The Impact of Student Loan Repayment Reform on Schooling, Work, and Borrowing Decisions of Men

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Abstract

A series of changes in U.S. policy on student loan repayment plans occurred between 1993 and 2015. Before the changes in policy, student loan debts were not forgiven and borrowers were expected to repay the full amount of debt. After the changes in policy, borrowers were given options to relieve a portion of their debt, with the portion being a function of income and sector of employment (public and non-profit vs. private). To study the effect of changes in student loan repayment plans on schooling, work, and borrowing decisions, I propose and structurally estimate a life-cycle dynamic discrete choice model. My simulation results imply that changes in student loan repayment plans will increase total years of postsecondary schooling by 10%, from 2.07 years to 2.28 years. In addition, 0.5% of the population who would have worked in the private sector will shift to the public sector, and 14% of student loan borrowers will be forgiven part of their debt.

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1 Introduction

The total outstanding student loan debt in the United States exceeded \$1.3 trillion in 2015, and more than 40 million Americans hold student loans.[1] Over the last decade, student loan debt increased by 26% per year on average, the fastest growing form of debt in the United States. The drastic growth in student loan debt can be attributed to at least two causes. First, the cost of postsecondary schooling has increased rapidly. According to Trends in College Pricing 2015, the CPI-deflated average tuition and fees rose by about 3% per year on average between 2004 and 2014.[2] The second explanation for the "explosion" in student loans is the increase in postsecondary enrollment. Between 2000 and 2010, total undergraduate enrollment rose 37%, resulting in more borrowing by college students. Although student loans are important in helping students and families finance postsecondary education, several studies have identified negative impacts of the growing debt burden on borrowers. First, both transitory and persistent shocks to earnings increased in recent years (Moffitt and Gottschalk 2012). The volatile job market put more student loan borrowers at risk of delinquency or default (Lochner and Monge-Naranjo 2004). Second, it has been shown that more than 20% of student loan borrowers face financial hardships while repaying, resulting in delay in their marriage, fertility, and homeownership (Gladieux and Perna 2005, Mishory et al. 2013, Bleemer, Brown, Lee et al. 2014). Third, student loan borrowers are less likely to choose low paying "public interest" jobs, such as teaching and nursing (Rothstein and Rouse 2011). Recent studies document a growing shortage of public servants, especially in the fields of education and public health (Ingersoll 2002, Fox and Abrahamson 2009).

To ease the burden of student loan borrowers, the U.S. government introduced a series of student loan forgiveness plans since 1993.[3] The Income-Contingent Repayment (ICR) plan, initiated in 1993, was the first federal income-contingent debt repayment option to forgive student loan borrowers after making eligible repayments for certain periods. Between 2007 and 2015, there were several consecutive reforms on student loan forgiveness plans in terms of

[1]Brown, Haughwout, Lee, et al. (2015) surveyed the recent student loan market using Federal Reserve Bank of New York Consumer Credit Panel data.

[2]Even after accounting for expansion in grants and tax benefits, the average net cost of attendance at public 4-year college rose by 64% in the past 20 years (Lochner and Monge-Naranjo 2015).

[3]Institutional details of reforms on student loan repayment plans from 1993 to 2015 are shown in the Appendix.

eligible monthly repayment, forgiveness period, and sector of employment. I refer to student loan repayment plans without forgiveness options (pre-1993) as the "Traditional Repayment Plan", and student loan repayment plans with all the forgiveness options (post-2015) as the "New Repayment Plan." Borrowers under the Traditional Repayment Plan must pay off all their student debt plus the interest.[4] However, the Traditional Repayment Plan is relatively flexible regarding monthly repayments and total repayment periods, as borrowers have deferment and forbearance options.

The New Repayment Plan contains all repaying options under the Traditional Repayment Plan as well as two additional subplans. The first subplan is the Income-Driven Repayment (IDR) plan. Student loan borrowers under the IDR are allowed to repay 10% of their monthly discretionary income, where discretionary income is defined as the difference between total income and the poverty line. After making eligible repayments for 20 years,[5] the remaining student loan balance will be forgiven. The second subplan is the Public Service Loan Forgiveness (PSLF) plan. After making eligible repayments for 10 years while working full-time in the public sector, the remaining student loan balance will be forgiven.[6] The introduction of the New Repayment Plan provides insurance to student loan borrowers against adverse labor market outcomes. Therefore, the IDR and PSLF plans reduce the risk of delinquency or default on student loan debt.

The key questions I address in this paper are as follows: First, will the New Repayment Plan increase college enrollment? This question is important because there is no consensus on how postsecondary enrollment would change if students were offered more generous financial support.[7] Second, will students borrow more during college when the New Repayment Plan is available? This issue relates to the government's budgetary planning, as the rise in

[4]The student loan debt cannot be discharged from bankruptcy, according to the U.S. Bankruptcy Code at 11 USC 523(a) (8). However, as discussed below, some borrowers do default on their student loans.

[5]Eligible repayment is defined as repaying the lesser of 10% of discretionary income or the amount under the Standard Repayment Plan (SRP). The SRP serves as a standard to pay off student debt in 10 years with fixed monthly payments. The accumulated repayment periods need not be continuous.

[6]Some student loan borrowers from before the policy change are also eligible to repay their remaining debt under the New Repayment Plan. However, the forgiveness plan is not retroactive, meaning that their previous repaying periods do not count toward the 10 or 20-year repayment schedules.

[7]Some studies found that financial support had a small effect on college enrollment. These studies include Keane and Wolpin (2001), Carneiro and Heckman (2002), Cameron and Taber (2004). Other studies found that financial support had a larger effect on college enrollment, such as Ellwood and Kane (2000), Dynarski (2002), Brown, Scholz, and Seshadri (2011).

student loan debt could potentially increase the government's fiscal burden. Third, will the New Repayment Plan change the sector of employment of college graduates? Specifically, will more graduates choose public sector jobs early in their careers? This question is significant because one goal of the PSLF program is to increase public service. Fourth, what is the estimated cost of the forgiveness plan to the U.S. government? Fifth, are there other alternative policies that achieve the same outcomes at a lower cost?

To study how the change in student loan repayment plans affects behavior, I develop and structurally estimate a life-cycle dynamic discrete choice model. I model the schooling, work, borrowing, and consumption decisions of individuals, starting from their high school graduation. My model is estimated using data from the National Longitudinal Survey of Youth 1979 (NLSY79), which provides information from age 18 to age 55. Although it is preferable to use more recent data such as the NLSY97, there are several limitations which make the NLSY97 unsuitable for my study. First, the NLSY97 does not provide observations beyond age 32. Second, the NLSY97 cohorts experienced several changes in student loan repayment plans during their enrollment in college.[8]

An alternative estimation approach to address some of these issues is a reduced-form method, such as difference-in-difference, that directly evaluates the impact of student loan repayment reform. However, a convincing reduced form approach is not feasible due to at least two reasons. First, there is no comparison group, as the student loan repayment reform applies to all student loan borrowers. It is difficult or impossible to find a control group, as everyone is treated. The only option for reduced form analysis is to compare outcomes before program implementation to those after implementation ("pre-post" strategy). Second, since the initial reform in 1993, there have been further changes to the plans, which makes it difficult to identify the impact of the New Repayment Plan using a reduced form approach. In addition, a structural model allows me to design and compare different policy experiments.

My model builds upon Keane and Wolpin (2001) and Johnson (2013), with the following significant extensions. First, my model distinguishes student loan debt from other net assets,

[8] One limitation of NLSY79 survey is that it did not start to ask questions on the accumulated student loan debt until 2004. I use the educational loans received at each college to generate an approximation for student loan debt before 2004. However, there is a potential measurement problem of student loan debt before age 30, and a 10-year gap with no information on student debt. I discuss the limitation and possible solutions in detail in Section 5.3.

and incorporates a portfolio allocation decision. This allows me to track the borrowing and repaying behavior of student loans directly. Keane and Wolpin (2001) and Johnson (2013) use total net assets to track borrowing and saving behaviors; however, they do not model student loan debt. Modeling and observing student loan debt is important, as it allows me to simulate the impact of policy changes on student loan repayment plans. Second, I model sector choice, specifically whether to work in the public or private sector. Sector choice is crucial to the analysis, as the New Repayment Plan is more lenient on forgiving student loans for public sector employees. Third, I model student loan default status and incorporate a penalty imposed upon default. The penalty on default is important to the model, as individuals tend to delay repayment if no penalty is imposed.

I estimate the model under the assumption that individuals in the NLSY79 repay under the Traditional Repayment Plan, as almost all individuals finished schooling in 1993.[9] The model estimates provide a good fit to the data. The predicted fraction of 2-year and 4-year college enrollment and the fraction of employment in the public and private sectors track the actual data quite well. The prediction fits the data at all observed ages for the percentage of population with student loan debt. The predicted median student loan debt of individuals with debt matches the data at most ages.

In the counterfactual simulations, I compare two scenarios: (1) individuals repay under the Traditional Repayment Plan (pre-1993); (2) individuals repay under the New Repayment Plan (post-2015). Simulation results imply that the change in repayment plan will have a modest impact on college enrollment and completion of bachelor's degree. Compared with the Traditional Repayment Plan, I predict that the total years of postsecondary schooling will increase by 10%, from 2.07 years to 2.28 years under the New Repayment Plan. The change in repayment plan is also predicted to increase the fraction of bachelor's degree holders by 0.9 percentage points from 23.5% to 24.4%. The 4-year college enrollment rate rises on average 1.6 percentage points before age 30, while 2-year college enrollment hardly changes.

[9] The ICR was not popular at the time of introduction due to its high monthly payment and long repayment periods (Schrag 2001). According to data from the National Student Loan Data System (NSLDS), 1.3% of the student loan borrowers participated in the ICR by 2013. Since the NLSY79 cohorts were at ages 30 to 37 in 1993, they were unlikely to be affected by the ICR.

In addition to the increase in college enrollment under the New Repayment Plan, the simulation results imply that college students will take on more student loans. Based on my simulation, individuals hold 14% more student loan debt between the ages of 23 and 30. However, the change in repayment plan has a small effect on shifting the sector choice of individuals. I find that individuals are, on average, 0.5 percentage point more likely to work in the public sector under the New Repayment Plan, an increase of 6% compared to the Traditional Repayment Plan. Other more important determinants of sector choice are factors such as wages, preferences, and the probability of lay offs.

I provide a back-of-the-envelope calculation on the estimated cost of the New Repayment Plan. According to the simulation, 13.8% of student loan borrowers (6.1% of the population) will have some of their student loan debt forgiven by the New Repayment Plan. The PSLF program forgives 0.7% of the student loan borrowers in 10 years, while the other 13.1% will be forgiven after 20 years of repayment. The net cost of the forgiveness plan is estimated to be $7 billion in present discounted value (PDV). I then simulate alternative policy experiments by holding constant cost to the government, and compare the effects on education, employment, consumption, and social welfare. The simulation results indicate that social welfare will be higher if the current student loan repayment plan is combined with an increase in the student loan borrowing limit. Increase in the student loan borrowing limit will offer borrowers more flexibility in the amount of borrowing, and will smooth consumption over borrowers' lifetime.

In order to check robustness of my structural model, I re-estimate my model on the more recent NLSY97 cohorts and compare simulation results of the NLSY97 cohorts to that of the NLSY79 cohorts. Although it is ideal to conduct an out-of-sample test by predicting impacts on the NLSY97 cohorts using parameters estimated from the NLSY79 cohorts, such an approach is impracticable due to the significant differences across the two cohorts' college attendance and borrowing behavior. Another motivation to check robustness of my model is that the NLSY97 survey provides a more accurate measurement on student loan debt than the NLSY79 survey before age 30. My simulation results show that a change in student loan repayment plan will have similar percentage impacts on schooling, work, and borrowing decisions for both NLSY cohorts, indicating that the empirical implications of my structural model are robust to using alternative birth cohorts.[10]

This paper is organized as follows. Section II discusses the existing literature. Section III lay out the model. Section IV presents data and summary statistics. Section V briefly talks about the solution and estimation strategies. Section VI demonstrates the estimated parameters and model fit. Section VII discusses the results and policy experiments. Section VIII conducts robustness checks. Lastly, Section IX concludes.

2 Literature Review

A considerable amount of literature has focused on studying the impact of borrowing constraints on human capital accumulation. There are three main streams of research on this topic. The first stream of research examines the relationship between family income and college enrollment. Over the past decades, there has been a longstanding puzzle that high school graduates from low-income families are much less likely to attend college than those from high-income families.[11] There are two main explanations for the large college enrollment gap: (1) students from low-income families are financially constrained; (2) students from different income groups differ by cognitive and non-cognitive skills. There is no consensus on which factor is the main cause of the gap. On one hand, some studies, such as Manski and Wise (1983), Ellwood and Kane (2000), Dynarski (2002), and Brown, Scholz, and Seshadri (2011), found a strong positive relationship between family income and college enrollment, indicating that children from low-income families are borrowing constrained. On the other hand, other studies, such as Cameron and Heckman (1998, 2001), Shea (2000), Keane and Wolpin (2001), Carneiro and Heckman (2002), Belley and Lochner (2007),[12] concluded that the enrollment gap across family income quantiles can be explained by ability differences, which implies that children from low-income families are not borrowing constrained. My

[10]In the Appendix, I evaluate the impact of ICR on college enrollment by adopting the "pre-post" strategy. I then test model validity by comparing the reduced form results to the simulation results from my structural model. I find both approaches present consistent results, which provides no evidence against validity of my model.

[11]College attendance rates among high school completers in the lowest income quartile are below 35%, while college attendance rates among the highest income quartile is around 80%.

[12]Belley and Lochner (2007) compared the NLSY79 and NLSY97 cohorts. They concluded that recent cohorts are more likely to be financially constrained.

paper contributes to this literature by examining whether more generous student loan repayment plans relax borrowing constraints, and further investigates the possible impact on college enrollment gap.

The second stream of literature investigates the effect on college enrollment of relaxing borrowing constraints, such as the student loan borrowing limit or interest rate. Cameron and Taber (2004) found no effect of the interest rate on college enrollment. Johnson (2013) found little impact of the borrowing limit on postsecondary schooling decisions. My paper differs from the existing literature, as I evaluate the effect of a loan forgiveness plan on college enrollment. A loan forgiveness plan has a similar effect as decreasing the interest rate, as both of them ease the burden of student loan debt. A reduction in the interest rate directly changes the budget constraint. However, the loan forgiveness plan is more complicated, as not every student loan borrower will benefit from the forgiveness plans.[13] Since the impact of a loan forgiveness plan on educational attainment has rarely been studied, my paper contributes to this stream of literature.

The third stream of literature focuses on income-contingent repayment plans. The concept of income-contingent loans was first proposed by Friedman and Kuznets (1945). Their original idea was that students borrow against future income streams to invest in themselves. However, due to the difficulty in loan design and law enforcement, this form of student loan was not seen until the 1980s.[14] Chapman (2006) provides a survey of income contingent student loans. Currently, Australia, Canada, Chile, New Zealand, Sweden, United Kingdom, United States and South Africa have provided income-contingent repayment programs for student loans. Numerous studies have suggested policy changes with respect to the income-contingent loans (Nerlove 1975; Krueger and Bowen 1993; Barr 1993). Lochner and Monge-Naranjo (2015) investigated income-contingent student loans from the perspective of theoretical analysis. They mainly focused on the issues of limited enforcement, costly verification and moral hazard of the income-contingent student loan.[15] As far as I can determine,

[13]Student loan forgiveness plans will forgive student loan borrowers after making eligible repayments for certain periods. Therefore, some student loan borrowers would have paid off their debt before becoming eligible for forgiveness.

[14]In 1970s, Yale introduced the Yale Tuition Postponement Option program which allows Yale students' repay their student loans base on their income. However, due limited enforcement on loan default, the program eventually failed.

[15]I do not study these incentive problems, as the Department of Education has the authority to collect

there is no existing literature investigating the effect of change in repayment plans in the U.S. Therefore, my paper contributes to study the impact of student loan repayment reform in U.S. by simulating a counterfactual.

My model is closest to Keane and Wolpin (2001) and Johnson (2013). Keane and Wolpin (2001) investigate how parental transfers and borrowing constraints affect educational attainment. They construct a dynamic discrete choice model of schooling, work, and savings decisions. Their model accounts for both observed and unobserved heterogeneity among youth. Using NLSY79 data, they find that more educated parents make larger transfers to their children, and the transfers are greater while in school. Borrowing constraints are tight, but relaxing the borrowing constraints has little effect on college enrollment decisions.[16] Johnson (2013) builds upon Keane and Wolpin (2001) to test the borrowing constraint of more recent cohorts from the NLSY97. Johnson constructs a richer model by accounting for college type, delaying entry to college, and degree completion. His model also incorporates grants and labor market uncertainty such as the probability of unemployment. The results are similar to Keane and Wolpin (2001), as borrowing constraints have a small impact on college enrollment, degree completion, and delayed entry to college. My model builds upon the framework of Keane and Wolpin (2001) and Johnson (2013), but I ask different questions.

3 Model

I set up a life-cycle discrete choice model that tracks individuals' schooling, work, saving, and borrowing decisions each period. Individuals can enroll in 2-year or 4-year college before age 30. They also make work decisions and choose between public and private sector employment. While enrolled, individuals can borrow a government-subsidized student loan up to a fixed limit. In addition to student loan borrowing, individuals can also save or borrow from other sources. After finishing college, student loan borrowers repay their student loan debt.

a defaulted federal student loan. The federal government could observe borrower's income through Internal Revenue Service (IRS). For the repayment enforcement, the federal government has the right to garnish wages or withhold taxes if student loan borrowers' default.

[16] Keane and Wolpin (2001) argue that relaxing borrowing constraints largely leads to decreased work while in college rather than to increase college enrollment.

3.1 Decision Period

The decision period starts when an individual graduates from high school and ends when he retires at age 65. Each year is divided into two decision periods, namely spring and fall semester.[17] Spring semester lasts for 6 months, from February to July. Fall semester runs from August to January.

3.2 Choice Variables

Individuals make schooling, work, and borrowing decisions each period. The vector of choice variables is

$$D = \{a^S_{t+1}, a^O_{t+1}, h^G_t, h^P_t, s^C_t, s^U_t\} \tag{1}$$

a^S_{t+1} is student loan debt at the end of period t. The range of permissible values of student loan debt is $\underline{a^S_{t+1}} \leq a^S_{t+1} \leq 0$. a^S_{t+1} cannot fall below the lower bound $\underline{a^S_{t+1}}$, which is the student loan borrowing limit at period t. a^S_{t+1} is negative because individuals cannot save on student loans. a^O_{t+1} is net assets other than student loan debt, with range $\underline{a^O_{t+1}} \leq a^O_{t+1}$. a^O_{t+1} can be either positive or negative. Positive a^O_{t+1} means the individual is a net saver, while negative a^O_{t+1} means the individual is a net borrower. $\underline{a^O_{t+1}}$ denotes the borrowing limit other than student loan debt at period t.

h^G_t is the work decision in the public sector, and h^P_t is the work decision in the private sector. Both h^G_t and h^P_t can take values 0, 0.5 and 1. $h^G_t, h^P_t = 0$ means the individual is not working. $h^G_t, h^P_t = 0.5$ means the individual works part-time. $h^G_t, h^P_t = 1$ means the individual works full-time. Individuals are allowed to change sector of employment across periods, but they cannot work in more than one sector in any given period.

s^C_t and s^U_t are schooling decisions at period t. s^C_t denotes enrollment in 2-year college, and s^U_t denotes enrollment in 4-year college. Both s^C_t and s^U_t take values 0, 0.5 and 1, namely not enrolled, part-time enrollment, and full-time enrollment. Individuals are assumed to enroll

[17] Keane and Wolpin (2001) and Johnson (2013) divide each year into spring, summer and fall semester. However, due to the low summer enrollment rate (below 2%), I exclude summer from my decision periods. The decision period changes to 1 year after age 30, as there are no more college enrollment choices beyond age 30.

in at most one college type at a given period, but they are allowed to transfer college types over periods. In my model, individuals are allowed to work full-time while enrolled full-time in school.[18]

3.3 State Space

The state variables in my model are

$$\begin{aligned}\Omega_t \;=\; & \{a_t^S, a_t^O, h_{t-1}^G, H_t^G, h_{t-1}^P, H_t^P, s_{t-1}^C, S_t^C, s_{t-1}^U, S_t^U, P_t, \\ & BA_t, Age_t, AFQT, Race, PI, State, Type\} \end{aligned} \tag{2}$$

H_t^G and H_t^P are cumulative work experience in the public sector and private sector respectively. S_t^C and S_t^U are accumulated years of schooling in 2-year and 4-year colleges, respectively. P_t is a binary indicator of receiving a parental transfer. BA_t is an indicator for completion of a bachelor's degree. The time-invariant state variables include the Armed Force Qualification Test (AFQT) score, race, initial parental income, state of residence, and type. AFQT is a measure of cognitive ability. PI is the initial parental income.[19] $Type$ captures permanent unobserved heterogeneity across the population.

3.4 Initial Conditions

At the beginning of the first period, individuals are endowed with 12 initial conditions. These initial conditions consist of state variables when the individual graduates from high school, as well as time-invariant observed and unobserved characteristics. The vector of initial conditions of the time-varying state variables is

$$I = \{a_0^S, a_0^O, H_0^G, H_0^P, P_0, Age_t\} \tag{3}$$

[18] As observed in NLSY data, around 7% of the respondents report working full-time while enrolling full-time in school before age 22.

[19] I use the NLSY79 Geocode data, which contains information on state of residence. Information on college tuition, room and board varies across state of residence.

a_0^S is the initial student loan debt, which is always 0 as individuals have not enrolled in college yet. a_0^O is initial net assets other than student loan debt. H_0^G and H_0^P denote individuals' initial working experiences in the public and private sectors, respectively.[20] P_0 is the indicator of the initial parental transfer. Age_t is the age when the individual graduates from high school.

3.5 Preferences and Shocks

Individuals draw shocks to preferences and wages each period. There are 6 mean-zero shocks in total: preference shocks for enrolling in 2-year and 4-year college; preference shocks for working in the public and private sectors; and shocks to wage offers in the public and private sectors. The vector of shocks $\varepsilon_t = (\varepsilon_t^C, \varepsilon_t^U, \varepsilon_t^G, \varepsilon_t^P, \varepsilon_t^{w_G}, \varepsilon_t^{w_P})$ is assumed to be jointly normally distributed and serially independent.

3.6 Budget Constraint

The budget constraint under the Traditional Repayment Plan is

$$
\begin{aligned}
& c_t + tc_{state}^C s_t^C + tc_{state}^U s_t^U + a_{t+1}^O + a_{t+1}^S + Fixcost I(a_t^S = 0 \ \& \ a_{t+1}^S < 0) \\
& = w_t^G h_t^G + w_t^P h_t^P + tr_t P_t + tg_t^C s_t^C + tg_t^U s_t^U + w^{\min} Unemploy I(s_t = 0) \qquad (4) \\
& +(1+r^l) a_t^O I(a_t^O > 0) + (1+r^b) a_t^O I(a_t^O < 0) + (1 + r^s + r^p Default_t) a_t^S \qquad (5)
\end{aligned}
$$

c_t is consumption in period t. tc_{state}^C and tc_{state}^U are the total cost of full-time 2-year and 4-year enrollment in the state of college attendance. Total cost of school varies across states, and includes tuition, room, and board. $Fixcost$ is a fixed cost for new student loan borrowers.[21] w_t^G and w_t^P are wages offered by different sectors. tr_t is the amount of parental transfer, including the monetary value of coresidence with parents.[22] tg_t^C and tg_t^U are grants

[20] Some observations from my sample accumulated work experience before enrolling in college.

[21] I incorporated a fixed cost for new student loan borrowers to account for the complexity of application and waiting time. Dynarski and Wiederspan (2012) argue that complexity in applying for student loan is a barrier to college attendance.

[22] Status of coresidence with parents is generated from individuals' dependency status. Dependency status

received at each college type. $w^{\min}$ is the social benefit payment when not employed, and not in school.

$Default_t$ is the accumulated number of periods in which an individual defaults on student loan debt. This is specified in detail in section 3.12. The interest rate is allowed to differ by asset type (a_t^O or a_t^S) and asset amount (net borrowers or net lender). Net borrowers face a fixed borrowing rate r^b, while net lenders face a fixed lending rate r^l. r^s is the interest rate on federal student loans. r^p is the penalty upon default on student loan debt. The budget constraint under the New Repayment Plan incorporates student loan forgiveness in additional to the budget constraint under the Traditional Repayment Plan. This will be described in Section 7.

3.7 Utility Function

Utility is a function of consumption, discrete choice variables and state variables.

$$u_t = \frac{c_t^{1-\rho}}{1-\rho} + g^u(s_t^C, s_t^U, h_t^G, h_t^P, a_{t+1}; \Omega_t, \varepsilon_t) \tag{6}$$

The utility function is constant relative risk aversion (CRRA) in consumption with the coefficient of risk aversion ρ. The CRRA utility function guarantees that individuals will engage in precautionary saving and consumption smoothing activities. The g^u function contains psychic costs of different types of working and schooling, and interactions with state variables. g^u also incorporates the random shocks. The utility function is assumed to be additively separable in consumption and other variables,[23] and the specific form is described in the Appendix.

is a function of age and parental transfer. According to Office of Federal Student Aid, a student's dependency status depends on age, marital status, any dependents, and military service etc. Coresidence with parents is considered as parental transfer of rent. Since IPEDS data contains information on the average room and board across states by year, I use IPEDS data to calculate the estimated cost of living. I use IPEDS data to calculate the estimated cost of living by state.

[23]The additively separable utility function follows Keane and Wolpin (2001) and Johnson (2013). This restriction is unlikely to affect the results because my utility function is flexible enough to control for interaction terms as well as polynomials.

3.8 Borrowing Constraints

For net assets other than student loan debt, individuals are allowed to choose any feasible value if $a_{t+1}^O \geq \underline{a_{t+1}^O}$, where $\underline{a_{t+1}^O}$ denotes the maximum they are allowed to borrow at period t.

$$\underline{a_{t+1}^O} = g^{\underline{a_{t+1}^O}}(HC_{t+1}, Age_{t+1}) \leq 0 \tag{7}$$

The lower bound $\underline{a_{t+1}^O}$ increases in absolute value with human capital accumulation (HC_{t+1}) and age, which is a proxy for repayment ability and credit history.[24] The function for the lower bound on student loan debt $\underline{a_{t+1}^S}$ is more complicated. $\underline{a_{t+1}^S}$ depends on the enrollment decision, accumulated years of schooling, student loan debt in the last period, and dependency status.

$$\underline{a_{t+1}^S} = g^{\underline{a_{t+1}^S}}(s_{t+1}^C, s_{t+1}^U, S_t^C, S_t^U, tc_{state}^C, tc_{state}^U, a_t^S, Age_t, P_t) \tag{8}$$

First, independent students are allowed to borrow more than dependent students. Age_t and P_t determine dependency status. Second, there is a student loan borrowing limit for each academic year in college. For instance, second-year undergraduates are allowed to borrow more than first-year undergraduates.[25] S_t^C and S_t^U are used to determine year in college. Third, undergraduate students' cumulative borrowing cannot exceed \$31,000 for dependent students, or \$57,500 for independent students. Fourth, student loan borrowing cannot exceed the cost of schooling (tuition, room and board) in each academic year.

3.9 Default

Without any punishment for default or delinquency, student loan borrowers will not start to repay student loan debt before they clear all other debts (e.g. mortgage, credit card), which have a higher interest rate. Therefore, I arbitrarily define default as the accumulated

[24] The lower bound of other net assets include borrowing limit from private student loan market and other lending sources. This assumption is consistent with existing literature (Avery and Turner 2012, Lochner and Monge-Naranjo 2011, Lochner and Monge-Naranjo 2015).

[25] For dependent students, first years can borrow up to \$5,500, second years can borrow up to \$6,500, the third-years and above can borrow up to \$7,500 for each academic year.

number of periods repaying less than the minimum of 5% of SRP or 5% of discretionary income while not enrolled in school.

$$Default_t = Default_{t-1} + I[a^S_{t+1} - a^S_t \leq \min(5\%DI_t, 5\%SRP)]I(s^C_t + s^U_t = 0) \tag{9}$$

The determination of default is very complicated and case by case in reality.[26] I use the accumulated periods of default because punishment lasts for more than one period. The punishment is more severe if individuals default more periods. I have tried several functional forms for default, including alternative values of percent of SRP and DI_t, and the results are robust.

3.10 Forgiveness Plan and Default

To model availability of the New Repayment Plan in the simulations, I define eligible repayments as repaying not less than 10% of the discretionary income or Standard Repayment Plan (SRP) in one period.[27] A repayment period is accumulated if the individual makes an eligible repayment in a given period.

$$RP^T_t = RP^T_{t-1} + I[a^S_{t+1} - a^S_t \geq \min(10\%DI_t, SRP)]I(s^C_t + s^U_t = 0) \tag{10}$$

$$RP^G_t = RP^G_{t-1} + I[a^S_{t+1} - a^S_t \geq \min(10\%DI_t, SRP)]I(s^C_t + s^U_t = 0)(h^G_t = 1) \tag{11}$$

RP^T_t is the accumulated number of repayment periods, and RP^G_t is the accumulated number of repayment periods while working in the public sector. DI_t is the discretionary income at period t. Individuals are allowed to repay their student loans while in college,

[26]The official definition of default is not repaying student loan according to the promissory note signed when the loan was issued. The promissory note contains the promised repayment periods and monthly repayment. Since the promissory note is unobserved, there is no unique functional form for the default status.

[27]The SRP serves as a standard to pay o student debt in 10 years with fixed monthly payments.Under the New Repayment Plan, individuals don't have to make eligible repayments each period. Any repayment amount below the lesser of 10% of discretionary income and SRP will not be counted as eligible repayments. However, individuals go into default if they repay less than a certain minimum amount at each period.

but repayments in college are not counted as eligible repayments. After accumulating 10 repayment years while working full time in the public sector or 20 repayment years in total, the remaining amount of student loan debt is forgiven.

$$a_{t+1}^{S} = 0 \ if \ RP_t^G = 10 \ or \ RP_t^T = 20 \tag{12}$$

3.11 Human Capital and Labor Supply

The human capital accumulation function is

$$HC_t = g^{HC}(H_t^G, H_t^P, S_t^C, S_t^U, BA_t, AFQT, Type) \tag{13}$$

Human capital increases with schooling and work experience. Completion of a bachelor's degree BA_t is included to account for the "sheepskin" effect. $Type$ is used to capture individuals' permanent unobserved heterogeneity.[28] At the beginning of each period, individuals receive a job offer with probability

$$P(offer_t = 1) = g^{offer}(HC_t, h_{t-1}^G, h_{t-1}^P, Race) \tag{14}$$

$offer_t$ is a binary variable indicating whether individual has the opportunity to work. If $offer_t = 0$, individuals are defined as unemployed when they are not enrolled in school. The probability of drawing a job offer increases with human capital and employment in the previous period. $Race$ is included to capture racial differences in the job market. After receiving a job offer, individuals draw wages from ex-ante known wage distributions and choose sector of employment.

$$\ln(w_t^G) = g^{w_G}(HC_t, H_t^G, S_t^G, S_t^U, Race, \varepsilon_t^{w_G}) \tag{15}$$

$$\ln(w_t^P) = g^{w_P}(HC_t, H_t^P, S_t^G, S_t^U, Race, \varepsilon_t^{w_P}) \tag{16}$$

[28] $Type$ is assumed to be a function of race, parental income, and AFQT. The specific functional form of $Type$ is presented in the Appendix.

Due to different wage patterns observed in public and private sectors, I allow the wage distributions to vary by sectors. The expected log wage is a linear function of years of schooling and a quadratic function of work experience. *Race* is to capture racial wage differences in the job market, and ε_t^w is the wage shock drawn at each period.

3.12 Parental Transfers

Parental transfers are assumed to be independent of the individuals' behavior, and the amount is deterministic. The probability of receiving a parental transfer at period t is of the form

$$\Pr(P_t = 1) = g^P(HC_t, ParentInc, P_{t-1}, s_{t-1}^C, s_{t-1}^U, Age_t, Race_t, offer_t) \tag{17}$$

Individuals from high income families are more likely to receive a parental transfer. If the individual receives a parental transfer in the previous period, he is more likely to receive a parental transfer this period as well. College enrollment status is also an important factor, as college students are more likely to receive financial support from the family. As individuals grow older, they are less likely to receive a parental transfer. Unemployed individuals are more likely to gain financial support from parents. Next, the amount of parental transfer, including the implicit value of coresidence is

$$tr_t = g^{tr}(HC_t, ParentInc, s_{t-1}^C, s_{t-1}^U, Age_t, Race_t, offer_t) \tag{18}$$

Parental income is a major determinant of parental transfer, as individuals from wealthier families are more likely to receive parental transfers (Carneiro and Heckman 2002, Belley and Lochner 2007, Brown, Scholz, and Seshadri 2012). Age negatively affects the amount of parental transfer. Other factors affecting parental transfers include human capital, college decision, race, and unemployment.[29]

[29] Individuals' own earnings could also affect the parental transfer probability and amount. The earnings is assumed to be a function of human capital, college decision, race and unemployment.

3.13 Grants and Degree Completion

Grants received from different college types take the form

$$tg_t^C = g^{grant}(AFQT, ParentInc, s_t^C, Race, Type) \tag{19}$$

$$tg_t^U = g^{grant}(AFQT, ParentInc, s_t^U, Race, Type) \tag{20}$$

Grants received in college mainly depend on two factors. First, individuals from low-income families are more likely to receive need-based grants.[30] Second, individuals with higher ability are more likely to receive merit-based grants.

The probability of completing a bachelor's degree is

$$\Pr(BA_t = 1) = g^{BA}(S_t^C, S_t^U, age_t, HC_t) \tag{21}$$

Bachelor's degree completion depends on years of college, age, and human capital accumulation. Although individuals are not guaranteed a bachelor's degree after a certain number of years of schooling, the probability of degree completion increases with years of education, age, and human capital accumulation.

4 Solution and Estimation Method

The solution and estimation method closely follow Keane and Wolpin (2001) and Johnson (2013). I solve the model backward from the last period at age 65.

4.1 Solution Method

Individuals make decisions each period to maximize their discounted lifetime utility starting from high school graduation until retirement at age 65. An individual's objective function can be characterized as a recursive Bellman equation

[30]For the need-based grants, I distinguish the amount of grants by college types across different states.

$$V_t(\Omega_t) = \max_{d_t \in D_t} u_t(d_t|\Omega_t) + \delta E(V_{t+1}(\Omega_{t+1})|d_t, \Omega_t) \tag{22}$$

d_t is an element of the feasible choice set D_t. The individual chooses the option d_t that gives him the highest period utility plus the expectation of discounted remaining lifetime utility at the next period. I use Monte-Carlo integration to calculate the expectation term over all continuous and discrete shocks. The model is solved backward from the terminal period at age 65. However, since NLSY79 cohorts provide information only up to age 55, I do not use information beyond age 55. Therefore, I assume that individuals' state variables remain the same after age 55 and they work full-time from 55 to 65.[31] Due to the large state space, it is computationally infeasible to solve the Emax functions over all possible combinations of state variables. Thus, I follow Keane and Wolpin (1994, 1997, 2001) to evaluate the Emax function by estimating a polynomial function of the state variables, using a random sample of state points. The estimated Emax parameters are used to interpolate or extrapolate the Emax function at other state points.[32]

4.2 Estimation Method

The estimation method used in my analysis is indirect inference. I use 647 moments and auxiliary regressions to estimate 151 structural parameters. The reason for not using Maximum Likelihood Estimation (MLE) is discussed in Keane and Wolpin (2001) and Johnson (2013): integration of the likelihood function is analytically intractable when some state variables are missing.[33] Indirect inference overcomes the problem of missing state variables (Keane and Smith 2003). The general idea of indirect inference is to set up a series of auxiliary regressions, which can be estimated on both the actual data and data simulated from the model. Indirect inference searches for the structural parameter values to minimize a distance function of the parameters of the auxiliary model estimated on actual and simulated data.

[31] In Keane and Wolpin (2001) and Johnson (2013), they make the same assumptions and model individuals until age 40. The present discounted value of wages earned between age 55 and 65 is assumed to be part of the terminal value function.

[32] I randomly draw 600 observations in each period and regress on 108 regressors (polynomial of state variables). The average R-square for the Emax regression is 0.992.

[33] Due to the survey methodology and interview time, there are missing values on three state variables: parental transfer indicator (P_t), student loan debt (a_t^S), and asset other than student loan debt (a_t^O).

This is realized by minimizing a criterion function. The construction of the criterion function in my model follows Gourieroux, Monfort and Renault (1993), Gallant and Tauchen (1993), and Gourieroux and Monfort (1996).

$$\hat{\beta}^{II} = \arg\min_{\beta}[\hat{\theta} - \tilde{\theta}(x(\beta))]'W[\hat{\theta} - \tilde{\theta}(x(\beta))] \tag{23}$$

$$\tilde{\theta}(x(\beta)) = \arg\max_{\theta} \log L(x(\beta)|\theta) \tag{24}$$

β is the vector of structural parameters and $\hat{\beta}^{II}$ is the vector of structural parameter estimates. $x(\beta)$ is the simulated data by using the structural parameters β. L is the likelihood function of the auxiliary models with parameter θ. $\tilde{\theta}(x(\beta))$ is the Maximum Likelihood Estimator (MLE) of the auxiliary regressions by using the simulated data. $\hat{\theta}$ is the MLE of the auxiliary regressions by using the actual (NLSY) data. W is a positive definite weighting matrix, which is set as the inverse of the Hessian matrix in my model. $\hat{\beta}^{II}$ is set to minimize the distance between $\hat{\theta}$ and $\tilde{\theta}(x(\beta))$. Therefore, the central idea of indirect inference is to choose the structural parameters that minimize the distance between the estimators of the auxiliary regressions evaluated on the actual and simulated data. Details of the moments and auxiliary regressions for indirect inference are shown in Appendix.

The identification assumptions used in my study are rational exceptions as well as the many behavioral and functional form assumptions already discussed. The rational expectations assumption is commonly used in structural estimation of life-cycle models. Dominitz and Manski (2010) suggested that college students could accurately estimate the median of the earnings distribution for college graduates. Other papers showed that youth tend to produce relatively accurate estimates of average wages for those with and without a college degree (Avery and Kane 2004, Barrow and Rouse 2004, Avery and Turner 2012).[34]

[34]Some papers also argued the implausibility of rational expectations. Individuals may form divergent beliefs as they process information differently (Harris and Raviv 1993, Morris 1995, and Wiswall and Zafar 2015).

5 Data and Descriptive Statistics

The data used in my study come from National Longitudinal Survey of Youth (NLSY) 1979. The NLSY79 (1979-2012) surveyed 12,686 respondents born between 1957 and 1964. The sample includes a nationally representative subsample, a supplemental oversample of blacks, Hispanics, and economically disadvantaged whites, and an oversample of respondents in the U.S. military. Respondents from NLSY79 were surveyed annually from 1979 to 1994, and biennially starting from 1994. The reason I use NLSY79 instead of the more recent NLSY97 cohort is that NLSY97 currently does not provide observations beyond age 32, while the NLSY79 provides mid-life information.

For the sample selection rules used in my study,[35] I include the nationally representative subsamples and the supplemental subsamples of blacks and Hispanics.[36] Due to significant differences in sector choice across gender, I separately estimate the model for males and females. The estimates in this paper exclude females.[37] I include individuals who obtain a high school degree because decision periods in my model start from high school graduation.[38] Furthermore, without initial states, the model cannot be solved and simulated. Therefore, I excluded respondents whose initial conditions were missing. I only keep white, black and Hispanics in my sample.[39] I exclude men who served in the army because veterans have various advantages in student loan borrowing and repaying method.[40] Finally, I am left with

[35] Details on observations eliminated from each step of sample selection rule is shown in Appendix Table 1.

[36] I exclude the 1643 white poor in the supplement sample and the 1280 individuals in the military oversample in NLSY79. There are two reasons for this selection, one is that NLSY97 doesn't include the white poor and the military oversample, the other is that white poor and military oversample are not followed in NLSY79 after 1990 interview.

[37] Comparison of descriptive statistics between males and females in the NLSY79 data is shown in Appendix Figure 5 - 8. Females are on average 7 percentage points more likely to work in the public sector and 15 percentage points less likely to work in the private sector than males after age 30. Currently, I am in the process of estimating the model for females.

[38] I only include individuals who graduate from high school between age 16 and 19, because individuals graduating earlier or later make systematically different schooling and work decisions. In the NLSY sample, 97.1% of the high school degree holders graduate from high school between age 16 and 19.

[39] White, black and Hispanics make up of 87.4% of the NLSY sample. To save state space, I eliminate other minority groups in my estimation.

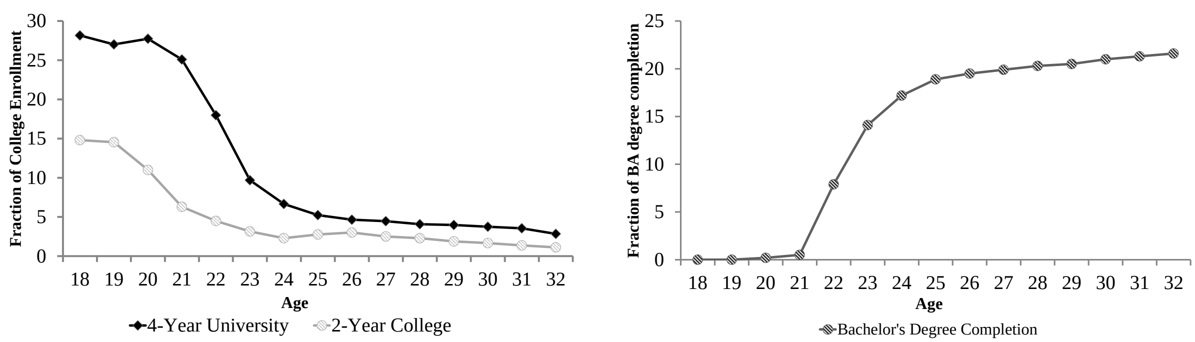
[40] Several programs provide educational benefits for veterans. These programs include Survivors' and Dependents' Educational Assistance Program (DEA), Veterans On-Line Application (VONAPP), and Military Officers Association of American (MOAA) etc. For instance, MOAA offers several educational assistance programs for veterans. These programs include interest-free loans, grants and scholarships.

a sample of 1,758 men and 96,690 person-semester observations.

5.1 College Enrollment (s_t^U, s_t^C) and Degree Completion (BA_t)

Since the vast majority of the population no longer enrolled in college after age 29, I model individuals' enrollment decisions before age 30 and assume no one attends college afterward. In the NLSY79, individuals are asked about the beginning and ending dates of all enrollments at 2-year or 4-year colleges. An individual is defined to attend college in the fall semester if he reports enrollment in the months of October, November, and December. Spring semester enrollment is counted if individuals enroll in February, March, and April.

Figure 1: Fraction of College Attendance and Degree Completion



(a) Fraction of College Enrollment (b) Fraction of BA Degree Completion

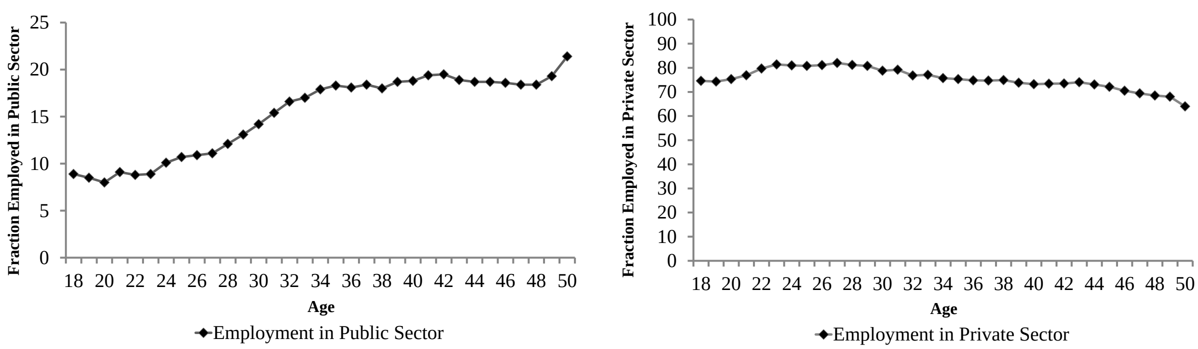
Figure 1 shows the fraction of college enrollment and Bachelor's degree completion at different ages. Subfigure (a) in Figure 1 displays the enrollment rate in both 4-year college and 2-year college. It is observed that the 4-year college enrollment is relatively constant above 25% between ages 18 and 21. Subsequently, 4-year college enrollment decreases with age. The fraction of 2-year college enrollment is 15% at ages 18 and 19, and then slowly declines with age. Less than 10% of the sample were enrolled in school after age 25. The bachelor's degree completion rate is displayed in subfigure (b). The BA completion rate is nearly 0 before age 22. Starting at age 22, the BA completion rate increases sharply, and eventually, more than 20% of the entire population holds a Bachelor's degree.

5.2 Employment Status ($h_t^G, h_t^P, Unemployment_t$)

Employment status is generated from individuals' reported number of hours worked each week at the survey date. An individual is defined as working full-time if he works on average more than 30 hours per week during a decision period (semester), part-time if he works more than 5 hours but less than 30 hours per week, and not working if works less than 5 hours a week. This definition is consistent with the PSLF program, as 30 hours per week also serves as a threshold for full-time employment. Unemployment status is derived from another question, where respondents are asked about labor force participation at each week.

The sector of employment (public sector or private sector) question is asked for each employer. I track the spell of each job and identify respondent's sector of employment in each semester. If the respondent holds more than one job in the same period, I use the job at which he works the most hours. If hours worked are the same, I use the job with the earliest starting date. Public sector refers to government or non-profit organization (including tax-exempt and charitable). Private sector is defined as the for-profit company or self-employment (including work without pay in a family business or farm).

Figure 2: Employment Rates by Sector and Age



(a) Fraction Employed in Public Sector (b) Fraction Employed in Private Sector

Figure 2 displays the employment rate in the public and private sectors. Subfigure (a) in Figure 2 displays the fraction of the population employed in the public sector. The fraction of employment in the public sector increases with age. After age 34, around 18% of the

NLSY79 cohort work in public sector. Subfigure (b) in Figure 2 displays the fraction of employment in private sector. The fraction of employment in the private sector is relatively constant at 75%. Before age 22, a large fraction of employment in the private sector is part-time.[41] After age 22, around 8% of the population work part-time in the private sector, while 67% work full-time in the private sector. A plausible explanation is that individuals are more likely to work part-time while enrolled in school.

5.3 Student Loans (a_t^S)

Student loan debt refers to the remaining amount of debt owed on government educational loans. However, the NLSY79 survey did not start to ask questions on the accumulated student loan debt until 2004. Before 2004, the survey only asks about educational loans received at each college attended since the previous interview. Therefore, I observe student loan debt for these years only for individuals currently enrolled in college. Due to the fact that repaying behavior is not observed, I assume that individuals will not start to repay educational loans until they leave college. Therefore, I treat the accumulated student loan borrowing as an approximation for accumulated student loan debt before individuals leave college. I track the accumulated student loan borrowing until age 30 as my model does not allow college choices beyond age 30. Starting from 2004, the survey directly asks about the accumulated student loan debt. In my study, I have information on accumulated student loan debt in the 2004, 2006, 2008, 2010, and 2012 surveys.

Table 1 displays the distribution of student loan debt by age. Panel A in Table 1 shows the accumulated student loan borrowing from the surveys before 2004. Panel B shows the accumulated student loan debt from the surveys since 2004. In Panel A of Table 1, student loan debt increases rapidly between ages 18 and 25 when the majority of the observations make school decisions. At age 25, 34% of enrolled students holds some student loan debt, and the median student loan borrowing for those who borrowed amounts to $8,700.[42] Student

[41] At age 18, 40% of the entire population work part-time in the private sector. This rate drops to 30% between age 19 and 21.

[42] According to Brown, Haughwout, Lee and Van der Klaauw (2015), observations in Survey of Consumer Finances (SCF) underreport their student loan debt by 30%. Many active borrowers can't tell the balance, and some student loan borrowers fail to report the amount. To test the robustness of underreporting, I scale up the NLSY reported student loan debt by 30% for each borrower and re-estimate the model. The newly

Table 1: **Student Loan Debt Summary Statistics**

Age	No. of Obs	Mean Total	Percentage With Debt	Median With Debt
Panel A: Surveys Years Before 2004				
18	1,419	-178	8.5	-2,742
19	1,281	-470	14.5	-2,935
20	1,144	-681	18.3	-3,459
21	917	-1,365	23.3	-4,658
22	749	-2,089	27.3	-5,481
23	667	-2,879	28.9	-7,350
24	401	-3,173	32.0	-7,937
25	359	-3,416	34.1	-8,694
26	324	-3,547	37.5	-8,755
27	292	-3,679	37.9	-8,803
28	264	-4,098	40.5	-8,697
29	239	-4,168	37.1	-9,318
30	207	-3,755	34.0	-8,994
Panel B: Surveys Years Since 2004				
40	951	-2,112	9.0	-9,352
41	960	-1,210	8.6	-8,095
42	1,086	-689	5.9	-7,189
43	1,112	-581	4.9	-7,019
44	1,069	-1,417	7.9	-6,142
45	1,454	-1,215	7.6	-8,663
46	2,022	-1,144	6.5	-7,019
47	2,012	-978	7.2	-8,663
48	1,877	-1,168	7.0	-8,663
49	1,509	-1,305	8.4	-9,529
50	943	-1,164	7.7	-7,816

[1] Assets are CPI-deflated, the CPI base year is 2004.
[2] Mean total refers to mean student loan debt among the whole population.

loan debt is relatively stable for enrolled students between age 25 and age 30. I observe a slight increase and decrease in student loan borrowers and median student loan debt.

In Panel B of Table 1, the percentage of population holding student loan debt was less

simulated student loan borrowing matches the scaled up data, and the counterfactual results are robust.

than 10% after age 40. However, the median student loan debt for those who still had debt is relatively stable at around $8,000. According to the aggregate data reported in Li and Goodman (2015), the percentage of population holding student loan debt is around 8% between ages 38 and 42. This rate slowly drops to 5% between ages 53 and 57. My data is consistent with their findings.

Two limitations exist in my sample. First, there is a 10-year gap with no information on student loan debt between ages 30 and 40. Since the NLSY79 observations were born between 1957 and 1964, the youngest observation was age 40 in 2004.[43] Second, there is a potential sample selection problem of student loan debt before age 30. The sample size in Panel A decreases by age due to the fact that I am forced to exclude observations who are not enrolled, as the accumulated student loan debt is not asked before 2004. Therefore, the median and percentage with debt in Panel A may not reflect the actual statistics in the entire population.

In order to check validity of student loan debt in my sample, I compare the median and percentage with debt in the NLSY79 to that in the NLSY97 and the Panel Study of Income Dynamics (PSID). Table 2 shows the distribution of student loan debt by age in the NLSY97 and the PSID. In the NLSY97, respondents are directly asked about the accumulated student loan debt when they reach age 18, 20, 25, and 30. Therefore, the NLSY97 provides a more accurate measure on student loan debt than the NLSY79 at observed ages. In the PSID, student loan debt questions are asked since the 2011 survey. Although student loan debt in the PSID is at family level, it provides information on the trend of student loan debt across ages. I find that NLSY79, NLSY97, and PSID all present consistent patterns of student loan debt from age 18 to age 30.

5.4 Net Assets Other Than Student Loan Debt (a_t^O)

Net assets other than student loan debt is defined as total assets minus total debt other than student loans. Variables used to calculate total assets include: (i) house values and

[43] I use the Panel Study of Income Dynamics (PSID) to check the median student loan debt and percentage with debt between ages 30 and 40. The PSID surveys student loan debt in the family level across all ages. Detailed comparison of the NLSY and PSID is shown in the Appendix.

Table 2: **Student Loan Debt: Comparing NLSY97 and PSID**

Age	No. of Obs	Mean Total	Percentage With Debt	Median With Debt
Panel A: National Longitudinal Survey of Youth 1997				
18	1,236	-508	14.3	-2,560
20	1,427	-1,739	25.8	-4,107
25	1,180	-5,967	41.0	-10,566
30	729	-6,607	44.6	-8,757
Panel B: Panel Study of Income Dynamics (2011-2013)				
18	34	-2,143	2.9	-142
19	70	-5,037	20.7	-1,287
20	129	-4,763	24.0	-1,431
21	172	-4,008	21.5	-1,028
22	240	-6,166	27.9	-2,035
23	304	-10,122	36.2	-3,490
24	348	-8,931	38.8	-3,524
25	435	-11,907	38.9	-4,518
26	482	-10,206	44.6	-4,673
27	470	-10,483	41.5	-4,519
28	470	-11,908	38.5	-4,792
29	455	-10,419	43.5	-4,658
30	467	-11,908	42.8	-5,231

[1] Assets are CPI-deflated, the CPI base year is 2004.
[2] Mean total refers to mean student loan debt among the whole population.

other property values, (ii) checking and saving account, bonds, stocks and money market funds etc., (iii) automobile values including all vehicles, (iv) net business values and farm values, (v) life insurance and pension funds. Variables used to calculate total debt include: (i) mortgage loans and land debt, (ii) credit card and money market debt, (iii) auto loans of all vehicles, (iv) other kinds of debt. Net assets other than student loan debt has the same sample selection problem as student loan debt in the previous subsection.

Table 3 shows the distribution of net assets other than student loan debt by age.[44] The median total in the third column denotes median net assets other than student loan debt.

[44] In order to eliminate the effect of extremely large values of assets, I show median asset instead of mean asset (Blau 2016).

Table 3: **Net Assets Other Than Student Loan Debt**

Age [1]	No. of Obs	Median Total	Percentage Negative	Median Negative
Panel A: NLSY79 Surveys Before 2004				
18	1,419	1,931	8.5	-1,844
19	1,281	3,511	12.0	-2,984
20	1,144	4,213	11.9	-3,687
21	917	5,171	13.3	-4,309
22	749	6,188	14.7	-4,567
23	667	7,160	15.1	-4,618
24	401	9,140	14.5	-4,790
25	359	10,664	14.2	-5,781
26	324	12,716	14.5	-6,059
27	292	15,898	13.6	-5,203
28	264	17,256	12.5	-4,356
29	239	20,263	11.0	-5,588
30	207	24,191	9.4	-5,736
Panel B: NLSY79 Surveys Since 2004				
40	875	81,999	4.0	-8,000
41	889	82,999	3.6	-14,001
42	1013	93,999	2.1	-17,000
43	1021	100,020	2.1	-33,001
44	902	99,143	3.2	-64,750
45	929	99,143	3.3	-53,381
46	1042	96,930	3.6	-33,876
47	995	93,224	5.0	-36,771
48	819	92,275	5.0	-34,399
49	837	90,502	4.3	-22,215
50	874	87,088	4.5	-25,506

[1] Assets are CPI-deflated, the CPI base year is 2004.

The percentage negative in the fourth column represents the fraction of the population with negative net assets other than student loan debt. The median negative in the last column denotes the median of observations with negative net assets other than student loan debt. Panel A displays the distribution of net assets other than student loan debt from age 18 to age 30. It is observed that median net assets other than student loan debt increases with age. The percentage of observations with negative net assets other than student loan debt first increases and then decreases with age. 15% of the population are net borrowers at age 23, and this figure drops to 9.4% at age 30.

Panel B of Table 3 shows descriptive statistics starting from age 40, as this is the age of the youngest respondents in 2004 in the NLSY79. The median and percentage with negative assets are relatively stable. There is a substantial decrease in net assets starting from age 45, and this is not observed in other cohorts (Blau 2016). The reason for this decline in net assets after age 45 is the significant drop in house values during the 2007 financial crisis. The average house value for homeowners in my NLSY79 sample is \$221,388 in 2004, and this value increases to \$277,636 in 2008. However, a major drop in house value occurred in the following years, resulting in an average house value of \$236,895 in the 2012 interview.[45] Moreover, there is big gap in median net assets other than student loan debt between age 30 and age 40. About 75% of median assets other than student loan debt were accumulated between ages 30 and 40.[46]

5.5 Total Net Assets ($a_t^S + a_t^O$)

Total net assets is the sum of student loan debt and net assets other than student loan debt. I observe total net assets of the NLSY79 cohort over ages 18 to 50. I show median total net assets by age in Figure 3.

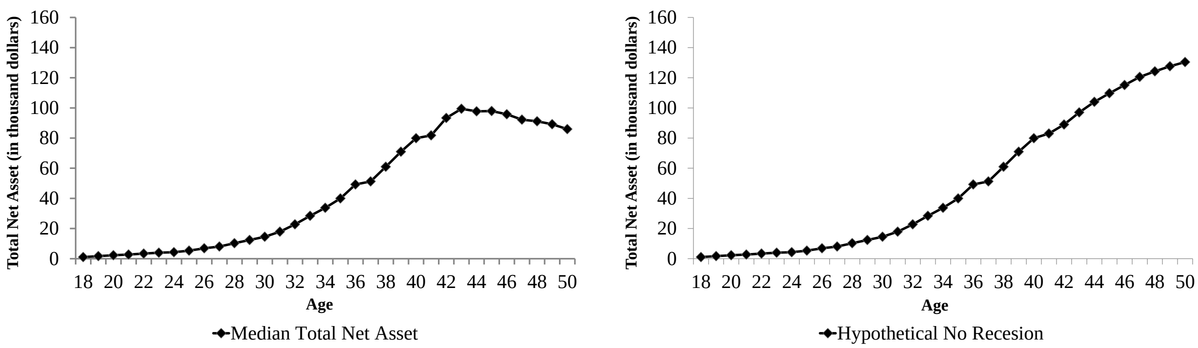
Subfigure (a) in Figure 3 displays the total net assets of the NLSY79 cohort. Due to the significant drop in house values during the 2007 financial crisis, total net assets of the NLSY79 cohort drops significantly starting from age 45. Subfigure (b) in Figure 3 displays the hypothetical total net assets if there had been no financial crisis.[47] The hypothetical asset line is plotted by assuming no drop in house value as shown in Appendix Figure 1. It

[45] The significant drop in house price between 2008 and 2012 is consistent with the record of U.S. House Price Index (HPI), which is shown in Appendix Figure 1. According to HPI data, the house price decreased by 20% between 2008 and 2012 in the U.S.

[46] I use Panel Study of Income Dynamics (PSID) data to show the student loan debt and net assets other than student loan debt at ages between 18 and 50 in the Appendix. PSID data presents a consistent pattern of student loan debt and net other assets as the NLSY data.

[47] I calculate the hypothetical total net asset by assuming zero real growth rate of the House Price Index after the 2007 financial crisis. As argued previously, the decrease in net asset at age 45 is due to the significant drop in house values during the recession.

Figure 3: Median of Total Net Asset by Age



(a) Median Total Net Asset of NLSY79 (b) Hypothetical Median Total Net Asset

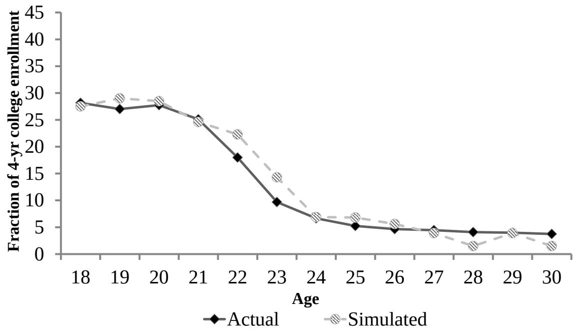
is observed that the NLSY79 cohort would have continued accumulating net assets in this scenario.

6 Parameter Estimates and Model Fit

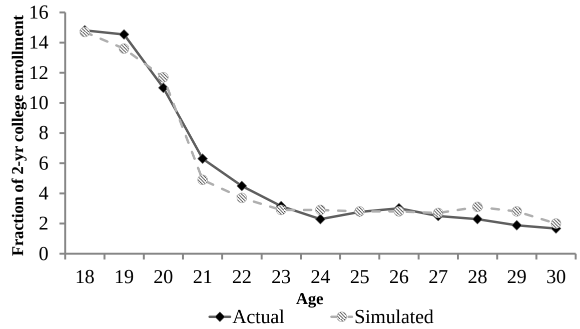
The parameters estimates and standard errors are shown in the Appendix. The estimated parameters are sensible in sign and magnitude, comparing to Keane and Wolpin (2001) and Johnson (2013). My model is estimated under the assumption that individuals in the NLSY79 repay under the Traditional Repayment Plan, and it provides a generally good fit to the data. The model fit is displayed in Figures 4 and 5. Figure 4 presents the fit of the model to college enrollment and employment status at different ages. Figure 5 presents the fit of model to student loan debt and net assets other than student loan debt. The solid line represents the NLSY79 (actual) data and the dashed line represents the simulated (predicted) data.

Subfigures (a) and (b) in Figure 4 illustrate the model fit of college enrollment at 4-year university and 2-year community college. The simulated fraction of college enrollment in both college types closely follow the actual data, matching the life-cycle profile of college enrollment. The maximum difference between simulated enrollment rate and actual data is

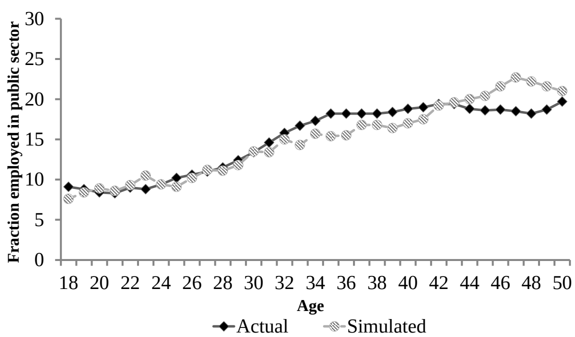
Figure 4: Model Fit of College Enrollment and Employment Status by Age



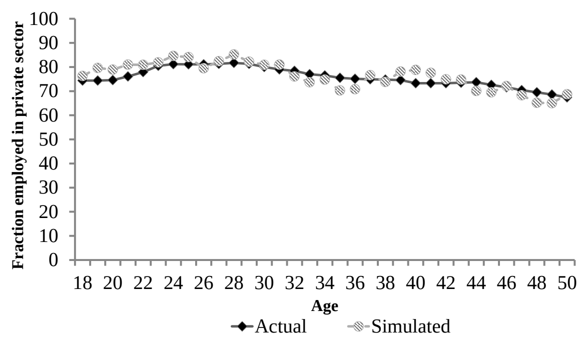
(a) Fraction of 4-Year College Enrollment



(b) Fraction of 2-Year College Enrollment



(c) Employment Rate in Public Sector



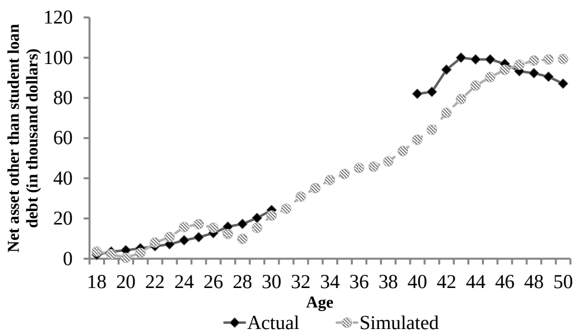
(d) Employment Rate in Private Sector

4.3 percentage points in 4-year college at age 23, a 19.3% gap, and 0.9 percentage points in 2-year college at age 21, a 6.2% gap. Subfigures (c) and (d) demonstrate model fit to the fraction of employment in the public and private sectors. The average difference between the simulated employment rate and the actual data is less than 1 percentage point, and the maximum difference is 4 percentage points in both sectors. The predicted employment in the public sector is higher than in the actual data after age 45. Predicted employment in the private sector closely follow the trend of the actual data .

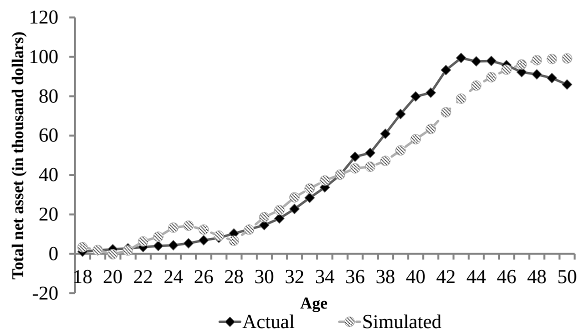
Figure 5 shows the fit of the model to net assets and student loan debt.[48] Subfigure (a)

[48]Following Keane and Wolpin (2001) and Johnson (2013), discrete asset choices are used to approximate continuous asset decisions. a^S_{t+1} has 16 grid points that are evenly distributed between \$0 and -\$46,000. a^O_{t+1}

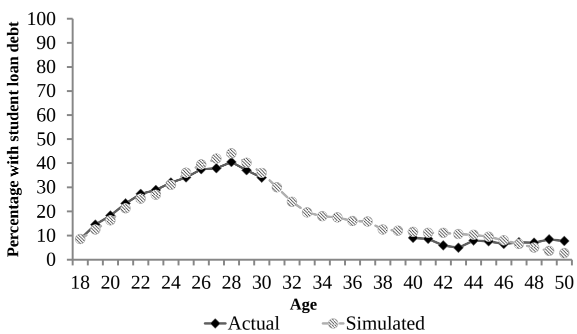
Figure 5: Model Fit of Net Asset and Student Loan Debt



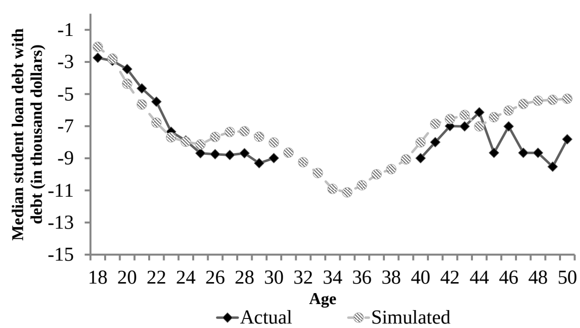
(a) Median Other Net Assets



(b) Median Total Net Asset



(c) Fraction With Student Loan Debt



(d) Median Student Debt Among Debt Holders

illustrates the model fit of net assets other than student loan debt. The predicted net assets other than student loan debt closely follow the actual data before age 30, with a maximum difference of \$5,500 at age 28, a 31.8% gap. As my model does not capture the exogenous shock in house prices during the financial crisis, I predict a continuous accumulation of net assets after age 40, in contrast to the actual decline.[49] Subfigure (b) has a similar pattern

has 17 grid points, ranging from -\$15,000 to \$170,000. I use the mean of assets between the 40^{th} and 60^{th} percentile as a proxy for median. The approximated median is very close to true median in the simulated data.

[49] To check robustness of the model, I have also tried to incorporate a negative shock to net assets starting from 2007. After introducing the negative shock, simulated net assets start to fall in 2007, which matches the trend of the true data. Counterfactual experiments yield very similar results, so the model is robust to matching the negative return to assets during the financial crisis.

as subfigure (a). My model predicts more fluctuations of the total net assets before age 35 than the actual data. The simulated data underpredicts the total net assets between ages 38 and 44, with a maximum difference of $20,000, a 22% gap.

Subfigures (c) and (d) in Figure 5 separately show the percentage of the population with student loan debt and the median student loan debt of individuals with debt. For the percentage of population holding student loan debt, my predicted data matches the actual data at all observed ages. The maximum difference between the predicted and actual fractions is 4 percentage points at age 27, a 10.5% gap. The predicted median student loan debt is accurate before age 25, but underpredicts the actual student loan borrowing by $1,500 between ages 25 and 30. After age 40, the average predicted student loan debt is quite accurate, but the model predicts a slow decrease, while the actual student loan debt fluctuates around $8,000. Fluctuation of the actual student loan debt after age 40 could be a result of small sample size. The model fit of the mean student loan debt over the whole population is shown in Appendix Figure 2.[50] One limitation of my model is that I don't have data to match the simulated student loan debt between ages 31 and 39. Although information from ages 31 to age 39 is important, my parameter estimates are not influenced by debt behavior at those ages. It is possible that the simulated student loan debt is different from the actual student loan debt between ages 31 and 39.

7 Simulation Results and Discussion

In this section, I shall address the research questions posed in the Introduction. First, I examine how the New Repayment Plan affects college enrollment. Second, I study how the change in repayment plan affects student loan borrowing behavior. Third, I investigate whether individuals shift their preference for the sector of employment under the PSLF program. Fourth, I provide a back-of-the-envelope calculation of the net cost of the New Repayment Plan. Lastly, I simulate alternative policy experiments and compare their effects

[50]Parents' student loan borrowing for children is not modeled, as it is included in the parental transfer. However, to test sensitivity of the model when individuals misreport their student loan debt by including parents' borrowing, I separately estimate the model under the scenarios when student loan borrowing limit is increased by 10%, 20%, 30%, and 40%. The model is robust as counterfactual experiments yield similar results.

on schooling, work, consumption, and social welfare.

To model availability of the New Repayment Plan in the simulations, I define eligible repayments as repaying not less than 10% of the discretionary income or Standard Repayment Plan (SRP) in one period.[51] A repayment period is accumulated if the individual makes an eligible repayment in a given period.

$$RP_t^T = RP_{t-1}^T + I[a_{t+1}^S - a_t^S \geq \min(10\% DI_t, SRP)]I(s_t^C + s_t^U = 0) \tag{25}$$

$$RP_t^G = RP_{t-1}^G + I[a_{t+1}^S - a_t^S \geq \min(10\% DI_t, SRP)]I(s_t^C + s_t^U = 0)(h_t^G = 1) \tag{26}$$

RP_t^T is the accumulated number of repayment periods, and RP_t^G is the accumulated number of repayment periods while working in the public sector. DI_t is the discretionary income at period t. Individuals are allowed to repay their student loans while in college, but repayments in college are not counted as eligible repayments. After accumulating 10 repayment years while working full time in the public sector or 20 repayment years in total, the remaining amount of student loan debt is forgiven.

$$a_{t+1}^S = 0 \ if \ RP_t^G = 10 \ or \ RP_t^T = 20 \tag{27}$$

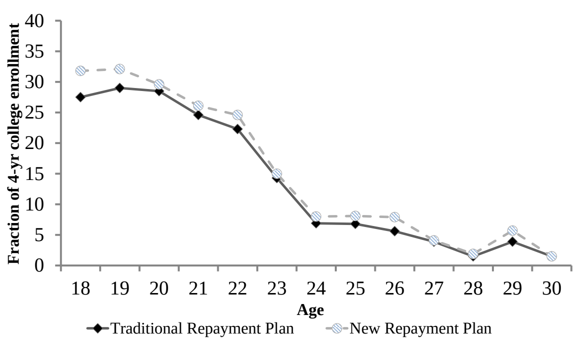
The model is estimated under the assumption that individuals repay under the Traditional Repayment Plan, where borrowers eventually pay off their student debt plus the interest. In the counterfactual simulations, I compare simulation results under the Traditional Repayment Plan and the New Repayment Plan respectively. The New Repayment Plan contains all repaying options under the Traditional Repayment Plan as well as the IDR and the PSLF plans. The IDR plan forgives student loan borrowers after they make eligible repayments for 20 years. The PSLF plan forgives student loan borrowers after they make eligible repayments for 10 years while working full-time in the public sector.

[51]The SRP serves as a standard to pay o student debt in 10 years with fixed monthly payments.Under the New Repayment Plan, individuals don't have to make eligible repayments each period. Any repayment amount below the lesser of 10% of discretionary income and SRP will not be counted as eligible repayments. However, individuals go into default if they repay less than a certain minimum amount at each period.

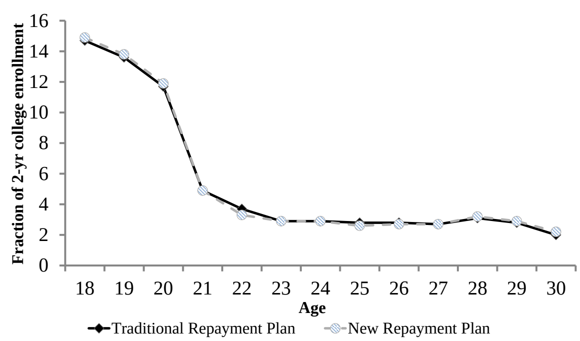
7.1 College Enrollment and New Repayment Plan

Figure 6 compares the simulated college enrollment under the Traditional Repayment Plan and the simulated college enrollment under the New Repayment Plan. Subfigure (a) in Figure 6 shows 4-year college enrollment and subfigure (b) in Figure 6 shows 2-year college enrollment. The solid line represents college enrollment under the Traditional Repayment Plan, and the dashed line represents college enrollment under the New Repayment Plan. The change in repayment plan raises the 4-year college enrollment by 1.8 percentage points on average. Most of the increase in 4-year college enrollment occurs between ages 18 and 22.

Figure 6: College Enrollment and Student Loan Repayment Plans



(a) 4-Year College Enrollment



(b) 2-Year College Enrollment

The 2-year college enrollment hardly changes when the New Repayment Plan is available. There are at least two reasons why most of the changes in college enrollment occurred in 4-year college. First, the average cost of 4-year college in my model is $8,053 per semester, while the average cost of 2-year college is only $1,248 per semester. Since student loan borrowers are not allowed to borrow more than the cost of schooling, the forgiveness plan gives individuals little incentive to enroll an additional semester in the 2-year college. Second, an additional year of 2-year college has a small effect on gaining a bachelor's degree. An extra year of 2-year college increases the probability of obtaining bachelor's degree by 1.3%, while an additional year of 4-year college increases the probability of gaining a bachelor's degree by 15%. Therefore, individuals are more likely to enroll in 4-year college under the

New Repayment Plan.

Table 4: **College Enrollment and Student Loan Repayment Plans**

	Traditional Repayment Plan	New Repayment Plan
4-Year College Enrollment at Age 18	27.5	31.8
4-Year College Enrollment at Age 19	29	32.1
Total Years of College Schooling	2.07	2.28
Bachelor's Degree Completion Rate	23.5%	24.4%

Table 4 compares the educational attainment under the Traditional Repayment Plan and the New Repayment Plan. The change in repayment plan increases the average total years of college by 10%, from 2.07 years to 2.28 years.[52] Moreover, the New Repayment Plan also increases the percentage of bachelor's degree holders by 0.9 percentage points, from 23.5% to 24.4%.

7.2 Student Loan Debt and New Repayment Plan

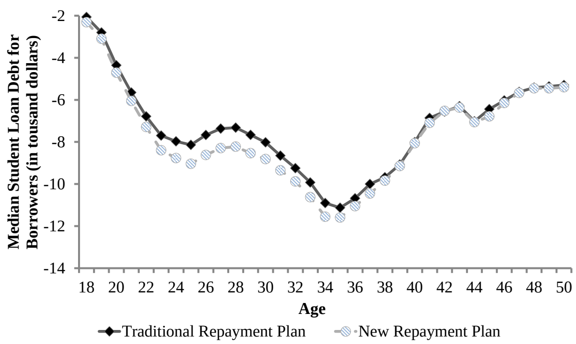
As the change in student loan repayment plan increases college enrollment, a next natural question to ask is whether college students take out more student loans? Under the New Repayment Plan, remaining student loan debt is forgiven when individuals have made eligible repayments for certain periods. The forgiveness plan gives student loan borrowers an incentive to borrow more if they plan to take advantage of the New Repayment Plan.

Figure 7 displays the change in student loan debt under different repayment plans. Subfigure (a) in Figure 7 shows the median student loan debt for borrowers who hold debt. Subfigure (b) in Figure 7 shows the fraction of the population with student loan debt.[53] As illustrated in Figure 7, college students tend to take on more student loans under the

[52] The relatively small change in college enrollment decisions in response to changes in financial aid plan is consistent with existing literature (Linsenmeier, Rosen, and Rouse 2006, Cellini 2010, Rothstein and Rouse 2011, Steiner and Wrohlich 2012).

[53] The mean student loan debt for population is shown in Appendix Figure 2.

Figure 7: Student Loan Debt and Repayment Plans



(a) Median Student Debt Among Debt Holders

(b) Fraction With Student Loan Debt

New Repayment Plan. There is a 14% increase in student loan borrowing among those who borrowed between ages 23 and 30, from \$7,000 to \$8,000. Before age 23 and after age 35, the median student loan debt for borrowers are very close to each other under different repayment plans. In subfigure (b) in Figure 7, the fraction of the population with student loan debt increases by around 20% from age 18 to age 33. Between ages 24 and 30, individuals are 8 percentage points more likely to hold student loan debt under the New Repayment Plan. After age 30, individuals tend to repay more slowly under the New Repayment Plan. At age 50, around 6% of the population hold some amount of student loan debt compared to 2.4% under the Traditional Repayment Plan.

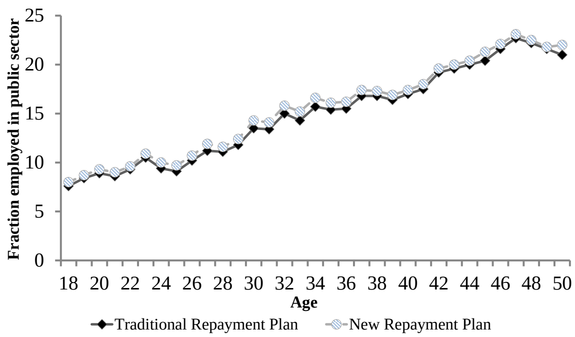
I find that most simulated students borrowed to the limit in each academic year between ages 18 and 21.[54] This is the reason why I observe no change in student loan borrowing between ages 18 and 21 when there is a change in repayment plan. However, college students can borrow more student loans if they enroll for additional years and their cumulative borrowings do not exceed the limit. My finding that the borrowing constraint is tight in postsecondary schooling is consistent with Johnson (2013). Johnson argues that although borrowing constraint is tight in postsecondary schooling, relaxing the borrowing constraint has little effect in enhancing college enrollment.

[54]This result is consistent with Lochner and Monge-Naranjo (2011), and Avery and Turner (2012).

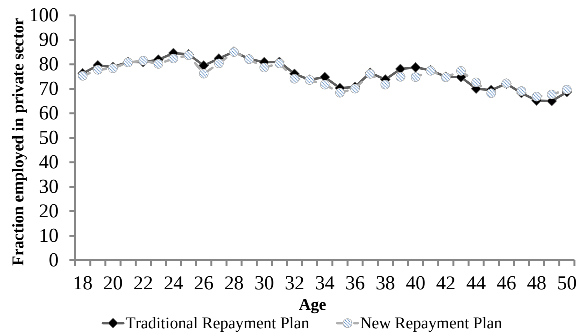
7.3 Sector of Employment and PSLF Program

The Public Service Loan Forgiveness (PSLF) program is part of the New Repayment Plan. Under the PSLF program, individuals working in the public sector are forgiven earlier than individuals working in the private sector. A primary goal of the PSLF program is to attract more graduates to work in the public sector. Therefore, I analyze whether the New Repayment Plan shifts individuals' decisions on sector of employment.

Figure 8: Sector of Employment and New Repayment Plan



(a) Fraction Employed in Public Sector



(b) Fraction Employed in Private Sector

Figure 8 displays the sector of employment under both repayment plans. Subfigure (a) in Figure 8 shows the fraction of employment in the public sector. According to the result of the simulation, individuals are on average 0.6 percentage points more likely to work in the public sector under the New Repayment Plan, an increase of 4%. Subfigure (b) in figure 8 shows the fraction of employment in private sector under different repayment plans. Individuals are 0.5 percentage points less likely to work in the private sector when the New Repayment Plan is available. In all, the change in repayment plan has no effect on the total employment rate. 0.5% of the population who previously worked in the private sector move to the public sector when there is a change in the repayment plan.

One possible reason for the small change in employment sector is that the increase in student loan debt is relatively small compared to the total net assets. At age 25, the increase in student loan debt accounts for 6% of the total net assets. Most individuals are unlikely to shift sector of employment just in response to the PSLF program. My result is consistent with the aggregate data. According to reports from the Education Department, around 0.3 million borrowers signed up for the PSLF program as of 2015.[55] Even if all of these borrowers choose to work in the public sector, they are only about 0.7% of the total student loan holders. Therefore, the proportion of individuals deciding to change sector of work solely for the PSLF program could be small. Another possible reason is that only individuals with relatively high debt-to-income ratio have incentives to take advantage of the PSLF program. The proportion of college graduates with excessive debt-to-income ratio is below 6%.[56] Moreover, the average remaining debt being forgiven by the PSLF program is $6,180 in my simulation. Therefore, it is unlikely for individuals to change their sector of employment when their debt-to-income ratio is low or the amount of student loan debt being forgiven is small.

7.4 Estimated Net Cost of the New Repayment Plan

Since the New Repayment Plan forgives remaining student loan debt after repaying for a certain number of periods, it is important to calculate the net cost of the New Repayment Plan compared to the Traditional Repayment Plan. Under the Traditional Repayment Plan, a simulated 2.4% of the high school graduates (5.4% of the student loan borrowers) fail to fully repay their student loan debt in the final period.[57] The average remaining debt is $5,895 among individuals who hold student loan debt in the final period. Under the New Repayment Plan, 6.1% of the population (13.8% of the student loan borrowers) will have some debt forgiven. According to the simulation, 0.3% of the population will be forgiven by the PSLF program after 10 years of eligible repayments, and 5.8% of the population will be forgiven after repaying for 20 years. The average remaining debt being forgiven under the

[55] Individuals have to sign the PSLF Employment Certification Form before the government tracks their cumulative repayment periods. Not everyone signing the form will be forgiven by the PSLF program, as some of them will have fully repaid the student loan debt before forgiveness.

[56] I define excessive debt-to-income ratio as monthly repayments exceed 20% of discretionary income under the standard 10-year repayment plan. The data used to calculate the ratio comes from 2008-2012 Baccalaureate and Beyond Longitudinal Study.

[57] Those who failed to clear their student loan debt include individuals who keep defaulting on their student loan debt, as well as those who borrowed too much and cannot fully repay their debt even in the last period. Student loan borrowers under the Traditional Repayment Plan must pay off all their debt plus interest.

PSLF program is \$6,238, and the average amount of debt being forgiven under the 20-year forgiveness plan is \$4,389 per person. According to data from Centers for Disease Control and Prevention (CDC), the number of births in the U.S. in 2014 was 3,998,076. Assuming the population of each cohort is 4 million and 80% of them graduate from high school, the estimated net cost to the federal government on the New Repayment Plan is \$7 billion in present discounted value (PDV).[58]

7.5 Alternative Policy Designs

I now simulate alternative financial aid policy experiments with the same net cost as the New Repayment Plan and compare their effects. The conventional ways of increasing financial aid for postsecondary education are subsidizing grants and increasing the student loan borrowing limit. According to Trends in Student Aid 2015, the total federal, state, institutional, and other grants increased by 64% over the last decade, while the student loan borrowing limit remained constant since 2007.[59] However, with the drastic growth in tuition and fees, more financial aid programs are needed to help low-income college students.

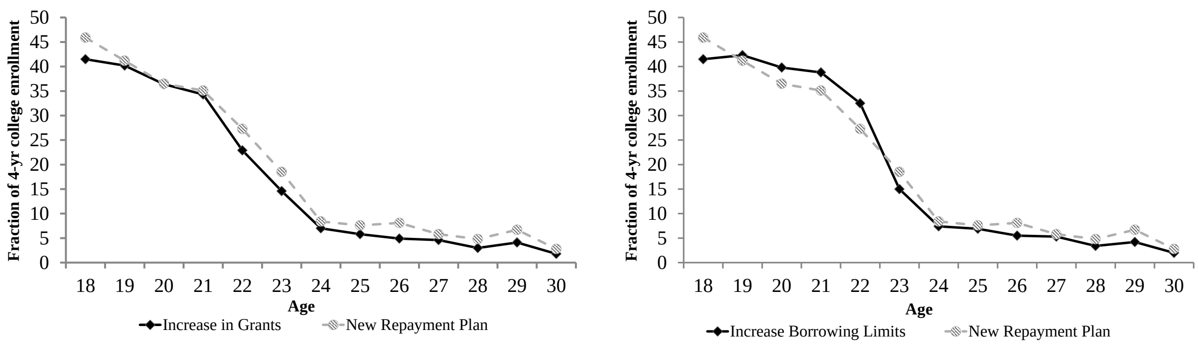
The benchmark of the model is the Traditional Repayment Plan. In order to make the policy experiments comparable, I simulate counterfactual experiments with the same net cost of \$7 billion as the New Repayment Plan. Then I compare the effects of each policy experiment on schooling, work, consumption and lifetime utility. To simulate the \$7 billion increase in grants, I include a multiplier in the grant formula and calculate the increase in grants at various values of the multiplier. I find that when the grant formula increases by 37%, total grants will increase by around \$7 billion in PDV. To simulate an increase in the student loan borrowing limit, I increment the annual loan limit and calculate the estimated net cost. I find that when the annual loan limit increases by \$3,000, the net cost for the federal government is around \$7 billion in PDV.[60]

[58] Annual estimated net cost of the New Repayment Plan is the cost of the New Repayment Plan minus cost of the Traditional Repayment Plan: 4,000,000×0.8×(5.8%×\$4,389+0.3%×\$6,238-2.4%×\$5,895), which is \$422 million a year. Assuming the annual interest rate is 6%, the total net cost for the federal government is \$7 billion in PDV.

[59] The student loan borrowing limit experienced moderate increases in 1987, 1993, and 2007. The annual student loan borrowing limit for independent undergraduates increased from \$2,500 in 1986 to \$5,500 in 2017.

[60] The \$7 billion cost comes from student loan default. An increase in the student loan limit results in

Figure 9: Four-Year College Enrollment and Policy Experiments



(a) Grants and New Repayment Plan

(b) Borrowing Limit and New Repayment Plan

Figure 9 shows the 4-year college enrollment when the $7 billion is spent on different policies, namely the increase in grants, increase in borrowing limit, and the New Repayment Plan.[61] Subfigure (a) in Figure 9 compares enrollment in 4-year college between the increase in grants and the New Repayment Plan. The New Repayment Plan stimulates more enrollment in 4-year college than the increase in grants. Subfigure (b) in Figure 9 compares the 4-year college enrollment between the increase in the borrowing limit and the New Repayment Plan. Although the New Repayment Plan stimulates more enrollments at age 18, the increase in the borrowing limit makes 4-year enrollment more persistent between ages 19 and 22.

Table 5 displays the effects of various student aid policy experiments on individual's schooling, work, consumption, and discounted lifetime utility. Net cost to federal government is defined as the cost of the simulated policy minus the cost of the Traditional Repayment Plan. According to the policy design, increase in grants, increase in borrowing limit, and the New Repayment Plan all have $7 billion net cost, while the Traditional Repayment Plan has $0 net cost. As illustrated in Table 5, the New Repayment Plan is most cost-effective at increasing the bachelor's degree completion rate. Moreover, the financial aid

more student loan borrowers and larger amount of student loan debt.

[61]Since the 2-year college enrollment is inelastic to financial aid policies, I only show the 4-year college enrollment.

Table 5: **Comparison of Student Aid Policy Experiments**

	Traditional RP	New RP	Grants	Borrowing Limit
Bachelor's Completion Rate	23.5	24.4	24.1	23.9
Average Public Employment	14.9	15.5	14.9	14.9
Average Private Employment	76.2	75.7	76.1	76.2
Consumption in First Period	10194	10559	10287	10231
Discounted Lifetime Utility	28043	28078	28052	28085
Net Cost to Federal Government	$0	$7 billion	$7 billion	$7 billion

policy experiments other than the New Repayment Plan have no effects on choice of sectors.

All three financial aid policies increase consumption in the first period. The reason is that financial aid policies either provide college students with more funding or allow them to borrow more in college. Finally, I consider discounted lifetime utility in the first period, i.e. the value function. All three financial aid policies increase the discounted lifetime utility to some extent. The increase in student loan borrowing limit generates the highest lifetime utility among the three policy designs. Therefore, if the goal of the government is to maximize lifetime utility, the borrowing limit of student loans should be increased. However, if the government also cares about educational achievement and sector of employment, it would be useful to increase the student loan borrowing limit on the basis of the New Repayment Plan.[62]

8 Robustness Checks

In this section, I conduct two robustness checks on the validity of my model. First, I compare the simulated impacts to the reduced form impacts of the Income-Contingent Repayment

[62]The student loan borrowing limit stayed the same during the past decade. There is only a 10% increase in the student loan borrowing limit since 1993 (Department of Education). Due to the drastic growth in college tuition, increase in the student loan borrowing limit is heavily debated (Lochner and Monge-Naranjo 2011).

(ICR) plan implemented in 1993.[63] Due to the lack of a comparison group and lack of data on program participation, I can only compare outcomes before implementation of the ICR plan to those after implementation ("pre-post" strategy). Second, I re-estimate my model on the NLSY97 cohorts and compare the simulation results of the NLSY97 cohorts to the simulation results of the NLS79 cohorts. Although it is ideal to conduct an out-of-sample check by simulating impacts on the NLSY97 cohorts using the estimated parameters from the NLSY79 cohorts, such approach is impracticable due to the substantial changes across the two cohorts in behavior. For example, the NLSY97 cohorts have a higher preference to schooling and a lower reversion to debt comparing to the NLSY79 cohorts. Therefore, I check the sensitivity of my results by re-estimating the structural model using an alternative set of birth cohorts.

8.1 Comparison of Simulation to Reduced Form Estimates

The ICR was the first federally initiated income-contingent debt repayment option to release burden of student loan borrowers. Under the ICR, remaining student debt will be forgiven if borrowers repay 20% of their discretionary income for 25 years. I use the PSID main interview (1988-1997) to study the reduced form estimation. The only education related question asked in the PSID main interview is the completed years of schooling at the time of interview. I apply the same sample selection rules used in the NLSY79 data to estimate the impact of ICR on college enrollment. Details of the reduced form estimation is shown in the Appendix.

The reduced-form estimates show that implementation of the ICR plan increased completed years of schooling by 0.2 years at ages 18 and 19, while the counterfactual simulation shows that completed years of schooling increases by 0.08 years at ages 18 to 19. Although the simulated impacts of the ICR is smaller, it is still consistent with the reduced form estimates. The reason is that initial college enrollment rate increased steadily between 1980 and 2005 (National Center for Education Statistics) even without introduction of the ICR.

[63]Since the introduction of the ICR in 1993, there were several consecutive reforms on student loan repayment plans between 2007 and 2015. The reason to evaluate the ICR instead of policy changes after 2007 is that several changes occurred at the same time since 2007 (e.g. Pell Grant increase, financial crisis etc.).

According to my PSID sample, completed years of schooling for individuals at ages 18 and 19 increased on average by 0.04 years annually between 1990 and 2000. If the average annual increase in completed years of schooling is deducted from the reduced form estimates, the simulated impact of the ICR is close to the reduced form impact. Therefore, the reduced form evidence is consistent with the simulation results.

8.2 Sensitivity of Simulation Across Birth Cohorts

I check sensitivity of my structural model by comparing simulation results of the NLSY79 and the NLSY97 cohorts. Ideally, it is useful to conduct an out-of-sample test by predicting impacts on the NLSY97 cohorts using parameters estimated from the NLSY79 cohorts. However, due to the significant changes in labor market, cost of college, and loan market, it would be inappropriate to predict impacts on the NLSY97 cohorts based on parameters estimated from the NLSY79 cohorts.[64] Therefore, I re-estimate my structural model on the NLSY97 cohorts, and compare the simulation results of the NLSY97 cohorts to the simulation results of the NLSY79 cohorts. If both cohorts predict consistent impacts of the change in repayment plans, my structural model would be robust to using alternative birth cohorts.

I follow the same sample selection rules and model specification to re-estimate my model using the NLSY97 data. Since the NLSY97 data only covers individuals' information between ages 18 and 32, I use the NLSY79 data to provide midlife information, such as employment, wages, and student loan debt after ages 40.[65] The 4-year college enrollment rate of the NLSY97 cohorts is 10 percentage points higher than the NLSY79 cohorts between ages 18 and 21, while 2-year college enrollment rate is similar for both cohorts. Employment patterns of the two cohorts are similar if the financial crisis did not take place.

There is a major difference of measurement on student loan debt between the NLSY79

[64] I used the parameters estimated from the NLSY79 cohorts to simulate counterfactuals on the NLSY97 cohorts. Although the predicted data does not match the NLSY97 data, simulated impacts are similar to the NLSY79 cohorts. A possible reason is that the initial state variables in the NLSY97 are quite similar to the NLSY79. For example, the portfolio of assets, work experience, indicator of parental transfer are similar for both NLSY cohorts at the initial age.

[65] It is important to have some midlife information to estimate the life-cycle structural model. Model fit of the combined data set is presented in the Appendix from Appendix Figure 9 to Appendix Figure 16.

and the NLSY97 surveys. In the NLSY79, I treat the accumulated student loan borrowing while enrolled in college as an approximation for student loan debt before age 30. In the NLSY97, the student loan debt is asked when respondents reach age 18, 20, 25 and 30. The student loan debt information in the NLSY97 is more precise than the NLSY79. The amount of student loan borrowing and percentage of population holding student debt is higher in the NLSY97 cohorts than in the NLSY79 cohorts. More than 40% of the population hold some amount of student debt at age 30 in the NLSY97, while only 34% of the population hold some amount of student debt at age 30 in the NLSY79. The median total net assets of the NLSY97 and the NLSY79 cohorts are close to each other at observed ages.

Table 6: **Simulated Changes of Repayment Plan Using NLSY79 and NLSY97**

Variable Name	NLSY79 Simulation			NLSY97 Simulation		
	TRP (1)	NRP (2)	Δ% (3)	TRP (4)	NRP (5)	Δ% (6)
4-Year Enrollment at Age 18	27.5	31.8	%15.6	40.4	45.9	%13.6
4-Year Enrollment at Age 19	29	32.1	%10.7	36.6	41.2	%12.6
Total Years of College	2.07	2.28	%10.1	2.48	2.71	%9.27
BA Degree Completion Rate	23.5	24.4	%3.83	36.5	37.1	%1.64
Median Student Debt at Age 20	-4,357	-4,707	%8.03	-4,835	-5,186	%7.26
Median Student Debt at Age 30	-8,017	-8,826	%10.1	-8,255	-9,163	%10.9
Fraction with Debt at Age 20	16.3	20.6	%26.4	20.9	25.7	%22.9
Fraction with Debt at Age 30	36.0	43.8	%21.7	50.6	59.3	%17.2
Average Public Employment Rate	14.9	15.5	%4.03	16.3	17.2	%5.52
Average Private Employment Rate	76.2	75.7	-%0.66	73.3	72.4	-%1.23
Net Cost to Federal Government	0	$7.0 billion		0	$15.9 billion	

Table 6 compares the simulated impacts of the change in student loan repayment plan using the NLSY79 and the NLSY97 cohorts. Columns (1) and (2) show the key simulation results of the NLSY79 cohorts under the Traditional Repayment Plan and the New Repayment Plan respectively. Columns (4) and (5) show the simulation results of the NLSY97 cohorts under the Traditional Repayment Plan and the New Repayment Plan. Columns (3) and (6) show the percentage change in key simulation results when the Traditional Repayment Plan is switched to the New Repayment Plan.[66] The change in student loan repayment plan increases 4-year college enrollment rate, total years of college, and Bachelor's degree completion rate for both NLSY cohorts. Simulated percentage changes of the education variables are similar for both NLSY cohorts when the Traditional Repayment Plan is switched to the New Repayment Plan.

The median student debt and fraction of population with student debt increase for both NLSY cohorts when the Traditional Repayment Plan is changed to the New Repayment Plan. Although the change in absolute value for the NLSY97 cohort is higher than the NLSY79 cohort, the percent change in median student debt and fraction with debt are similar for both NLSY cohorts at ages 20 and 30. According to the simulation, 0.5% of the population in NLSY79 shift from private sector to public sector when the repayment plan changes. For the NLSY97 cohort, 1% of the population working in private sector shift to public sector when the Traditional Repayment Plan changes to the New Repayment Plan. Net cost of the New Repayment Plan is lower for NLSY79 cohorts than the NLSY97 cohorts. One possible reason is that the fraction of population holding student debt and the amount of student debt being forgiven is lower in the NLSY79 cohorts.

In general, the simulated impacts of the percentage change in repayment plan are similar for individuals' schooling, work, and borrowing decisions using the NLSY79 and the NLSY97 cohorts. According to my simulation, the change in repayment plan has a larger impact in magnitude, but similar percentage change on the NLSY97 cohorts comparing to the NLSY79 cohorts. The change in repayment plan will increase college enrollment by around 10% for both NLSY cohorts. Student loan borrowing increases by around 10% during college, and less than 1% of the population working in the private sector shift to public sector due to the forgiveness plan. The robustness check presents consistent results for both the NLSY79 and the NLSY97 cohorts, indicating that the implications of the structural model are robust to using alternative birth cohorts.

[66] The percentage change in key simulation result is calculated as $\Delta\% = \frac{NRP-TRP}{TRP} \times 100\%$.

9 Conclusion

A series of changes in U.S. policy on student loan repayment plans occurred between 1993 and 2015. The changes in policy offer student loan borrowers options to relieve a portion of their debt. In order to study how the changes in student loan repayment plans affect decisions on schooling, work, and borrowing, I solve and structurally estimate a life-cycle dynamic discrete choice model. I compare the simulation results under the Traditional Repayment Plan (pre-1993) and the New Repayment Plan (post-2015). I find that the change in repayment plan will increase the 4-year college enrollment by 1.6 percentage points on average. According to the simulation, 0.5% of the population working in the private sector will shift to the public sector, and 13.8% of the student loan borrowers will be forgiven part of their debt. Alternative counterfactual experiments are simulated and I find that social welfare will be higher if the New Repayment Plan is combined with an increase in the student loan borrowing limit.

Several limitations exist in this model. First, identification of the parameters relies on functional form assumptions rather than variation within the data. As argued in the Introduction, direct evaluation of the changes in repayment plan is impracticable due to the absence of a comparison group. For future studies, reduced form estimation using regime changes in student loan repayment plan will be a useful complement to this study. Certain demographic groups can be used to construct comparison groups. For example, the Military College Loan Repayment Program (CLRP) initiated in 2008 offers student loan borrowers up to $65,000 of repayments if they join the military and take part in the CLRP. As the program is only available to enlistees with no prior military service, veterans can be constructed as a control group to study the impact of the change in student loan repayment plans.

Second, my model could underpredict the impact of student loan repayment reforms as I do not model student loan debt borrowed from the Federal Family Education Loan (FFEL) program and graduate schools. The FFEL program enables parents to borrow student loans to pay for their dependents' higher education. In my model, I incorporate student loan borrowing from the FFEL program as part of the parental transfers. However, student loan borrowers can take advantage of the New Repayment Plan by consolidating the FFEL loans into their student loans. Since I do not model individuals' choice of graduate schools, student loan borrowings from the graduate school are excluded. My model understates the accumulated student loan debt from higher education. In order to evaluate a more precise impact of student loan repayment reforms, it is helpful to model the FFEL program and graduate school choices in future studies.

Third, my model is partial equilibrium, and does not take into account equilibrium responses of college enrollment. My model assumes that the supply of college slots is perfectly elastic, meaning that individuals can enroll in college at their own decision. Although this assumption might be true for less prestigious state 4-year colleges as well as community colleges, the supply of slots at top-ranked universities is inelastic (Lovenheim 2011). Ignoring the supply side of the higher education market could generate an upward bias towards the impact of student loan repayment reform on college enrollment. Therefore, building a general equilibrium model of the college enrollment could be an interesting future topic.

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Appendices

A.1 Utility function (g^u):

$$
\begin{aligned}
u_t = {} & \lambda_0 \frac{c_t^{1-\rho}}{1-\rho} + \lambda_1 s_t^U I(age < 24) + \lambda_2 s_t^C I(age < 20) + \lambda_3 I(s_t^C + s_t^U > 0) I(BA_t = 1) \\
& + [\lambda_4 Black + \lambda_5 Hispanic + \lambda_6 AFQT_1 + \lambda_7 AFQT_2 + \lambda_8 AFQT_3][I(s_t^U = 0.5) + I(s_t^U = 1)] \\
& + [\lambda_9 Black + \lambda_{10} Hispanic + \lambda_{11} AFQT_1 + \lambda_{12} AFQT_2 + \lambda_{13} AFQT_3][I(s_t^C = 0.5) + I(s_t^C = 1)] \\
& + \lambda_{14} I(s_t^U > 0) I(s_{t-1}^U > 0) + \lambda_{15} I(s_t^C > 0) I(s_{t-1}^C > 0) + \lambda_{16} I(s_t^U > 0) Age_t + \lambda_{17} I(s_t^C > 0) Age_t \\
& + [\lambda_{18} + \lambda_{19} Black + \lambda_{20} Hispanic + \lambda_{21} I(type = 2) + \lambda_{22} I(type = 3) + \varepsilon_t^{w_G}] I(h_t^G > 0) \\
& + [\lambda_{23} + \lambda_{24} Black + \lambda_{25} Hispanic + \lambda_{26} I(type = 2) + \lambda_{27} I(type = 3) + \varepsilon_t^{w_P}] I(h_t^P > 0) \\
& + \lambda_{28} [I(h_t^G = 1) + I(h_t^G = 0.5)] Age_t + \lambda_{29} [I(h_t^G = 1) + I(h_t^G = 0.5)] I(Age_t < 30) \\
& + \lambda_{30} [I(h_t^P = 1) + I(h_t^P = 0.5)] Age_t + \lambda_{31} [I(h_t^P = 1) + I(h_t^P = 0.5)] I(Age_t < 37) \\
& + \lambda_{32} [I(h_t^G = 1) + I(h_t^P = 1)] I(s_t^U = 1) + \lambda_{33} [I(h_t^G = 0.5) + I(h_t^P = 0.5)] I(s_t^U = 1) \\
& + \lambda_{34} [I(h_t^G = 1) + I(h_t^P = 1)] I(s_t^C = 1) + \lambda_{35} [I(h_t^G = 0.5) + I(h_t^P = 0.5)] I(s_t^C = 1) \\
& + \lambda_{36} [I(h_t^G = 1) + I(h_t^P = 1)] I(s_t^U = 0.5) + \lambda_{37} [I(h_t^G = 0.5) + I(h_t^P = 0.5)] I(s_t^U = 0.5) \\
& + \lambda_{38} [I(h_t^G = 1) + I(h_t^P = 1)] I(s_t^C = 0.5) + \lambda_{39} [I(h_t^G = 0.5) + I(h_t^P = 0.5)] I(s_t^C = 0.5) \\
& + \lambda_{40} [I(s_t^C > 0) + I(s_t^U > 0)] I(type = 2) + \lambda_{41} [I(s_t^C > 0) + I(s_t^U > 0)] I(type = 3) \\
& + \lambda_{42} I(h_t^G + h_t^P > 0) I(Age_t < 20) + \lambda_{43} I(s_t^C + s_t^U > 0) I(Age_t < 20)
\end{aligned}
$$

A.2 Human capital function (g^{HC})

$$
\begin{gathered}
HC_t = \exp\{\phi_1 + \phi_2 S_t^U + \phi_3 S_t^C + \phi_4 BA_t + \phi_5 \min(H_t^G + H_t^P, 16) + \phi_6 [\min(H_t^G + H_t^P, 16)]^2 \\
+ \phi_7 (H_t^G + H_t^P - 16) I(H_t^G + H_t^P > 16) + \phi_8 (H_t^G + H_t^P - 16)^2 \\
I(H_t^G + H_t^P > 16) + \phi_9 AFQT + \phi_{10} I(type = 2) + \phi_{11} I(type = 3)\}
\end{gathered}
$$

A.3 Wage function in public sector (g^{w_G})

$$
w_t^G = HC_t \exp\{\alpha_1^G I(h_t^G = 0.5) + \alpha_2^G I(s_t^C + s_t^U > 0) + \alpha_3^G Black + \alpha_4^G Hispanic + \varepsilon_t^{w_G}\}
$$

A.4 Wage function in private sector (g^{w_G})

$$
w_t^P = HC_t \exp\{\alpha_1^P I(h_t^P = 0.5) + \alpha_2^P I(s_t^C + s_t^U > 0) + \alpha_3^P Black + \alpha_4^P Hispanic + \varepsilon_t^{w_P}\}
$$

A.5 Wage offer probability (g^{offer})

$$\Pr(offer_t = 1) = 1 - \Phi[\alpha_1 + \alpha_2 HC_t + \alpha_3 I(h^G_{t-1} + h^P_{t-1} = 0) + \alpha_4 Black + \alpha_5 Hispanic]$$

A.6 Minimum earnings ($w^{\min}$)

$$w^{\min} = w_0 + w_1(H^G_t + H^P_t)$$

A.7 Probability of parental transfer (g^P)

$$\begin{gathered}\Pr(P_t = 1) = HC_t[\xi_1 + \xi_2 Inc + \xi_3 \frac{ParentInc^2}{1000} + \xi_4 I(s^C_{t-1} + s^U_{t-1} > 0)] \\ +\xi_5 I(s^C_{t-1} + s^U_{t-1} > 0) ParentInc + \xi_6 I(P_{t-1} = 1) + \xi_7 Age_t + \xi_8 HC_t \\ +\xi_9 I(Age_t > 23) + \xi_{10} Black + \xi_{11} Hispanic + \xi_{12} I(offer_t = 1)\end{gathered}$$

A.8 Amount of parental transfer (g^{tr})

$$\begin{gathered}tr_t = \exp\{\chi_1 + \chi_2 I(s^U_t > 0) + \chi_3 I(s^U_t > 0) ParentInc \\ +\chi_4(s^C_t + s^U_t + 12) + \chi_5 Age_t + \chi_6 ParentInc + \chi_7 \frac{ParentInc^2}{1000} \\ +\chi_8 HC_t + \chi_9 Black + \chi_{10} Hispanic + \chi_{11} I(offer_t = 1)\}\end{gathered}$$

A.9 Grant at 4-year college ($g^{grant^U_t}$)

$$\begin{gathered}grant^U_t = \zeta^U_1 + \zeta^U_2 AFQT + \zeta^U_3 \frac{AFQT^2}{1000} + \zeta^U_4 Inc + \zeta^U_5 \frac{ParentInc^2}{1000} \\ +\zeta^U_6 I(type = 2) + \zeta^U_7 I(type = 3) + \zeta^U_8 Black + \zeta^U_9 Hispanic\end{gathered}$$

A.10 Grant at 2-year college ($g^{grant^C_t}$)

$$grant^C_t = \zeta^C_1 + \zeta^C_2 Inc + \zeta^C_3 \frac{Inc^2}{1000} + \zeta^C_4 Black + \zeta^C_5 Hispanic$$

A.11 Bachelor's degree completion (BA_t)

$$\begin{gathered}\Pr(BA_t = 1|eligible) = \Phi[\beta_1 + \beta_2 S^U_t I(S^U_t > 4.5) \\ +\beta_3 S^U_t I(S^U_t > 5.5) + \beta_4 HC_t + \beta_5 HC^2_t]\end{gathered}$$

A.12 Number of repayment periods total ($g^{RP^T_t}$)

$$RP^T_t = RP^T_{t-1} + I[a^S_{t+1} - a^S_t \geq \min(10\% DI_t, SRP)] I(s^C_t + s^U_t = 0)$$

A.13 Number of repayment periods public ($g^{RP^G_t}$)

$$RP_t^G = RP_{t-1}^G + I[a_{t+1}^S - a_t^S \geq \min(10\% DI_t, SRP)]I(s_t^C + s_t^U = 0)I(h_t^G = 1)$$

A.14 Default function ($g^{Default_t}$)

$$Default_t = Default_{t-1} + I[a_{t+1}^S - a_t^S \leq \min 5\%(DI_t, SRP)]I(s_t^C + s_t^U = 0)$$

A.15 Lower Bound of Other Assets ($\underline{a_t^O}$)

$$\underline{a_t^O} = -exp\{\nu_1 + \nu_2\Phi_t + \nu_3\Phi_t^2 + \nu_4 Age_t + \nu_5 I(Age_t \leq 23)\}$$

A.16 Type Probability Distribution

$$\Pr(type = k) = \frac{\pi_{0,k} + \pi_{1,k}AFQT_1 + \pi_{2,k}AFQT_2 + \pi_{3,k}Inc_1 + \pi_{4,k}Inc_2 + \pi_{5,k}Black + \pi_{6,k}Hispanic}{1 + \sum_{m=2}^{3}\exp\{\pi_{0,m} + \pi_{1,m}AFQT_1 + \pi_{2,m}AFQT_2 + \pi_{3,m}Inc_1 + \pi_{4,m}Inc_2 + \pi_{5,m}Black + \pi_{6,m}Hispanic\}}$$

A.17 Terminal value function (V^{Term})

$$V^{Term} = \mu_1 a_T^S + \mu_2 a_T^O$$

A.18 Preference shocks and wage shocks distribution

$$\begin{pmatrix} \varepsilon_t^C \\ \varepsilon_t^U \\ \varepsilon_t^G \\ \varepsilon_t^P \\ \varepsilon_t^{w_G} \\ \varepsilon_t^{w_P} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_C^2 & & & & & \\ \sigma_{CU}^2 & \sigma_U^2 & & & & \\ \sigma_{CG}^2 & \sigma_{UG}^2 & \sigma_G^2 & & & \\ \sigma_{CP}^2 & \sigma_{UP}^2 & \sigma_{GP}^2 & \sigma_P^2 & & \\ \sigma_{Cw_G}^2 & \sigma_{Uw_G}^2 & \sigma_{Gw_G}^2 & \sigma_{Pw_G}^2 & \sigma_{w_G}^2 & \\ \sigma_{Cw_P}^2 & \sigma_{Uw_P}^2 & \sigma_{Gw_p}^2 & \sigma_{Pw_p}^2 & \sigma_{w_G w_p}^2 & \sigma_{w_p}^2 \end{pmatrix}\right]$$

Parameter Description	Symbol	Estimate (SE)
1. Utility Function[67]:		
Relative risk aversion[68]	ρ	2.0 (0.0)
Consumption scale	λ_0	$1.1e+6$ $(7.1e+4)$
4-year college preference before age 24	λ_1	299.6 (13.1)
2-year college preference before age 20	λ_2	471.9 (6.73)
Preference school after BA	λ_3	-313.4 (12.7)
Black (4-year college)	λ_4	-29.3 (160)
Hispanic (4-year college)	λ_5	-95.4 (320)
$AFQT_1$ (4-year college)	λ_6	-20.4 (23.1)
$AFQT_2$ (4-year college)	λ_7	-64.9 (13.3)
$AFQT_3$ (4-year college)	λ_8	-38.9 (37.8)
Black (2-year college)	λ_9	22.6 (25.1)
Hispanic (2-year college)	λ_{10}	27.5 (7.89)
$AFQT_1$ (2-year college)	λ_{11}	-42.3 (19.2)
$AFQT_2$ (2-year college)	λ_{12}	-53.4 (82.5)
$AFQT_3$ (2-year college)	λ_{13}	-30.5 (17.9)
4-year college persistence	λ_{14}	2.02 (2.32)
2-year college persistence	λ_{15}	-1.01 (1.61)
Preference 4-year college	λ_{16}	14.1 (1.44)
Preference 2-year college	λ_{17}	-0.03 (0.45)
Preference work public sector	λ_{18}	-18.1 (2.56)
Black (public sector)	λ_{19}	-0.22 (0.22)
Hispanics (public sector)	λ_{20}	-4.46 (0.86)
Type 2 (public sector)	λ_{21}	-548.7 (28.7)
Type 3 (public sector)	λ_{22}	-103.2 (6.34)
Preference work private sector	λ_{23}	-2.39 (3.96)
Black (private sector)	λ_{24}	0.58 (2.29)
Hispanics (private sector)	λ_{25}	-0.11 (1.44)
Type 2 (private sector)	λ_{26}	-244.9 (12.2)
Type 3 (private sector)	λ_{27}	-131.1 (11.5)
Public employment with age	λ_{28}	40.3 (8.4)
Public employment before age 30	λ_{29}	-144.1 (38.7)

Parameter Description	Symbol	Estimate (SE)
Private employment with age	λ_{30}	12.9 (0.32)
Private employment before age 37	λ_{31}	32.0 (9.64)
Work full-time 4-year college full-time	λ_{32}	-205.1 (36.3)
Work part-time 4-year college full-time	λ_{33}	-31.8 (19.3)
Work full-time 2-year college full-time	λ_{34}	-46.3 (99.7)
Work part-time 2-year college full-time	λ_{35}	-9.03 (1.13)
Work full-time 4-year college part-time	λ_{36}	-167.8 (40.2)
Work part-time 4-year college part-time	λ_{37}	-71.4 (180)
Work full-time 2-year college part-time	λ_{38}	-37.3 (21.0)
Work part-time 2-year college part-time	λ_{39}	-23.5 (72.1)
Psychic cost schooling type 1	λ_{40}	-512.3 (24.5)
Psychic cost schooling type 2	λ_{41}	-535.9 (81.3)
Disutility of working before age 20	λ_{42}	58.6 (3.42)
Disutility of schooling before age 20	λ_{43}	164.0 (30.5)
2. Human Capital Function:		
Constant	ϕ_1	2.66 (0.04)
4-year college schooling	ϕ_2	0.02 (0.02)
2-year college schooling	ϕ_3	0.02 (0.02)
BA degree completion	ϕ_4	0.19 (0.01)
Younger experience	ϕ_5	0.07 (0.0009)
Younger experience squared	ϕ_6	-0.003 (0.00005)
Older experience	ϕ_7	0.03 (0.002)
Older experience squared	ϕ_8	-0.001 (0.00006)
$AFQT$	ϕ_9	0.0002 (0.00003)
Type 2	ϕ_{10}	-0.11 (0.02)
Type 3	ϕ_{11}	-0.21 (0.02)
3. Wage Function in Public Sector:		
Part-time work	α_1^G	-0.02 (0.07)
Enrolled in school	α_2^G	-0.36 (0.26)
Black	α_3^G	-0.12 (0.15)
Hispanic	α_4^G	-0.05 (0.54)

Parameter Description	Symbol	Estimate (SE)
4. Wage Function in Private Sector:		
Part-time work	α_1^P	-0.02 (0.04)
Enrolled in school	α_2^P	-0.22 (0.16)
Black	α_3^P	-0.04 ($6.4e-3$)
Hispanic	α_4^P	-0.01 ($3.0e-3$)
5. Unemployment Probability:		
Constant	α_1	-1.41 (0.09)
Human capital	α_2	-0.02 (0.0009)
Not working in previous semester	α_3	0.41 (0.18)
Black	α_4	0.25 (0.16)
Hispanic	α_5	0.11 (0.02)
6. Minimum Earnings:		
Constant	ω_0	155.8 (130)
Experience	ω_1	57.1 (23.1)
7. Probability of Parental Transfer:		
Constant	ξ_1	1.99 (1.81)
Family income	ξ_2	0.001 (0.002)
$Inc^2/1000$	ξ_3	-0.001 (0.004)
Attend college previous semester	ξ_4	0.07 (0.22)
Attend previous interacted with family income	ξ_5	1.34 (0.59)
Parental transfers previous semester	ξ_6	-0.14 (0.002)
Age	ξ_7	-0.00005 (0.00006)
Human capital	ξ_8	0.07 (0.06)
Age>21	ξ_9	-0.04 (0.08)
Black	ξ_{10}	0.31 (0.72)
Hispanic	ξ_{11}	0.21 (0.22)
Unemployed	ξ_{12}	2.05 (1.49)
8. Amount of Parental Transfers:		
Constant	χ_1	10.3 (0.15)

Parameter Description	Symbol	Estimate (SE)
4-year college attendance	χ_2	0.09 (0.06)
4-year attendance family income	χ_3	0.0028 (0.0004)
Years of schooling	χ_4	0.0004 (0.001)
Age	χ_5	-0.12 (0.003)
Family income	χ_6	0.0017 (0.0003)
$Inc^2/1000$	χ_7	-0.005 (0.004)
Human capital	χ_8	0.03 (0.007)
Black	χ_9	0.07 (0.09)
Hispanic	χ_{10}	-0.016 (0.18)
Unemployed	χ_{11}	2.08 (0.18)
9. Grants at 4-year college:		
Constant	ζ_1^U	1.99 (2.19)
$AFQT$	ζ_2^U	-43.0 (4.33)
$AFQT^2/1000$	ζ_3^U	285.7 (11.3)
Family income	ζ_4^U	-75.4 (18.6)
$Inc^2/1000$	ζ_5^U	31.9 (11.1)
Type 2	ζ_6^U	-354.7 (880)
Type 3	ζ_7^U	-129.5 (302)
Black	ζ_8^U	885.4 (163)
Hispanic	ζ_9^U	662.3 (436)
10. Grants at 2-year college:		
Constant	ζ_1^C	1662.2 (694)
Family income	ζ_2^C	-18.3 (49.2)
$Inc^2/1000$	ζ_3^C	39.9 (18.9)
Black	ζ_4^C	209.5 (139)
Hispanic	ζ_5^C	88.1 (186)
11. Degree Completion Probability:		
Constant	β_1	-2.23 (0.003)
Years at 4-year college if > 4.5	β_2	-0.0006 (0.0001)
Years at 4-year college if > 5.5	β_3	0.04 (0.001)
Human capital	β_4	0.36 (0.002)

Parameter Description	Symbol	Estimate (SE)
Human capital squared	β_5	$6.9e-5$ $(6.6e-5)$
12. Lower Bound of Other Assets:		
Constant	ν_1	1.11 (0.23)
Human capital	ν_2	0.15 (0.02)
Human capital squared	ν_3	-7.6$e-4$ (1.3$e-4$)
Age	ν_4	0.67 (0.07)
Age 23 or older	ν_5	0.25 (0.19)
13. Distribution of Type Probability		
Type 2:		
Constant	$\pi_{0,2}$	-0.54 (0.48)
$AFQT_1$	$\pi_{1,2}$	0.95 (1.09)
$AFQT_2$	$\pi_{2,2}$	3.47 (1.12)
Inc_1	$\pi_{3,2}$	0.40 (1.29)
Inc_2	$\pi_{4,2}$	7.35 (2.61)
Black	$\pi_{5,2}$	-0.05 (1.76)
Hispanic	$\pi_{6,2}$	0.36 (0.31)
Type 3:		
Constant	$\pi_{0,3}$	-0.05 (0.37)
$AFQT_1$	$\pi_{1,3}$	1.92 (0.54)
$AFQT_2$	$\pi_{2,3}$	0.88 (0.57)
Inc_1	$\pi_{3,3}$	2.81 (1.37)
Inc_2	$\pi_{4,3}$	0.41 (0.39)
Black	$\pi_{5,3}$	0.11 (2.12)
Hispanic	$\pi_{6,3}$	-0.04 (7.82)
14. Terminal value function:		
Penalty on terminal student loan asset	μ_1	0.06 (0.06)
Penalty on terminal other net asset	μ_2	0.05 (3.07)
14. Distribution of Shocks:		
Preference for 2-year college	σ_C	$1.1e+5$ $(2.5e+4)$
Preference for 4-year college	σ_U	$2.0e+4$ $(3.3e+4)$

Parameter Description	Symbol	Estimate (SE)
Preference for work in public sector	σ_G	1832 (225)
Preference for work in private sector	σ_P	0.24 (8.18)
Wage shock in public sector	σ_{w_G}	0.004 (0.009)
Wage shock in private sector	σ_{w_P}	$4.7e-5$ $(3.8e-4)$

[68]Calculation of standard errors follows the expression in Proposition 3 in Gourieroux, Monfort, and Renault (1993)

[68]The relative risk aversion parameter ρ is predetermined from literature at value 2.

Auxiliary Regressions for Indirect Inference

College Enrollment

- Fraction of full/part time 4-year college enrollment between age 18 and 30.
- Fraction of full/part time 2-year college enrollment between age 18 and 30.
- Regression of 4-year college enrollment on constant and AFQT quartiles.
- Regression of 2-year college enrollment on constant and AFQT quartiles.
- Regression of 4-year college enrollment on constant, 2-year and 4-year college enrollment in previous period.
- Regression of 2-year college enrollment on constant, 2-year and 4-year college enrollment in previous period.
- Fraction of BA completion between age 18 and 30.
- Regression of BA completion on schooling years, afqt quartiles, race between age 21 and 25.
- Highest grade completed between age 25 and 30.
- Delaying regression of never delayed, delayed 1 year to 3 years.
- Fraction of receiving parental transfer between age 18 and 30.
- Average amount of parental transfer received between age 18 and 30.
- Receipt of parental transfers on family income, race, age and school attendance.
- Amount of parental transfers received if positive on family income, years of school, race and age.
- Regression of average 2-year grant on average parental income, race and AFQT.
- Regression of average 4-year grant on average parental income, race and AFQT.
- Belley Lochner's college enrollment regression on AFQT and parental income quartiles.

Employment

- Fraction of working full/part time in the public sector between age 18 and 50.
- Fraction of working full/part time in the private sector between age 18 and 50.
- Fraction of unemployment between age 18 and 30.
- Unemployment on constant, unistock, comstock, hasba, experience, AFQT, race and age.

- Fraction of working in public sector full/part time in 4-year/2-year college.
- Fraction of working in private sector full/part time in 4-year/2-year college.
- Fraction of enrolling in 4-year college full/part time in public/private sector.
- Fraction of enrolling in 2-year college full/part time in public/private sector.
- Average wage of working in public sector between age 18 and 50.
- Average wage of working in private sector between age 18 and 50.
- Variance of wages in public/private sectors between age 18 and 30.
- Regression of wage on lagged wage and constant in both sectors.
- Log wage in public/private sector on constant, university stock, community stock, experience, race, age and AFQT.
- Regression of employment in public/private sector on constant and previous employment status.
- Average monthly unemployment benefits on experience.

Assets and Student Loan Debt

- Median asset other than student loan debt at available ages.
- Fraction of individuals with negative asset other than student loan debt.
- Median asset other than student loan debt if negative.
- Fraction of individuals holding student loan debt.
- Median student loan debt for those who borrowed.
- Trend of net asset other than student loan debt: regression of asset other than student loan debt on the previous period other asset.
- Trend of student loan debt: regression of student loan debt on the previous period student loan debt.

Institutional Details of Student Loan Repayment Plans

Income-Drive Repayment (IDR)

In order to release the debt burden of student loan borrowers, federal government introduced Income-Driven Repayment (IDR) plans. An IDR plan sets monthly student loan repayment at an amount that is intended to be affordable based on borrowers income and family size. Up to now, there are five IDR plans, namely Income-Contingent Repayment (ICR), Income-Based Repayment (Original IBR), Pay As You Earn (PAYE), Income-Based Repayment (New IBR), and Revised Pay As You Earn (REPAYE). I shall discuss each IDR plan in detail as follows.

1. Income-Contingent Repayment (ICR)

The Income-Contingent Repayment (ICR) plan became available on October 1, 1993. ICR was the first federally initiated income-contingent debt repayment option to release burden of student loan borrowers. The monthly payment under ICR compares two payment ceilings and picks the lower of the two. The first ceiling is defined as 20 percent of discretionary income, where discretionary income is defined as the difference between adjusted gross income (AGI) and 100 percent of the poverty line[69]. The second ceiling is a complicated secondary calculation based on the product of the monthly payment under 12-year repayment with income-percentage factors based on the borrowers income and marital status. In practice, however, the calculation based on the first ceiling is lower for almost all borrowers. After making eligible repayments under ICR for 25 years, the remaining debt will be forgiven. However, the ICR program was criticized not generous enough for student loan borrowers due to its high monthly payment and long repayment periods (Schrag 2001).

[69]The poverty line is based on the borrowers family size and state of residence.

2. Income-Based Repayment (Original IBR)

The Income-Based Repayment (Original IBR) plan was introduced as part of the College Cost Reduction and Access Act (CCRAA), which was signed into law in 2007. The original IBR became active on July 1, 2009. The monthly payment under original IBR is 15% of the discretionary income[70], up to the amount under Standard Repayment Plan (SRP)[71]. After making eligible repayments under original IBR for 25 years, the remaining debt will be forgiven.

3. Pay As You Earn (PAYE)

The Pay As You Earn (PAYE) was passed by President Obama on December 21st, 2012. The monthly payment under PAYE is 10% of the discretionary income, up to the amount under SRP. Remaining student debt will be forgiven after making eligible repayments under PAYE for 20 years. However, PAYE is only applicable to direct student loan borrowers who took out their first loan after September 30th, 2007 and at least one loan after September 30th, 2011. Therefore, PAYE is only applicable to limited group of borrowers.

4. Income-Based Repayment (New IBR)

The Income-Based Repayment plan was revised by Obama administration in 2014. For student loan borrowers who take out their first loan on or after July 1 2014, they are eligible to participate in the new IBR. Under the new IBR, borrowers repay 10% of their discretionary income, up to the amount under SRP. Remaining balance will be forgiven after making eligible repayments under new IBR for 20 years.

5. Revised Pay As You Earn (REPAYE)

The Revised Pay As You Earn (REPAYE) became available since December 17, 2015. Under the REPAYE, borrowers repay 10% of their discretionary income, up to the amount under

[70] Discretionary income for all Income-Drive Repayment plan is defined as the amount of adjusted gross income (AGI) above 150% of the poverty level. The only exception is for ICR, where income is defined as the amount of AGI above 100% of the poverty level.

[71] The SRP serves as a standard to pay off student debt in 10 years with fixed monthly payments.

SRP. Remaining balance will be forgiven after making eligible repayments under REPAYE for 20 years. The difference between REPAYE and new IBR is that REPAYE disregard when the borrower first obtained the loan. All the repayment plans are not retrospective in terms of repayment periods. The first borrowers to be forgiven under REPAYE will be in December 17, 2035. Appendix Table 1 summarizes the availability date, eligibility loans, monthly payment, and forgiveness periods of each IDR plans illustrated above.

Appendix Table 1: **Summary of Income-Driven Repayment (IDR) Plans**

Repayment Plan	Availability	Eligibility	Monthly Payment	Forgiven After
ICR	Oct 1, 1993	All Direct Loan borrowers	20% of discretionary income (DI)	25 years
Original IBR	Jul 1, 2009	All federal student loan borrowers	lesser of 15% of DI and SRP	20 years
PAYE	Dec 21, 2012	Take out first loan after Sep 30, 2007	lesser of 10% of DI and SRP	20 years
New IBR	Jul 1, 2014	Take out first loan after Jul 1, 2014	lesser of 10% of DI and SRP	20 years
REPAYE	Dec 17, 2015	All Direct Loan borrowers	lesser of 10% of DI and SRP	20 years

* Information in the table comes from different sources, including Federal Student Aid Office, IBRinfo, and FinAid.

Public Service Loan Forgiveness (PSLF)

The Public Service Loan Forgiveness (PSLF) Program was introduced by the CCRAA in 2007. PSLF forgives the remaining balance on the Direct Loans after borrowers made 120 qualifying monthly payments under a qualifying repayment plan while working full-time in public sector[72]. The PSLF program is not retrospective in terms of repayment periods prior to 2007. The first borrower to be forgiven under the PSLF program will be in October 1st 2017. Qualifying repayment refers to any repayment plans under IDR or SRP.

[72]Public sector refers to government organizations at any level and non-profit organizations.

Appendix: Student Loan Debt Across Cohorts

Since the NLSY79 data excludes observations who graduates from college, median student loan debt in Table 1 may not reflect the true median in population. Therefore, I shall first compare the pattern of student loan debt between NLSY79 and NLSY97 cohorts from age 18 to age 30. In the NLSY97, student loan debt is asked when respondents are at ages 18, 20, 25, and 30.

Appendix Table 2: **Student Loan Debt of NLSY79 and NLSY97**

Age	Sample	No. of Obs	Mean Total	Percentage With Debt	Median With Debt
Panel A: National Longitudinal Survey of Youth 1979					
18	NLSY97	1,419	-178	8.5	-2,742
20	NLSY97	1,144	-681	18.3	-3,459
25	NLSY97	359	-3,416	34.1	-8,694
30	NLSY97	729	-3,755	34.0	-8,994
Panel B: National Longitudinal Survey of Youth 1997					
18	NLSY79	1,236	-508	14.3	-2,560
20	NLSY79	1,427	-1,739	25.8	-4,107
25	NLSY79	1,180	-5,967	41.0	-10,566
30	NLSY79	729	-6,607	44.6	-8,757

Appendix Table 2 shows the student loan debt of the NLSY97 and the NLSY79 cohorts.

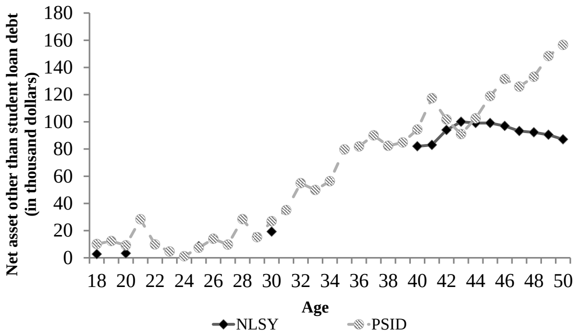
Panel A in Appendix Table 2 shows the student loan debt of the NLSY79 cohorts, which comes from Table 1. Panel B in Appendix Table 2 shows the student loan debt of NLSY97 cohorts at ages 18, 20, 25, and 30. The NLSY97 data represents median of the whole population. It is observed that although the student loan debt accumulated in NLSY97 cohort is higher than that in NLSY79 cohort, the pattern of the student loan debt across ages are very similar for the two cohorts. Furthermore, since the NLSY data fails to provide information on student loan debt between ages 30 and 40, alternative data is used to check the pattern of student loan debt and other net assets at the age gaps. I use the PSID family-level data in 2011 and 2013, as questions on student loan debt start from 2011 in PSID[73].

Appendix Figure 1 shows the comparison of NLSY and PSID data on net assets and student loan debt. Subfigure (a) and (b) illustrate the median other net assets and median total net assets respectively. The solid line represents the NLSY data and the dashed line represents the PSID data. The PSID net assets is quite close to NLSY data before age 44. Starting from age 44, the NLSY cohorts experienced housing bust which decreased the net assets dramatically. The larger fluctuation in PSID data is due to the smaller sample size. It is observed that the growth rate of net assets gets bigger after age 30.

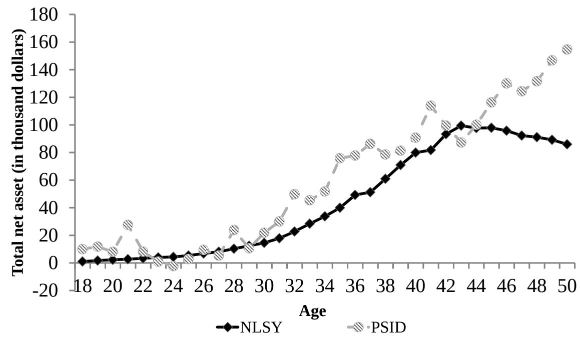
Subfigure (c) in Appendix Figure 1 shows the percentage of population with student loan debt. The fraction with student debt in PSID data is quite close to NLSY data before age 30. However, the fraction with student debt in NLSY data drops faster than PSID data. After age 45, 10% of the population in NLSY hold student debt while around 20% of the population in PSID hold some student debt. At least two possible reason can be used to explain the difference. First, NLSY ask about the student loan debt of the respondents, while PSID ask about the total student loan debt of the whole family. Second, the NLSY and PSID respondents are of different cohorts. Individuals at age 40 are born in 1972 in the PSID data, while respondents in NLSY79 data are born around 1960. Therefore, the student loan borrowing behavior among the cohorts could be different.

[73]Majority of the data sets do not contain questions on student loan debt. Survey of Consumer Finances (SCF) and Survey of Income and Program Participation (SIPP) contain questions on the form of college financial aid, but not on the amount of student loan borrowing. Consumer Expenditure Survey (CE) collects information on student loan debt since 2013. However, due to the low response rate on student loan borrowing, CE is not useful for my study.

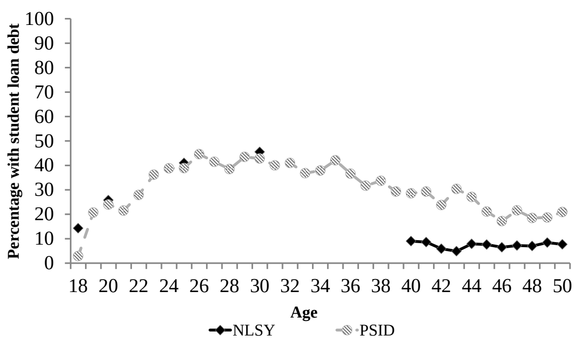
Appendix Figure 1: Net Asset and Student Loan Debt of NLSY and PSID



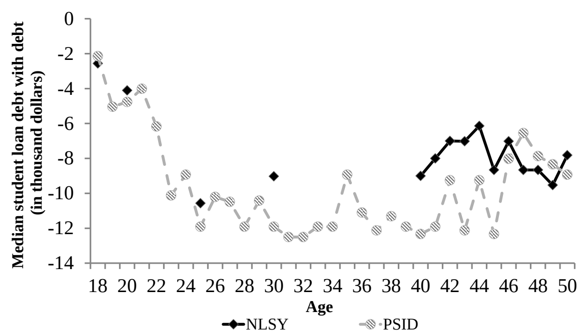
(a) Median Other Net Assets



(b) Median Total Net Asset



(c) Fraction With Student Loan Debt



(d) Median Student Debt Among Debt Holders

Subfigure (d) in Appendix Figure 1 demonstrates the median student loan debt among individuals with debt. The median student loan debt of PSID and NLSY observations are not far from each other. Generally, the PSID observations borrow more than the NLSY observations. The two reasons listed above could also be applied to explain the difference. The large fluctuation in both NLSY and PSID data are due to the small sample problem, as only a small proportion of the population hold student debt after age 40.

Appendix Table 3: **Observations and Sample Selection Rules**

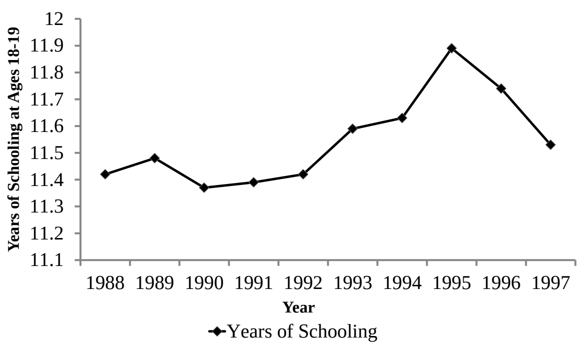
Description of Selection Rules	No. of Obs NLSY79	No. of Obs NLSY97
Full sample observations	12,686	8,984
Exclude white poor and military oversample[1]	-2,923	—
Exclude females	-4,926	-4,385
Exclude Obs who failed to obtain HS degree	-1,502	-1323
Obtain HS degree between age 16 and 19	-128	-104
Exclude Obs with missing initial states[2]	-1374	-1439
Keep white, black and Hispanics	-75	-61
Exclude Obs who served in the army[3]	—	-200
Number of observations remaining	1758	1472

[1] The white poor and military oversamples are only available for NLSY79. Thus, it is not applicable to NLSY97.
[2] Missing initial state variables include missing AFQT scores, earliest asset or initial parental transfer.
[3] Since observations served in the army are contained in the military oversample in NLSY79, this population has already been excluded.

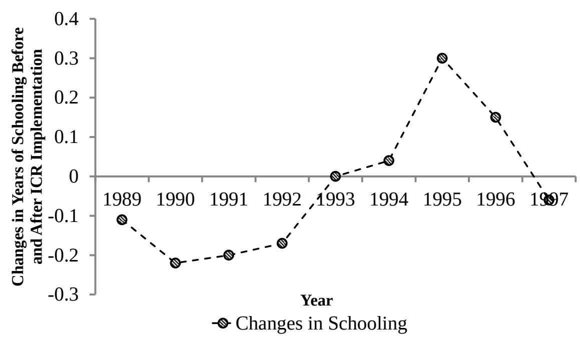
Appendix: Reduced-Form Estimates of the ICR

Potential data sets to study the impact of ICR are NLSY79, CPS, and PSID. However, the NLSY79 cohorts were at ages 30 to 37 in 1993, and the CPS data is not directly usable as there is a major revision in sample design in 1994. Therefore, the NLSY79 and CPS are not suitable for this study. I use the PSID main interview as it covers different cohorts across different years. The drawback of PSID main interview is that it does not ask questions on sector of employment nor amount of student loan debt. The only related question asked in PSID main interview is the total completed years of schooling at the time of interview. To evaluate the impact of ICR on initial college enrollment behavior[74], I apply the same sample selection rules as the NLSY79 data used in counterfactual simulation, and keep observations at ages 18 and 19.

Appendix Figure 2: Completed Years of Schooling at Ages 18 and 19 in PSID



(a) Completed Years of Schooling



(b) Changes in Years of Schooling

Appendix Figure 2 shows the completed years of schooling at ages 18 and 19 between years 1988 and 1997 in the PSID. Subfigure (a) illustrates the completed years of schooling and subfigure (b) illustrates the changes in years of schooling before and after implementation of ICR in 1993. In subfigure (a), the completed years of schooling fluctuates between 11 and 12 years. It is observed that there was an increase in years of schooling since the

[74]Initial college enrollment refers to enrolling in college immediately after graduation in high school.

implementation of ICR in 1993. The completed years of schooling dropped afterwards in 1996 and 1997. Subfigure (b) shows the change in years of schooling by comparing with the base year 1993. Negative value means that the completed years of schooling is less than that in the base year 1993, and vice versa. I use the following model specification to evaluate impact of the ICR on completed years of schooling at ages 18 and 19.

$$School_{it} = \beta_0 + \beta_1 ICR_t + \beta_3 X_{it} + \varepsilon_{it} \tag{28}$$

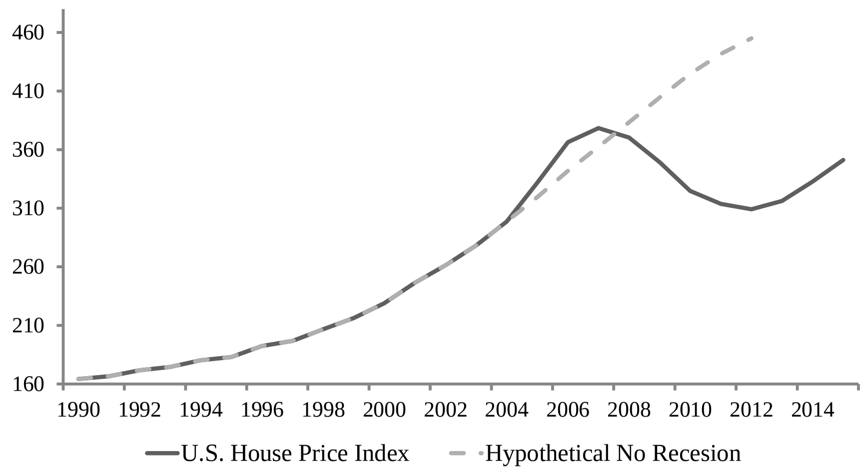
$School_{it}$ is the completed years of schooling at ages 18 and 19. ICR_t is a binary variable of the ICR treatment. ICR_t equals 0 if the interview year is before the implementation of ICR (1988-1992); ICR_t equals 1 if the interview year is after the implementation of the ICR (1994-1997). X_{it} denotes the individual characteristics, such as race, gender, income, states, and other family background. ε_{it} denotes the unobserved individual characteristics. The parameter of interest is β_1, which estimate the impact of ICR on completed years of schooling at ages 18 and 19.

Appendix Table 4: **Estimate of β_1 in Different Year Windows**

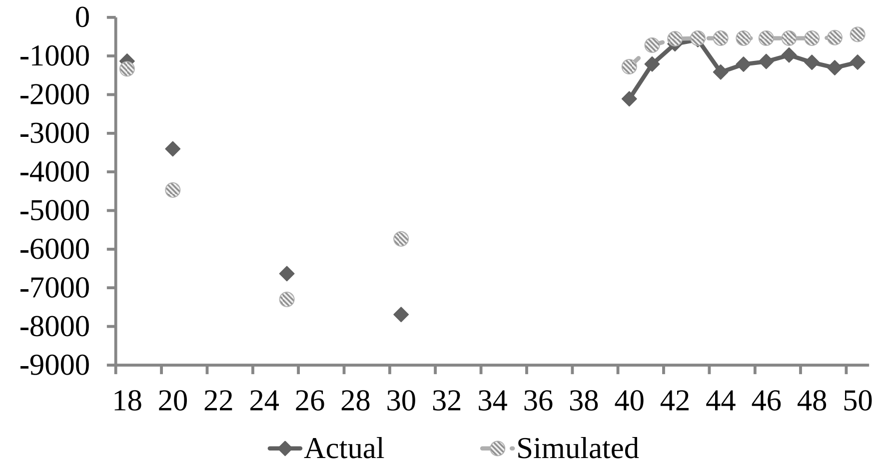
Variables	Window of 1 Year (1992-1994) (1)	Window of 2 Years (1991-1995) (2)	Window of 3 Years (1990-1996) (3)	Window of 4 Years (1989-1997) (4)
$ICR_t(\beta_1)$	.0326	.1854	.2132	.2067
	(.0579)	(.1014)	(.0820)	(.0533)
No. of Obs	1,784	3,529	5,048	6,479

Appendix Table 4 shows the estimates of β_1 in different time windows. The first column shows estimate when the window is 1 year; the second column shows estimate when the window is 2 years; the third column shows estimate when the window is 3 years; and the fourth column shows estimate when the window is 4 years. It is observed that the estimate of β_1 is around 0.2 except the first column, and the estimates are statistically significant. The estimate of β_1 implies that the implementation of the ICR plan increases completed years of schooling by 0.2 years, or 2 percent at ages 18 and 19.

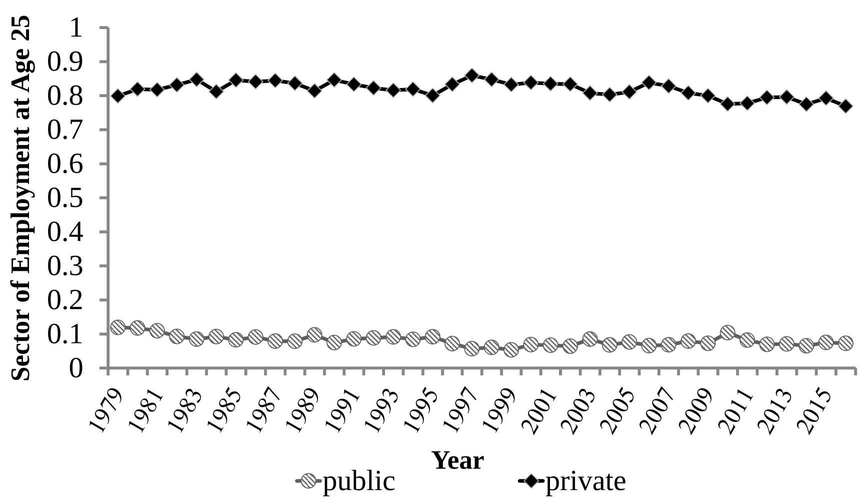
Appendix Figure 1: House Price Index in United States



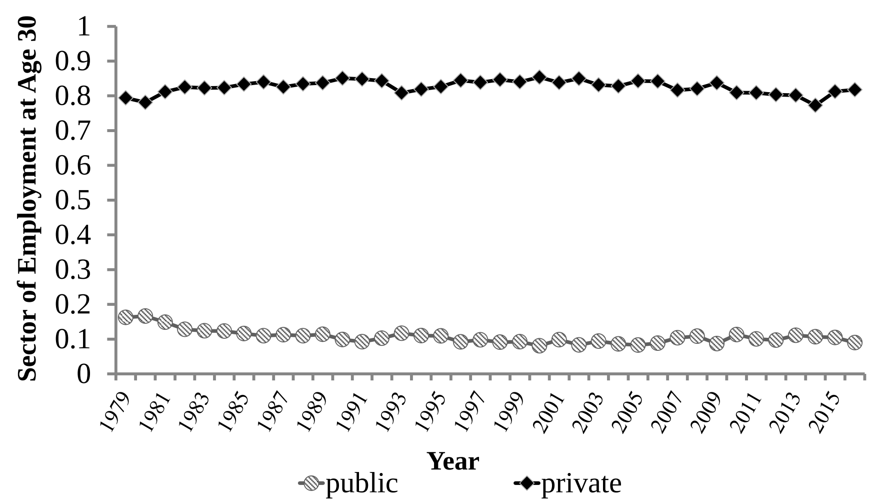
Appendix Figure 2: Total Mean Student Loan Debt



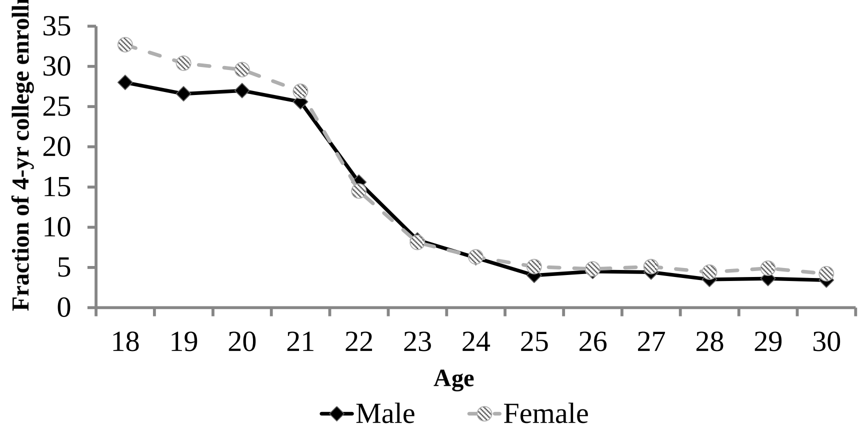
Appendix Figure 3: CPS Employment Sector at Age 25



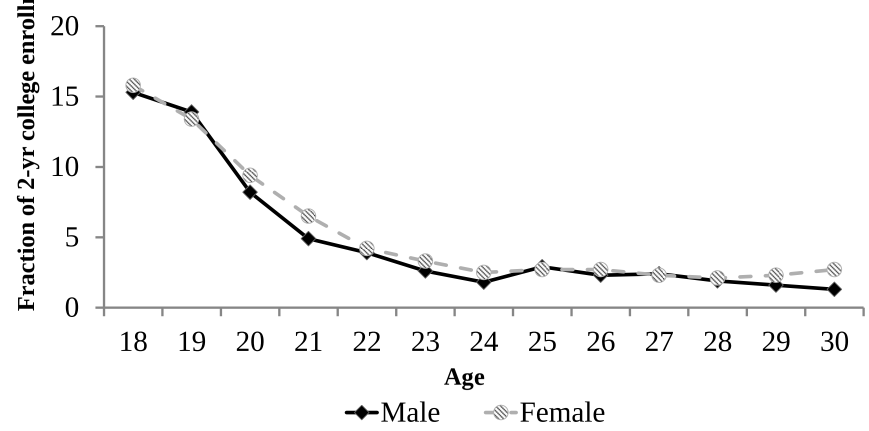
Appendix Figure 4: CPS Employment Sector at Age 30



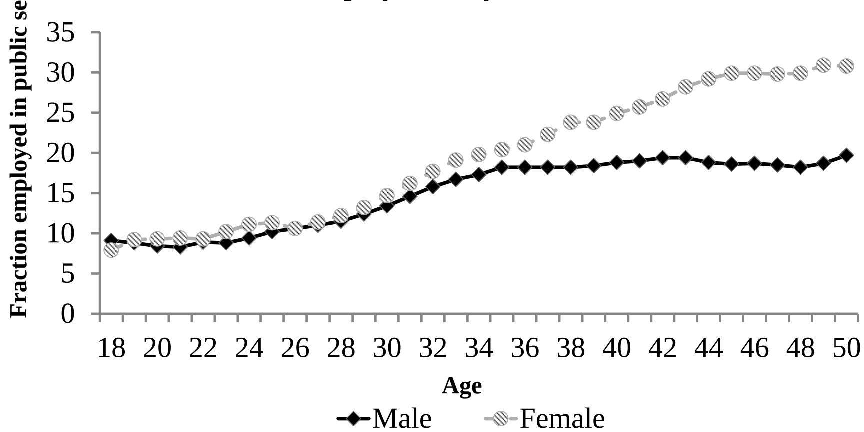
Appendix Figure 5: NLSY79 4-Year College Enrollment by Gender



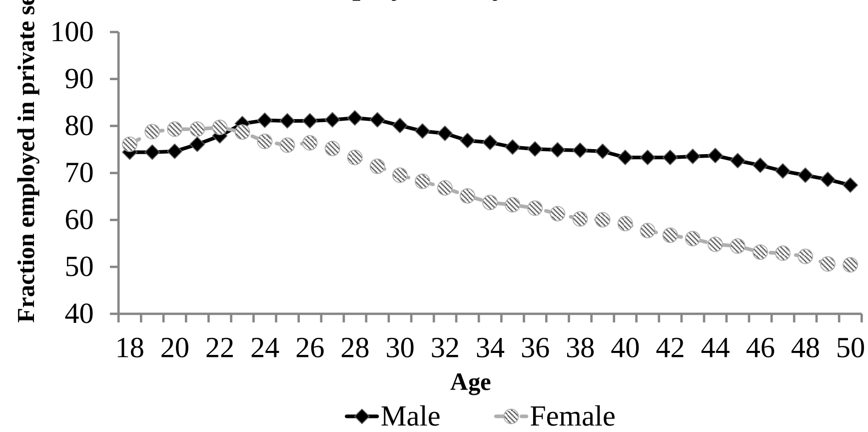
Appendix Figure 6: NLSY79 2-Year College Enrollment by Gender



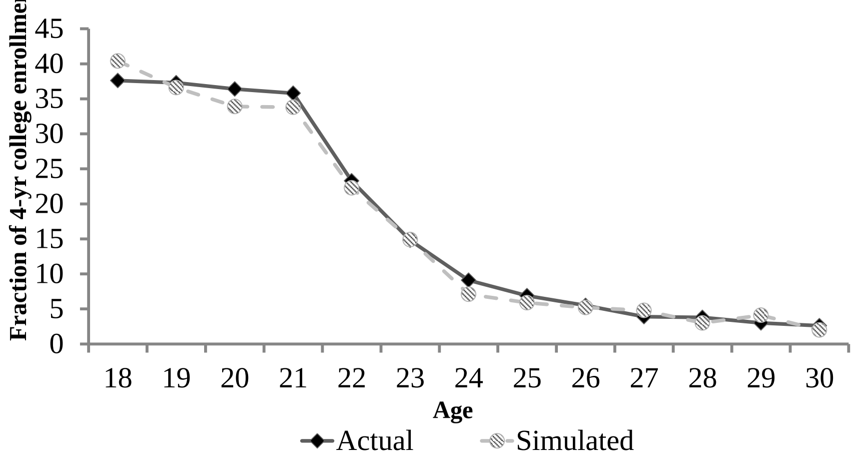
Appendix Figure 7: NLSY79 Public Sector Employment by Gender



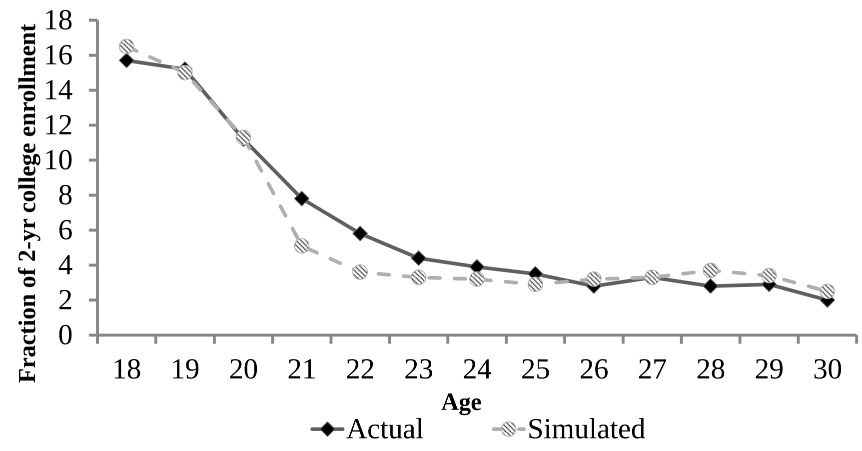
Appendix Figure 8: NLSY79 Private Sector Employment by Gender



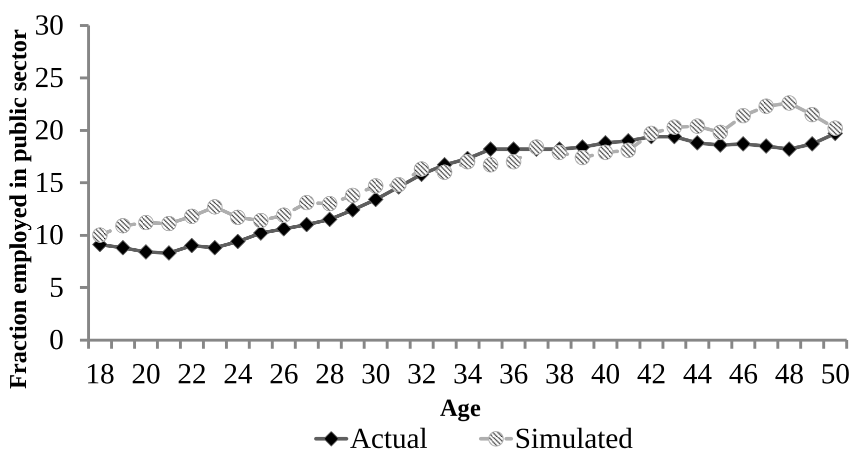
Appendix Figure 9: 4-Year College Enrollment



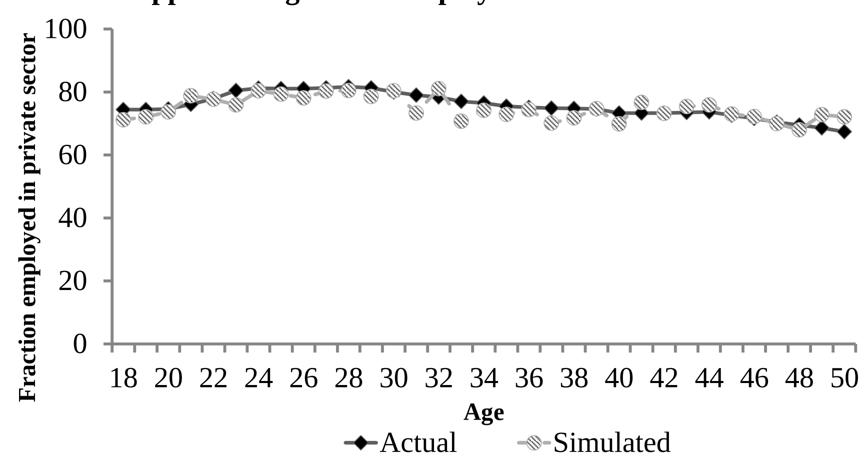
Appendix Figure 10: 2-Year College Enrollment



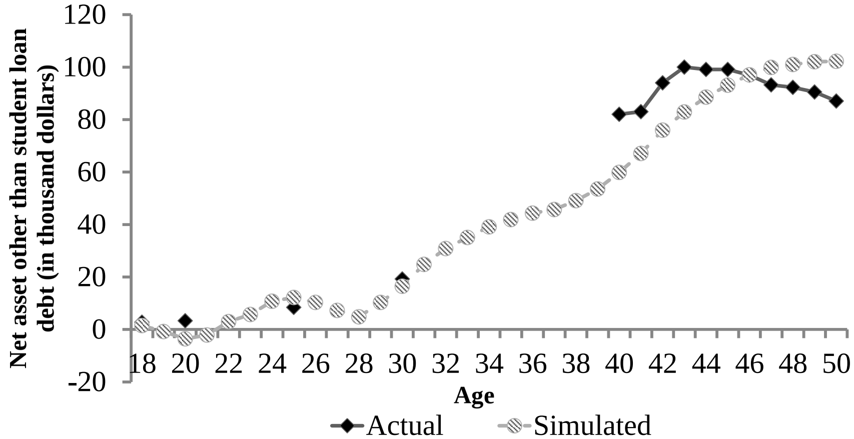
Appendix Figure 10: Employment in Public Sector



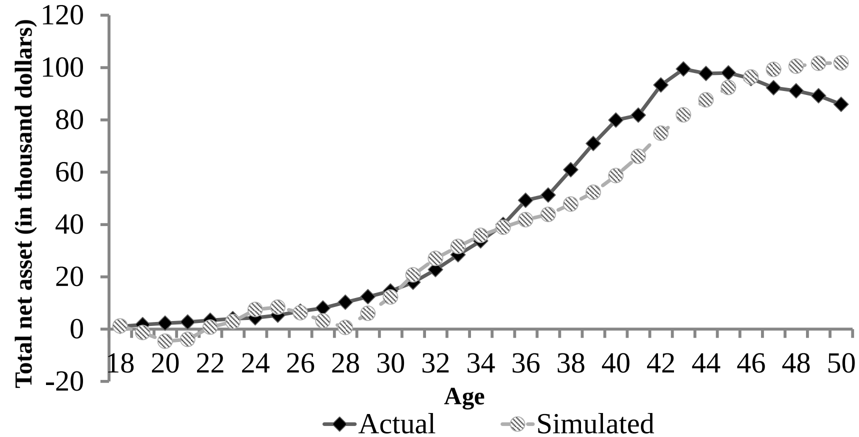
Appendix Figure 12: Employment in Private Sector



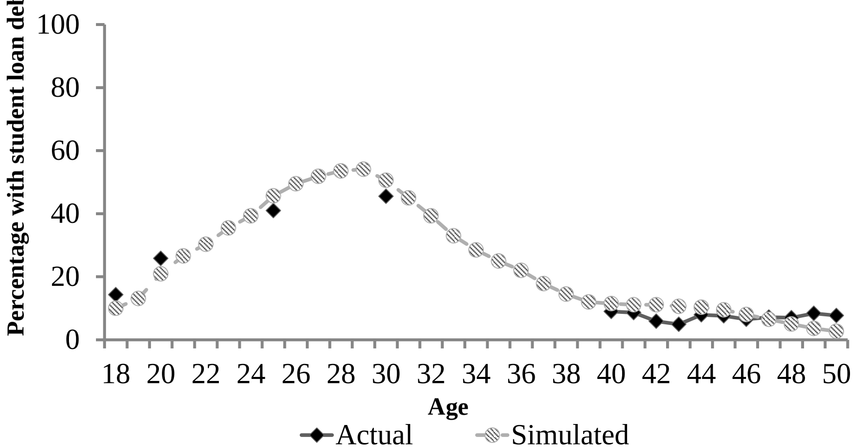
Appendix Figure 13: Median Other Net Assets



Appendix Figure 14: Median Total Net Asset



Appendix Figure 15: Fraction With Student Loan Debt



Appendix Figure 16: Median Student Debt