that rise in debt since 1990 has contributed to income stagnation, lowering affected graduates' income by 1.9% on average. Because it does not distort occupational choices, an income contingent repayment scheme would increase income for constrained graduates by 3.5% on average.

JEL Classification: E21, I22, J24, J31, J64
Keywords: Student debt, occupational choice.

---

*I am extremely grateful to Greg Kaplan for crucial advice, support, and encouragement. I thank Ishita Rajani, Cristian Alonso, Nikhil Gupta, Caitlin McGugan, Dan Goetz, and Ben Young for discussions that helped to shape the paper. This project has also benefitted from useful feedback from participants in the Princeton Macro/International Macro Lunch Seminar.

†Correspondence: Department of Economics, Princeton University, Princeton, NJ 08544. Tel.: (412) 526-8239. Email: jweidner@princeton.edu. Web: http://scholar.princeton.edu/jweidner

1 Introduction

In the spring of 2016, nearly 2 million Americans graduated with bachelors' degrees (Hussar and Bailey, 2016). About two-thirds of them will have needed to take out student loans in order to do so, due in part to rising education costs. While the cost of college has nearly doubled, the average student loan debt burden has nearly tripled since the 1990-1991 academic year (see Figure 1a). Over this same time period, graduates have seen almost no growth in median wage income in their early career, averaging only 0.1% per year over this time period (Figure 1b). These two trends have prompted a large discussion about the effects of student debt on graduates' outcomes in the wake of the Great Recession.[1]

Repayment of debt for recent graduates is likely to be more difficult as compared to graduates from earlier cohorts. Higher debt combined with stagnant income implies a lower buffer stock of assets. Risk averse agents with low buffer stocks are unable to self-insure against risks and will avoid risky, but lucrative choices. Many papers have found negative effects of student debt consistent with debtors being financially constrained and unable or unwilling to take advantage of risky opportunities.

In this paper, I examine the impact that debt has on graduates' income in their early working lives. In particular, I ask four questions. i) Does student debt affect graduates' income? ii) Does debt affect decisions in the labor market in ways that could lead to lower income? iii) How has the increase in debt since the early 1990s affected graduates' incomes? and iv) How would less distortionary repayment schemes affect graduates' income? I answer the first two questions using survey data and the last two questions using a structurally estimated model.

To empirically assess the effect of student debt on graduates' early labor market outcomes, I use two surveys, each of which allows me to explore different dimensions of graduates' experiences. The first is the Baccalaureate and Beyond (B&B), a restricted use survey of a nationally representative sample of college graduates in their final year of

[1]The weak recovery and large levels of debt post the Great Recession have also led some to speculate about a student debt bubble or crisis. See Avery and Turner (2012), Akers and Chingos (2014), Brown et al. (2014), (Dynarski, 2014), and Looney and Yannelis (2015) for discussions.

obtaining a bachelors' degree. This survey follows students in selected years after graduation, allowing me to examine the effect of debt on income one- and four-years after graduation using an extremely rich set of high quality information about graduates, such as demographics, test scores, socioeconomic background, and the post-secondary institution attended. The second data set I use is the 1997 National Longitudinal Study of Youth (NLSY97), from which I examine the subset of graduates who received a bachelors' degree. While the NLSY97 does not have as extensive controls as the B&B (particularly in regards to institutional characteristics), survey respondents were interviewed much more frequently, allowing for a more in depth look at labor market outcomes after graduation. In particular, I am able to construct weekly job histories and examine the impact of initial asset levels on non-employment duration.

I find that debt negatively affects both income and graduates' decisions in the labor market. In particular, I show that graduates with an additional ten thousand dollars in student loans have about 1-2% lower income one year after graduation. This result is not being driven by a vast set of graduate characteristics that jointly determine income and debt, such as ability, socio-economic background, and the graduate's post-secondary institution. This effect is scarring, as graduates with debt have lower income the first year after graduation but show no evidence of faster growth rates in subsequent years.

The negative effects of debt on income are driven by a subset of graduates who report changing their behavior in the labor market specifically because of their debt, which I take to be evidence of short-run repayment constraints. An additional ten thousand dollars in debt makes constrained graduates 2.3% more likely to choose jobs that are unrelated to their field of study than their unconstrained peers. Constrained graduates are also more likely to choose unsatisfying and non-professional jobs than unconstrained graduates. I find that these decisions do impact income, as graduates in jobs related to their field of study earn 25% more than similar graduates in unrelated jobs one-year after graduation and have about 7.5 percentage points faster income growth between one- and four-years after graduation.[2]

[2]This accords with several studies that examine the returns from matching skills to occupations. Guvenen et al. (2015) who highlight the benefits from correctly matching skills to occupations are large

Graduates with higher debt are also more likely to exit non-employment faster. In particular, graduates are 0.2% more likely to exit non-employment in a given week for every additional ten thousand dollars in debt. In a McCall (1970) search model, the inability to endure non-employment leads graduates with debt to lower their reservation wages and exit non-employment faster, which implies lower average income conditional on employment.

Compared to their debt-free peers, graduates with debt may end up with worse labor market outcomes as they choose less risky but less lucrative job options. Early labor market decisions have been well documented to be crucial for workers' long term income trajectory. For example, Topel and Ward (1992) show that the majority of earnings growth comes in early working life when workers switch jobs more frequently.[3] However, if finding a new job or switching to a better job is costly or risky, then risk-averse graduates with higher levels of debt are willing to accept worse jobs in expected value because they are unable to self-insure against the worst outcome.[4]

To quantify the effect of student debt on graduates' income and labor market decisions and evaluate the last two questions, I build a Roy (1951) model of occupational choice that takes into the account the effects that debt has on reservation wages and the graduates' choice to work in a job related to their field of study. From income and occupational choice data from the B&B, I structurally estimate the parameters from the model and use them to construct income counterfactuals for a simulated sample of graduates.

I use the model income counterfactuals to show that the increase in debt from 1993 to 2008 decreased income one year after graduation by about 1.8% for the roughly 20% of graduates affected by debt. The reservation wage channel is relatively more important

and persistent over workers' lifetimes. Kinsler and Pavan (2015) document that a large amount of premiums across majors are contingent on working in a job related to that major. Robst (2007) also shows that workers in unrelated jobs earn less than workers in related jobs with the same amount of schooling. The effect varies by field of study, with fields such as engineering that emphasize specific skills suffering more from being in an unrelated field.

[3] Oreopoulos et al. (2012) and Altonji et al. (2016) confirm the importance of early labor market experiences. They show that a worker's initial job placement determines much of her long-term wage trajectory.

[4] Danforth (1974) shows that reservation wages decrease with asset holdings if the agent has decreasing absolute risk aversion in the Arrow-Pratt sense.

as nearly all affected graduates are able to remain in a field related to their major after their debt level increased. The increase in debt from 1993 to 2008 caused income for affected graduates who remained in related jobs to be about 2% lower, whereas those who did switch to an unrelated job only lost about 1%. Based on my empirical results, this short-term loss reduction for graduates who switch comes at the cost of long-term income gains as they forego the extra income that accrues to those in related jobs later in life.

I also show that repayment schemes that do not distort labor market decisions would increase income for affected graduates by almost 3.5%. Income contingent repayment, loan forgiveness, and bankruptcy protection are three popular policy proposals that have been discussed in the media, and all would build some state-contingency into student debt contracts. Student debt notably lacks this feature, unique amongst other types of consumer debt.[5] Compared with the current fixed payment scheme, an income contingent repayment scheme will be less distortionary in terms of occupational choice.[6]

My results are consistent with other papers documenting the negative effects of debt on graduates' early working life outcomes, that are consistent with debt repayment inducing constraints. In a series of papers, Elliott et al. (2013a,b,c) use the Survey of Consumer Finances and find that that student debt negatively affects asset levels, particularly home equity and retirement savings. Student debt also lowers homeownership rates, as graduates with debt are less likely to assume the risk of being a homeowner as shown in Mezza

[5]A key feature of student loans is that it is particularly difficult for student loans be discharged in bankruptcy proceedings. Before 1990, graduates could file for bankruptcy under Chapter 7 and discharge loan balances with no restrictions. The Student Loan Default Prevention Initiative Act limited discharge to loans originated more than seven years before bankruptcy proceedings or if repayment caused undue hardship (a very high standard to prove). The Higher Education Amendments to the Bankruptcy Code in 1998 removed the seven year discharge basis. Graduates who default are subject to more onerous penalties than if they default on other types of debt. For example, wages and federal tax returns can be garnished and holds may be put on transcripts. See Ionescu (2011) for more information.

[6]Ionescu (2011) finds that allowing student loans to be discharged in bankruptcy benefits graduates with low assets and increases human capital accumulation. This effect is similar to the beneficial impacts of unemployment insurance and bankruptcy in terms of search. Marimon and Zilibotti (1999) show that unemployment insurance allows for better matching of skills between workers and firms. Acemoglu and Shimer (2000) that unemployment insurance can increase aggregate productivity as workers are insured against unemployment risk and are able to search for firms with higher productivity. Herkenhoff et al. (2016) show that unemployed workers with greater access to credit take longer to find a job, but after finding a job they earn more and tend to work at more productive firms. Dobbie and Song (2015) show that after bankruptcy, income and employment *increases*.

et al. (2016), Cooper and Wang (2014), and Houle and Berger (2015).[7] Ambrose et al. (2015) show that counties with higher student debt per capita have lower rates of small business formation. They hypothesize that graduates with student debt are less able to self-finance small business ventures. Student debt also negatively affects marriage rates, financial stability, and psychological functioning, as shown in Gicheva (2016), Gicheva and Thompson (2014), and Walsemann et al. (2015) respectively.

My results do contradict some recent findings. Two prominent related papers are Rothstein and Rouse (2011) and Field (2009), both of which find evidence that debt *increases* graduates' incomes as they select into higher paying occupations. Rothstein and Rouse (2011) examine a policy change at a prestigious university, in which the university virtually eliminated loans from their financial aid packages. They find that this caused graduates to select into lower paying jobs such as teaching or public-service. Field (2009) looks at the random allocation of generosity of financial aid packages offered to law students at New York University. She finds that recipients of packages with more loans were more likely to go into corporate law, while recipients of packages with more grants were more likely to go into public interest fields. The generalizability of these studies is unclear, as both examine highly selective institutions and professions.

Four recent papers that are closest to mine in terms of scope are Akers (2013), Zhang (2013), Luo and Mongey (2016), and Chapman (2015), all of which use the B&B as well. Akers (2013) finds that while debt increases the likelihood of employment at the expense of the likelihood to attend graduate school for women, it has insignificant effects on income. Zhang (2013) also finds that debt reduces the probability of attending graduate school, but also has limited effects on income and occupational choice. Luo and Mongey (2016) find that graduates with more debt take higher paying jobs that have lower non-pecuniary

[7] Mezza et al. (2016) use anonymized individual credit bureau data combined with information on Pell Grant and federal student loan histories to show that student debt reduces the homeownership rate in the first five years after graduation. Using the PSID and the 1988 National Educational Longitudinal Survey, Cooper and Wang (2014) find that student debt is associated with lower homeownership rates individuals who were college age in the 1990s even after controlling for measures of ability, family characteristics, and demographics. Houle and Berger (2015) use panel data from the NLSY97 and also show that student loan debt is associated with lower homeownership rates; however they attribute this trend to a secular decline in homeownership rates rather than an inherent effect of debt itself.

amenities. Chapman (2015) finds that graduates that qualify for merit-aid scholarships (and thus have lower debt) have lower income after graduation. While each of these studies use instrumental variables techniques to overcome omitted variable bias, it is unclear if the instruments used are truly exogenous.[8] In addition, the instrumental variables approach only identifies the effect of debt on the group affected by the instrument, again limiting generalizability. I take a control variables approach, controlling for an extensive (more so than any other study I am aware of) battery of controls. I also exploit variation across space, time, and institutions to confirm my results.

The paper is organized as follows. In Section 2, I discuss the datasets I use in more detail, I present my empirical results regarding the effect of student loans in Section 3. In Section 4, I build a model of occupation choice and discuss the estimation of the structural parameters. Using the model, I conduct counterfactual analyses regarding the effect of the increase in student debt over the last 25 years on graduates' income in Section 5 and the potential impact of different repayment schemes in Section 6. In Section 7, I conclude.

2 Data

I examine the effect of student debt on graduates' income and occupational choices using two datasets. In this section, I discuss the relative strengths and weaknesses of each.

[8] Akers (2013) uses variation in the number of concurrently enrolled siblings and rules regarding Pell Grant awards. Number of siblings in college may affect type of school a graduate applies to, affecting income through a channel other than debt and violating the exclusion restriction. The instruments used in Zhang (2013) and Luo and Mongey (2016) are based on the generosity of institutional financial aid packages, in terms of the relative balance of grants (which do not need to be repaid) and loans (which do). If graduates choose their institution based on the financial aid packages the university offered, then the exclusion restriction is violated. Chapman (2015) uses state variation in merit-aid scholarships to estimate the effect of student loans. As merit-aid scholarships are offered by states usually with a stated policy of reducing or preventing "brain drain", they are often are restricted to be used at in-state schools.

2.1 Baccalaureate and Beyond

The B&B is a set of three longitudinal studies conducted on behalf of the National Center for Education Statistics (NCES).[9] The studies examine the labor market outcomes for a nationally representative sample of individuals receiving bachelors degrees in the United States during the 1992-93, 1999-2000, and 2007-2008 academic years (B&B1993, B&B2000, and B&B2008). Each wave of the survey interviewed about eleven, ten, and fifteen thousand graduates, respectively. Follow up interviews were conducted one year after graduation for all three waves (1994, 2001, 2009), four years after graduation for the B&B1993 and B&B2008 (1997 and 2012), and ten years after graduation for the B&B1993 (2003). Initial samples were drawn from the National Post-Secondary Aid Study, which provides student information from a variety of sources including interviews and administrative data from government databases and college records. The B&B provides extensive and high-quality information on demographics, measures of ability, family background, education, and labor market outcomes not available in other data sources.

The B&B also includes identifiers for the graduates' post-secondary institution. From this, I am able to merge in institutional characteristics from the Integrated Postsecondary Education Data System (IPEDS), also compiled by the NCES. IPEDS collects data on all post-secondary institutions in the United States that receive federal funding. This data includes institution characteristics such as type of degrees conferred, selectivity, tuition and other costs, admissions and enrollment, student financial aid, human resources, and more.

2.2 National Longitudinal Study of Youth 1997

The NLSY97 is a longitudinal survey of about 9,000 individuals born between 1980 and 1984. Survey respondents have been sampled approximately annually since 1997. The survey collects documents labor market and educational outcomes along with information about the respondents' family background.

[9]This data was made available under a restricted use license. See http://nces.ed.gov/pubsearch/licenses.asp for more information.

The major limitations of the NLSY97 are sample size and available controls. As the NLSY97 was intended to survey a nationally representative sample of youths in 1997, the majority of the sample will not have received a bachelors' degree. As I focus on those with a bachelors' degree, I am limited to less than 20% of the original sample. Also, compared to the B&B, the NLSY97 has a significantly limited set of covariates, particularly as they pertain to graduates' postsecondary institutions.

While the NLSY97 has far fewer respondents and less extensive controls than the B&B, it does has more detailed information about labor market outcomes. Two dimensions stand out. The first is that weekly job histories are constructed for respondents, which allows me to examine the effect of debt on labor market transitions. The second is that labor market outcomes are recorded for all surveyed years after graduation, not just the first, fourth, and tenth as in the B&B. This provides more frequent outcomes, allowing more comprehensive documentation of the effect of debt on income.

2.3 Sample Selection

My selected sample includes graduates who were less than or equal to 30 years of age and were graduating with a bachelor's degree at the time of the initial interview. I also only include those who usually worked full time (more than 30 hours per week) in a given year to mitigate any effects from part-time work.[10] All dollar values are deflated to 2009 dollars using the CPI and all regression results are appropriately weighted.

Using the B&B, I examine the effect that debt has on income and occupational choice after controlling for a vast battery of controls and exploiting multiple types of variation. Using the NLSY97, I confirm my results on income from the restricted-use B&B and use the weekly job histories to examine the effect of debt on non-employment duration.

[10] Results are similar when I include part-time work, after adjusting for the mechanical effect of increased hours. Duration results from the NLSY97 does not have this restriction.

3 Empirical Results

Using the B&B and the NLSY97, I show that graduates with student debt have 1-2% lower income one year after graduation. This result is remarkably consistent, and remains after applying an extensive battery of controls for joint determinants of debt and income. My preferred specification includes controls for ability, family background, and institutional characteristics. This effect is scarring even into later years as graduates with debt have lower initial income but show no signs of faster income growth in subsequent years. Income loss is particularly acute for graduates who are constrained by their debt early in their career. I show that graduates with debt exit non-employment faster and are more likely to choose jobs unrelated to their field of study, both of which can explain their lower incomes.

3.1 Short-Term Effect on Income

I find, using the B&B, that student debt is associated with 1-2% lower income one year after graduation. This result is robust to an extensive list of controls and persists even after accounting for trends across institution, space, and time. I also find that debt has a negative effect on income in the NLSY97. The 2008 wave of the B&B is the most recent and features a larger set of controls, as well as specific questions regarding the effect of student debt on labor market decisions. As such, I present results separately for the B&B2008 first. I then present results using all waves of the B&B and the NLSY97.

3.1.1 B&B2008

To examine the effects of student loan debt, s_i[11], on (log) income one year after graduation, $y_{i,t+1}$, I use the following Mincer-style regression relating income to debt level

[11]The measure of student debt is the self-reported amount of total cumulative debt for undergraduate education, including loans from all sources: federal and state governments, institution, family, friends, and private banks. While self-reported, this measure of cumulative debt is of high quality as it is specifically scrutinized by the NCES for consistency. It is compared to data from the National Student Loan Data System (NSLDS), a complete record for each student who has borrowed federal loans as well as other information on private borrowing.

controlling for graduate characteristics $X_{i,t+1}$::

$$y_{i,t+1} = \gamma s_i + \beta X_{i,t+1} + \varepsilon_i.$$

An additional ten thousand dollars in student debt is associated with 1.8% lower income one year after graduation after controlling for demographic characteristics likely to be observed by potential employers. I show my estimates of γ in Table 1. In column 1, I control for the following list of demographic characteristics: a cubic in age, gender and marriage dummies, an interaction term for married females, a set of five dummies for race (white, black, Hispanic, Asian, other), a set of dummies for the number of post-secondary institutions the graduate attended (1, 2 ,3, or 4+), and a set of dummies for the graduate's major (STEM and related fields, social science fields, and other).

The exogeneity assumption for this regression is likely violated as omitted variables that jointly determine income and student debt are included in the residual, in particular ability.[12] To address this, I add several proxies for ability in column 2 of Table 1 and find that an extra ten thousand dollars of debt is associated with 1.5 percent lower income. The measures of ability that I use are a cubic in college GPA, a cubic in SAT scores, high school GPA, and an indicator for Advanced Placement or college credit classes in high school.

If there is some measure of unobserved ability not accounted for by this list of proxies, then the exogeneity assumption is still not satisfied and my estimate of the effect of student debt on income may still be biased. I address this by using the extensive set of information in the B&B and adding additional controls for the two major determinants of student loans debt: family socio-economic background and the graduates' alma mater.

After controlling for graduates' socio-economic background, the negative effect of debt on income remains, though slightly attenuated to about 1.1 percent. In column 3 of Table 1, I add controls for the graduate's socio-economic background: dummies for the parents' education levels, whether the graduate attended a private high school, a cubic in the

[12]For example, people with higher ability may correctly forecast higher returns from college in the form of higher future income.

family's adjusted gross income, and a cubic in the family's Expected Family Contribution from their Free Application for Federal Student Aid (a measure of family wealth).

Accounting for the role that post-secondary institutions play in jointly affecting income and debt balances also does not overturn my estimate of the effect debt has on income. Post-secondary institutions can have an effect on income as more selective and prestigious colleges ostensibly admit higher ability students and thus are correlated with higher incomes. This, in and of itself, only affects my estimate of γ if institutions affect debt levels as well, which is theoretically unclear. If more prestigious institutions are more expensive and require more loans on average, then ability and loans are positively correlated. However, if more prestigious institutions also have more generous financial aid packages, then ability and student loans are negatively correlated. As such, I control for the effect that institutions may have in two ways: (1) institution characteristics (column 4) or institution fixed effects (columns 5 and 6). I prefer the former as variation across the financial aid packages of similar caliber schools is informative about the effect of student debt on income.

Accounting for institution characteristics compares the outcomes of two otherwise identical graduates at similar schools. As I show in column 4, an extra ten thousand dollars in student loans is associated with 0.9% lower income after controlling for institution characteristics. The set of characteristics that I control for are if the institution is in-state, if it has a regional tuition compact with surrounding states, if it is a state's flagship institution, dummies for selectivity (for-profit, open, minimally, moderately, and very selective) and the types of degrees granted (given by the school's Carnegie 2000 code), along with cubics for sticker price, average grant amount per full-time-equivalent student, and number of full-time faculty per 100 full-time-equivalent students.

Rather than compare graduates at similar institutions, I exploit within-institution variation using institution fixed effects in columns 5 and 6. The effect of student loans on income barely changes to about -1.4% per ten thousand in student loans. To allow for variation with each cell, I exclude respondents from any institution that has less than three students. This restricts to about two-thirds of the original sample and about 600

institutions. However, allowing for more variation within each cell causes both the sample size and number of institutions sampled from to drop off sharply. In column 6, I require an institution to have at least 15 students in each wave. The coefficient is still negative, but is insignificant as I use only about a quarter of the original sample which come from less than 100 institutions.

Using information on graduates' home states, I also exploit within home state variation to identify γ.[13] Identification of the effect of debt comes from comparing otherwise identical graduates at similar institutions from the same state. The effect of student loans remains similar, at about 1% lower income for every ten thousand dollars in debt.

Using an extensive battery of controls, I find that the negative effect of student loans to be extremely robust. Graduates with an additional ten thousand dollars in debt have about 1% lower income one year after graduation. This result is also robust to whether I use variation across or within both institution and states. In the next subsection, I exploit additional variation across time using the other waves of the B&B, and show that my result is robust.

3.1.2 B&B: All Waves

In this subsection, I present results utilizing all three waves of the B&B. This allows me to identify the effect of student debt on income off of variation within-institution and within-state *across time*. Pooling all waves, my specification becomes

$$y_{i,c,t+1} = \gamma s_{i,c,t} + \beta X_{i,c,t+1} + \phi_c + \varepsilon_{i,c}.$$

where ϕ_c is a cohort fixed effect for each cohort $c \in \{1993, 2000, 2008\}$. For all results, I control for demographic, ability, and socio-economic background.[14]

Exploiting variation within similar institutions over time gives a similar result as the

[13] State of residence is taken from their parents' state of residence from the graduate's FAFSA. I require each state to have at least 30 observations for adequate variation within each cell. This drops graduates from 10 states.

[14] Some control variables in each category are not available in each wave and as such I use a slightly restricted set of control variables. Unavailable covariates are AP classes, high school GPA, SAT scores, EFC, and faculty to student ratio.

2008 wave only. As shown in column 1 of Table 2, an additional ten thousand dollars in student loans is associated with a 0.7% decrease in income one year after graduation. The effect of student loans is identified primarily off of two otherwise identical people at similar institutions but at different points in time.

The estimated coefficient is similar using institution fixed effects. Changes in financial aid policies or the prestige of the institution over time help identify the effect of debt on income. Columns 2 and 3 of Table 2 show results that require three and fifteen graduates in at least two out of the three waves. Again, allowing for more variation within each institution again comes at the cost of sample size and institutions sampled from, with the coefficient in column 3 being insignificant but of similar magnitude.

Instead of exploiting time variation at the institution level, I now use time variation at the state level using state fixed effects.[15] The effect is identified off of a common time trend exposing graduates in different states differently. Again, the results are remarkably similar with an additional ten thousand dollars in loans corresponding to 0.8% lower income.

The coefficient remains the same allowing for state-specific time trends by including state-cohort fixed effects. As states experiences different labor market patterns over the last 15 years, I allow for state specific time trends using state-cohort fixed effects in column 5, but it has no effect on the coefficient[16]

To summarize, controlling for an extensive set of graduate characteristics, I find that student loans have a negative impact on income one year after graduation, about 1% per ten thousand dollars in debt. This result is extremely robust to the set of controls and the dimension of variation exploited.

3.1.3 NLSY97

I find a similar effect of debt on income one year after graduation in the NLSY97. With this dataset, I cannot control for as many covariates as I can in the B&B, par-

[15] These specifications require at least 30 graduates in each cohort-state.

[16] I intend to add time-varying labor market characteristics for each state rather than state-cohort fixed effects. My prior is that the results will be similar.

ticularly on the institution dimension.[17] I control for a cubic in age, gender, marital status, an interaction term for married females, parent's education, dummy variables for the graduate's high school grades, a cubic in the graduate's score on the Armed Services Vocational Aptitude Battery test (a popular proxy for ability), cubics in the graduate's family income and net worth, and dummy variables year of the survey.

Graduates in the NLSY with an additional ten thousand dollars in student loans have about 4.3% lower income one year after graduation. I show show the estimated coefficient of debt on income in each year after graduation in Figure 2a, with one and two standard error confidence intervals. This effect is noticeably larger than the coefficient from the B&B, however it is imprecise as there are only about 900 graduates in my sample. The NLSY97 is not a representative sample of graduates but a representative sample of the population as a whole. Only 908 graduates satisfy my sample selection criteria, much lower than the roughly nine thousand from the 2008 wave or nineteen thousand from all three waves of the B&B.

While insignificant, it is reassuring to see that the negative effect of student debt on short-run income is not just a feature of one particular (restricted use) survey.

3.2 Medium- and Long-Term Effects

In this subsection, I show that graduates with debt have lower incomes in later years of their working life, but similar levels once I condition on income one year after graduation. Taken together with the results from the previous subsection, this suggests that the negative effects of student loans persist even into later working life as graduates with student debt do not have any faster income growth in subsequent years and show no signs of catching up with their debt-free peers.

[17] The NLSY97 does have information from transcript data for a subset of graduates. I am currently working to incorporate this data into my analysis.

3.2.1 B&B

I look now at the follow up surveys from the 1993 and 2008 B&B to examine the medium- and long-term effects of student loans on graduates' income. The negative short-run effects of student debt persist into the medium run (four years after graduation). There seems to be some weak evidence of graduates catching up in the long run (ten years after graduation), but this only comes from the earliest cohort, where debt levels were relatively low.

Using these follow-up surveys, I look at incomes four- and ten-years after graduation, conditional and unconditional on income one year after graduation. The specification I use is

$$y_{i,t+\tau} = \gamma s_i + \beta X_{i,t+\tau} + \varepsilon_i.$$

for $\tau = \{4, 10\}$, with cohort fixed effects as appropriate. I also estimate a specification controlling for income one year and/or four years after graduation to get at the effect of debt on income growth rates. The sample is restricted to graduates that work full-time in each year.

Graduates' student debt is associated with lower income four years after graduation. As seen in columns 1 and 2 of Table 3, an additional ten thousand dollars in student debt is associated with about 0.8% lower income. Column 1 pools both the 1993 and the 2008 cohort (with a cohort fixed effect), while column 2 focuses on the 2008 cohort only.

Taken together with the results from Section 3.1, debt leaves a permanent scar on lifetime income. Graduates with debt start from a lower income level in the first year of college and show no signs of faster growth after that. I show results from the corresponding specification that includes income one year after graduation in columns 3 and 4 of Table 3. The negative effect of debt is mitigated and insignificant in both cases. If the coefficient on loans in columns 3 and 4 were large and positive, this would suggest that while graduates may start from a lower income, their income grows faster than their debt-free counterparts allowing them to catch up over time. This, however is not the case, with debt leaving a

permanent scar on graduates' income path.

There is some weak evidence of graduates with debt catching up over the longer term. I show the effect of debt on income ten years after graduation for the 1993 cohort, controlling for income one and four years after graduation. As seen in column 5, the effect of student debt conditional on past income is positive, suggesting that graduates with debt end up with an additional 1% higher income ten years after graduation for every ten thousand dollars in debt, though this is insignificant.

3.2.2 NLSY

I corroborate the effect of debt on longer run income observations in the NLSY97.[18] Rather than income just at specified years after graduation, the NLSY97 has information for all years after graduation. I examine the effect of debt on income separately for each year after graduation, both unconditional and conditional on income one year after graduation.

I estimate the specification from the previous subsection separately for income in each year after graduation. Figure 2 shows the coefficient on student debt for each year after graduation, with one and two standard error confidence intervals. Panel a shows the effect of debt on income each year after graduation, while panel b shows the effect conditional on income one year after graduation. The point corresponding to one year after graduation is the point discussed in the previous section.

Student debt is a permanent drag on income for the entirety of graduates' early labor market experiences. After graduation, the effect of student debt is negative for every year after graduation, averaging about -3.4% lower income for every ten thousand dollars. While the estimate is extremely negative for the eighth year after graduation, about -9%, only about 150 graduates are included in this regression.

As in the B&B, conditional on income one year after graduation, the effect of student debt is near zero. Panel b of Figure 2, shows the coefficient on debt is near zero and insignificant for nearly every year after graduation conditional on initial income. Gradu-

[18] Debt in the NLSY97 is the cumulative amount borrowed from each term enrolled in college.

ates with debt have a permanent scar that does not seem to be mitigated through faster earnings growth in later working life.

Another way to see this is to pool all post-graduation income observations in the following specification:

$$y_{i,t+\tau} = \gamma s_i + \beta X_{i,t+\tau} + \phi_1 \tau + \phi_2 \tau^2 + \phi_3 \tau^3 + \varepsilon_{i,t+\tau}$$

This specification allows for a common cubic trend for years after graduation in income. Again, I also present a specification adding a control for income one year after graduation.

Student debt does influence income in later years in a graduate's working life, but primarily through the effects on income in the first year. I show in Table 4 the effect of student debt on deviations in income from a common time trend in years after graduation. Graduates with an additional ten thousand in debt have about 4.6% lower income in the years after graduation (column 1). As seen in column 2, this effect is mitigated upon the inclusion of income in the first year after graduation. If graduates were catching up with their debt free peers, the coefficient in column 2 would again be positive

The effect of an additional ten thousand dollars in student debt is similar in magnitude to that of an additional ten thousand dollars in initial liquid assets. I replace student debt with the level of financial assets at age 20 to the regression in columns 3 and 4. An additional ten thousand dollars in initial liquid assets is associated with an additional 1% income. This is of similar magnitude to the coefficient estimated from the B&B, which suggests that the effect of reducing debt balances is the same as increasing liquid asset balances.

In both the B&B and NLSY97, graduates with debt start with lower income and do not seem to catch up with their debt-free peers with higher income growth later. I present evidence in the next subsections as to the mechanisms relating higher debt to lower income.

3.3 Constrained Graduates

I show in this section that the negative effect of student debt on income is completely concentrated on a group of graduates who report changing their labor market behavior specifically because of their student debt, referred to as constrained graduates going forward. The 2008 wave of the B&B asks graduates with debt if they changed their labor market behavior in any way during the first year after graduation specifically because of their student debt. Graduates are then followed up with question relating to specific behaviors: working more jobs, more hours, taking a job unrelated to field of study, or taking a worse job. I take an affirmative answer to any of these questions as evidence the graduate is constrained by her debt, perhaps because her buffer stock of assets is low.

Constrained graduates are not an insignificant group of graduates and are spread out across the distribution of debt. Table 5 shows some statistics on the distribution of student debt for the constrained and unconstrained groups. About 46% of graduates with debt report being constrained by their debt. The median debt level for constrained graduates is about 25 thousand dollars, compared to about 18 thousand dollars for the unconstrained. While those who are constrained do have more debt at every point in their respective distributions, it is not *just* graduates with high debt that are constrained.

3.3.1 Short-Run Effects on Income

The short run effect of student debt is concentrated specifically on constrained graduates. Including an indicator variable taking the value one if the graduate is constrained, $\mathbf{I}_s$, I estimate the effect of student debt conditional on demographics ability, socio-economic background, and college characteristics:

$$y_{i,t+\tau} = \gamma s_i + \phi_s \mathbf{I}_s + \beta X_{i,t+\tau} + \varepsilon_i.$$

Constrained graduates have about 8% lower income than unconstrained graduates. The coefficient suggests that the constrained graduates have 7.7-8.2% lower income than unconstrained, depending on if I include those with no debt as unconstrained (column

1) or exclude them entirely (column 2). Controlling for whether or not the graduate is constrained or not, student debt has no marginal effect on income, suggesting that debt in and of itself is not necessarily bad.

I now allow the effect of student debt to have a differential impact on constrained and unconstrained graduates and find student debt only has a negative effect for unconstrained graduates. I interact the effect of student debt on income with the indicator variable for constrained graduates, $\mathbf{I}_s$, and unconstrained graduates, $\mathbf{I}_n$:

$$y_{i,t+\tau} = \gamma_s \mathbf{I}_s s_i + \gamma_n \mathbf{I}_n s_i + \phi_s \mathbf{I}_s + \beta X_{i,t+\tau} + \varepsilon_i.$$

Debt has a slight negative and insignificant marginal effect on income, -0.1% per ten thousand, for unconstrained graduates. However, the negative effect of debt on income is fully borne by the constrained group, 1.4% lower income per ten thousand dollars of debt.

The effect of debt on income one year after graduation is completely felt by this group of graduates whose labor market behavior was affected by their debt burden. Next, I examine the medium term implications of being constrained.

3.3.2 Medium-Run Effects on Income

The negative effect of debt for constrained graduates extends out to four years after graduation. Graduates who were not constrained show basically no effect of student debt in terms of levels or growth rates as compared with graduates with no debt. Constrained graduates show lower levels of income four-years after graduation, but small effect of debt on growth rates.

I use the same specification as in Section 3.3.1, except now I look at income four years after graduation, $y_{i,t+4}$. I show in the first column of Table 7 the effect of an additional ten thousand dollars in student loans on income four years after graduation, allowing for different effects for unconstrained and constrained graduates. As with income one year after graduation, student debt has a small insignificant negative effect on unconstrained grad-

uates. Constrained graduates have about 1.2% lower income four years after graduation for every ten thousand dollars of debt.

Student debt has persistent effects on only constrained graduates. As seen in column 2 of Table 7, unconstrained graduates have similar income levels to their debt-free peers four years after graduation both conditional and unconditional on income one-year after graduation. As the coefficient is negative and insignificant for constrained graduates, they start from a lower level of income one year after graduation, but do not seem to catch up in any way by four years after graduation.

Given that the group of graduates who were report changing their behavior specifically because of their debt are the ones negatively affected, debt seems to distort early labor market decisions, the outcomes of which persist over time. In the next subsection, I examine the effects of debt on graduate behavior in the labor market.

3.4 Effect on Labor Market Decisions

The group of graduates whose debt is associated with lower income are those graduates which changed their behavior because of student debt. I look at effect of debt on two sets of labor market behaviors, non-employment duration and occupation choice.

Using the NLSY, I show that graduates with debt have an increased probability of exiting non-employment, with an additional ten thousand dollars of debt increasing the probability of exit in a given week by 0.2 percentage points. This is consistent with a McCall (1970) model. As graduates repay debt even when not employed, the cost of remaining out of work is higher which lowers reservation wages. A lower reservation wage means that graduates with debt are more likely to exit non-employment and have lower income on average.

With the B&B, I show that student debt has an effect on occupation choice both for constrained and unconstrained graduates. Unconstrained graduates are more likely than debt-free graduates to choose a job that is related to their field of study. Constrained graduates, however are more likely to choose a job that is *unrelated*. They also are less likely to be satisfied with their jobs and are less likely to choose professional or technical

occupations.

3.4.1 Non-Employment Duration: NLSY97

Using the constructed weekly job histories from the NLSY97, I examine the effect of debt on time spent not employed. Conditional on being not employed, graduates with debt are more likely to exit non-employment in a given week. Non-employed graduates with an additional ten thousand dollars in student loans are 0.2-0.9 percentage points more likely to exit non-employment each week.

I use a duration framework similar to the literature that evaluates the effect of unemployment insurance on unemployment duration, Farber and Valletta (2015) for example. I assume a non-employment spell ends in a given week if an unobserved latent variable $y_{i,t}$ for spell i in week t is positive. $y_{i,t}$ depends on personal characteristics, $X_{i,t}$, and debt s_i.

$$y_{i,t} = \gamma s_i + \beta X_{i,t} + \varepsilon_{i,t}$$

The hazard function for a spell ending is then

$$h(t) = P(y_{i,t} > 0) = P(-\varepsilon_{i,t} < \gamma s_i + \beta X_{i,t}) = F(\gamma s_i + \beta X_{i,t})$$

I take F to be logistic function. I include the covariates discussed in 3.1.3, along with year fixed effects.[19]

Graduates with debt are more likely to exit non-employment spells. I show the average marginal effect of an additional ten thousand dollars of student debt on the probability of exiting non-employment in column 1 of Table 8. An additional thousand dollars in student loans is associated with an excess 0.2 percentage point probability of exit in a given week. Student loan debts seem to affect the speed at which the graduate exits

[19] As in Farber and Valletta (2015), I recode likely spurious 1 week transitions. Letting E represent employment in a week and N as non-employment, I recode ENE to EEE and NEN to NNN. This affects 55 and 650 spells respectively. I also truncate any uncompleted non-employment spells to end in the last week.

non-employment.

The effect of student debt on duration should be larger in the first year after graduation, when presumably the graduate has had less time to pay back her loans or accumulate a buffer-stock of assets. I show in column 2 the average marginal effect of student debt on the probability of exiting non-employment limiting to spells within the first 52 weeks after graduation. An additional ten thousand dollars in debt indeed increases the average probability of exiting non-employment in a given week in the first year by about 0.9 percentage points.

Debt affects the speed at which graduates accept jobs. Next, I examine the impact of debt on characteristics of selected jobs.

3.4.2 Occupational Choice: B&B

Using the B&B, I examine the effect of debt on graduates' occupational choices. I find that student debt does affect occupational choice. Constrained graduates with debt are more likely to be in "worse" jobs, consistent with the phrasing of the question used to identify them. Unconstrained graduates are more likely to be in "better" jobs, even than their debt-free peers.

I use a linear probability model to assess the effect of student loans on characteristics of the graduate's job. The specification is

$$C_{i,t+1} = \gamma_s s_i \mathbf{I}_s + \gamma_n s_i \mathbf{I}_n + \beta X_{i,t+1} + \varepsilon_i.$$

where $C_{i,t+1}$ is a binary variable with some characteristic of the graduate's job one year after graduation and $X_{i,t+1}$ are the set of demographic, ability, socio-economic, and institution characteristic controls used in Section 3.1.1.

An additional ten thousand dollars of debt increases the likelihood of unconstrained graduates to choose occupations related to their field of study by 1.3 percentage points, while it decreases the likelihood for constrained graduates by 1 percentage point. In column 1 of Table 9, I show the effect that student debt have on whether or not the

graduate's occupation is related to her field of study.[20] An additional ten thousand dollars in debt increases the probability that an unconstrained graduate's current job is related to their field of study by 1.3 percentage points, while it decreases that probability by 1 percentage point for unconstrained graduates.

For every ten thousand dollars of debt, constrained graduates are also 4.2 percentage points more likely to choose jobs that are not satisfying. As seen in column 2, an additional ten thousand dollars in debt increases the probability that an unconstrained graduate is satisfied with her job by 1.7 percentage points, and decreases that probability by 2.5 percentage points for constrained graduates.

Debt increases the likelihood for graduates to choose non-professional jobs by 2.2 percentage points relative to their unconstrained peers. I divide occupation codes into "professional" and "non-professional" and examine the effect of debt on occupational choice.[21]. Unconstrained graduates are 1.4 percentage points more likely to be in a "professional" job for every ten thousand dollars of debt. Constrained graduates are 0.8 percentage points less likely for every ten thousand dollars of debt.

These characteristics are very important in terms of income and selecting out of them is costly for graduates. The final two columns show the effect of being in a related job one year after graduation on income one and four years after graduation. I show in column 4 the income gains from being in a related job. Graduates who are in jobs related to their field of study earn about 25% more than those that are in unrelated jobs. In column 5, I show the effects on income four years after graduation. Even controlling for initial income, graduates who start in related jobs earn an additional 7.4% in income four years after graduation.

Constrained graduates select into unrelated jobs, presumably because they are easier to find. However, these graduates are forgo future income gains presumably because of short-

[20] I classify a job as related if the graduate reports their job is either strongly or somewhat related to their field of study.

[21] A list of SOC codes and the division is in the Appendix. Some examples of "professional" occupations are Engineers (11), Healthcare professionals (non-nurses) (14), and Postsecondary Educators (26). Examples of "non-professional" occupations are Construction/mining occupations (9), Food service occupations (13), and Sales occupations (28).

run repayment constraints. The interaction of student loans and financial constraints affect the ability of graduates to sort into jobs that best utilize their particular set of skills.

4 Income Counterfactuals

Using income and occupational choice data from the 2008 wave of the B&B, I structurally estimate a Roy (1951) model of occupation choice. I then use the estimated parameters and the empirical distributions of characteristics and debt to construct counterfactual income histories for graduates to evaluate the impact of the rise in student debt between the 1993 wave and the 2008 wave and the potential impact of income contingent loans.

4.1 Model of Occupational Choice

I use a static model of occupational choice in order to focus on the impact of debt on labor market decisions. Agents inelastically supply all their time as labor, and choose a job to that maximizes income.

Upon graduation, a graduate enters the labor market with some level of debt, s. There are two types of jobs, those related to the graduates field of study (R) and those unrelated to her field of study (U). Given her characteristics, X, and level of student debt, a graduate draws a job of each type, $(\varepsilon^U, \varepsilon^R)$, from a joint distribution F, and compares the utility from each job should she choose to work in either job. She then selects the job which gives her the higher utility.

The problem for the graduate is

$$
\begin{aligned}
V(s, X, \varepsilon^U, \varepsilon^R) &= \max\left\{u(c^R), u(c^U)\right\} \\
\text{s.t. } c^U - s &= Y^U \\
\text{s.t. } c^R - s &= Y^R
\end{aligned}
$$

I assume $u(\cdot)$ is monotone increasing and student loans are non-state-contingent, so the graduate's occupational choice is just based on income maximization.

Log income,y_i, is additively separable between characteristics of the graduate, each with its type-specific loading factor β^j, and the effect of the particular job, ε^j

$$y_i^U = X_i'\beta^U + \varepsilon_i^U$$
$$y_i^R = X_i'\beta^R + \varepsilon_i^R$$

I assume that the distribution of jobs across types that a graduates faces is

$$\begin{bmatrix} \varepsilon_i^U \\ \varepsilon_i^R \end{bmatrix} \sim \mathcal{N}\left(\begin{bmatrix} s\gamma^U \\ s\gamma^R \end{bmatrix}, \begin{bmatrix} \sigma_U^2 & \sigma_{UR} \\ \sigma_{UR} & \sigma_R^2 \end{bmatrix} \right)$$

which is a function of her student debt burden. For example, if γ^R is negative, then a graduate with debt faces a worse (in expectation) marginal distribution of R-type jobs than her debt-free counterpart. This is intended to capture in a reduced form way the effect that debt has on reservation wages for risk averse agents as in Danforth (1974). As reservation wages decrease, lower wages become more acceptable and graduates effectively draw from a worse wage distribution.

Identification of this model from from wage and occupational choice data data involves uniquely determining β^U, β^R, and F, which is complicated by the fact that observed wages in each job are conditional on the graduate choosing that job; that is her counterfactual wage in the alternate job is not observed. The structural identification of this model is well documented and relatively simple; see Heckman and Honoré (1990) and French and Taber (2011).[22] Following French and Taber (2011), structural identification proceeds in four steps, 1) a "reduced form" probit intended to determine the probability that graduates choose either job, 2) a wage equation that accounts for the selection into job type that is essentially the second step in a Heckman two-step, 3) a "structural probit" that determines the structural parameters as functions of the reduced form coefficients,

[22] As discussed in Heckman and Honoré (1990) and French and Taber (2011), this model is primarily identified off of the normality assumption. I am working on non-parametrically identifying this model.

and 4) retrieving the variance covariance matrix of the residuals. See the Appendix or French and Taber (2011) for a more detailed description of the strategy.

This model is identified up to a normalization regarding the effect of student debt on the marginal distributions of jobs, γ^U and γ^R. If student loans positively affect the marginal distribution of unrelated jobs, the result is indistinguishable in terms of occupational choice from the case where debt negatively affects the marginal distribution of related jobs. As such, I normalize γ^U to zero.

For the wage and occupational choice data, I use the 2008 wave of the B&B. The observables are the full set of regressors used in Section 3. The occupational choice data refers to the whether the graduate refers to her job one year after graduation as related or not. The income data is log income one year after graduation.[23] For constrained graduates, s_i is set to their level of student debt. For both unconstrained graduates and graduates without debt, s_i is set to zero. I report in Table 10 the salient parameters for the discussion; the estimated value of γ^R and the variance-covariance matrix of the joint distribution of jobs across types. Other parameters are reported in the Appendix.

As expected from my empirical results in Section 3, debt has a negative effect on the marginal distribution of R-type jobs. For a given set of characteristics, a person with higher debt is more likely to draw a worse R-type job and thus more likely to end up in an unrelated job. The marginal distribution of U-type jobs is slightly more variable than R-type jobs, but job draws are highly correlated across types, with a correlation coefficient of about 0.82.

In the next section, I use the estimated parameters to construct income counterfactuals for a given sample as I change the environment.

5 Rise in Student Loan Debt

As discussed in the introduction, the aggregate amount of student loan debt has risen since the early 1990s. In this subsection, I use the estimated parameters to back out how

[23] I am working on an multi-period extension to incorporate both income four years after graduation, as well as modeling the acquisition of student debt.

this rise affected graduates' incomes and occupational choices. While income for most graduates is unaffected by the rise in debt, I find the increase in debt from 1993 to 2008 caused income to decrease by about 1.87% for those affected by the debt increase. Nearly all of these graduates remained in jobs related to their major after the debt increase, but the small group that did switch to an unrelated job had smaller income losses.

From the 1993 cohort to the 2008 cohort of the B&B, debt increased across the entire distribution. I show in Table 11 the distribution of student debt for each cohort of the B&B. In 1993 only about forty percent of graduates had student debt, whereas in the 2008 cohort about two-thirds of graduates have some debt. Nearly all of the increase in loan balances occurred between the 1993 and the 2000 cohort, with the distribution of debt remaining relatively stable between the 2000 and 2008 cohort. Graduates in 2008 owed about 16 thousand dollars on average in debt, up from 5.8 thousand in the 1993 cohort. The average conditional on having debt rose by a similar amount. [24]

I simulate an economy of graduates with debt by drawing a random sample (with replacement) of 100,001 observations from the empirical joint distribution of characteristics and student debt from the B&B2008. Given their level of debt under the 2008 distribution of debt, I draw jobs for each person from the appropriate joint distribution. I then construct incomes in each type for each person using job draws, their characteristics and estimated loading factors, from which they select the maximum.

I construct the 1993 debt counterfactual by assigning the debt level from the 1993 distribution corresponding to the graduates' percentile in the 2008 distribution. I then correspondingly adjust the R type job draw. For example, the person at the 90th percentile in the 2008 distribution had about 40 thousand dollars in debt. This person would be assigned 27 thousand dollars in debt under the 1993 distribution, and her R-type job draw would be adjusted upwards by 0.143 (13*0.011).

About 80% of graduates have income that is unaffected by the change from the 1993 debt distribution to the 2008 distribution. 40% of graduates will have zero debt in both the 1993 and 2008 case, and only about half of the 60% of graduates with debt are

[24] This is somewhat at odds with the average debt per full-time equivalent undergraduate presented from the College Board in Figure 1a. More research needs to be done to examine the discrepancy.

constrained. Of this 30%, about 28 percent get a good enough draw of the unrelated job that they choose the unrelated job and the change in debt has no effect on them. The remaining 20% either are in a worse job related to their major or were induced to switch to a unrelated job.

For the roughly 20 percent of graduates that are affected by the change in debt, increasing debt from the 1993 level to the 2008 level causes income to fall by 1.87% on average. The vast majority, about 97%, of graduates remain in related jobs but received worse wages because of the increase in debt. Income for these graduates fell by about 1.95% on average. The graduates who were induced to change to a job in an unrelated field had their income fall by only 1.1%. Graduates who are induced to switch have mitigated income losses in the short run. Though not modeled, smaller income losses likely come at the cost of future income growth, as shown in Table 9.

I also divide affected graduates into two groups: those who had no debt in 1993 but positive debt in 2008 and those who had positive debt in 1993 but more debt in 2008. About 75% of the affected are in the latter group, along with larger average income losses. The average income loss from the first group was about 1.2% on average, which those whose positive debt levels increased lost almost double that, about 2.1%.

The rise in debt from 1993 to 2008 reduced income for affected graduates by about 1.87% on average. This change is mostly due to graduates who remain in jobs related to their field of study, but end up with worse jobs. The occupational change attenuates the short-run income loss for those graduates who switched, but likely comes at the cost of longer-run income growth. Graduates who still would have borrowed in the low debt regime in 1993 were the most affected, losing about 2.1% on average.

6 Policy Change

Student debt in the United States has two features that make it particularly distortionary in terms of graduates' choices in their early working life: short debt maturity relative to the life of the asset and non-state contingent repayment. In my model, the

effect of these two characteristics correspond to the distortionary effect of student debt on decisions in the labor market: γ^R. I find that when student loans do not distort decisions in the labor market, affected graduates earn about 3.5% higher income on average.

While the life of the underlying asset, human capital, is an entire lifetime, the maturity of student debt is typically only ten years. Relative to a longer maturity loan, monthly payments are thus larger. Given that graduates are closer to their borrowing constraints in their early working life, a longer maturity loan would ease constraints in early working life allowing for more optimal labor market decisions.

Unlike other categories of consumer debt, student debt is not dischargeable in bankruptcy unless in extreme circumstances, which often is a particularly high legal bar to clear (see (Pardo and Lacey, 2009)). Payments under the standard repayment plan are a fixed value, amortizing the debt over typically ten years. While there are income-based repayment plans, they are opt-in and take up is low due to high administrative barriers. Current repayment plans are also no vary responsive to high-frequency income shocks, limiting their state contingency (see (Dynarski, 2014)). The fact that student debt must be repaid, even in the worst state of the world, leads risk-averse agents to avoid that state at all costs. Allowing for more state-contingency into repayment essentially works as insurance for risk-averse graduates and allows them to take the appropriate risks in the labor market.

As the same amount of student loans must be repaid regardless of job draw or chosen occupation, a repayment scheme can be characterized by the distortionary effects it has on occupational choice: γ^R. A negative γ^R (as estimated), makes graduates with student loans more likely to draw a worse related job and more likely to choose jobs unrelated to their major, as compared to if they had no loans. A γ^R of zero corresponds to a repayment plan that has no relative distortionary effects on reservation wages or occupational choice. A positive γ^R makes it more likely for graduates to get better jobs related to their major, which is perhaps implementable through directed tax rebates.

Using the estimated parameters and the empirical distribution of student loans from the 2008 B&B, I re-run the simulation varying γ^R in the neighborhood of the estimate. As in the previous subsection, I draw 100,001 observations from the empirical distribution

of graduates from the 2008 wave of the B&B, along with a job draws from the estimated distribution. I then calculate the wage each individual would receive in both related and unrelated jobs, of which they select the one with the highest wage.

Changing to a repayment system that does not affect graduates' labor market decisions would increase income for affected graduates by 3.5% on average. I show in Figure 7 the average change in income for affected graduates changing from the estimated value of γ^R to the value on the x-axis. The average income gains are increasing in γ^R.

Again, the vast majority of income gains come from affected graduates who remain in jobs related to their fields. Given that they had a good enough related job prior to the income based repayment plan, they capture all of the change to the marginal distribution. Graduates who chose a job unrelated to their field do not capture all of the gains as part of the change goes toward inducing them to choose a related job. As discussed in the previous section, the gains from switching to a related job are likely understated as I do not take into account the longer run benefits of switching to a related job.

A more careful evaluation of the cost and benefits of income contingent repayment schemes in general equilibrium is incredibly important. Income based repayment plans may change the relative payoffs for going to college and thus would affect attendance and stop-out decisions. Also, designing the optimal repayment system requires data on lifetime earnings and borrowing. The analysis in this section, however, provides an important discussion towards the optimal repayment scheme as labor market decisions would need to be modeled when using the types of administrative data which would inform lifetime earnings.

7 Conclusion

In this paper, I document the effect of student debt on income and labor market decisons for recent college graduates. I find that student debt has a negative effect on income, consistent with student debt lowering the buffer stock of assets for recent graduates and constraining graduates' decisions. Compared to their debt-free peers, graduates with

debt are less willing or able to self-insure against labor market risk, and as such will be less likely to take risky but lucrative opportunities. By estimating the parameters from a structural model of occupation choice, I show that the rise in debt from 1993 to 2008 led to lower incomes for college graduates.

There are a number of important avenues for future research. First, the rise in student debt itself suggest a need to study the reason why students are borrowing more. While the skill premium is increasing, suggesting prospective college students should be willing to borrow more to finance higher education, overoptimistic expectations of the returns to education may lead graduates to over-leverage themselves. Second, the interaction between household formation and student debt may play an important role. For example, a partner without student debt allows for some within household insurance, while labor market outcomes may be particularly poor if both partners have student debt. Third, the impact of the effect of debt on income plays an important role for evaluating the returns to education. Are students correctly evaluating the constraining impact that debt potentially has when they make their borrowing decisions? This paper suggests that early labor market outcomes are incredibly important for graduates, and as such, it is crucial to correctly evaluate the expected returns in order to backwards induct the appropriate college specialization and even attendance decisions.

Finally, at a policy level, the effect of student debt repayment schemes likely affect income over graduates' entire working life. Optimal repayment schemes should take into account the effect that repayment has on graduates' risk in the labor market and the accordant decisions graduates make. Research has shown in the micro-finance context (see (Field et al., 2013)) demonstrating that less strict repayment terms in the short-run allow for more business investment due to relaxed financial constraints. Income contingent loans will likely similarly increase income for graduates as they have a less distortionary effect on graduates' labor market outcomes.

References

Acemoglu, Daron and Robert Shimer (2000), "Productivity gains from unemployment insurance." *European Economic Review*, 44, 1195–1224.

Akers, Beth and Matthew M. Chingos (2014), "Is a student loan crisis on the horizon?" Research report, Brookings Institution, Brown Center for Education Policy.

Akers, Elizabeth (2013), "Excess sensitivity of labor supply and educational attainment: Evidence from variation in student loan debt." Mimeo.

Altonji, Joseph G., Lisa B. Kahn, and Jamin D. Speer (2016), "Cashier or consultant? entry labor market conditions, field of study, and career success." *Journal of Labor Economics*, 34, S361–S401.

Ambrose, Brent W., Larry Cordell, and Shuwei Ma (2015), "The impact of student loan debt on small business formation." Federal Reserve Bank of Philadelphia Working Paper 15-26, Federal Reserve Bank of Philadelphia.

Avery, Christopher and Sarah Turner (2012), "Student loans: Do college students borrow too much–or not enough?" *Journal of Economic Perspectives*, 26, 165–92.

Brown, Meta, Andrew Haughwout, Donghoon Lee, Joelle Scally, and Wilbert van der Klaauw (2014), "Measuring student debt and its performance." Staff report, Federal Reserve Bank of New York.

Chapman, Stephanie (2015), "Student loans and the labor market: Evidence from merit aid programs." Mimeo.

College Board (2014a), "Trends in college pricing." Technical report.

College Board (2014b), "Trends in student aid." Technical report.

Cooper, Daniel and J. Christina Wang (2014), "Student loan debt and economic outcomes." *FRB of Boston Current Policy Perspectives*, 14.

Danforth, John P. (1974), "Expected utility, infinite horizon and job search." Discussion Paper 42, Center for Economic Research, Department of Economics, University of Minnesota.

Dobbie, Will and Jae Song (2015), "Debt relief and debtor outcomes: Measuring the effects of consumer bankruptcy protection." *American Economic Review*, 105, 1272–1311.

Dynarski, Susan (2014), "An economist's perspective on student loans in the united states." *Brookings Economic Studies Working Paper Series*.

Elliott, William, Michal Grinstein-Weiss, and Ilsung Nam (2013a), "Does outstanding student debt reduce asset accumulation?" CSD Working Paper 13-32, Washington University, Center for Social Development.

Elliott, William, Michal Grinstein-Weiss, and Ilsung Nam (2013b), "Is student debt compromising homeownership as a wealth building tool?" CSD Working Paper 13-33, Washington University, Center for Social Development.

Elliott, William, Michal Grinstein-Weiss, and Ilsung Nam (2013c), "Student debt and declining retirement savings." CSD Working Paper 13-34, Washington University, Center for Social Development.

Farber, Henry S and Robert G Valletta (2015), "Do extended unemployment benefits lengthen unemployment spells? evidence from recent cycles in the us labor market." *Journal of Human Resources*, 50, 873–909.

Federal Reserve Bank of New York (2015), "The labor market for recent college graduates." https://www.newyorkfed.org/research/college-labor-market/college-labor-market_wages.html. Accessed: 2016-10-18.

Field, Erica (2009), "Educational debt burden and career choice: Evidence from a financial aid experiment at nyu law school." *American Economic Journal: Applied Economics*, 1, 1–21.

Field, Erica, Rohini Pande, John Papp, and Natalia Rigol (2013), "Does the classic microfinance model discourage entrepreneurship among the poor? experimental evidence from india." *American Economic Review*, 103, 2196–2226.

French, Eric and Christopher Taber (2011), "Chapter 6 - identification of models of the labor market." volume 4, Part A of *Handbook of Labor Economics*, 537 – 617.

Gicheva, Dora (2016), "Student loans or marriage? a look at the highly educated." *Economics of Education Review*, 53, 207 – 216.

Gicheva, Dora and Jeffrey Thompson (2014), "The Effects of Student Loans on Long-Term Household Financial Stability." Working Papers 14-2, University of North Carolina at Greensboro, Department of Economics.

Guvenen, Fatih, Burhanettin Kuruscu, Satoshi Tanaka, and David Wiczer (2015), "Multidimensional skill mismatch." Working Paper 21376, National Bureau of Economic Research.

Heckman, James J. and Bo E. Honoré (1990), "The empirical content of the roy model." *Econometrica*, 58, 1121–1149.

Herkenhoff, Kyle, Gordon Phillips, and Ethan Cohen-Cole (2016), "How credit constraints impact job finding rates, sorting aggregate output." Working Paper 22274, National Bureau of Economic Research.

Houle, Jason and Lonnie Berger (2015), "Is student loan debt discouraging home buying among young adults?" *Social Service Review*, 89, 589–621.

Hussar, William J. and Tabitha M. Bailey (2016), "Projections of education statistics to 2024." Technical report, National Center for Education Statistics.

Ionescu, Felicia (2011), "Risky human capital and alternative bankruptcy regimes for student loans." *Journal of Human Capital*, 5, 153–206.

Kinsler, Josh and Ronni Pavan (2015), "The specificity of general human capital: Evidence from college major choice." *Journal of Labor Economics*, 33, 933–972.

Looney, Adam and Constantine Yannelis (2015), "A crisis in student loans?: How changes in the characteristics of borrowers and in the institutions they attended contributed to rising loan defaults." *Brookings Papers on Economic Activity*, 2015, 1–89.

Luo, Mi and Simon Mongey (2016), "Student debt and job choice: Wages vs. job satisfaction." Mimeo.

Marimon, Ramon and Fabrizio Zilibotti (1999), "Unemployment vs. mismatch of talents: Reconsidering unemployment benefits." *The Economic Journal*, 109, 266–291.

McCall, J. J. (1970), "Economics of information and job search." *The Quarterly Journal of Economics*, 84, 113–126.

Mezza, Alvaro A., Daniel R. Ringo, Shane M. Sherlund, and Kamila Sommer (2016), "On the effect of student loans on access to homeownership." Finance and Economics Discussion Series 2016-010, Board of Governors of the Federal Reserve System.

Oreopoulos, Philip, Till von Wachter, and Andrew Heisz (2012), "The short- and long-term career effects of graduating in a recession." *American Economic Journal: Applied Economics*, 4, 1–29.

Pardo, Rafael I. and Michelle R. Lacey (2009), "The real student-loan scandal: Undue hardship discharge litigation." *American Bankruptcy Law Journal*, 83.

Robst, John (2007), "Education and job match: The relatedness of college major and work." *Economics of Education Review*, 26.

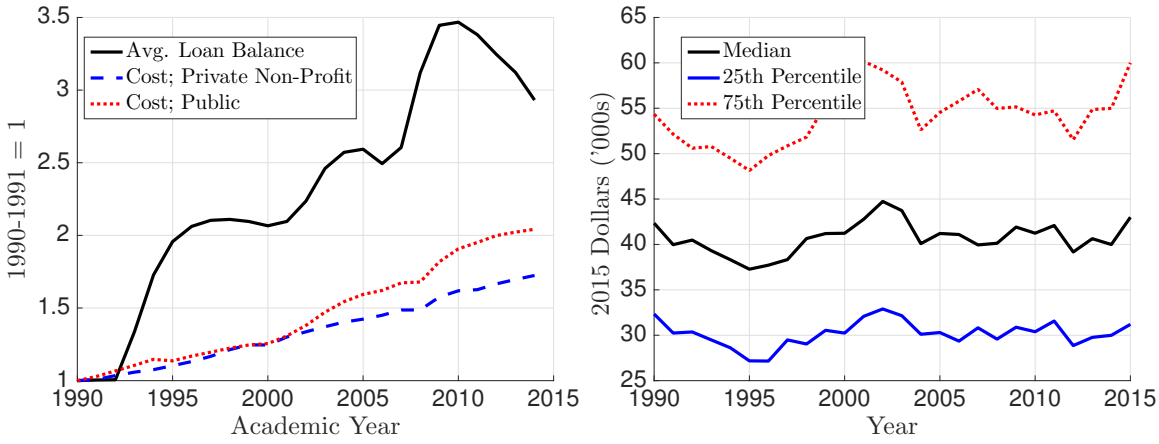
Rothstein, Jesse and Cecilia Elena Rouse (2011), "Constrained after college: Student loans and early-career occupational choices." *Journal of Public Economics*, 95, 149–163.

Roy, A. D. (1951), "Some thoughts on the distribution of earnings." *Oxford Economic Papers*, 3, 135–146.

Topel, Robert H. and Michael P. Ward (1992), "Job mobility and the careers of young men." *The Quarterly Journal of Economics*, 107, 439–479.

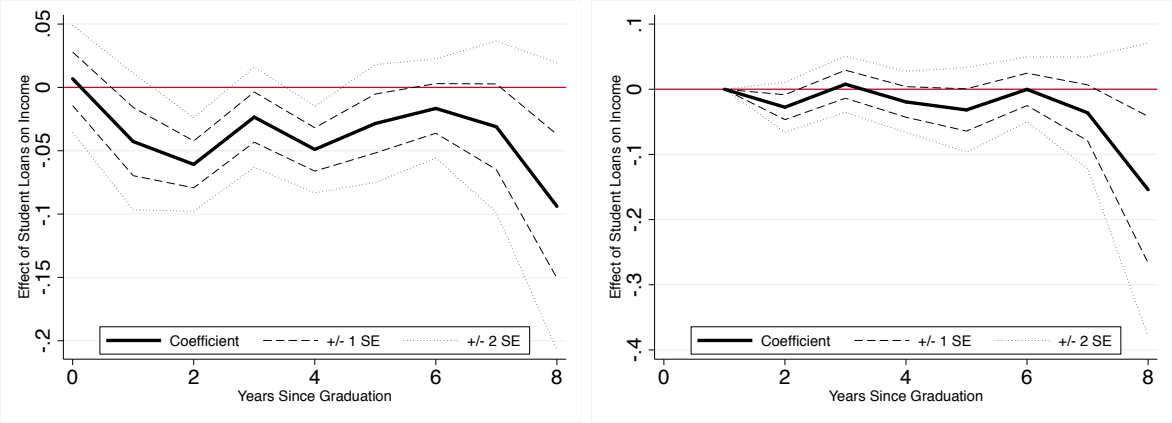
Walsemann, Katrina M., Gilbert C. Gee, and Danielle Gentile (2015), "Sick of our loans: Student borrowing and the mental health of young adults in the united states." *Social Science Medicine*, 124, 85 – 93.

Zhang, Lei (2013), "Effects of college educational debt on graduate school attendance and early career and lifestyle choices." *Education Economics*, 21, 154–175.



(a) Debt (b) Income

Figure 1: Student loan debt and median income for recent graduates. Panel a): Real tuition, fees, room, and board for private non-profit and public universities and real average undergraduate loan balances per full time equivalent student indexed to 1990 values. Source: College Board (2014a,b). Panel b): Median, 25th, and 75th percentile of real wage income for people age 22-27 with a bachelor's degree. Source: Federal Reserve Bank of New York (2015).



(a) Unconditional (b) Conditional

Figure 2: Effect of an additional ten thousand dollars on income in a given year after graduation. NLSY97. Solid line is the coefficient on student debt. Dashed and dotted line are one and two (robust) standard error bands around the coefficient. See text for list of controls.

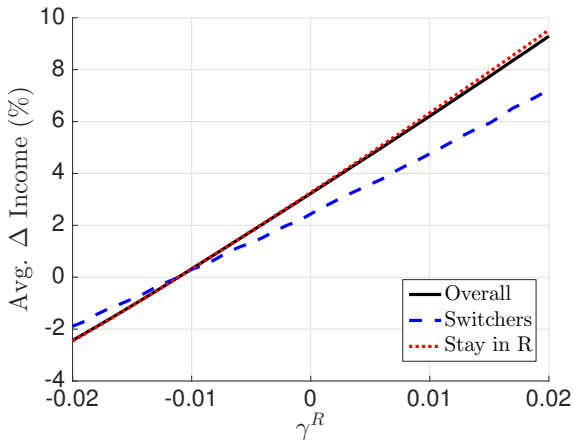


Figure 3: Average change in income for affected graduates due to changes in γ^R

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}
Stud. Loan (10k)	-0.018^{***}	-0.015^{***}	-0.011^{***}	-0.009^{**}	-0.014^{**}	-0.007	-0.01^{**}
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.009)	(0.005)
Controls							
Demographics	Y	Y	Y	Y	Y	Y	Y
Ability	N	Y	Y	Y	Y	Y	Y
Financial	N	N	Y	Y	Y	Y	Y
College Chars.	N	N	N	Y	N	N	Y
College FE	N	N	N	N	Y	Y	N
State FE	N	N	N	N	N	N	Y
N	8,510	8,100	8,100	8,100	5,770	1,940	7,940
N. Institutions				1,680	660	80	
R^2	0.087	0.103	0.119	0.140	0.319	0.200	0.166

Table 1: Effect of an additional ten thousand dollars of student loans on log wages one year after graduation. 2008 cohort. See text for list of controls in each specification. Robust standard errors reported except in columns 5-7. Standard errors are clustered at the institution level in columns 5 and 6, and at the state level in column 7. Sample sizes and number of institutions rounded to the nearest 10 for privacy concerns.

	(1)	(2)	(3)	(4)	(5)
	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}
Stud. Loan (10k)	-0.008^{***}	-0.013^{***}	-0.007	-0.008^{***}	-0.008^{***}
	(0.003)	(0.005)	(0.010)	(0.003)	(0.003)
Controls					
Cohort FE	Y	Y	Y	Y	Y
Demographics	Y	Y	Y	Y	Y
Ability	Y	Y	Y	Y	Y
Socio-Economic	Y	Y	Y	Y	Y
College Chars.	Y	N	N	Y	Y
College FE	N	Y	Y	N	N
State FE	N	N	N	Y	N
Cohort-State FE	N	N	N	N	Y
N	19,060	11,260	3,200	17,400	17,400
N. Institutions	2,170	420	50		
R^2	0.131	0.189	0.152	0.141	0.147

Table 2: Effect of an additional ten thousand dollars of student loans on log wages one year after graduation. All cohorts. See text for list of controls in each specification. Robust standard errors reported except in columns 2-5. Standard errors are clustered at the institution level in columns 2 and 3, and at the state level in columns 4 and 5. Sample sizes and number of institutions rounded to the nearest 10 for privacy concerns.

	(1)	(2)	(3)	(4)	(5)
	Log y_{t+4}	Log y_{t+4}	Log y_{t+4}	Log y_{t+4}	Log y_{t+10}
Stud. Loan (10k)	-0.007	-0.008^{*}	-0.002	-0.002	0.008
	(0.004)	(0.005)	(0.004)	(0.004)	(0.012)
Log y_{t+1}			0.454^{***}	0.488^{***}	0.137^{***}
			(0.025)	(0.030)	(0.021)
Log y_{t+4}					0.275^{***}
					(0.036)
Controls					
Cohort FE	Y	N	Y	N	N
Demographics	Y	Y	Y	Y	Y
Ability	Y	Y	Y	Y	Y
Financial	Y	Y	Y	Y	Y
College Chars.	Y	Y	Y	Y	Y
Cohort	93 & 08	08	93 & 08	08	93
N	10,700	6,780	10,700	6,780	3,870
R^2	0.112	0.128	0.279	0.319	0.266

Table 3: Effect of an additional ten thousand dollars of student loans on log wages four and ten years after graduation. 1993 and 2008 cohort. See text for list of controls in each specification. Robust standard errors reported. Sample sizes rounded to the nearest 10 for privacy concerns.

VARIABLES	(1) Log $y_{t+\tau}$	(2) Log $y_{t+\tau}$	(3) Log $y_{t+\tau}$	(4) Log $y_{t+\tau}$	
Stud. Loan (10k)	-0.034***	-0.017			
	(0.013)	(0.019)			
Log y_{t+1}		0.319***		0.321***	
		(0.085)		(0.088)	
Fin. Assets at 20 (10k)			0.013***	0.010	
			(0.005)	(0.007)	height
Demographics	Y	Y	Y	Y	
Ability	Y	Y	Y	Y	
Financial	Y	Y	Y	Y	
College Char.	N	N	N	N	
N	4916	3023	4665	2880	
Clusters	1284	817	1205	774	
R^2	0.187	0.321	0.184	0.316	

Table 4: Long term effect of an additional ten thousand dollars of student loans on income after graduation, conditional and unconditional on income one year after graduation. NLSY97. See text for list of controls.

		% of Debtors	Mean	P10	P25	P50	P75	P90
2008	Didn't Change	53.69	2.16	0.46	1.01	1.81	2.78	4.16
	Changed	46.31	2.94	0.96	1.70	2.53	3.88	5.19

Table 5: Summary statistics for debt levels in the 2008 B&B. Tens of thousands of $2009. Source: B&B.

	(1)	(2)	(3)
	Log y_{t+1}	Log y_{t+1}	Log y_{t+1}
Stud. Loan (10k)	-0.001	0.003	
	(0.005)	(0.006)	
Constrained	-0.082^{***}	-0.077^{***}	
	(0.019)	(0.020)	
Stud. Loan (10k): Unconstrained			-0.001
			(0.006)
Stud. Loan (10k): Constrained			-0.014^{***}
			(0.005)
Controls			
Demographics	Y	Y	Y
Ability	Y	Y	Y
Financial	Y	Y	Y
College Chars.	Y	Y	Y
N	8,100	6,110	8,100
R^2	0.144	0.140	0.141

Table 6: Effect of an additional ten thousand dollars of student loans on income one year after graduation for constrained and unconstrained graduates. B&B2008. Robust standard errors reported. See text for list of controls. Sample sizes rounded to the nearest 10.

	(1)	(2)
	Log y_{t+4}	Log y_{t+4}
Stud. Loan (10k): Unconstrained	-0.001	-0.001
	(0.006)	(0.005)
Stud. Loan (10k): Constrained	-0.012^{**}	-0.004
	(0.005)	(0.005)
Log y_{t+1}		0.476^{***}
		(0.031)
Controls		
Demographics	Y	Y
Ability	Y	Y
Financial	Y	Y
College Chars.	Y	Y
N	6,460	6,460
R^2	0.144	0.326

Table 7: Effect of an additional ten thousand dollars of student loans on income four years after graduation for constrained and unconstrained graduates. B&B2008. Robust standard errors reported. See text for list of controls. Sample sizes rounded to the nearest 10.

	(1)	(2)
	Pr(Exit)	Pr(Exit)
Stud. Loan (10k)	0.002*	0.009***
	(0.001)	(0.002)
Controls		
Demographics	Y	Y
Ability	Y	Y
Financial	Y	Y
College Char.	N	N
N	48,104	13,839
Clusters	1,109	860
R^2	0.0299	0.0177

Table 8: Average marginal effect of an additional ten thousand dollars in student debt on the probability of exiting non-employment. NLSY97. Standard errors clustered at the individual level.

	(1)	(2)	(3)	(4)	(5)
	Job Related $t+1$	Satisfied $t+1$	Non-Prof. $t+1$	Log y_{t+1}	Log y_{t+4}
Stud. Loan (10k): Unconstrained	0.013^{***}	0.017^{***}	-0.014^{***}		
	(0.005)	(0.005)	(0.006)		
Stud. Loan (10k): Constrained	-0.01^{**}	-0.025^{***}	0.008^{*}		
	(0.005)	(0.005)	(0.005)		
Job Related $t+1$				0.228^{***}	0.074^{***}
				(0.020)	(0.027)
Log y_{t+1}					0.463^{***}
					(0.033)
Controls					
Demographics	YES	YES	YES	YES	YES
Ability	YES	YES	YES	YES	YES
Financial	YES	YES	YES	YES	YES
College Chars.	YES	YES	YES	YES	YES
N	8,100	7,460	8,100	8,100	6,460
R^2	0.094	0.047	0.085	0.175	0.329

Table 9: Effect of an additional ten thousand dollars of student loans on occupational choice and characteristics one year after graduation for constrained and unconstrained graduates. Columns 4 and 5 demonstrate the implications of those choices. B&B2008. Robust standard errors reported. See text for list of controls. Sample sizes rounded to the nearest 10.

Parameter	Estimate	Std. Errors
γ^R	-0.011	—
σ_R^2	0.183	—
σ_U^2	0.292	—
σ_{UR}	0.190	—

Table 10: Estimated structural parameters. Standard errors coming soon.

		% Has Loans	mean	p10	p25	p50	p75	p90
1993	Unconditional	41.25	0.58	0.00	0.00	0.00	0.90	1.96
	Conditional		1.40	0.30	0.60	1.21	1.88	2.71
2000	Unconditional	68.13	1.72	0.00	0.00	1.36	2.63	3.99
	Conditional		2.52	0.55	1.27	2.17	3.17	4.68
2008	Unconditional	65.61	1.65	0.00	0.00	1.19	2.55	4.06
	Conditional		2.52	0.56	1.22	2.10	3.31	4.78

Table 11: Summary statistics for debt levels in each wave of the B&B. Tens of thousands of $2009. Source: B&B.