Bankruptcy Rules, College Enrollment, and Default Incentives for Student Loans*

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Abstract

I consider the implications of a change in the bankruptcy rule for student loans from liquidation to reorganization in a heterogeneous model of life-cycle earnings and human capital accumulation. The model explains quantitatively and qualitatively characteristics of defaulters under reorganization. I find that the policy change induced a significant decline in default rates. Financially constrained borrowers will choose to default under liquidation, whereas under reorganization borrowers default for strategic reasons. Findings suggests higher college enrollment under liquidation and substantial welfare gains for the bottom earnings quartile relative to higher earnings quartiles when dischargeability is allowed. Current work studies the effects of the policy change on human capital accumulation across different groups of high-school graduates.

JEL classification: D91; G33; I22
Keywords: Bankruptcy; Student loans; Default incentives; Human capital

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1 Introduction

The rapid rise in personal bankruptcy filing rates in the last decade with a historic high of 7% in 1997 (of U.S. adult population) centered attention on the nation's bankruptcy rule. The literature is voluminous with the main focus on studying incentives created by various bankruptcy laws on filing behavior within unsecured credit. In the same period, default rates for student loans averaged 12% with the highest rate of 22.4% in 1990 (a 2-year basis cohort default rate). The total amount of outstanding debt reached $25 billion in 2001. Little attention, however, has been given to analyzing bankruptcy rules under the student loan market. But evidence about how much borrowers and lenders respond to the incentives created by bankruptcy laws would help policy makers as they work to redesign it. This paper studies repayment incentives and human capital investment across different groups of high-school graduates in an environment that mimics the student loan market characteristics.

The Federal Student Loan Program (FSLP) has grown significantly in the recent years with 7 million people currently borrowing under the program.[1] One in twenty of borrowers defaults on his loan payments. High default rates in the late 1980s have led legislators to introduce a series of policy reforms that gradually made student loans nondischargeable under Chapter 13 in the Bankruptcy Code. Rather than a disposal of the assets through liquidation sale under Chapter 7, the reorganization chapter gives the debtor the opportunity to restructure his assets and liabilities. He needs to reorganize and start repaying his loans. Dischargeability was initially restricted in 1990 to a 7-year first payment basis or undue hardship basis, the former feature being eliminated by Higher Education Amendments to the Bankruptcy Code in 1998. A couple of questions arise immediately: How are the repayment incentives affected by the change in the bankruptcy rule? What are the implications for welfare and default rates and college enrollment?

[1] In the fiscal year 2001, 54$ billion were borrowed under the FSLP. In the same year the unsecured debt amounted to $692 billion.

In order to address the proposed issues, I develop a heterogeneous life-cycle economy that builds up on previous work on college enrollment, borrowing and repayment under the FSLP (see Ionescu(2007)). That paper generalizes the Ben-Porath human capital model in Huggett, Ventura, and A.Yaron (2006) and accounts for various repayment schemes available under the FSLP. It abstracts, however, from accounting for different bankruptcy arrangements, the focus of the current study. Following this previous research, central to the current model is the decision of the high-school graduate to invest in his college education and to borrow against his own future income. I allow for heterogeneity in ability, human capital stock, and asset level to study repayment incentives across different groups of students. This paper takes a further step in the analysis of incentives created by the FSLP in that I allow for dischargeability on student loans and study the relationship between debt, earnings and repayment incentives under both liquidation and reorganization rules. The option to discharge one's debt provides partial insurance against bad luck such as job loss, but drives up interest rates making life-cycle smoothing more difficult. I introduce two sources of uncertainty in this economy: earnings and interest rate on loans (under the program the interest rate is based on the 91-day Treasury-bill rate and it fluctuates with the market). The agent can self-insure against these shocks by accumulating assets.

The novelty of this work is that it simulates bankruptcy characteristics of the student loan market, which are very different than those of the standard credit markets. Student loans are not secured by any tangible asset, so there might be some similarities with the unsecured debt market, but unlike those types of loans (credit cards), guaranteed student loans are uniquely risky - eligibility conditions being very different. Loans are financial need based, not credit ratings based and are subsidized by the government. Agents are eligible to borrow up to the full college cost minus the expected family contribution. When repaying college loans, borrowers face a menu of repayment schedules. More importantly, the interest rate does not reflect the risk that some borrowers might exercise the option to default as in the standard credit market, hence the difficulty in my treatment of capturing that particular risk. The feedback of any bankruptcy law into the interest rate is exactly how the default is paid for. I endogenize the bankruptcy decision, crucial to the proposed welfare analysis. I consider penalties on defaulters similar to those implemented in the actual program, that might bear part of the default risk. To conduct the proposed policy experiments, I first calibrate the model to match key properties of distributions for life-cycle earnings for high-school graduates.

The model explains quantitatively and qualitatively characteristics of defaulters for the reorganization period, as delivered by Baccalaureate and Beyond (B&B 93/97) data set for college graduates in 1992/1993: borrowers with lower earnings levels and higher debt levels are more likely to choose default over repayment. The model predicts that ability and human capital determine college participation college, whereas parental wealth is not crucial for this decision. I use the model to run a counter-factual experiment that allows for the possibility to discharge one's debt. My results suggests that the change in the bankruptcy rule from liquidation to reorganization induced a decline in default rates by 11.66%. In the case of liquidation financially constrained people will choose to default, whereas under reorganization people default for strategic reasons rather than financial constraints. The model implies higher college enrollment rates and a welfare improvement under liquidation relative to the case reorganization and repayment is required with substantial welfare gains for bottom earnings quartiles relative to higher earnings quartiles. The "new" college graduates discharge on their debts once they graduate. Current work studies the effects of the change in the bankruptcy rule on human capital investment across different groups of high-school graduates.

This paper complements two directions of study in the literature: bankruptcy and higher education policies. The first line of research has focused on personal bankruptcy laws and their implications for filing rates with significant contributions by Athreya (2002) and Chatterje, Corbae, Nakajim, and Rios-Rull (2004). These studies innovate by explicitly modeling a menu of credit levels and interest rates offered by credit suppliers with the focus on default under Chapter 7 within the unsecured credit market.[2] A recent paper by I.Livshits and M.Tertilt (2003) incorporates both bankruptcy regimes, contrasting liquidation within U.S. to reorganization in Germany in a life-cycle model with incomplete markets calibrated to the two economies. The literature has mostly abstracted from studying bankruptcy under both regimes within U.S. The second line of research, higher education government policies and their effects, has been extensively explored with most of the interest directed toward subsidies for financially-constrained students.[3] The literature has generally ignored the analysis of default behavior under the student loan market. An exception is the work by Lochner and Monge who look at the interaction between borrowing constraints, default, and investment in human capital in an environment based on the U.S. Guaranteed Student Loan (GSL) program. They develop a model to explain empirical findings regarding characteristics of defaulters. As opposed to their paper, I incorporate the analysis of incentives created by the bankruptcy reform and provide both a qualitative and a quantitative assessment of policy implications on repayment behavior, default rates, and college enrollment. More importantly, I allow for heterogeneity in ability and human capital that I calibrate to match key properties of life-cycle earnings distribution for high-school graduates, using a method developed by Huggett et.al. and extended in Ionescu (2007).

To my knowledge, this is the first paper to study the effects of both liquidation and reorganization bankruptcy regimes on college enrollment, default incentives for student loans and welfare. The paper is organized as follows: Section 2 provides background on the bankruptcy rules; next two sections describe the model and the calibration procedure; I present results in Section 5 and conclude in the last section.

[2]Other relevant research include papers by Athreya and Simpson (2006) and Li and Sarte (2006).

[3]Important contributions are papers by Becker (1993), Caucutt and Kumar (2003), Carneiro and Heckman (2002), and Keane and Wolpin (2001).

2 Bankruptcy Under The FSLP and The Cost of Default

Bankruptcy in the model is closely related to Chapter 7, "The Liquidation Chapter" and Chapter 13, "Adjustment of the Debts of an Individual With Regular Income", one of the "Reorganization Chapters" under the Bankruptcy Code. The most significant distinction between them is in regard to the administration of the estate. Rather than a disposal of the assets through liquidation sale, the purpose of the reorganization chapters is to preserve and protect the integrity of assets from the claims of creditors, so as to permit the debtor an opportunity to reorganize and restructure his assets and liabilities and to become economically viable. Table 1 presents a summary of main differences between the two bankruptcy rules.

Table 1: Bankruptcy rules under FSLP

	Chapter 7 - Liquidation	**Chapter 13 - Reorganization**
Purpose	Disposal of the assets	Protection of the assets integrity
Dischargeability	Allowed	Not allowed
Cost	Wage garnishment Exclusion from credit markets Seizure of tax refunds	Wage garnishment Debt increase Seizure of tax refunds Loss of consolidation rights
Benefit	Loans discharged	Bad credit report erased

Students who participated in the loan program before 1990 could file for bankruptcy under Chapter 7 without any restrictions and could discharge on their loans. In this paper I refer to this period as "liquidation". Dischargeability was initially limited in 1990 by the Student Loan Default Prevention Initiative Act to one of the two cases: (1) if the first payment on the debt became due more than 7 years before the filing of the bankruptcy petition or (2) if it would cause undue hardship on the debtor. The Higher Education Amendments to the Bankruptcy Code in 1998 eliminated the 7-year discharge basis, keeping "undue hardship" as the only basis for obtaining a discharge. After the reforms, students cannot discharge on their loans anymore. They file for bankruptcy under Chapter 13 and enter a repayment plan. The indebted defaulter is required to reduce consumption to finance at least partial repayment of his obligations. Availability of discharge is limited, so I refer to this period as "reorganization".[4]

The design of the current program is such that students need to repay on their loans six month after graduation. The rate on education loans is set by the government, based on the 91-day Treasury-bill rate, and it fluctuates with the market. Borrowers start repaying under the standard plan that assumes fluctuating payments. If they do not make any payments within 270 days, they are considered in default, unless an agreement with the lender is reached. Default status is reported to credit bureaus. Penalties on defaulters include: garnishment of their wage, seizure of federal tax refunds, possible hold on transcripts, ineligibility for future student loans, bad credit reports that exclude them from other credit markets. Institutions with high default rates are also penalized, but I focus on the individual decision, so I abstract from those. The main differences between the consequences to default under the two regimes are that (1) In the case of liquidation the loan is discharged and no repayment is required but in the case of reorganization a repayment plan is implemented. Debt can increase by as much as 25%. The defaulter loses his right to consolidate after default, so paying under no-consolidation status is the only available option the borrower enters repayment next period; (2) Under liquidation, defaulters are excluded from credit markets, whereas under reorganization bad credit reports are erased and credit market participation is not restricted; (3) The wage garnishment is interrupted under reorganization once the defaulter enters repayment.

The Department of Education and student loan guaranty agencies are authorized to take ("garnish") a limited portion of the wages of a student loan debtor who is in default. Due to

[4] As a practical matter, it is very difficult to demonstrate undue hardship unless the defaulter is physically unable to work. The 7 year basis discharge is irrelevant to the current study as filing for bankruptcy within my data and model occurs within 4 years after graduation.

recent changes in the law, the Department may garnish up to 10% of the defaulter's wages. Wage garnishment could be avoided if it would result in an extreme financial hardship for the defaulter. I will adjust the garnishment relative to the minimum income.

The IRS can intercept any income tax refund the defaulter may be entitled to until student loans are paid in full. This is one of the most popular methods of collecting on defaulted loans, and the Department of Education annually collects hundreds of millions of dollars this way. Each tax year, the guaranty agency holding the defaulter's loans must review the account to verify that the defaulter has not made any loan payments within the previous 90 days. In this case, the agency notifies the IRS that the loans are in default and if the defaulter is entitled to a tax refund, the IRS proposes to keep all or some of the tax refund. This punishment can be avoided, however, if the borrower has repaid the loan, is making payments under a negotiated repayment agreement or the loans were discharged in bankruptcy. Thus, I will not model this punishment given either dischargeability or immediate repayment in my set-up.

3 Model

The environment is a life cycle economy with heterogeneous agents that differ in their learning ability, human capital stock and initial assets that include parental contribution for college. Time is discrete and indexed by j. I model the decision of a high school graduate to invest in his college education by maximizing the present value of utility over the life-cycle:

$$\max \sum_{j=1}^{J} \beta^{j-1} u(c_j),$$

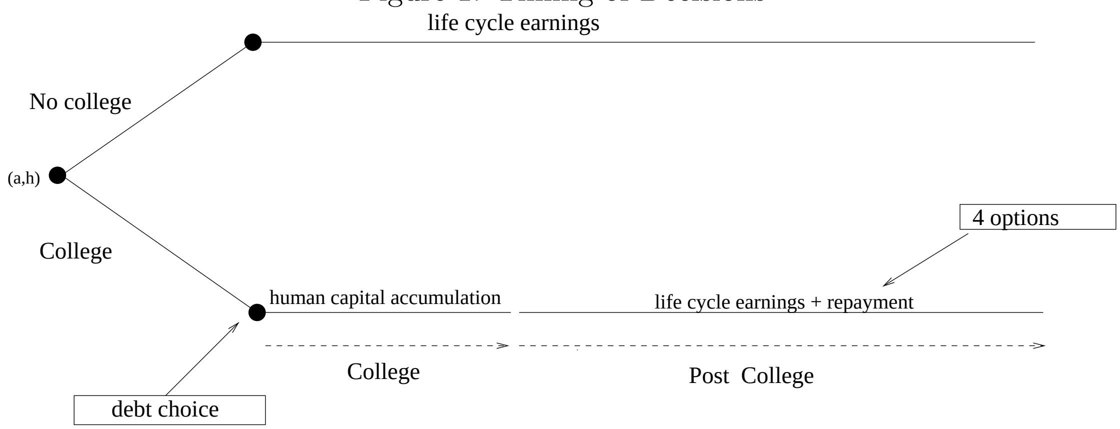
where $u(.)$ is strictly concave and increasing, and β is the discount factor. The per-period utility function is CRRA, $u(c_j) = \frac{{c_j}^{1-\sigma}}{1-\sigma}$, with σ as the coefficient of risk aversion.

My model builds-up on the environment in Ionescu (2007) that generalizes the human capital model developed by Ben-Porath and updated by Huggett et.al. I extend this previous work in several ways: (1) I allow for human capital accumulation in college. I assume that the technology for human capital accumulation is the same during college and post college and that human capital is not productive until graduation. (2) There are three sources of heterogeneity: immutable learning ability, initial stock of human capital and initial assets. (3) College costs can be financed by parental contribution and student loans. (4) Education investment is risky: the interest rate on loans is uncertain. (5) College graduates can default on their loans under alternative bankruptcy regimes.

On the college path as well as on the no college path, agents optimally allocate time between market work and human capital accumulation. Human capital stock refers to "earning ability" and can be accumulated over the life-cycle, while learning ability is fixed at birth and does not change over time. Agents face idiosyncratic income shocks and may save at the riskless interest rate. Additionally, agents on the college path optimally choose the loan amount and the repayment status for college loans. When deciding to go to college, the agents might be financially constrained and need to borrow to continue their education. They start repaying their loans once they graduate from college. A description of the timing in the model is provided in Figure 1.

The optimal life-cycle problem is solved in two stages. First, for each schooling choice, I solve for the optimal path of consumption, time allocation and human capital investment. In the case of college graduates, I also solve for optimal borrowing and repayment decision rules. Individuals then select between college versus no college to maximize lifetime utility.

Figure 1: Timing of Decisions



3.1 Agent's Problem: No College Path

Agents who choose not to go to college maximize the present value of utility over their lifetime by dividing available time between market work and human capital accumulation; they save in the risk-free market. Their problem is identical to the one described in Ben-Porath (1967) except for the saving option, idiosyncratic income shocks and risk aversion. The problem is given below by:

$$\max_{l_j, h_j, x_j} \left[E \sum_{j=1}^{J} \frac{c_j^{1-\sigma}}{1-\sigma} \beta^{j-1} \right] \tag{1}$$

$$s.t. \quad c_j \leq z_j w_j h_j (1 - l_j) + (1 + r_f) x_j - x_{j+1} \text{ for j=1,2...J}$$

$$l_j \in [0, 1],\ h_{j+1} = h_j (1 - \delta_{nc}) + f(h_j, l_j, a),\ x_j \geq 0.$$

Agents derive utility from consumption each period; earnings are given by $z_j y_j$ with z_j the stochastic component and y_j the product of the rental rate of human capital, w_j, the agent's human capital, h_j, the time spent in market work, $(1 - l_j)$. The idiosyncratic shocks, z_j to earnings each period evolve according to a Markov process with support Z=[$\underline{z}, \overline{z}$], where $\underline{z}$ represents a bad shock and $\overline{z}$ represents good productivity shock. The Markov process is characterized by the transition function Q_z and is assumed to be the same for all households. Agents may save at the riskless interest rate, r_f. Current savings are x_{j+1}. The initial assets, x_1, include the parental contribution for college education. The depreciation rate of human capital is δ_{nc}. Human capital production, $f(h_j, l_j, a)$, depends on the agent's learning ability, a, human capital, h_j, and the fraction of available time put into human capital production, l_j. Following Ben-Porath (1967), this is given by $f(h, l, a) = a(hl)^\alpha$ with $\alpha \in (0, 1)$. The rental rate evolves over time according to $w_j = (1 + g_{nc})^{j-1}$ with the growth rate, g_{nc}.

I formulate the problem in a dynamic programming framework. The value function $V_j(a, h, x)$, gives the maximum present value of utility at age j from states h and x when learning ability is a. In the last period of life, agents consume their savings. The value function in the last period of life is set to $V_J(x, d, r, z) = u(x)$.

$$V_j(a, h, x, z) = \max_{l, h', x'} \left[\frac{(wh(1-l) + (1 + r_f)x - x')^{1-\sigma}}{1-\sigma} + \beta E V_{j+1}(a, h', x', z') \right]$$

$$s.t.\ l \in [0, 1],\ h' = h(1 - \delta_{nc}) + a(hl)^\alpha,\ x \geq 0.$$

Solutions to this problem are given by optimal decision rules: $l_j^*(a, h, x)$, $h_j^*(a, h, x)$, and $x_j^*(a, h, x)$, which describe the optimal choice of the fraction of time spent in human capital production, human capital and asset carried to the next period as a function of age j, human capital, h, ability, a, and assets, x. The value function, $V_{NC}(a, h, x) = V_1(a, h, x)$, gives the maximum present value of utility if the agent chooses not to go to college from state h, when learning ability is a, and initial assets are x.

3.2 Agent's Problem: College Path

As in the previous case, agents who pursue college maximize the present value of utility over their lifetime by dividing available time between market work and post-college human capital accumulation. They also save using the risk free assets. Additionally, they optimally choose the loan amount for college education and the repayment status for their college loan in order to maximize the present value of utility. The problem is given below by:

$$\max_{l_j,h_j,x_j,p_j,d} \left[E\sum_{j=1}^{J} \beta^{j-1}\frac{c_j^{1-\sigma}}{1-\sigma} \right] \tag{2}$$

$$\begin{aligned} s.t. \quad & c_j \leq (1-l_j) + x_j(1+r_f) + t(a) + d - \hat{d} - x_{j+1} \text{ for j=1,...,4} \\ & c_j \leq z_j w_j h_j(1-l_j) - p_j(d_j) + x_j(1+r_f) - x_{j+1} \text{ for j=5,...,J} \\ & l_j \in [0,1],\ h_{j+1} = h_j(1-\delta_c) + f(h_j,l_j,a))^{\alpha},\ x_j \geq 0 \\ & d \in D = [0, \overline{d}(x)],\ d_{j+1} = (d_j - p_j)(1+r_j),\ p_j \in P. \end{aligned}$$

For college period $j = 1,..,4$, the growth rate, g_c, is 0. Thus the rental rate of human capital is 1. Human capital is not productive until graduation. Agents are allowed to borrow up to $\overline{d}(x)$, the full college cost minus the expected family contribution that depends on initial assets, x. They pay direct college expenses, $\hat{d}$, and receive a transfer, $t(a)$, each period while in college.[5] Agents derive utility from consuming each period. Post college, their earnings are given by $z_j y_j$ with z_j the stochastic component and y_j, the product of the rental rate of human capital, w_j, the agent's human capital, h_j, the time spent in market work, $(1-l_j)$. The idiosyncratic shocks, z_j have the same properties as before. Their current savings are x_{j+1} and bankruptcy status is reflected by the payment they have chosen $p_j(d_j) \in P = [p_{nc}, 0]$ with p_{nc} the variable payment and 0 payment in the case they declare bankruptcy. The interest rate on loans, r_j, is stochastic and follows a two state Markov

[5] This depends on the agent's ability and is interpreted as a scholarship that higher ability agents may receive.

process. As before, the stock of human capital increases when human capital production offsets the depreciation of current human capital given by rate, δ_c. Human capital production, $f(h_j, l_j, a)$, is given by $f(h, l, a) = a(hl)^\alpha$ with $\alpha \in (0, 1)$. I assume that the technology for human capital accumulation is the same during the schooling and training periods, given by $h_{j+1} = h_j(1 - \delta_c) + a(h_j l_j)^\alpha$. The rental rate equals $w_j = (1 + g_c)^{(j-1)}$ with the growth rate, g_c.

The college path problem is solved in several steps. As before, I formulate it in a dynamic programming framework. The value function in the last period of life is set to $V_J(x, d, r, z) = u(x)$. The problem is solved backwardly starting with the post-college period, $(j = 5, .., J)$ for which the Bellman equation is given by

$$V_j(a, h, x, d, r, z) = \max_{l, h', x', p, d'} \left[\frac{(zw_j h(1 - l) + (1 + r_f)x - x' - p(d))^{1-\sigma}}{1 - \sigma} + \beta E V_{j+1}(a, h', x', d', r', z') \right]$$

$$s.t.\ l \in [0, 1],\ h' = h(1 - \delta_{nc}) + a(hl)^\alpha)^\alpha,\ x \geq 0$$

$$d' = (d - p)(1 + r),\ p \in P.$$

I take $V_5(a, h, x, d, r)$ as a terminal node for the college period and solve for the optimal rules for $j = 2, ..., 4$ for which the Bellman equation is

$$V_j(a, h, x, d) = \max_{l, h', x'} \left[\frac{((1 + r_f)x + 1 - l + t(a) + d - \hat{d} - x')^{1-\sigma}}{1 - \sigma} + \beta V_{j+1}(a, h', x', d) \right]$$

$$s.t.\ l \in [0, 1],\ h' = h(1 - \delta_{nc}) + a(hl)^\alpha.$$

Finally, I solve for the optimal rules for the first period of college which also includes the optimal loan amount for college education. The Bellman equation for the first year in college is

$$V_1(a,h,x) \quad = \quad \max_{l,h',x',d} \left[\frac{((1+r_f)x + 1 - l + t(a) + d - \hat{d} - x')^{1-\sigma}}{1-\sigma} + \beta V_2(a,h',x',d) \right]$$

$$s.t. l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^{\alpha},\ x \geq 0$$

$$d \in D = [0, \overline{d}(x)].$$

Solutions to this problem are given by optimal decision rules: $l_j^*(a,h,x,r)$, the fraction of time spent in human capital production, $h_j^*(a,h,x,r)$, human capital, and $x_j^*(a,h,x,r)$, asset carried to the next period as a function of age, j, human capital, h, ability, a, assets, x, and college debt, d, when the realized state is r. Additionally, for the post-college period rules include $p_j^*(a,h,x,d)$, optimal repayment choice for $j \geq 5$, and $d^*(a,h,x)$, optimal borrowing for $j = 1$. The value function, $V_C(a,h,x) = V_1(a,h,x)$, gives the maximum present value of utility if the agent chooses to go to college from state h when learnings ability is a and initial assets are x.

3.2.1 Repayment and the Cost of Default

Corresponding to the bankruptcy status, there are two value functions: the value in the case the borrower declares bankruptcy and the value for the case the borrower repays.

Case 1: Default

The value functions for the default status are given separately for each bankruptcy rule.

- Dischargeability/Liquidation

Once the borrower decides to declare bankruptcy, there is no repayment in the period default occurs and any period thereafter. The consequences to default are modeled to mimic those in the data: a wage garnishment and exclusion from credit markets. In my model, this corresponds to a garnishment of a fraction ρ_L of the earnings and the inability to borrow and save in the risk free market within ten periods after default.[6] V^{DL} represents the value function for the period default occurs and the following nine periods

$$V_j^{DL}(a,h,x,d,r,z) \quad = \max_{l,h'} \quad \left[\frac{(zw_jh(1-l)(1-\rho_L)+(1+r_f)x)^{1-\sigma}}{1-\sigma} + \beta EV_{j+1}^{DL}(a,h'y',z')\right]$$

$$s.t. \quad d' \quad = 0,\ l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^\alpha$$

and V^{ADL} represents the value function for periods after default, when liquidation occurred and penalties were imposed.

$$\begin{aligned} V_j^{ADL}(ya,h,x,z) \quad &= \quad \max_{l,h'x'} \left[\frac{(zw_jh(1-l)(1+r_f)x-x')^{1-\sigma}}{1-\sigma} + \beta EV_{j+1}^{ADL}(a,h',x',z')\right] \\ s.t. \qquad & x' = 0,\ l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^\alpha \end{aligned}$$

- Non-Dischargeability/Reorganization

In the case of bankruptcy under reorganization, the consequences to default include a wage garnishment the period default occurs, reflected in the model by $\rho_R \in (0,1)$, and an increase in the debt level the agent enters repayment the next period by μ . Once he enters repayment, it is assumed that he will never default again. The bad credit reports are erased and he is allowed to borrow/save in the bond market without any restrictions. V^{DR} represents the value function for the period default occurs with $V^{AD}(a,h,x,d,r,z) \in \{V^{DL}(.), V^{ADR}(.)\}$.

$$V_j^{DR}(a,h,x,d,r,z) \quad = \quad \max_{l,h'x'} \left[\frac{(zw_jh(1-l)(1-\rho_R)+(1+r_f)x-x')^{1-\sigma}}{1-\sigma} + \beta EV_{j+1}^{ADR}(a,h',x',d',r',z')\right]$$

[6]Prohibiting saving is meant to capture the seizure of assets in a Chapter 7 bankruptcy.

$$s.t. \qquad d' = d(1+\mu)(1+r), x' > 0$$

$$l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^{\alpha}$$

and V^{ADR} represents the value function for periods after default, when reorganization is required.

$$\begin{aligned} V_j^{ADR}(y,x,d,r,z) &= \max_{hl,h'x'} \left[\frac{(zw_j h(1-l) + (1+r_f)x - x' - p_{nc}(d))^{1-\sigma}}{1-\sigma} + \beta E V_{j+1}^{ADR}(y',x',d',r',z') \right] \\ s.t. \quad & d' = (d - p_{nc})(1+r),\ x' > 0 \\ & l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^{\alpha} \end{aligned}$$

Case 2: Repayment status

The agent has not defaulted yet, but he might choose to do so in the current period. Optimal repayment implies maximizing over the two value functions, V^R, which represents maintaining the repayment status and V^{AD}, which means default occurred in the current period.

$$\begin{aligned} V_j^R(a,h,x,d,r,z) &= \max_{l,h',x',p,d'} \frac{(zw_j h(1-l) + (1+r_f)x - x' - p(d))^{1-\sigma}}{1-\sigma} + \beta E \max \\ & \left[V_{j+1}^R(a,h',x',d',r',z'), V_{j+1}^{AD}(a,h',x',d',r',z') \right] \end{aligned}$$

$$s.t.\ d' = (d-p)(1+r),\ p \in P$$

$$l \in [0,1],\ h' = h(1-\delta_{nc}) + a(hl)^{\alpha}$$

Optimal repayment implies maximizing over these value functions. With the appropriate parameters and the estimated Markov process for loan rates and earnings shocks, I solve for optimal choices within each repayment status and then dynamically pick the optimal repayment choice, $p_j^*(a, h, x, d)$, $\forall j = 5, 6..., J$.

3.3 Enrollment Choice

The agent chooses to go to college if $V_C(a, h, x) \geq V_{NC}(a, h, x)$, where $V_{NC}(a, h, x)$ gives the maximum present value of utility if the agent chooses not to go to college, and $V_C(a, h, x)$ gives the maximum present value of utility if the agent chooses to go to college from state h, when learning ability is a and initial assets are x.

4 Calibration

The calibration process involves the following steps: First, I assume parameter values for which literature provides evidence. For the policy parameters, I use data from the Department of Education (DOE). Second, I calibrate the Markov process for interest rates on loans, using the time series for 91-day Treasury-bills for 1980-1996 and the stochastic earnings process using PSID family files. The third step involves calibrating the distribution of initial characteristics. For the initial asset distribution I use the Survey of Consumer Finance (SCF) and High-School and Beyond (HB) data sets. Calibrating the joint initial distribution of learning ability and human capital is particularly challenging, given that there is no data counterpart. The model period equals one year.

4.1 Parameters

The parameter values are given in Table 2. The discount factor is 1/1.04 to match the risk free rate of 4%, and the coefficient of risk aversion chosen is standard in the literature. Agents live 38 model periods, which corresponds to a real life age of 20 to 57. Statistics for lifetime

Table 2: Parameter Values

Parameter	Name	Value	Target/Source
β	Discount factor	0.96	real avg rate=4%
σ	Coef of risk aversion	2	
r_f	Risk free rate	0.04	avg rate in 1994
J	Model periods	38	real life age 20-57
g_c	Rental growth for college	0.0065	avg growth rate PSID
g_{nc}	Rental growth for no college	0.0013	avg growth rate PSID
δ_c	Depreciation rate for college	0.0217	decrease at end of life-cycle PSID
δ_{nc}	Depreciation for no college	0.0101	decrease at end of life-cycle PSID
α	Production function elasticity	0.7	Browning et. al. (1999)
$\overline{d}$	College cost	31,775*	College Board
$\hat{d}$	Tuition per college year	3,813*	College Board
$t(a)$	Scholarship	$33\%\overline{d}$	DOE-NCES
T	Loan duration	10	DOE
$\underline{e}$	Minimum earnings upon default	\$4117	Dept. of Education
ρ	Wage garnishment upon default	0.1	DOE - default rate
μ	Debt increase upon default	0.05	DOE

* This is in 1982-1984 constant dollars.

earnings are based on earnings data from the PSID 1969-2002 family files. I use earnings of heads of households aged 25 in 1969 and follow them through 2002.[7] The sample consists of all high-school graduates working, temporarily laid off or looking for work but currently unemployed. The sample includes 229 high-school graduates. Among these 49 have a college degree. Given the sample size, I also construct similar profiles using CPS data for 1969-2002 with synthetic cohorts. Samples for each year in CPS are constructed similarly to the PSID sample. There are an average of 5000 observations in each year's sample. Figures A-1 and A-2 in the appendix present statistics for my samples. The statistics constructed using PSID do not look differently from those from CPS, so I use the PSID data set for earnings, since

[7] I consider a five year bin to allow for more observations, i.e., by age 25 at 1969, I mean all heads that are 23 to 27 years old. Real values are calculated using the CPI 1982-1984. There is no data on labor earnings for years 1993-1995, 2000, so I construct these using variables for wages/salaries of head from main job, extra job, bonuses, tips, overtime, income from professional practice or trade, labor part of income from farm, business, market gardening, and roomers and boarders. There are no interviews for years 1998, 2000 and 2002, so there is missing data for labor earnings for years 1997, 1999 and 2001. I use linear interpolation on those years when constructing life-cycle earnings profiles.

they are based on one cohort followed from 1969 to 2002.

The rental rate on human capital equals $w_j = (1+g)^{j-1}$, and the growth rate is set to $g_c = 0.0065$ and $g_{nc} = 0.0013$ respectively. I calibrate these growth rates to match the Panel Study of Income Dynamics (PSID) data on earnings for high-school graduates and college graduates. For details on the procedure see Ionescu (2007). Given the growth in the rental rates, I set the depreciation rates to $\delta_c = 0.0271$ and $\delta_{nc} = 0.0101$ respectively, so that the model produces the rate of decrease of average real earnings at the end of the working life cycle.[8] The model implies that at the end of the life cycle negligible time is allocated to producing new human capital and, thus, the gross earnings growth rate approximately equals $(1+g)(1-\delta)$. When I choose the depreciation rate on this basis, the values lie in the middle of the estimates given in the literature surveyed by Browning, Hansen, and Heckman (1999).

I set the elasticity parameter in the human capital production function, $\alpha = 0.7$. Estimates of this parameter are surveyed by Browning et al. and range from 0.5 to almost 1.0. I vary α within this range and a 0.7 value best fits the college enrollment percentage within my sample. This is consistent with recent estimates in **?**. Higher values will deliver more steeply sloped age-earnings profiles especially for college graduates given higher ability levels for this group. The positive correlation between ability and human capital lifts up the age-earnings profiles of high ability agents relative to low ability agents and hence delivers a higher college enrollment percentage for higher values of α.

The duration of the loan and the penalties upon default are set according to the DoE's data (National Center of Education Statistics - NCES). These involve a wage garnishment upon default, $\rho_L = \rho_R = 0.10$, and the minimum wage that would trigger financial hardship on the part of the defaulter. The garnishment is not imposed, however, if it means that the

[8] I use rates of growth in earnings at the end of the life cycle for the two education groups to set depreciation rates equal to 0.0217 and 0.0101 respectively. The growth rate in mean earnings at the end of the life-cycle is -0.02077 for college graduates and -0.01006 for no college.

weekly income would be less than 30 times the federal minimum wage. Based on the current minimum wage of \$5.15, this means that a minimum of \$154.40 (30 x \$5.15) of the weekly wages are protected from garnishment. In my model, this would be translated in an annual minimum income of \$4117 in 1984 constant dollars. The debt increase is picked to target the default rate for college graduates 92/93 in the B&B data sample from the NPSAS data set (Department of Education).

The maximum loan amount is based on the full college cost estimated as an enrollment weighted average (for public and private colleges) and transferred in constant dollars using the CPI 1982-1984.[9] The same procedure is used to estimate direct college expenditure, which represents 31% of the full college cost at public universities and 67% at private universities. The enrollment weighted average of tuition cost is 48% of the full college cost. The tuition per each year in college is \$3,813 in constant 1982-1984 dollars. According to the NCES data, 12% of college students on average received merit based aid over the past years, the major source being the institutional aid. I use the Baccalaureate and Beyond (B&B) 93/97 data set with college graduates from 1992-1993. The sample consists in 7,683 students. Among those, 10% received merit based grants. The amount of financial aid received increases by GPA quartiles. On average, the merit aid represents almost 33% of the college cost. In my model, I set $t(a)$ equal to 33% of the college cost per year in college for the top decile of learning ability.

4.2 Stochastic Processes for Student Loan Rates and Earnings

The rate follows a stochastic process, given by a 2 by 2 transition matrix $\Pi(R^{'}, R)$ on $\{\underline{R}, \overline{R}\}$. I use the time series for 91-day Treasury-bill rates for 1980-1996, adjusted for inflation. I fit the time series with the AR(1) process: $R_t = \mu(1-\rho) + \rho R_{t-1} + \varepsilon$, $\varepsilon \sim N\ (0, \sigma^2)$. The

[9]The enrollment-weighted cost for college was \$53,855 in 2000-2004 for private universities and \$20,900 for public universities in constant 1982-1984 dollars. Among the students enrolled, 67% went to public and 33% to private universities. The enrollment-weighted average cost is \$31,775 in constant dollars.

estimates of the two moments are given by $\rho = 0.9038$ and $\sigma = 0.7788$. I aggregate this to annual data; the autocorrelation is given by 0.297 and the unconditional standard deviation by 1.817. I have approximated this process as a two-state Markov chain. The support is $R \in \{1.038, 1.075\}$. The transition matrix is $\begin{bmatrix} 0.65 & 0.35 \\ 0.35 & 0.65 \end{bmatrix}$.

In the parametrization of the stochastic idiosyncratic labor productivity process I follow **?** who build a panel from the Panel Study of Income Dynamics (PSID) to estimate the idiosyncratic component of labor earnings. They use annual data from PSID from 1968 to 1991 for wage earnings and report separate values for different skill levels. This estimation is suitable for my model. With $u_{ij} = \ln(z_{ij})$ the stochastic part of the labor income process for household i at time j, the estimated model is:

$$\begin{aligned} u_{ij} &= y_{ij} + \epsilon_{ij} \\ y_{ij} &= \rho z_{i,j-1} + \nu_{ij} \end{aligned}$$

where ϵ_{ij} $N(0, \sigma_\epsilon^2)$ and ν_{ij} $N(0, \sigma_\nu^2)$ are innovation processes. The variables y_{ij} and ϵ_{ij} are realized at each period over the life cycle and are referred to as persistent and transitory 'life-cycle shocks", respectively. The reported values are $\rho = 0.935$, $\sigma_\epsilon^2 = 0.017$, and $\sigma_\nu^2 = 0.061$. I have approximated this process as a two state Markov Chain, normalizing the average value for the idiosyncratic shock to be 1. The resulting support is the set $Z = \{0.286, 1.714\}$ with the transition probability matrix:

$$\begin{bmatrix} 0.9455 & 0.0045 \\ 0.0455 & 0.9455 \end{bmatrix}.$$

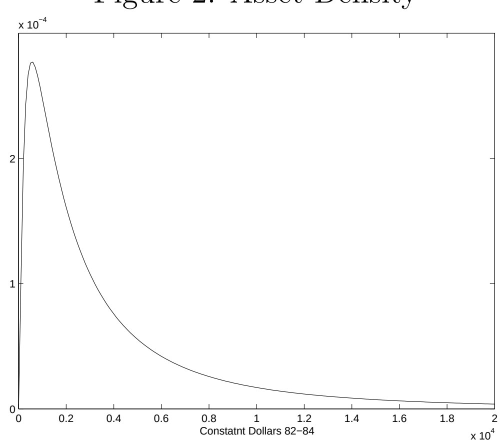
4.3 Asset Distribution

For the asset distribution, I combine two data sets, SCF and HB. For SCF, the sample consists of 174 individuals, 18-20 years old. Assets include paper assets, current value of home, value of other properties, value of all vehicles, value of business where paper assets are given by the sum of financial assets, cash value of life insurance, loans outstanding, gas leases, value of land contracts and thrift accounts. For HB, the sample consists of 3721 seniors in high school. I use their expected family contribution for college. The summary statistics are given in Table 3 and density of initial assets in Figure 2.

Table 3: Asset Distribution

Summary Statistics	High School Graduates
Mean	23,100
Standard Deviation	32,415

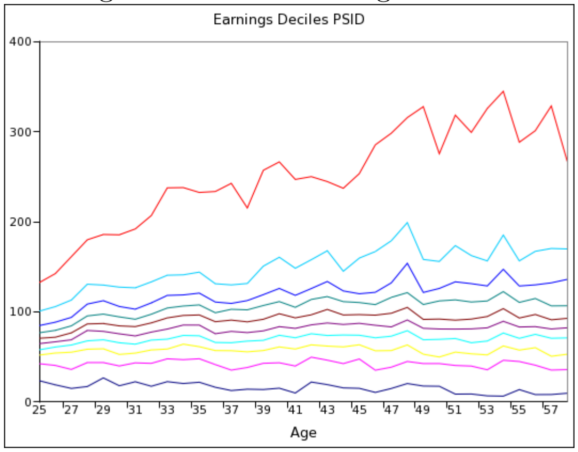
Figure 2: Asset Density



4.4 Ability and Human Capital Distribution

I calibrate the initial distribution of ability and human capital to match key properties of the life-cycle earnings distribution in US data. In order to carry out this procedure, I follow Ionescu (2007) where I extend the method developed by Huggett et.al. on the Ben-Porath

Figure 3: Data Earnings Deciles



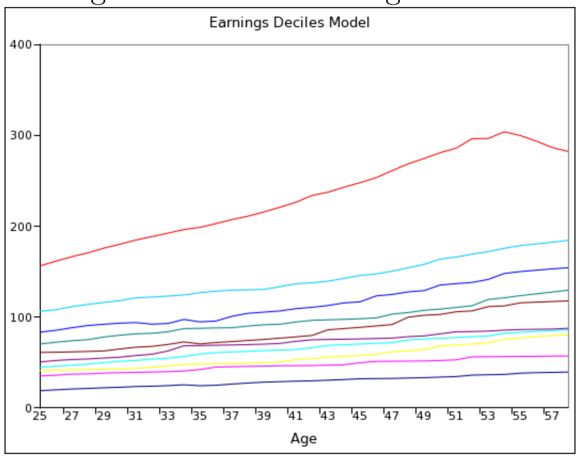
framework. I use the PSID 1969-2002 family files for heads of household aged 25 in 1969 and followed until 2002 for life-cycle earnings. Figure 3 shows the earnings deciles for the life-cycle.[10]

Earnings distribution dynamics implied by the model are determined in several steps. i) I compute the optimal decision rules for human capital using the parameters described in Table 2 for an initial grid of the state variable; ii) I solve for the enrollment decision and compute the life-cycle earnings for any initial pair of ability and human capital; iii) I choose the joint initial distribution of ability and human capital to best replicate the properties of US data documented in Figure A-1.

Using a parametric approach, I search over the vector of parameters that characterize the initial state distribution to minimize the distance between the model and the data. I restrict the initial distribution on the rectangular grid in the space of human capital and learning ability to be jointly, log-normally distributed. This class of distributions is characterized by 5 parameters. In practice, the grid is defined by 20 points in each dimension. I find the vector of parameters $\gamma = (\mu_a, \sigma_a, \mu_h, \sigma_h, \rho_{ah})$ characterizing the initial distribution that solves the

[10]For each age, I use a five year bin. Earnings are in real terms, deflated using the 1982-1984 CPI and normalized so that they equal 100 at the end of the life-cycle.

Figure 4: Model Earnings Deciles



minimization problem below,

$$\min_{\gamma}\left(\sum_{j=5}^{J}|log(m_j/m_j(\gamma))|^2+|log(g_j/g_j(\gamma))|^2+|log(d_j/d_j(\gamma))|^2\right)$$

where $m_j, d_j,$ and s_j are mean, dispersion and inverse skewness statistics constructed from the PSID data, and $m_j(\gamma), d_j(\gamma),$ and $s_j(\gamma)$ are the corresponding model statistics. Overall I match 102 moments. Figure 4 presents the model counterpart for the earnings deciles from the PSID data presented above. For details on the initial distribution characteristics, calibration algorithm and data fit, see Ionescu (2007).

5 Results

I first describe data findings regarding repayment incentives under reorganization and the predictions of the model for this bankruptcy regime; in Section 5.2, I present the results of the counterfactual experiment that changes the bankruptcy rule to allow for dischargeability and I analyze the relationship between college debt, post-graduate earnings, and default under both bankruptcy rules. In section 5.3, I discuss effects on college enrollment and in section 5.4, I present welfare implications of the two regimes.

5.1 Repayment Incentives under Reorganization

Table 4 describes data findings for default rates across different groups of college graduates who re-pay on their education loans facing chapter 13 bankruptcy. Data descriptions are based on NPSAS samples. I use B&B for college graduates 1992/1993. The data set is nationally representative and it is comprised in students, parents and institutions. School information is transcript based and student information is based on interviews. The survey has followed a random sample of 11,000 individuals who received their baccalaureate degree during the 1992-1993 academic year through 1997. There is an initial survey at graduation time and two follow up interviews in 1994 and 1997. I restrict my attention to the graduates that borrowed for undergraduate education under the FSLP and graduated from college in the period 1992/07 - 1993/06. I do not take into account students who went to graduate school because those continuing to graduate school are eligible for deferments in their loan repayment. The default rate is defined as the number of respondents who reported that they had defaulted since graduation, divided by the total number of respondents.

Interesting empirical patterns include:[11]

1. Default rates are declining in earnings, both conditioned and unconditioned on college debt.

2. Default rates are increasing in education debt levels both conditioned and unconditioned on earnings post-college.

3. Default rates are U-shaped in SAT/ACT scores, even after controlling for post-college-earnings and education debt.

[11] Other two features, that I do not present here and I do not model include:
1. Default rates vary across students with different undergraduate majors, but those differences largely disappear after controlling for actual post-school earnings and education debt.
2. Blacks and Hispanics default at significantly higher rates than whites and Asians, even after controlling for actual post-school earnings and education debt.

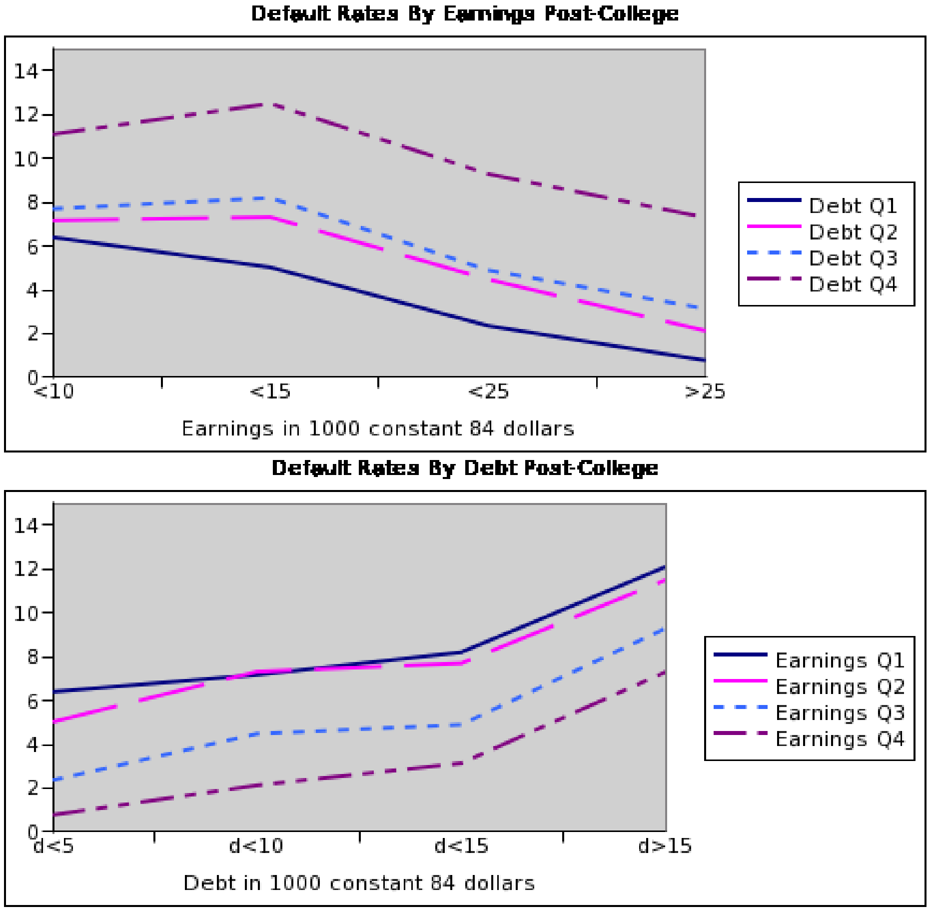
Table 4: Default By Characteristics - Data - Reorganization

Variable	Default Rate	Sample Size
All	5.6	3021
Average annual earnings*		
Quartile 1 ($< \$10000$)	8.36	604
Quartile 2 ($\$10000-\$14999$)	5.8	813
Quartile 3 ($\$15000-\$24999$)	4.1	568
Quartile 4 ($\geq \$25000$)	3.72	481
FSLP amount borrowed*		
Quartile 1 ($< \$5000$)	4.63	696
Quartile 2 ($\$5000-\$9999$)	5.9	756
Quartile 3 ($\$10000 - \$14999$)	6.2	662
Quartile 4 ($\geq \$15000$)	9.4	681
SAT/ACT Quartile		
Quartile 1	7.5	687
Quartile 2	5	687
Quartile 3	2.4	595
Quartile 4	8.6	495

Figures 5 show default rates against earnings levels for all four groups of debt post-college and against debt levels for all four groups of earnings post-college respectively.

Table 5 and Figures 6 present the model counterparts for default rates across different groups of characteristics. The model replicates the first two facts quantitatively and qualitatively. Borrowers with lower earning levels are more likely to choose default over repayment. Given the income contingent punishment upon default, the consequences for borrowers within lower income groups will be less severe. Furthermore, if borrowers qualify for the minimum level of earnings, wage garnishment is not imposed. Borrowers with higher debt levels will be more inclined to opt for default, given higher debt burdens relative to their income. Note that when controlled for debt levels, default rates present an increasing pattern for lower earnings levels and then a declining trend. The model cannot capture this feature, as Figure 6 suggests. The reason is that under the actual program, borrowers have the possibility to switch for an income contingent plan; data suggests that borrowers within lower quartiles

Figure 5: Default Rates - Data - Reorganization

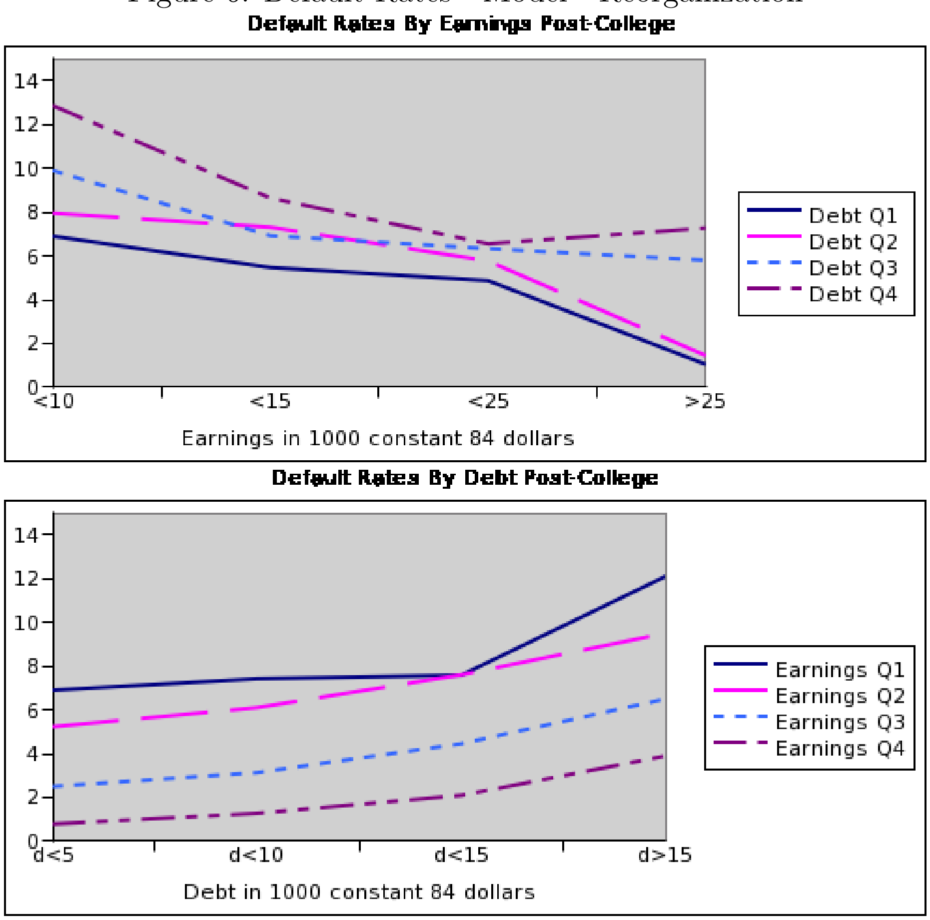


Note: Default rates are given for 1997, four years after graduation against earnings post-college at the market entrance level and against debt accumulated in college.

Table 5: Default Rates - Reorganization

Variable	Model	Data
All	5.6	5.6
Average annual earnings		
Quartile 1 (< \$10000)	8.74	8.36
Quartile 2 (\$10000−\$14999)	7.6	5.8
Quartile 3 (\$15000−\$24999)	3.58	4.1
Quartile 4 (≥ \$25000)	1.37	3.72
FSLP amount borrowed		
Quartile 1 (< \$5000)	3.78	4.63
Quartile 2 (\$5000−\$9999)	6.28	5.9
Quartile 3 (\$10000 − \$14999)	6.75	6.2
Quartile 4 (≥ \$15000)	8.54	9.4

Figure 6: Default Rates - Model - Reorganization



Note: Default rates are computed four years after graduation against earnings post-college at the market entrance level and against debt accumulated in college.

Table 6: Default Rates - Liquidation - Model

All	17.26
Earnings	
Quartile 1 (< \$10000)	24.45
Quartile 2 (\$10000−\$14999)	21.05
Quartile 3 (\$15000−\$24999)	15.33
Quartile 4 (≥ \$25000)	5.86
Debt	
Quartile 1 (< \$5000)	7.21
Quartile 2 (\$5000−\$9999)	18.26
Quartile 3 (\$10000 − \$14999)	36.77
Quartile 4 (≥ \$15000)	64.5

of earnings will choose this option. The model abstracts for now from including the income contingent scheme. No other option available, these groups of borrowers will opt for the default path. Extending the model to account for the other repayment schemes is considered in future research.

5.2 Repayment Incentives under Liquidation

I study the effects of policy reform that made student loans nondischargeable. The model predicts that the change in the bankruptcy rule from liquidation to reorganization induced a decline in default rates by 11.66%.

Table 7: Default By Bankruptcy Rules

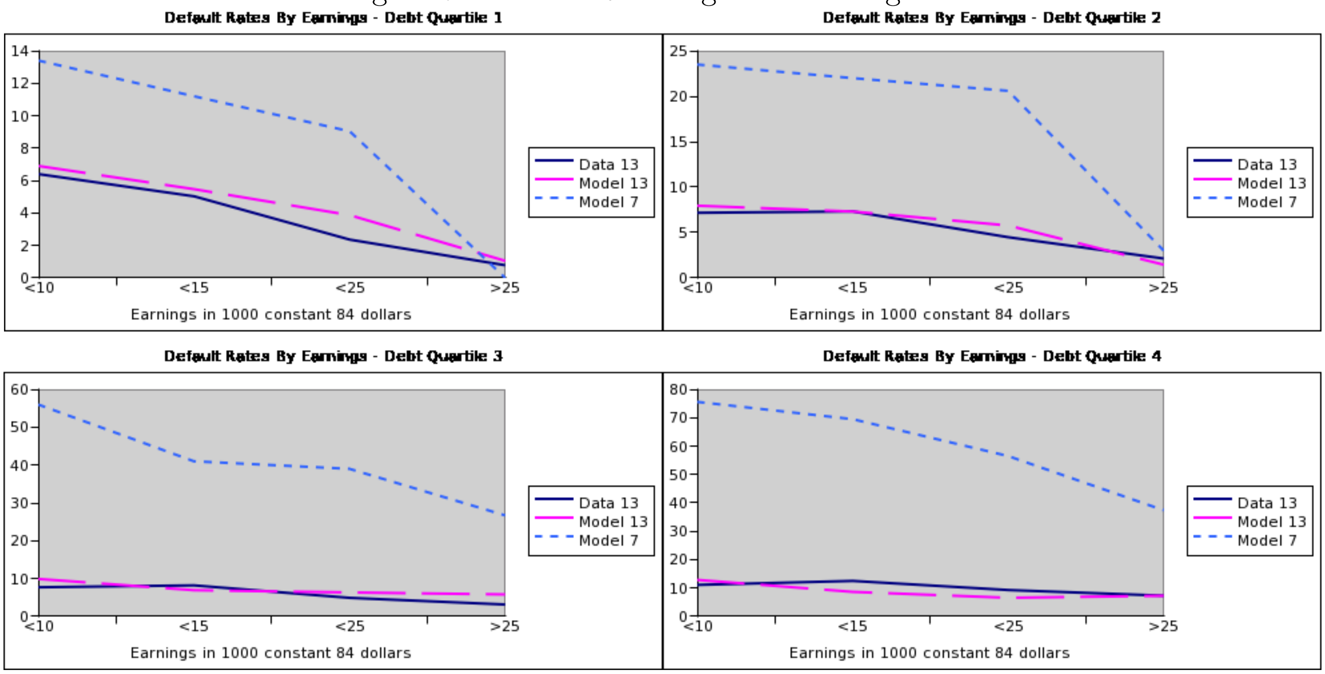
	Default Rate
Data-Reorganization	5.6%
Model-Reorganization	5.6%
Model-Liquidation	17.26%

In the counterfactual experiment when the rule is changed to allow for liquidation, the model predicts the same qualitative results as under reorganization: increasing pattern of default rates against debt levels and declining against earnings levels. Note, however, that the default rate for the highest group of debt level is 64.5% compared to the average of 17.26% whereas for reorganization is 8.54% compared to the average of 5.6%. Given more severe consequences to default contingent on debt under reorganization, borrowers with high debt levels will default less relative to the case when they can discharge their debt. Relative to the agents within the lowest debt group, the agents within the highest debt group will default 8.95 times more under liquidation and only 2.26 times more under reorganization. Figures 7 and 8 present default rates for the reorganization bankruptcy rule, both in data and model counterparts together with the predictions of the model for liquidation rule. The first set of graphs describes default rates against earnings when controlled for debt accumulated in college and the second set default rates against debt levels when controlled for earnings post-college. Note that default under liquidation is more sensitive against both debt levels and earnings levels given dischargeability and wage garnishment extended for ten periods in the case of this bankruptcy arrangement.

Figures 9 show the value functions for repayment versus default under each bankruptcy rule. The top graph is drawn against college debt conditioned on asset level and the bottom one against asset level post-college conditioned on debt. Both are drawn for a borrower with average earnings post-college. The value functions for repayment and default under reorganization decline in debt whereas that for default under liquidation is flat given no contingency on debt post-college. Given the same level of asset and earnings, less is needed to trigger default under liquidation. All three value functions increase in asset levels with default under liquidation increasing at a lower rate, given the exclusion from the market. For a given level of debt and earnings post-college more assets are needed to trigger default.

The counterfactual experiment suggests that in the case of liquidation financially constrained people will choose to default, whereas under reorganization people default for strategic reasons rather than financial constraints. This can be seen as well from Table 8 which illustrates the predictions of the model regarding characteristics of defaulters and nondefault-

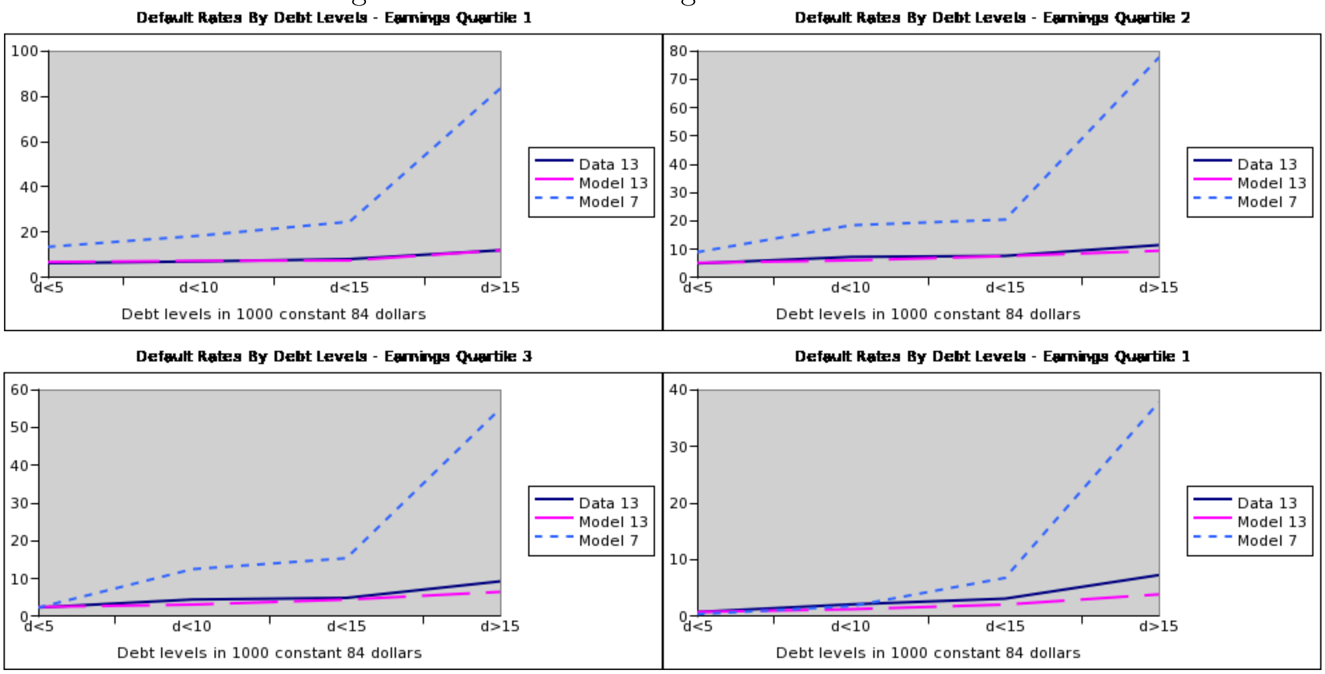
Figure 7: Default Rates Against Earnings



Note: Default rates are computed four years after graduation against earnings post-college at the market entrance level.

ers for the two regimes. Data counterparts for the reorganization period are also presented. Differences in debt burdens are more significant for the case when liquidation is allowed. This is because debt levels on average are similar for defaulters relative to nondefaulters under reorganization, given the debt contingent punishment, whereas differences in debt levels between the two groups are more sizable under liquidation given dischargeability. This feature is consistent with the finding in the B&B sample as the table above shows. Regarding earnings levels, differences between defaulters and nondefaulters are similar under the two bankruptcy regimes. Defaulters on average have lower earnings under both liquidation and reorganization given the wage garnishment consequence to default under both. The differences in terms of asset levels are similar under both rules. Defaulters have lower savings on average relative to nondefaulters, consistent with data. In the B&B sample, 47% of defaulters have savings and 70% of nondefaulters have savings. Levels are not available.

Figure 8: Default Rates Against Debt Levels



Note: Default rates are computed four years after graduation against debt accumulated in college.

Table 8: Characteristics of Defaulters versus Nondefaulters

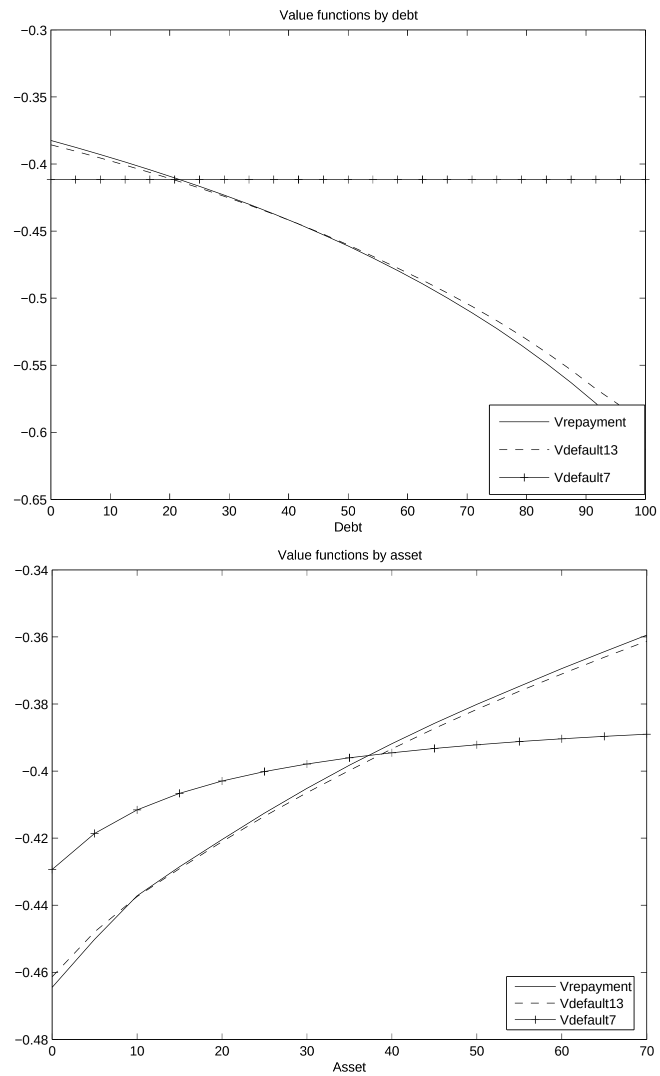
Model

	Liquidation		Reorganization	
Mean	Default	Nondefault	Default	Nondefault
Earnings	10165	16040	9436	15729
Debt	9879	7038	7659	7419
Debt burden	0.97	0.43	0.81	0.47
Asset	552	10554	331	10052

Data

	Reorganization	
Mean	Default	Nondefault
Earnings	14168	15767
Debt	7889	7336
Debt burden	0.56	0.47

Figure 9: Repayment Versus Default Value Functions

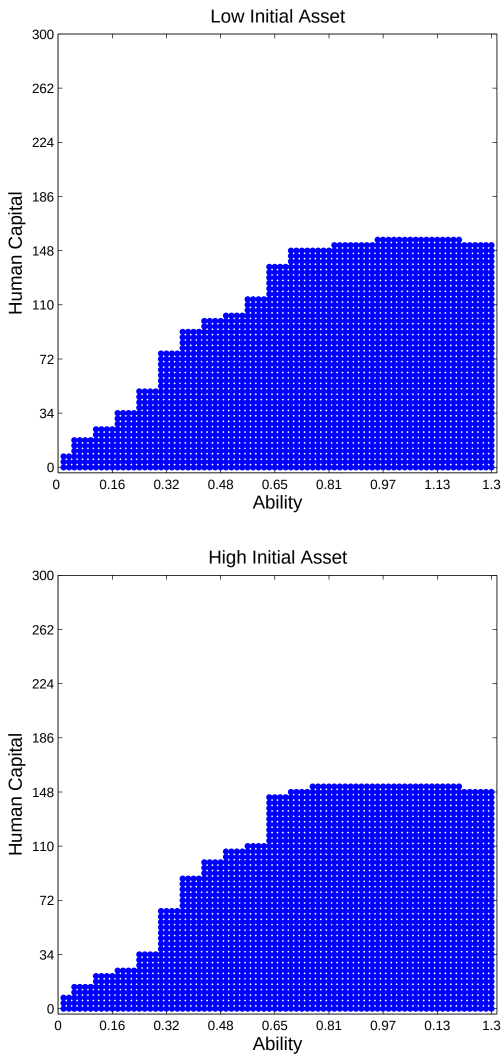


An interesting feature of the data is the pattern of default rates across SAT/ACT test score quartiles. Default rates are highest for the most able (quartile 4) at 8.6%, followed closely by the lowest ability quartile, which had a default rate of 7.5%. Default among those in the third ability quartile was by far the lowest with only 2.4% choosing not to re-pay their loans. Total loan amounts were quite similar across ability quartiles, with the least able borrowing the most at $11,425 (about $1,000 more than all other ability categories). A version of this model that allows for private information and a learning process over ability is the objective of future research that aims to explain default rates across ability levels.

5.3 Effects on College Enrollment (preliminary and incomplete)

The model predicts that agents with higher ability levels and lower human capital will choose college over work, result consistent with Ionescu (2007). There is a trade-off between ability and human capital such that college still represents a worthwhile investment. The high-school graduate with a higher ability level takes advantage of this investment opportunity given the high returns to education. At the same time, the market values human capital in the case agent chooses to work and a low level of human capital stock implies a low cost of investing in college. Parental wealth is not crucial for college participation. Figure 10 illustrates model's prediction for college enrollment on the grid of learning ability and initial human capital stock for two levels of initial wealth. The top picture represents the average level within the bottom decile of the initial asset distribution and the bottom picture the average level within the top decile. Note that, for a given combination of ability and human capital, a change in initial asset will not alter the decision to enroll in college. The intuition behind this result is that many eligible high school graduates decide not to enroll in college if their return to college education would be too low to pay for the forgone earnings for college years. Either they lack the necessary ability or their human capital levels are too

Figure 10: College Enrollment by Initial Heterogeneity



high. Hence, college investment is not attractive.

The model predicts 25% of agents will enroll in college for the benchmark case when bankruptcy is declared under chapter 13. Conditional on enrollment, the model predictions for the benchmark case are consistent with data for life-cycle earnings for college graduates and high school graduates that do not go to college. The model predicts a college premium of 1.42. In my sample the college premium is 1.59. Murphy and Welch (1992) estimate an average college premium of 1.58. When dischargeability is allowed under Chapter 7, college enrollment is 32%. From the pool of people who chose not to enroll before, higher ability levels enroll. This induces changes in life-cycle profiles for the two education groups, with lower levels on average for those who do not enroll and higher for college graduates. "New college graduates" will choose to default taking advantage of the possibility to discharge their debts. Current work studies these effects across different groups of high-school graduates.

5.4 Welfare Implications

For the welfare analysis, I use as a measure the aggregate welfare with agents being equally weighed. In my evaluation, I account for the limited size of the government budget. The role of the government is to subsidize the student loan program. In the context of the model, this supposes financing the cost of discharged loans minus the part recouped through wage garnishment. I assume the cost is financed through lump-sum transfers from agents.[12]

Table 9 presents changes in welfare under liquidation relative to the benchmark economy when reorganization is modeled. Allowing for dischargeability induces substantial welfare gains for the bottom initial earnings quartile relative to the higher initial earnings quartiles. The model suggests an improvement in welfare for upper quartiles of debt levels. Overall, the model delivers that liquidation is more efficient than reorganization on welfare grounds.

[12] My model suggests a cost of $ 16.4 million for an economy of 10000 agents, of which $2.47 millions are recouped through wage garnishments.

Even though the cost associated with default imposes a welfare loss to the society, having the opportunity to discharge one's debt counteracts this effect. College enrollment is higher and life0cycle earnings profiles improve on average for high-school graduates.

Table 9: Welfare Gains

	Total	Q1	Q2	Q3	Q4
Earnings post-college	2.67%	3.02%	0.08%	0.03%	0.06%
Debt post-college	3.44%	0.03%	1.41%	6.02%	6.3%

6 Conclusion

I developed a life-cycle stochastic economy that explains quantitatively and qualitatively characteristics of defaulters for the reorganization period: default rates are declining in earnings, both conditioned and unconditioned on college debt and are increasing in education debt levels both conditioned and unconditioned on earnings post-college. The model overestimates the differences in debt levels and earnings levels between defaulters and nondefaulters relative to the data. Including other payment plans in the model might correct for this.

The model predicts that the change in the bankruptcy rule from liquidation to reorganization induced a decline in default rates by 11.66%. The counterfactual experiment suggests that in the case of liquidation financially constrained people will choose to default, whereas under reorganization people default for strategic reasons. When the bankruptcy rules are changed to allow for dischargeability, the model suggests substantial welfare gains for bottom initial earnings quartile relative to the higher initial earnings quartiles. Overall, earnings profiles are higher on average and there is a welfare improvement under liquidation. Results show that under liquidation more people choose to enroll, but they default on their debts once they graduate from college. Ability and human capital stock determine enrollment in college, while parental wealth is not crucial for this decision.

Current work studies the implications of the change in the bankruptcy rules on human capital investment decision across different groups of high-school graduates. One feature that the model cannot account for regards default rates across ability levels. Separate research considers a version of this model that allows for unobservability in ability and learning processes over ability levels in an attempt to capture this particular pattern.

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A Appendix

Figure A-1: Data PSID

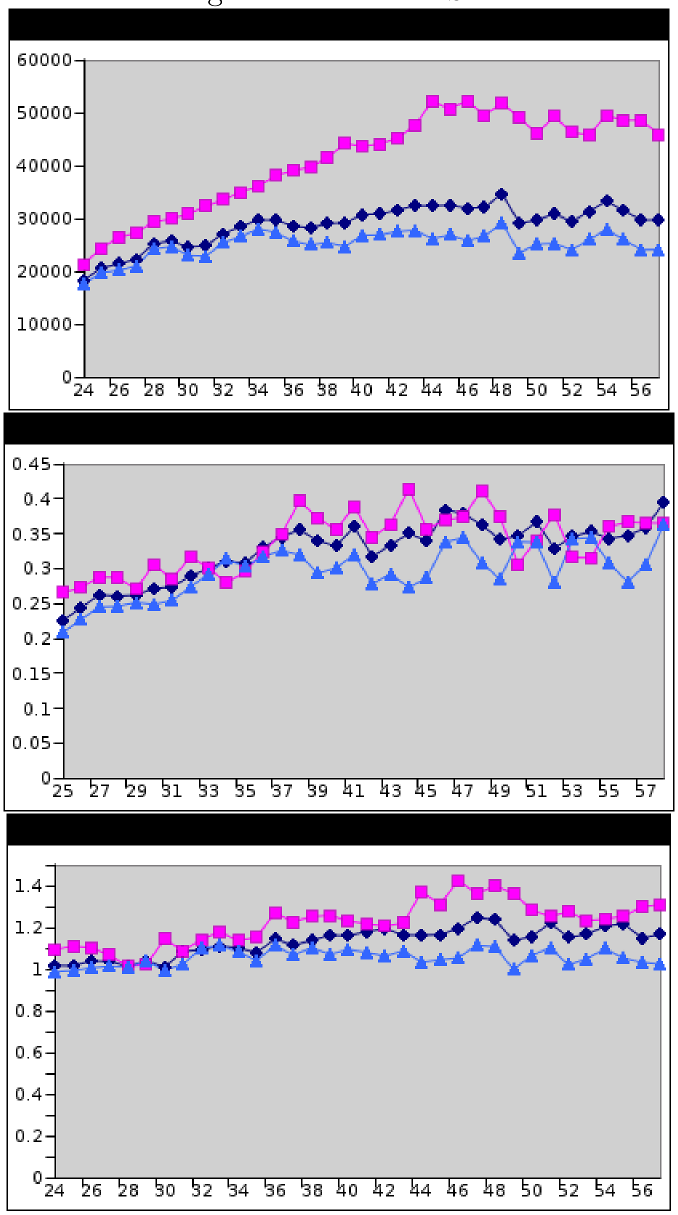

Figure A-2: Data CPS