Bankruptcy and Delinquency in a Model of Unsecured Debt

[PRELIMINARY; DO NOT CITE]

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Abstract

Limited commitment for the repayment of unsecured consumer debt originates from two places: (i) formal bankruptcy laws granting a partial or complete legal removal of unsecured debts under certain circumstances, and (ii) informal default via non-payment followed by renegotiation: "delinquency." In the US, both channels are used routinely. This paper introduces a model of unsecured consumer credit in the presence of both bankruptcy and delinquency. Our model has three messages. First, with respect to the choice between formal bankruptcy and delinquency: wage shocks matter. Specifically, we find that delinquency is readily utilized by borrowers with the worst labor market outcomes even when they owe only relatively minor levels of debt while bankruptcy is used by households whose persistent (i.e. longer-run) earnings prospects are somewhat higher, and then, only for higher debt levels than those that make delinquency optimal. Second, our model suggests that financial distress is likely to be persistent. Third, we show that, in broad terms, bankruptcy and delinquency are "substitutes," with increases in the costs of delinquency increasing bankruptcy rates.

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1 Introduction

Personal bankruptcy is a formal procedure that removes unsecured debt obligations subject to some costs. It is used by a large number of U.S. households each year, with greater than 1 million filings annually in each of the past two decades. Bankruptcy is, however, not the only route available for households to delay or lower their debt obligations: they can simply stop repaying as promised—and payment delayed can become payment denied. Faced with such actions by borrowers, lenders retain access to the legal right to seize resources from such delinquent account holders. Most prominently, lenders may garnish wages, subject to court approval. However, lenders' ability to credibly promise to take such actions ex-post is limited by the fact that the household always retains formal bankruptcy as an option. Subject to this constraint, competitive lenders will be forced, ex-post, to strike a deal—generally by revising the principal and/or interest on the loan.

The process of obtaining debt relief via delinquency appears relevant. Work of Ausubel and Dawsey (2004), who analyze data from a large United States issuer of MasterCard and Visa card accounts, shows that a nontrivial fraction of debts do get modified in this way: their data, 8.8 percent of the debtors were delinquent for at least two months. This is similar to aggregate data indicating that in recent years (2008-2012), approximately 10 percent of unsecured credit balances are classified at any given time by lenders as delinquent. Additionally, 1.3 percent of borrowers remained delinquent for long enough to obtain "informal bankruptcy" protection by having their debts written off by lenders. This proportion is of the same order of magnitude as the 1.5 percent who filed in their date for formal bankruptcy protection.[1] These authors thus conclude that "an economic model of consumer lending that

[1]Their study is representative of approximately the top 50% of the U.S. population as ranked by credit history.

assumes formal bankruptcy as the only alternative to repayment misses an essential branch of the tree."

Our goal in this paper is to isolate and understand the nature of the relationship between these two empirically relevant ways in which households alter repayment relative to *ex ante* agreements: formal personal bankruptcy and informal delinquency. The primary theoretical contribution of this paper is the tractable addition of a delinquency option (the informal skipping of a promised payment) into an otherwise standard consumption-savings model with bankruptcy. From a quantitative perspective, we will calibrate the model to better understand the role that the joint presence of delinquency and bankruptcy play in unsecured credit allocation to US households, and the manner in which these options help households deal with shocks. Since our model features not just bankruptcy but also delinquency, we can also use it to understand the interactions policies induce between them.[2]

Our model has three messages. First, with respect to the choice between formal bankruptcy and delinquency: wage shocks matter. Specifically, we find that delinquency is readily utilized by borrowers with the worst labor market outcomes, especially when the latter are persistent, even when they owe only relatively minor levels of debt. By contrast, bankruptcy is used by households whose persistent (i.e. longer-run) earnings prospects are somewhat higher, and then, only for higher debt levels than those that make delinquency optimal. The difference arises from the fact that poor future income prospects are necessary for delinquency to yield debt forgiveness. In other words, bankruptcy does offer a "fresh start" relative to delinquency to those the capacity to earn modest levels of income.

Second, our model also suggests that financial distress is likely to be persistent. The

[2]This is particularly relevant for understanding novel policy changes, such as the unveiling by the newly-created Consumer Financial Protection Bureau, of policies regulating debt collection practices for delinquent borrowers. See "CFPB to Supervise Large Debt Collection Firms," American Banker, October 24, 2012.

same earnings-related outcomes that make both delinquency and bankruptcy optimal at a given time, tend to be persistent and elevate the odds of the recurrence of these events at nearby dates.

Third, we show that, in broad terms, bankruptcy and delinquency are "substitutes," with increases in the costs of one option substantially increasing use of the other. Our model implies that increases in the stringency of delinquency by means of high permissible levels of garnishment can lower delinquency rates, but may increase rates of bankruptcy.

Our quantitative analysis is based on the model of household-level labor market outcomes of Low, Meghir, and Pistaferri (2010). We choose this model because it offers a rich characterization of risk, especially wage- and employment-risk. It also allows for workers to reject wage offers, which we would like to preserve as a real option, given that our model is one where debt relief options might a priori be expected to affect acceptance of work opportunities. An important aspect of using the Low, Meghir, and Pistaferri (2010) process is that it allows us to parameterize our model to quarterly measures of risk and credit use. This is especially important because it allows us to generate delinquencies of a length (i.e. one quarter) that in the data, often prove to be transitory.

The ability to default on debt without formal declaration of personal bankruptcy is important for at least two related reasons. First, as mentioned above, the option to informally default through delinquency may matter for the decisions of households with respect to formal bankruptcy–and vice versa. Agents who opt to become or remain delinquent and put off bankruptcy choose to face the costs of delinquency because they view them as preferable to the costs they associate with formal bankruptcy, even when the latter leaves any future income "free and clear" (in the case of the predominant form, Chapter 7 "liquidation" bankruptcy). The reasons here have to do with the relative short-term costs of the option,

but also with the path of expected future income. In the case of delinquency, these costs are expected levels of wage garnishment and potentially increased costs of rolling over debt. In the case of formal bankruptcy, the losses are determined by the extent to which agents face court- and stigma-related costs.

Importantly, one possibility is that households routinely find delinquency preferable to bankruptcy, at least initially. That is, delinquency may simply be a stop en route to a bankruptcy that was always part of a household's optimal plan. However, it may also be a gamble by households that, by surviving temporarily via delinquency, they will receive better income draws that will allow them to avoid any costs associated with bankruptcy. Of course, the costs of delinquency at any date will rise as expected future household income rises—since the expected present value of payment via garnishment will rise, all else equal. Thus, bankruptcy may even be used by some agents with high expected future incomes, but who currently have large debts. *Ex ante*, this constellation of outcomes is unlikely, but this consideration shows that the interaction of these options may be important for the dates, states, and extent to which households repudiate debt.

Nonetheless, recent work is suggestive that the relative costs of default matter in a related manner. Ashcraft, Dick, and Morgan (2007), and later Li, White, and Zhu (2010), Lilienfeld-Toal and Mookherjee (2010), have all suggested that the reform led to greater *mortgage* default, as households worked harder to repay unsecured debts than they otherwise might. While our focus is not on the choice between mortgage default and unsecured debt default (in part because such a question would require a model of house price declines given the secured nature of mortgage debt), what *is* relevant is that there may indeed be a tradeoff between delayed repayment or non-repayment in one form versus another.

Our work is related to recent work of Chatterjee and Gordon (2012), and ongoing work

of Benjamin and Mateos-Planas (2012) though ours employs a life-cycle model to generate a portion of debt from purely intertemporal smoothing motives, as opposed to risk alone. In contrast to Chatterjee and Gordon (2012), we model the process of loan modification via a renegotiation process that determines a household's obligations upon informal default.

With respect to the manner in which we model the renegotiation of debt in delinquency, our model most closely follows that of Kovrijnykh and Szentes (2007). Specifically, in our model, as in theirs, upon delinquency, the incumbent lender restates the value of the principal owed, but does so in a way that maximizes its expected present value conditional on the borrower's current state. Our approach imposes only that borrowing terms satisfy what is ex-post optimal for lenders, taking as given the household's outside options in the eventuality of delinquency.

Our work is also related to recent work by Herkenhoff and Ohanian (2012), who study the effect of mortgage default and modifications in the weak recovery of U.S. labor markets after the Great Recession. In their model, mortgages are perpetuities with fixed payments and a fraction of agents are endowed with a mortgage upon entering the world. Delinquency and loan modifications provide a way to delay payments.[3]

The roadmap for the remainder of the paper is as follows. Section 2 develops the model of debt, delinquency, and bankruptcy. Section 3 characterizes the model. Section 4 describes the parameterization of the model. Section 5 contains presents our results, focusing on the decisions of households with respect to the use of the two different debt relief measures. Section 6 concludes.

[3]They find that foreclosure delays have a significant effect on the unemployment rate.

2 Model

We introduce delinquency into an otherwise standard quantitative consumption-savings model of life cycle with bankruptcy (Athreya, Tam, and Young, 2009); delinquency is a mean of delaying or avoiding the option of bankruptcy, which requires one period of legal exclusion from credit markets to exercise and also carries (for convenience) a utility cost. We then use the model to address a variety of facts about unsecured credit (e.g., the fraction of households with negative net worth and debt-income ratios among borrowers), formal bankruptcy (e.g., filing rates and debt discharged via bankruptcy), and delinquency (e.g. delinquency rates and delinquency histories).

The central difference between bankruptcy and delinquency is that after delinquency, the borrower still faces a debt, though it will now reflect renegotiation. By contrast, after bankruptcy (Chapter 7 liquidation bankruptcy in particular), the household receives a "fresh start" and owes nothing.

A key aspect of our model is that it captures this difference in a tractable way. It does so by recognizing that competition among lenders will force a creditor to let bygones be bygones, ensuring that the renegotiated debt level be one that maximizes the expected payoff to the lender. This debt level is a value that depends only the current state of the household, and critically, is independent of the initial debt amount: it is purely forward looking.

Lastly, we endogenize the interest rate on delinquent accounts by allowing lenders to "mark up" or "charge off" delinquent accounts, but as above, their ability to do (and interest in doing) so is limited by both the option to declare bankruptcy and the presence of potential entrants; interest rates on new loans are competitively determined by zero-profit conditions.

2.1 Preferences and Endowments

All households are finitely lived, with the head of the household living at most for J periods, and have standard time-separable preferences over consumption. Households vary in their size over the life-cycle, with the effective family size (in adult-equivalent terms) being denoted by η_j. Households receive stochastic endowments as a function of their permanent "type" e, to be interpreted as a household's formal schooling attainment level.

Households have a process for labor income y that is random and has both age and education-specific components; we will be more specific about this process in a later section but to conserve on notational burden we only specify that y' given y has probability $\pi(y'|y)$. Finally, households discount the future exponentially, with parameter β.

At any age-j, a household wishing to borrow may issue one-period debt with a face value b_j, due next period. Households issue all debt to a single lender. In the following period, the household can do one of three things: (i) they can repay their debts as promised, (ii) they can file for formal bankruptcy protection that immediately relieves them of any obligations to repay their debt, or, as will be emphasized here, (iii) they can simply not repay the debt as promised. The last option is what we refer to as "delinquency."

The ability to avoid a full repayment when it is due in the following period implies that the household's debt issued the current period, b_j, will be discounted relative to its face value with price $q_{j,e}(b_j, y_{j,e}) : B \times Y \longrightarrow [0, 1)$. We now detail the effects of each option on current resources and then turn to the differing dynamic consequences each choice induces.

2.2 Budget Constraints

A household that repays its debts as promised has a completely standard budget constraint. It is given as

$$c_j + q_{j,e}(b_j, y)b_j = b_{j-1} + y. \tag{1}$$

A household that formally declares bankruptcy is, as already noted, relieved of any obligations to repay its debts. However, there is an immediate consequence that appears in the budget constraint: the household cannot save or borrow in the current period, and formally declares bankruptcy consumes real resources $\Delta(y)$, arising from court costs and legal fees.[4] Therefore, consumption is

$$c_j = y - \Delta(y), \tag{2}$$

and where

$$b_j = 0. \tag{3}$$

Lastly, a household that decides to skip debt payments, but does not seek formal bankruptcy protection, is said to be in delinquency. In this case, the household's budget constraint is again one where the household cannot borrow or lend in the current period. However, a household that is delinquent immediately faces garnishment of its income. As a result, given that a proportion of its income $\psi \geq 0$ is garnished, the household is left with current period consumption

$$c_j = (1 - \psi)\, y. \tag{4}$$

[4]Because some costs can be waived for cause, Δ will depend on y in the quantitative model.

In terms of current consequences for available resources, then, the difference between bankruptcy and delinquency is simply the income lost in delinquency. However, there are also consequences for the effect of expenditures on the utility of current consumption, as well as differing dynamic consequences, as we now describe via a recursive formulation of the household's problem.

2.3 Value Functions

Let b_{-1} denote debt due in the current period, and b denote any new debt issued in the current period. Lastly, let the indicator $d = \{0, 1, 2\}$ denote complete repayment, delinquency, and bankruptcy, respectively. For a household that chooses in the current period to repay debt normally, the household problem is given by

$$v_{j,e}^{d=0}(b_{-1}, y) = \max_{b} \left\{ \frac{\eta_j}{1-\sigma} \left(\frac{c_j}{\eta_j} \right)^{1-\sigma} + \beta \sum_{y'} \pi(y'|y)\, v_{j+1,e}(b, y') \right\}. \tag{5}$$

subject to (1).

The remaining lifetime utility of a household that chooses not to repay, but instead becomes delinquent, obeys the functional equation

$$v_{j,e}^{d=1}(b_{-1}, y) = \frac{\eta_j}{1-\sigma} \left(\frac{c_j}{\eta_j} \right)^{1-\sigma} - \psi_D + \beta \sum_{y'} \pi(y'|y)\, v_{j+1,e}(h_{j+1,e}(b_{-1}, y'), y') \tag{6}$$

subject to (4).

We see here that the household not only faces wage garnishment in each period, but also faces a utility cost $\psi_D > 0$, reflecting all additional costs associated with remaining delinquent.

The key to this problem is that in the following period the household faces a revised debt obligation $h_{j+1,e}(b_{-1}, y')$.

Lastly, when a household invokes formal bankruptcy protection, the continuation payoff is given by the solution to

$$v_{j,e}^{d=2}(b_{-1}, y) = \frac{\eta_j}{1-\sigma}\left(\frac{c_j}{\eta_j}\right)^{1-\sigma} - \psi_B + \beta \sum_{y'} \pi(y'|y)\, v_{j+1,e}(0, y'), \tag{7}$$

subject to (2).

Here, it should be noticed that the key advantage of bankruptcy relative to delinquency is that the household will enter the next period with *no debt*—as seen in the term $v_{j+1,e}(0, y')$. However, in the current period, we see that, as with delinquency, household expenditures generate a lower level of utility than they would otherwise. We allow the transactions costs on consumption expenditures arising from the default actions of delinquency and bankruptcy to vary, rather than restricting them to be equal. Indeed, they will not be equal: it will turn out in our calibration that $\psi_B > \psi_D$; i.e., bankruptcy is costlier than delinquency in terms of the current effect on the utility of consumption.

The presence of a utility representation of default costs allows for the parsimonious representation of all costs of outright formal debt repudiation implied by the existence of the unsecured credit market. This cost includes, most obviously, any "psychological" costs of lenders' collections efforts along with a variety of costs associated with poor credit. Moreover, relative to existing work, our measures of these costs more clearly separate the costs of delinquency from those arising in formal bankruptcy than existing work because both options are explicitly modeled as available. While we choose to model this cost as a direct loss of

utils, it can also be viewed as a proportional loss of consumption; the implications of the two models are not significantly different.

Given the options available to a household in a given period, their expected maximal lifetime utility satisfies

$$v_{j,e}\left(b_{-1},y\right)=\max\left\{v_{j,e}^{d=0}\left(b_{-1},y\right),v_{j,e}^{d=1}\left(b_{-1},y\right),v_{j,e}^{d=2}\left(b_{-1},y\right)\right\}.$$

As noted at the outset, in addition to the effects on current income or utility, the main distinction between bankruptcy and delinquency is that the latter leaves the household with remaining debt obligations. To describe this, consider a household that has ceased repayments and now stands delinquent. In this case, the lender must decide how to restructure in light of the household's decision. It will choose the revised face value of debt b to maximize the value of obligations, taking as given the household's future options to declare bankruptcy, remain delinquent, or become "current" on debts. Let the mapping from initial delinquent debt b_{-1} and the revised debt, as a function a household's characteristics be given by $h_{j,e}(\cdot)$:

$$h_{j,e}\left(b_{-1},y\right)=\underset{b}{\operatorname{argmax}}\left\{bq_{j,e}\left(b,y\right)\right\}. \tag{8}$$

This function is key in our analysis because it determines the evolution of the face value of debt in the case of delinquency. The revision of debt implies an interest rate on delinquent debt that we will focus our theoretical section on characterizing.

The problem that leads to the function $h_{j,e}(\cdot)$ can be thought of as simply an "announcement" by a lender on what he would prefer the borrower to repay. However, since the

borrower has the options to (1) do nothing (that is, to remain delinquent) or (2) go bankrupt and owe nothing, lenders are constrained in their ability to extract resources from the borrowers – lenders will choose the new debt level to maximize the expected payments, where the function q represents the market's expectation of future repayment. We are implicitly assuming here that there is no commitment on the part of lenders regarding pricing along the delinquency branch – that is, if we had instead assumed that $h_{j,e}(b_{-1}, y)$ was determined by Nash bargaining *ex ante*, without commitment the lender would renege on any agreement and choose (8) *ex post*.[5]

2.4 Pricing Function

The price function will, of course, be very important for our analysis. It is trivial in the case of saving, $b \geq 0$:

$$q_{j,e}(b, y) = \frac{1}{1+r}, \tag{9}$$

where r is the risk-free rate. However, when households borrow, $b < 0$, the price function will be the solution to a functional equation. In particular, this function will solve

$$q_{j,e}(b, y) = \frac{\mathbb{Q}}{1+r+\phi}, \tag{10}$$

[5]This reneging would occur independent of the nature of the bargaining solution; for example, it would also arise under proportional bargaining.

where ϕ is a transaction cost of intermediation that applies only to borrowing and $\mathbb{Q}$ is given as follows:

$$\begin{aligned}\mathbb{Q} &= \sum_{y'} \pi\left(y'|y\right) \mathbf{1}\left(d_{j+1,e}\left(b,y'\right)=0\right) + \\ & \sum_{y'} \pi\left(y'|y\right) \mathbf{1}\left(d_{j+1,e}\left(b,y'\right)=1\right) \left[\psi y' + \frac{q_{j+1,e}\left(h_{j+1,e}\left(b,y'\right),y'\right) h_{j+1,e}\left(b,y'\right)}{b}\right].\end{aligned}$$

The last equation is the price function for debt with risk of bankruptcy *and* risk of delinquency. First, consider states in which the household chooses the case of full repayment, denoted by the case $d = 0$. In these cases, lenders get one dollar per dollar lent. Next, consider the role of states in which households choose bankruptcy ($d = 2$). Given that lenders obtain nothing in cases of bankruptcy, no terms referring to that state are explicitly included. Notice that in this case both $d \neq 0$ and $d \neq 1$. Therefore, the RHS of the preceding equation collapses to zero in all states next period in which bankruptcy is declared. Finally, and more interestingly, focus on states that lead households to choose delinquency, whereby $d = 1$. In these cases, the final term on the RHS is activated. Because lenders can garnish part of the household's income, we obtain the term $\psi\left(\omega_{j+1,e}y'\right)$. But creditors of currently delinquent borrowers can also adjust the interest rate or the face value of debt for the next period. Recall that this decision is made to maximize the market value of debt, $q_{j+1,e}\left(h_{j+1,e}\left(b,y'\right),y'\right) h_{j+1,e}\left(b,y'\right)$, where the choice of h was described in equation (8). Thus, we have a recursive representation for the evolution of debt and interest rates *along the path* in which in households remain delinquent.[6]

[6]The fact that one can write these prices as functional equations was noticed in the literature on international finance by Hatchondo and Martinez (2009) and Chatterjee and Eyigungor (forthcoming) and also used by Hatchondo, Martinez, and Sanchez (2011) in a model of mortgage default.

3 Theoretical characterization

We now present a theoretical characterization of our model. Before that, we add an assumption that will hold in all our quantitative exercises. In particular, we assume that the costs in the current period of delinquency are smaller than the costs in the current period of bankruptcy: $\psi_D < \psi_B$. However, because bankruptcy generates complete debt forgiveness both may be used in equilibrium.

The first property of our model that is worth highlighting is that h is independent of previous obligations b_{-1}. As a consequence, hereafter we write it as $h_{j,e}(y)$.[7] This observation makes it feasible for us to prove the following proposition.

Lemma 1 *$v_{j,e}(b_{-1}, y)$ is weakly increasing in b_{-1}.*

This result is used in the next lemma, which characterizes the default decision in terms of the current amount of debt, b_{-1}.

Lemma 2 *The following statements are true about the current stock of debt, b_{-1}, and the decision between bankruptcy, delinquency, and debt repayment:*

1. *Suppose a household with state (b_{-1}, y) chooses bankruptcy. Then, a household with state $(\widehat{b}_{-1}, y)$ with $\widehat{b}_{-1} < b_{-1}$ also would choose bankruptcy*

2. *Suppose a household with state (b_{-1}, y) chooses delinquency. Then, a household with state $(\widehat{b}_{-1}, y)$ with $\widehat{b}_{-1} < b_{-1}$ also would choose delinquency*

3. *Suppose a household with state (b_{-1}, y) chooses debt repayment. Then, a household with state $(\widehat{b}_{-1}, y)$ with $\widehat{b}_{-1} > b_{-1}$ also would choose debt repayment.*

[7] In the presence of interest rate ceilings, this independence may not hold; we are studying the effects of ceilings in ongoing work.

This results implies that households with little debt choose repayment and households with large debt choose either delinquency or bankruptcy. It also implies that the choice between these two decisions depends on income and not on the stock of debt.

The next proposition states the main theoretical result.

Proposition 1 *A delinquent household borrows the amount of debt in delinquency until the next period at an implicit interest rate that can never be higher than the corresponding market rate.*

The intuition is simple. Households in delinquency are, in effect, forcing creditors to lend the delinquent amount. If the interest rate that creditors apply to that debt is higher than a market rate that is available for a households with those characteristics trying to borrow the amount (in order to roll over those obligations), then the household would strictly prefer avoiding delinquency.

4 Calibration results

4.1 Quantitative model

We will now be more specific about the process for y discussed in the previous section; specifically, we assume it follows the income process estimated by Low, Meghir, and Pistaferri (2010). We made this choice because it allows employment risk (employed vs. unemployed) and it is estimated for higher frequency (quarterly). As discussed in the introduction, these two features are key to understand delinquency.

Households vary in their formal educational attainment, e, that can be high (with measure Υ) or low (with measure $1 - \Upsilon$), and their age a, which takes values from 22 to 72 with

mandatory retirement at 62. Both education and age affect productivity. There is also a persistent shock to productivity, n.

In addition, workers are matched with firms with productivity that depends on a match-specific component that changes only when the worker changes firm. The match-specific productivity is denoted by m.[8] New draws of match quality come from a normal distribution with mean 0 and variance $\sigma^2_{m,e}$.

Given these parameters, wages $w(e, a, n, m)$ are given by

$$\ln(w_a(e, a, n, m)) = x_a(e) + n_a + m_a, \tag{11}$$

where x_a is a deterministic age-income profile and n_a is a random-walk component

$$n_a = n_{a-1} + \zeta_a \tag{12}$$

where $\zeta_a \sim N\left(0, \sigma^2_{\zeta,e}\right)$.

Households may also suffer shocks that lead to disability. In this case, they receive transfers that will be specified further below. Disposable earnings of a household of age a, with productivity n, firm-worker match-specific component m, who are not currently obtaining disability insurance are given by

$$\mathbf{y}(a, n, m, p) = p\left(w(e, a, n, m)\right)h\left(1 - \tau\right) - F_e) \tag{13}$$

where h is the *fixed* number of hours worked by an employed agent, τ is the proportional tax rate that used to finance all the social programs, and F_e is a fixed commuting cost. When

[8]Note that firms do not differ in their productivity. Rather, workers at any moment in time belong in a particular match that determines (in part) their productivity.

an offer is available, workers decide to work or not, and this decision is denoted by $p = 1$ or $p = 0$, respectively.

Labor is subject to search frictions, whereby a job offer arrives with probability λ_e^E if the household is employed and λ_e^N if the household is unemployed. Thus, education also affects the likelihood of reemployment. If a new work opportunity arises, workers decide whether to switch jobs or not. When employed, all worker-firm matches are subject to exogenous separation at rate δ_e. Additionally, workers can quit to pursue other employment opportunities or become unemployed. The period utility function is

$$U(c, p) = \frac{\left(c \exp\left(\varphi_e p\right)\right)^{1-\gamma}}{1-\gamma}$$

where $\gamma \geq 0$ is the coefficient of relative risk aversion and $\varphi_e < 0$ governs the disutility of supplying labor.

There is a social safety net that partially insures workers against the risk of unemployment and the risk of permanent loss of productivity. The former arises from search frictions, and the latter arises as individuals face the risk of becoming disabled, in which case their productivity falls to zero. Households receive unemployment payments (with replacement ratio relative to n of ϑ up to a maximum benefit Ξ) the first period they are unemployed, only if they did not quit, and continue to receive work offers (stochastically). By contrast, disability is an absorbing state. Individuals that are eligible decide whether to apply for disability insurance or not. An individual is eligible to apply for disability if he is older than 50 years old, unemployed, and didn't apply for disability the last period; applications are

successful with probability $s \in [0,1]$ and yield benefits

$$D_{it} = \begin{cases} 0.9 \times \overline{w} & \text{if } \overline{w} \leq a_1, \\ 0.9 \times \overline{w} + 0.32 \times (0.9 \times (\overline{w} - a_1) & \text{if } a_1 < \overline{w} \leq a_2, \\ 0.9 \times \overline{w} + 0.32 \times (0.9 \times (a_2 - a_1) + 0.15 \times (\overline{w} - a_2) & \text{if } a_2 < \overline{w} \leq a_3, \\ 0.9 \times \overline{w} + 0.32 \times (0.9 \times (a_2 - a_1) + 0.15 \times (a_3 - a_2) & \text{if } \overline{w} > a_3. \end{cases}$$

where $\overline{w}$ is the persistent component of the previous wage.

Lastly, individuals are eligible to receive food stamps, modeled simply as an increment to income Γ rather than a voucher for a specific consumption good. These transfers are represented by the function $T_j(\mathbf{y})$.

4.2 Parameters, Targets of Calibration, and Fit

We now study the quantitative properties of the model. To maintain comparability to existing work, wherever possible, the parameters are taken from previous estimations. The parameters are displayed in Table 1 . The choice of risk aversion coefficient $\gamma = 2$ is standard in macroeconomics. The annual risk free rate is $r = 1.5$ percent, also standard. The parameters ϕ is set at 3 percent annually to capture the wedge between the interest rate for credit and deposits that is not accounted by the risk of default. Finally, filing bankruptcy is costly. That cost can be taken directly from the data and depends on the household labor status.[9]

We focus throughout on stationary equilibria in which decisions remain constant functions of the household's state over time. Both the income process and risk-free rate are, for simplicity, modeled as exogenous. Now, we describe the parameters that are taken directly

[9]See, e.g. GAO (2008).

from the work of Low, Meghir, and Pistaferri (2010). The values are presented in middle panel of Table 1.

Other parameters are calibrated to match specific targets regarding bankruptcy. We calibrate three parameters in this manner: β, preference discount factor; ψ_D, non-pecuniary cost of delinquency; and ψ_B, non-pecuniary cost bankruptcy. The obtained values are presented in the bottom panel of Table 1. The parameters obtained by this method are in the range of values used in previous studies. Nevertheless, our benchmark calibration implies that the households under study are slightly less patient than is typically implied by models that assume complete markets. In models such as ours with incomplete markets stemming from uninsurable risk, discount factors of close to 0.95 are not unusual. For example, Davila, Hong, Krusell, and Rios-Rull (2011) features discount factors below 0.9, as does the earlier estimation of Cagetti (2003); these papers require a low discount factor in order to mitigate strong precautionary savings motives. In contrast, our focus is on households' use of expensive unsecured credit—in order for households to borrow at observed interest rates they must be quite impatient on average.

The targets are three moments: the bankruptcy rate, the share of debt in delinquency, and the mean of the ratio of assets to income. The obtained parameters and the model's fit of targeted moments are presented in Table 2. The incidence of bankruptcy, as measured by the bankruptcy rate, and the incidence of delinquency, as measured by the share of debt in 90+ delinquency are replicated by the model remarkably well. The ratio of asset to income is also closely reproduced by the model.

5 Results

We now employ the quantitative model described above to help answer two questions. First, what is the nature of the relationship between an individual's circumstances and their decisions to use delinquency and bankruptcy? Second, what are the implications of systematic changes in the costs of informal default? For the first question, we will focus on the behavior of income, employment, consumption and debt in the periods before and after each of the two types of default event: delinquency and bankruptcy. For the second question, we will examine a set of counterfactual regimes in which varying amount of labor earnings may be seized ("garnished") by a creditor for the satisfaction of debt obligation.

5.1 Default over the life-cycle

We first demonstrate that our benchmark model accurately captures salient observations on default. Tables 3 to 5 display model outcomes under the benchmark parameterization. The model reproduces overall delinquency rates (the fraction of individuals currently behind on obligations) relatively well although they were not targeted. To be clear, these numbers are stocks, measuring delinquency at a given point in time.[10] The baseline model also replicates the conditional delinquency rates of the high- and low-educated, with the latter contributing more to delinquency . The model also replicates well the interest rates paid by households, as shown by Table 4. Finally, Table 5 demonstrates that the mean age and income of those

[10]The data for this table is computed using the SCF 2004. The questions in this survey do not identify delinquency perfectly. However, the survey asks the following two questions about delinquency: (1) Now thinking of all the various loan or mortgage payments you made during the last year, were all the payments made the way they were scheduled, or were payments on any of the loans sometimes made later or missed?, and (2) Were you ever behind in your payments by two months or more? According to our definition, to be in delinquency a households needs to have a positive answer to both questions. Additionally, because these questions include all types of debts, to try to keep only those delinquent in unsecured debt, we exclude the households with no credit cards and those that reported they are paying their mortgage behind schedule.

delinquent, bankrupt, and solvent are closely approximated by the model as well.[11] Overall, therefore, the benchmark model, while parsimonious, performs well while using primarily non-calibrated parameters (especially those governing income and employment process over the life-cycle) and relatively few additional internally-calibrated parameters.

While the previous table (Table 5) presented averages for age and income among debtors, it is of interest to know the model's implications for the evolution of debt itself over the life-cycle. This is given in Figure 1, and shows clearly that unsecured borrowing is primarily a feature of young borrowers, and perhaps more interestingly, a feature of the better educated borrowers. The main mechanism behind this pattern is intertemporal smoothing. For both education groups, the future (from the perspective of very young ages) will be better, on average, than the present. The overall profile of mean income of the well-educated is steeper, and at a higher level, for the former than the latter, as see in Figure 2. As a result, both groups borrow, with the better-educated doing more of it than the less-educated. The relatively greater motive to borrow at all, and to borrow more once doing so, amongst the high-education group is shown both in the amount of debt conditional on borrowing (Figure 1) but also, and even more clearly, in the proportion of households choosing to become indebted early in life. The relatively slow decay of the fraction of indebted households also clarifies that the maturity of unsecured is not necessarily short. This is consistent with work of *Calem and Gordy (?)* who show that the serial correlation of unsecured debt in annual data is above 0.9.

Given our focus on debt default, how are the borrowing patterns described above related to delinquency and bankruptcy? Figure 3 reports the life-cycle behavior of delinquency (left) and bankruptcy (right). Two points are apparent. First, default occurs more or less

[11] In the SCF, households in bankruptcy are those that answered yes to the question "Have you ever filed for bankruptcy?" and answered a year ago to the question "When was that?".

contemporaneously with debt. It is not the case, for example, that debts incurred when young are primarily defaulted only at much later dates when, perhaps, lifetime income has been more fully resolved. In other words, default as a whole is not a tool reserved for use only when income becomes known with some precision to be lower than earlier expectation, but rather as a consumption smoothing tool at higher frequencies.

The next main feature of results pertaining to the life-cycle of debt and default is that of the routes employed by borrowers to delay or reduce repayment, delinquency is far more common option among the highly-educated, by roughly a factor of two, but not for those with low education. Interestingly, for the latter, delinquency and bankruptcy not only occur at lower rates overall, the rates themselves are very similar.

Two additional features are noteworthy. First, bankruptcy is less concentrated at young ages than is delinquency, with rates declining somewhat more slowly over the life-cycle. Second, Figure 3 shows that while individuals from different education levels have similar bankruptcy rates over the life-cycle, this is not true for delinquency. Instead, delinquency is both more frequent and more front-loaded for well-educated households. Remember that this households borrow more because they have high long-run average income. Thus, they find themselves more often in financial distress when they are hit by bad and persistent income shocks. In this case, delinquency is less costly than bankruptcy because it allows this group of households to obtain temporary debt relief. This point will be developed in more detail below.

Having presented default outcomes for various (age-related) collections of households, it is critical to describe the decision making that, along with shocks to earnings, led to those outcomes. Figure 4 describes household choices for a representative young household (age 29) as a function of debt as of the beginning of the period (x-axis) and the current-period

realization of the persistent shock to wages n. We see immediately that persistently low-wage states are necessary, and nearly sufficient, to trigger delinquency. For those with low debt levels, the intuition is that delinquency offers a way to smooth consumption without paying the costs that would make bankruptcy worthwhile. By contrast, for those with higher debt levels, delinquency offers a significant level of debt forgiveness, arising from the poor income prospects of the households. The necessity of the debt reduction can be seen in the figure by noticing that absent such forgiveness, higher levels of debt would simply lead to bankruptcy in more states of nature in the near-term.

A central aspect of our paper is the ability to receive partial debt relief in the wake of delinquency, without the total erasure of debt in a formal bankruptcy. This possibility is relfected in the function $h(\cdot)$ that transforms existing debt into a updated, and possibly lower, value of debt owed. Figure 5 explains how h is determined. It plots the amount of resources, $-bq\,(b,.)$, delivered today to a household that promises to pay back b next period, conditional on having a persistent component of productivity n low and high. First, notice how h is determined: it is the value of the promised amount b that maximizes the current market value of that obligation, $-bq\,(b,.)$. For a household with a high persistent component of productivity, n_h, this amount is the highest value of the dashed green line, denoted $h\,(n_h)$ in Figure 5. Similarly, for households with a low persistent component of productivity, n_L, the value of h is determined using the function described by the blue solid line. The maximizer is referred to as $h\,(n_l)$. Two features are relevant. First, the level of the face value of debt that a delinquent debtor will have next period is increasing in the persistent component of income; i.e., $-h\,(e_h) > -h\,(e_l)$ in Figure 5. As explained further below, this generates the pattern that leads households to leave delinquency through bankruptcy when income rises.

The decision of delinquency can also be analyzed with Figure 5. Consider a household with current debt equal to the point A on the vertical axis of the Figure 5. Would this household find delinquency attractive? The answer depends on the current level of the persistent component of productivity, n. First, it is easy to see that a household with high productivity n_h can roll over that amount of debt. This household can do that in the credit market by promising to pay exactly B next period. With this strategy, the household does not need to make any payment in this period. If the household decides to be delinquent, consumption today will be exactly the same as that under the roll-over strategy because there is no debt payment made this period. However, in the next period, the amount owed will be $h(n_H)$, which is strictly larger than B. Second, consider a household with a low persistent component of income, n_L. Notice that there is no way that this household can roll over the total amount of debt A at the competitive price offered in the credit market conditional on n_L. Indeed, this household could at most obtain the amount C in the market. This amount of debt, C, implies that the household must repay $A - C$ this period and will owe exactly the amount of debt $h(n_L)$ in the next. Instead, if this household chooses delinquency, the amount owed for the next period will be the same, $h(n_L)$, but it will force the incumbent lender to refinance the total amount of debt A so consumption this period will be higher. This household could indeed find delinquency attractive.

5.2 The Timing of Delinquency and Bankruptcy

We now examine the the persistence of, and interplay between, the two forms of default. Figure 7 plots the proportion of households who are delinquent at a given date t conditional on being delinquent at date t=0.[12] The immediate lesson of this figure is that delinquency is

[12]Due to its persistence and often early occurrence in the life-cycle, in the case of delinquency, we use the first date of delinquency in a person's lifetime. For the case of bankruptcy, which is more transient (analyzed

a very persistent state, even when compared against borrowers of the same mean age. The probability of being delinquent both before and after being delinquent at t=0 remains nearly twice as high as for the overall (mean-age-adjusted) group, and even higher still relative to the overall population.

Figure 8 has two messages. First, past delinquency is more likely given current bankruptcy. Given that one has entered bankruptcy at t=0, we see that the likelihood of delinquency is much higher than the age-adjusted rate. Second, many bankruptcies are *not* preceded by delinquency: it is far from an immediate precursor to bankruptcy. The model implies that between 85-90% of bankruptcy filers will not have been delinquent in the four quarters prior to a bankruptcy.

Lastly, we see that bankruptcy, through its extreme nature–whereby all debts are removed and not simply rescheduled or renegotiated–lowers the incidence for future delinquency in the immediate aftermath of t=0. Over the longer run, however, we see that past bankruptcy are associated with future delinquencies, in almost identical proportions for both education groups.

To what extent is a delinquent borrower likely to have had a past bankruptcy? In Figure 9, we see that the model suggests that the odds, while substantially higher than for the two reference groups we have defined, are still low in absolute terms, at between 2 and 3 percent one year prior to a delinquency.

5.3 Income and Employment Dynamics Near Default Events

Having displayed the persistence and co-movement-related properties of bankruptcy and delinquency, we now turn to the main goal of this paper: to better understand the use

below), we use a symmetric window.

of default, and it's two variants, bankruptcy and delinquency, as tools for household risk management. We therefore now focus on the model's implications for the typical situation being dealt with by households seeking debt relief via either channel of default. Specifically, we now study the relationship between default and income, education, and default.

Given the intuitive connection between income and credit use and default, a natural starting point is the behavior of income in the neighborhood of a bankruptcy event. This is given in Figures 10 and 11. In this, and in any of the following figures in which we focus on those for whom a given credit event occurs, we fix the date at which the event occurs is normalized to t=0. The remaining dates trace the circumstances of this subset over time before and after the event.

In Figures 10 and 11, we see two immediate and natural implication of the model: at the time of default, both those using bankruptcy and delinquency have incomes (all values in quarterly units) substantially lower than the mean income.[13] As we saw, borrowers are in general younger than the overall population, so this is to be expected. However, it is still true even after we condition on age. The lower flat green-dashed line shows the mean income for those of the same age as the mean age of those with the default event at t=0.

A second observation is that the incomes of delinquent debtors is substantially (approximately 25%) higher than those of bankruptcy filers. Part of this is driven by the higher mean age of bankruptcy filers and the upward sloping age-income profile of all households. However, the gap between overall income of agents the same age as the mean age of bankruptcy files is also much larger than is the case for delinquent filers.

The movements in income just noted arise primarily from changes in employment sta-

[13]The results for labor earnings (instead of income) are nearly identical and so not given separately here. The similarity occurs because of the overwhelming importance of labor income for most households–especially for the relatively young cohorts that will disproportionately populate the rolls of debt defaulters.

tus. Because our model allows for both variation in wages, but perhaps more importantly, variation in employment status, we can examine how employment, specifically, is related to default. At high frequencies, the latter is the dominant force behind overall income, especially for the young. In Figure 12 we see that the employment rate for both education groups drops sharply in the period preceding a delinquency, with the low-education group suffering more. This is again consistent with the idea that delinquency helps create "breathing space" for dealing with the first instance of poor labor market outcomes for households, while bankruptcy is for longer spells of unbroken misfortune.

The net effect is that bankruptcy filers are generally in worse circumstances than delinquency users, and have been so for a long time (more than one year). This is perhaps natural: bankruptcy carries significant costs that are worth paying only when debts are substantial. But for debts to be substantial, incomes and employment rates in the periods preceding default will be low on average, relative to the (age- and education-adjusted) mean–which they are. For example, in Figure 13, we see that employment rates are falling on average for a full year before bankruptcy.

An interesting aspect of the relationship between labor market outcomes and default is that because both forms of default are used disproportionately by younger households, income (as seen in Figures 10 and 11) is substantially lower than the unconditional mean, and lower also that the age-adjusted mean. We see from Figures 12 and 13 that the employment rates too are systematically lower than the group with the same average age as the defaulters. This is a key part of the reason for the persistence in delinquency rates seen earlier in Figure 7. However, these rates are routinely *higher* for the debtors than they are for the overall population, reflective of the lower reservation wages of the young.

Given that incomes before, and after, default events are substantially lower for defaulters

than for the overall population, and given that default itself has occurred–it is natural to expect that households paths of debt will show relatively high levels of borrowing. This is confirmed in Figures 14 and 15. One sharp difference is apparent, though. The gap between the levels of debts in the pasts of those who enter bankruptcy and all others is much higher than is the case for delinquent households. In the case of bankruptcy filers, we see that even as far back as five quarters prior to default via bankruptcy, the average debt of the filers is between $200 (low education) and nearly $600 higher (high education). By contrast, those who eventually become delinquent look essentially identical in debt to their solvent counterparts. In this sense, in equilibrium, delinquency will be harder to predict than bankruptcy. Nonetheless, at high frequencies, both forms of default are preceded by fairly run-ups in debt, with the well-educated increasing their borrowing most.

Delinquency and bankruptcy are associated with different dynamics after the default event. As seen, again in Figures 14 and 15, since (by definition) bankruptcy eliminates unsecured debt altogether, households balance sheets are cleared up and they renew debt accumulation. The reason for this was seen in Figures 10 and 11–earnings remains lower than (even the age-adjusted) mean. As a result, agents can expect future income to be higher than current income, and therefore borrow to smooth consumption.

For the same reasons, post-default dynamics are different for those invoking delinquency. Debt increases slightly relative to overall (age-adjusted) mean debt, but not as substantially as in the case of post-bankruptcy borrowing. Unlike in bankruptcy, income returns close to its age-adjusted mean with a few quarters. This highlights the interplay between income, age, and debt in differentiating those who find delinquency useful, relative to those who find bankruptcy useful.

Roughly, delinquency is for recent spells of misfortune that can be expected not to persist,

while bankruptcy is invoked after a long spell of misfortune along with a relatively lower expectation for near term future income.

In what we have presented so far, we have focused on the "intensive" margin of debt, i.e. we have presented conditional moments of debt given that debt is present on a household's balance sheet. A natural question is therefore how representative such moments are. Figures 16 and 17 convey the point that these dynamics describe nearly all households who enter default. These figures present the proportion of households who are indebted before and after a default event. Of course, at t=0, all households are indebted, but what is more striking is the very high proportion of households who remain indebted after a default event, In the case of bankruptcy, the proportion drops to zero by definition at the beginning of the period following bankruptcy, but rebounds almost immediately thereafter. This is consistent with the income of these agents being lower than the mean for their demographic group–especially for the high-education households. Thus, the forces the trigger default are persistent spells of misfortune that typically (overwhelmingly) lead to/necessitate credit use after default. And in this case, the extensive margin does not seem to differ across bankruptcy and delinquency.

5.4 Policy Towards Delinquency

To this point, our focus has been purely positive, aimed only understanding the implications of the two channels of debt default as defined by the law as it current is. However, a policy-related motivation for our work was to understand the feedback effects present between delinquency policy and formal bankruptcy.

We will concentrate on income garnishment policy. In the benchmark model, garnishment was set to zero, to reflect current practices that severely restrict actual garnishment. Table 6 displays the results for selected objects across garnishment regimes. The main implications of

garnishment are as follows. First, garnishment has strong effects on overall delinquency. It is, of course, natural, that the sign of response of delinquency to garnishment. The model shows that this effect is quantitatively strong as well. For example, at even a garnishment rate of ten-percent, we see that delinquency rates fall to roughly one-fourth of their benchmark value. At the intensive margin, the total volume of debt that is delinquent also drops very sharply, from 7.78% in the benchmark economy, to just 1.57%. At higher garnishment rates, both delinquency rates and debt in delinquency stabilize. This is suggestive of the presence of a population of debtors for whom the option of delinquency is not particularly valuable, and another subset for whom it is not. Low, but positive, garnishment rates appear enough to push these "marginal delinquents" into becoming current. As evidence that the preceding is accurate, we see that mean debt-to-income ratios fall from 4.03 by a fourth, to 3.19.

Given that delinquency is being constricted as a option, to what extent to households deploy bankruptcy to deal with reductions in income relative to expectations? A first observation is that bankruptcy rates do rise as delinquency becomes more expensive, as does the total amount of debt discharged each year via bankruptcy, something consistent with their role as partial substitutes as tools of debt relief. This is consistent with the earlier results that document the differential role that bankruptcy is playing relative to delinquency. The former continues to be used for more serious income disruptions than the former. However, it is not the case that there is a wholly offsetting shift from delinquency to bankruptcy.

Our analysis so far is motivated by the fact hat the implications of garnishment for overall bankruptcy and delinquency are not a priori obvious, and depend on the quantitative strengths of preferences, wage risk, and default costs. However, conditional on personal circumstances, particularly debt, increasing the cost of garnishment should have a more unambiguous effect on default risk, since bankruptcy–which wipes out all debt–becomes

relatively cheaper. Figure 6 shows that this is the case for all households.

As seen above, the model suggests that in the U.S. economy, there is a set of borrowers who do not value delinquency very highly. This is also seen in the decline in the proportion of delinquent households who are employed. At garnishment rates above 10%, we see that no delinquent borrower is employed. Thus, the wage tax arising from a nontrivial garnishment regime is an effective deterrent. Of course, part of this outcome is driven the fact that agents can turn down employment opportunities, and may do so if it makes debt relief sufficiently less costly. On balance, this force, while present in principle, is not quantitatively important as the income loss from ignoring work opportunities is very costly. This is reflected in the overall invariance of unemployment rates to garnishment.

5.4.1 Garnishment and Financial Distress Dynamics

How will garnishment likely matter for the dynamics of debt and employment around default events? Figures 18 shows the effect on mean income at the time of a delinquency event across garnishment regimes. Intuitively, harsher garnishment lowers the income of those who find delinquency optimal, at the time they invoke delinquency. This is unsurprising as garnishment makes delinquency costs higher under high wages. Interestingly, however, the importance of persistent income risk in driving delinquency that we have already described plays a more general role as well. We see in the figure that incomes are lower in periods prior to, and following, the default as well. The extensive margin of employment features the same pattern. Figure 20 shows employment rates around delinquency events falling systematically with garnishment. This is a useful feature of our model, as it shows that households considering delinquency (i.e. households for whom near-term delinquency is relatively likely event) will also reject employment offer more regularly. This makes sense as

earnings make debt costlier to escape from, and act as an implicit tax in states of the world where delinquency is useful. In summary, therefore, garnishment can be expected to shift delinquency towards those with more persistent misfortune. By contrast, the garnishment regime has little impact on either the incomes or employment paths around bankruptcy events. This is shown in Figures 19 and 21.

To understand the role of garnishment for debt dynamics around default, we display in Figures 22 and 23 the path of mean debt for those with a default event at date t=0. We've seen that delinquency rates fall with garnishment already; Figure 22 , we see that garnishing has a substantial effect on the size of delinquencies as well–cutting them nearly in half when comparing the benchmark to the 10% garnishment case. As above, though, garnishment primarily affects delinquency, and as seen in Figure 23, has little effect on bankruptcy at the intensive margin of indebtedness. The fact that the immediate effects of garnishment fall primarily on delinquency rates, and earnings and employment around delinquency, is natural given the change in costs that these measures impose. Bankruptcy is still affected, however, as we see from the figures, as borrowing costs and debt use are affected for all households in all states.

5.5 Welfare

Table 7 shows the welfare gains of being born in economies with different garnishment .This is a long-run measure of welfare, and shows that after an initial step to a welfare of about one-third of one percent, welfare remians constant as allocations stabilize. Our model suggests that garnishment does not have the power to significantly alter allocations.

To gauge welfare gains or losses in the shorter-run, we next examine the implications of tarting from the steady state without garnishment, we compute the welfare gains of

introducing a 10 percent garnishment on newly issued debt. Figure 24 shows the welfare gains of such a reform . It shows that all households are made worse off in the short run by the removal of the flexibility provided by garnishment. [TO BE COMPLETED]

6 Concluding remarks

In this paper, we have shown that delinquency, whereby borrowers do not repay as initially promised, is different from bankruptcy protection, and that each plays a distinct role even as each is related to the other. In the data, both delinquency and bankruptcy are used frequently as ways to *ex post* alter obligations previously established. The former merely allows a delay in repayment, with no legal implications for a household's liability, but where creditors retain rights to seize labor income, while the latter formally eliminates a debt obligation. The delay in repayment requires a restatement of the debt owed from that point onward, and this amount will determined under competitive conditions because households continue to hold bankruptcy as an option.

Ours is a step in understanding consumer borrowing that incorporates both the option to delay and the option to remove debts. Our model sheds light on costs and benefits of each and also helps uncover the limits of formal bankruptcy protection to alter allocations. Roughly, while existing work has suggested that strict bankruptcy laws can change credit terms and borrowing substantially (see Athreya, 2008), our work suggests that this conclusion depends on the alternatives available, notably, the alternative to simply remain delinquent. In particular, we show that stricter control of delinquency, as defined by a relatively high ability to garnish wages, leads to more risk of bankruptcy and lower welfare (on average).

We have attempted, wherever possible, to discipline our quantitative analysis with avail-

able data. In particular, we confronted with data a variety of the model's implications for facts related to credit market aggregates and household-level income processes. As seen, the model suggested that formal and informal default interact in a rich manner, and in ways dependent on household income processes. It is also clear from the results that our model offers many additional implications for the dynamics of household default and consumption that would be useful to more fully evaluate. However, the full set of these quantitative implications simply requires better *panel* data on debts and forms of default than is currently available.

Lastly, a simplification of the model was to abstract from labor-leisure choices along the "intensive" (hours) margin. Work of Pijoan-Mas (2006) and others has shown that work effort can be a channel by which households mitigate wage fluctuations–in principle including those induced by garnishment. Our approach ties income more closely to episodes where workers lack an *opportunity* to supply labor, e.g., unemployment. Future work relaxing this to also include the intensive margin of labor supply may be useful. However, here again, it would be ideal to have data relating labor hours and income to delinquency and bankruptcy. We hope, therefore, that in the future, with the requisite data, research can advance along these lines.

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7 Appendix

7.1 Proof of Lemma 1

Notice that $v^{d=1}$ and $v^{d=2}$ are independent of b_{-1}. Thus, we must show that $v^{d=0}(b_{-1}, y)$ is increasing in b_{-1}. This problem can be written as

$$v_{j,e}^{d=0}(b_{-1}, y) = u\left(b_{-1} + \omega_{j,e} y_j - q_{j,e}(b^*, y)\, b^*, n_j\right) + \beta \sum_{y'} \Pr\left(y', |y\right) v_{j+1,e}(b^*, y')$$

where b^* is the maximizer. Now, we take $\widehat{b}_{-1} > b_{-1}$ and show that $v_{j,e}^{d=0}\left(\widehat{b}_{-1}, y\right) > v_{j,e}^{d=0}\left(b_{-1}, y\right)$. It is clear that

$$v_{j,e}^{d=0}\left(b_{-1}, y\right) < u\left(\widehat{b}_{-1} + \omega_{j,e} y_j - q_{j,e}\left(b^*, y\right) b^*, n_j\right) + \beta \sum_{y',} \Pr\left(y'|y\right) v_{j,e}\left(b^*, y'\right)$$

because u is increasing, and

$$u\left(\widehat{b}_{-1} + \omega_{j,e} y_j - q_{j,e}\left(b^*, y\right) b^*, n_j\right) + \beta \sum_{y'} \Pr\left(y'|y\right) v_{j+1,e}\left(b^*, y\prime\right) \leq v_{j,e}^{d=0}\left(\widehat{b}_{-1}, y\right).$$

because b^* is also available for the state $\left(\widehat{b}_{-1}, y\right)$ but it may not be the maximizer. ■

7.2 Proof of Lemma 2

These results are straightforward because $v_{j,e}^{d=0}$ is increasing in b_{-1} and both $v_{j,e}^{d=1}$ and $v_{j,e}^{d=2}$ are independent of b_{-1}. ■

7.3 Proof of Proposition 1

First, we define the implicit rate that is charged to a household in delinquency. This rate is

$$r^D(b_{-1}, y) = h\left(\mathbb{I}\right)/b_{-1} - 1.$$

Second, notice that in the competitive credit market the household could or could not be able to rollover the amount of debt b_{-1}. If it cannot, the proposition's statement is trivially true. If it can rollover b_{-1}, it means that there exist a $\overline{b}$ such that $\overline{b}q(\overline{b}, y) = b_{-1}$. In this

case, the market interest rate is

$$r^M(b_{-1}, y) = \bar{b}/b_{-1} - 1.$$

By contradiction, assume that

$$r^M(b_{-1}, y) < r^D(b_{-1}, y),$$

and the households prefers delinquency; i.e.,

$$v^{d=1}(b_{-1}, y) > v^{d=0}(b_{-1}, y).$$

We'll show this implies a contradiction. First, notice that

$$r^M(b_{-1}, y) < r^D(b_{-1}, y)$$

implies

$$\bar{b}(b_{-1}, y)/b_{-1} < h\left(y\right)/b_{-1},$$

and

$$\bar{b}(b_{-1}, y) > h\left(y\right).$$

Now, since both are rolling over all the obligations, consumption this period is the same under both options (ignoring garnishment). But by borrowing at the market rate and avoiding delinquency the household eludes the utility cost δ. So, in terms the utility today, the

household prefers avoiding delinquency. Then, since

$$v^{d=1}(b_{-1}, y) > v^{d=0}(b_{-1}, y),$$

it must be the case than the utility from tomorrow and on is larger if the households chooses delinquency today (in expected value),

$$\sum_{y'} \pi\left(y'|y\right) v\left(\overline{b}(b_{-1}, y), y'\right) < \sum_{y'} \pi\left(y'|y\right) v\left(h\left(b_{-1}, y\right), y'\right)$$

But this is contradicted, because $\overline{b}(b_{-1}, \mathbb{I}) > h\left(y\right)$ and v weakly increasing in b. ■

Table 1: Parameters values

		High Edu.	Low Edu.
Education distribution	Υ	0.568	0.432
Std. deviation of permanent shock	σ_ζ	0.106	0.095
Std. deviation of firm-worker shock	σ_m	0.229	0.226
Job separation rate	δ	0.022	0.039
Job arrival rate in unemployment	λ^N	0.709	0.657
Job arrival rate in employment	λ^E	0.623	0.579
Fixed cost of work	F	$\$1,213$	$\$1,088$
Disutility of working	φ	-0.620	-0.550
Total hours of work	h	500	500
UI replacement ratio	ϑ	0.750	0.750
UI cap	Ξ	$\$2,384$	$\$2,384$
DI application successful rate	s	0.500	0.500
Maximum food stamp	Γ	\$800	\$800
DI threshold 1	a_1	$\$1,203$	$\$1,203$
DI threshold 2	a_2	$\$7,260$	$\$7,260$
DI threshold 3	a_3	$\$16,638$	$\$16,638$
Risk aversion	γ	2.00	
Risk-free interest rate	r	0.375%	
Transaction cost	ϕ	0.75%	
BK filing fee for $p = 1$	Δ	$\$1,200$	
BK filing fee for $p = 0$	Δ	\$600	
Discount factor	β	0.957	
Non-pecuniary cost BK	ψ_B	1.786	
Non-pecuniary cost DQ	ψ_D	0.104	

Table 2: Fit of targeted statistics

	Data	Model
Share of debt in 90+ DQ, %	8.9	7.8
Bankruptcy rate, %	0.26	0.26
Mean (assets/income)	4.07	3.89

Source: "Share of debt in 90+ DQ" obtained from Quarterly Delinquency Report of the NY Fed. "Bankruptcy" rate is obtained from the Bankruptcy Institute. "Mean (assets/income)" is obtained from SCF 2004.

Table 3: Incidence of Delinquency in the model

Statistics	Data	Model
Delinquency rate, all	2.03	0.97
Delinquency rate, low education	2.54	1.27
Delinquency rate, high education	1.13	0.74

Source: SCF 2004.

Table 4: Mean Interest Rates,

	Data	Model
High Education Households	12.2%	9.7%
Low Education Households	13.1%	10.1%
All Households	12.7%	9.9%

Source: SCF 2004.

Table 5: Characteristics of households in financial stress

		Data	Model
Solvent			
	Age	43.6	41.4
	Income	64,052	69,240
Delinquent			
	Age	34.7	37.3
	Income	21,375	37,086
Bankrupt			
	Age	33.8	40.8
	Income	21,644	45,827

Source: SCF.

Table 6: The effect of garnishment on delinquency and bankruptcy

		Garnishment						
Statistics	BM	1%	3%	5%	10%	15%	20%	30%
Delinquency rate, %	0.97	0.57	0.32	0.27	0.25	0.26	0.26	0.26
Debt in DQ, %	7.78	4.25	2.06	1.70	1.57	1.60	1.64	1.65
Bankruptcy rate, %	0.26	0.25	0.27	0.29	0.30	0.30	0.30	0.30
Debt in Bk, %	2.42	2.49	2.76	2.84	3.01	2.99	2.94	2.96
DQ and Employed, %	0.74	0.35	0.08	0.02	0.00	0.00	0.00	0.00
BK and Employed, %	0.18	0.19	0.23	0.25	0.26	0.26	0.26	0.26
Mean (debt/income), %	4.03	3.57	3.28	3.22	3.19	3.18	3.18	3.18
People in debt, %	19.12	18.40	17.94	17.84	17.65	17.66	17.67	17.67

Table 7: Welfare gains of increasing garnishment

		Garnishment						
Statistics	BM	1%	3%	5%	10%	15%	20%	30%
Welfare gains, CE %	–	-0.16	-0.31	-0.37	-0.37	-0.38	-0.37	-0.37
Mean c unemployed / Mean c employed	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Variance of log c	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Mean c young / Mean c old	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Mean (assets/income), %	3.89	3.90	3.90	3.90	3.91	3.91	3.91	3.91

Figure 1: Life-cycle profile of debt by education group

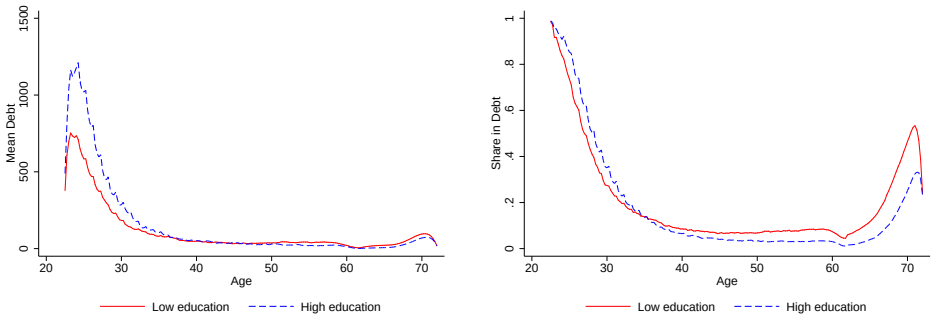

Figure 2: Life cycle profile productivity

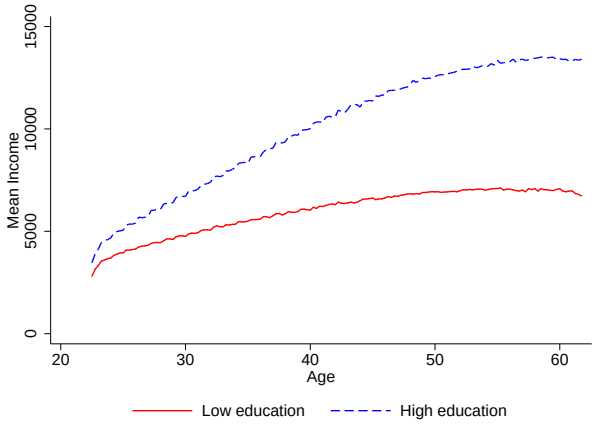

Figure 3: Delinquency (left) and Bankruptcy (right) over the life-cycle

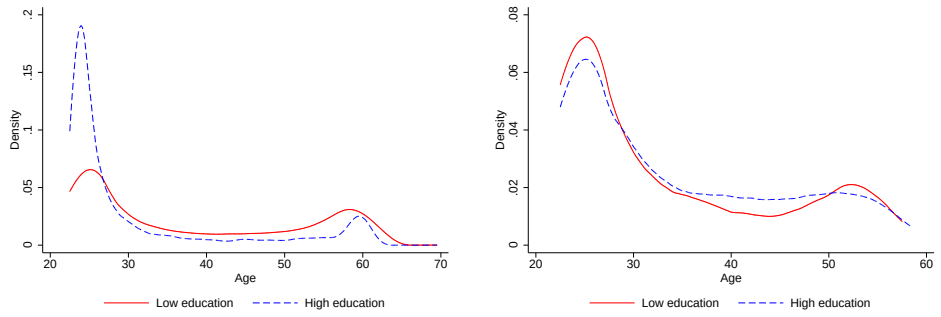

Figure 4: Repayment decision as a function of productivity

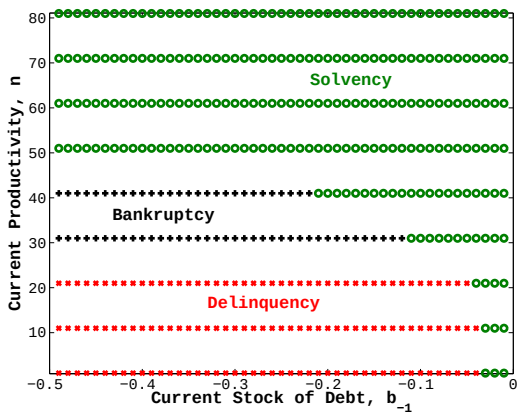

Figure 5: Why would households choose delinquency?

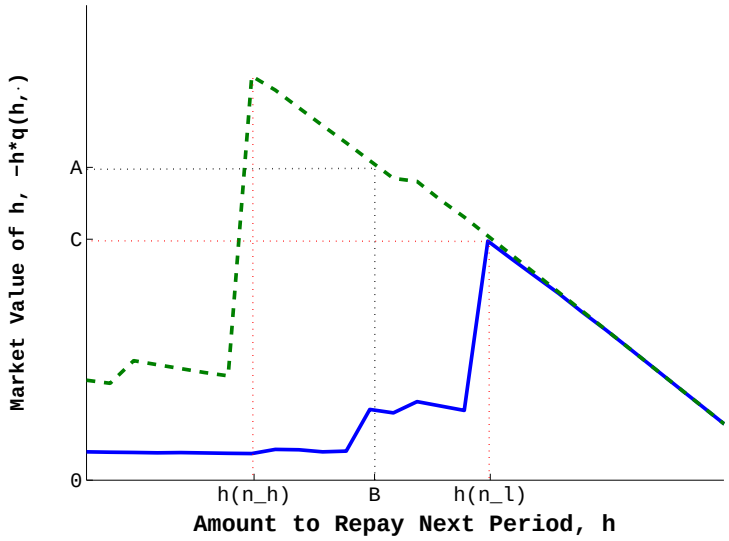

Figure 6: Interest Rate, Benchmark vs. Garnishment

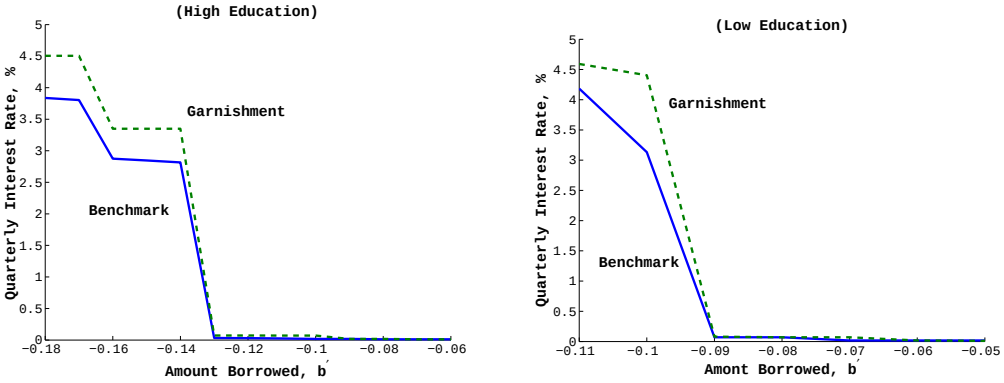

Figure 7: High persistence in DQ

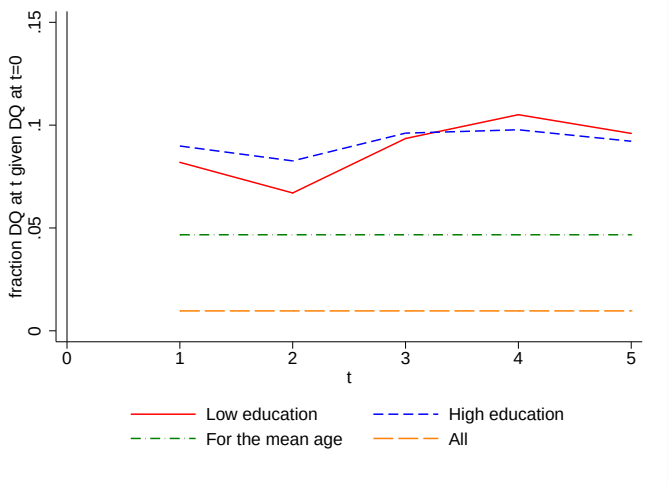

Figure 8: Persistence of poor financial conditions

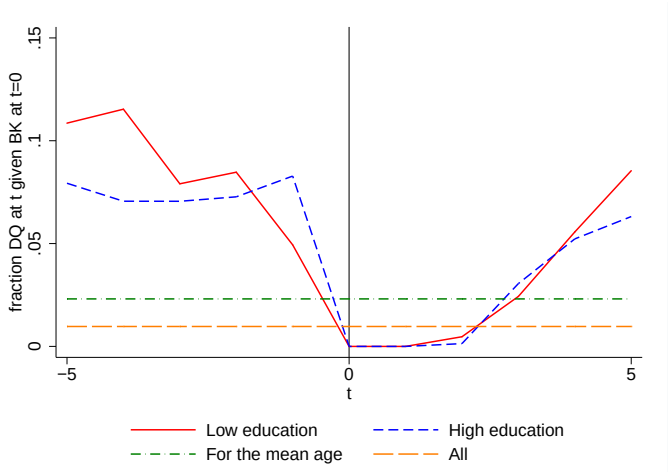

Figure 9: DQ follows BK

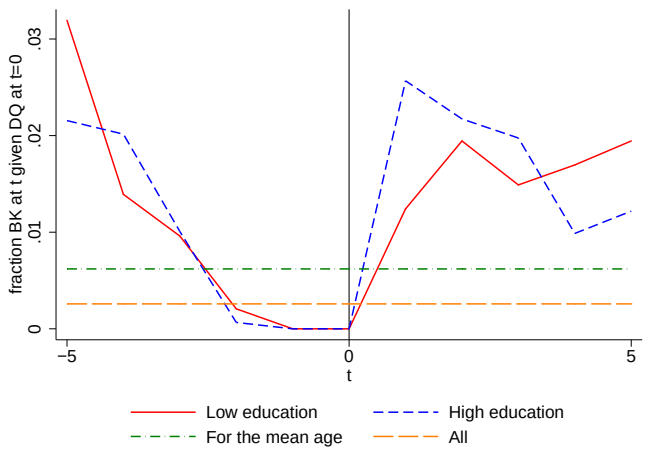

Figure 10: Income around DQ

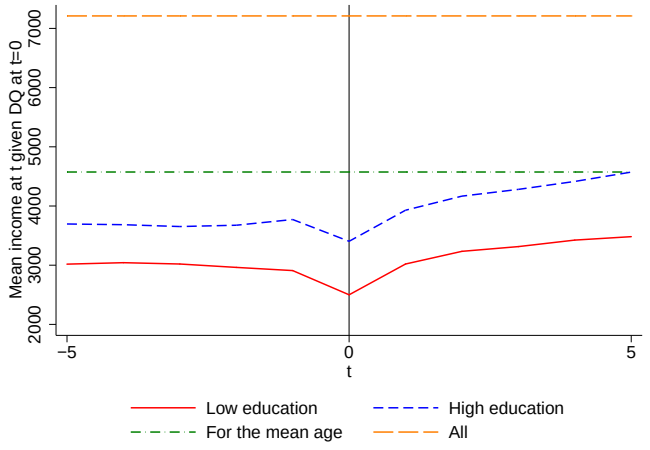

Figure 11: Income around BK

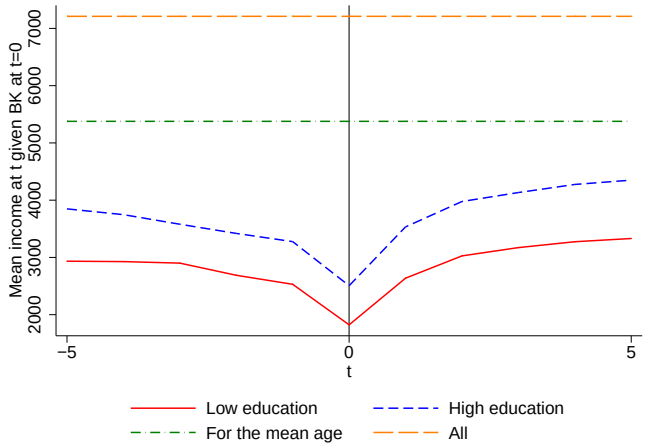

Figure 12: Employment around DQ

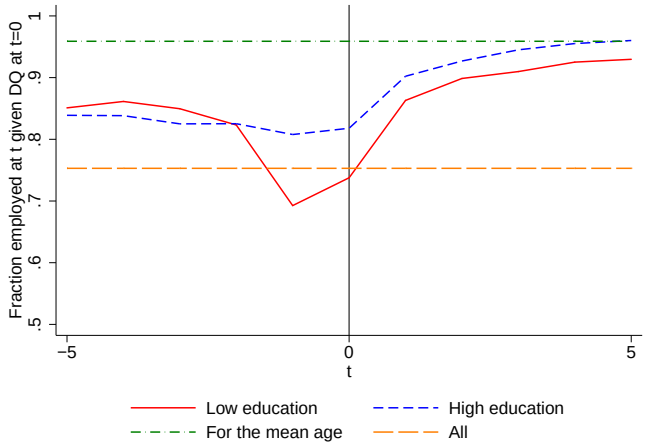

Figure 13: Employment around BK

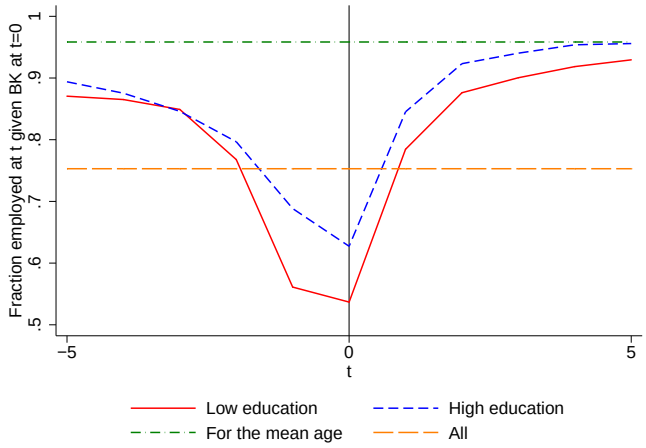

Figure 14: Debt around DQ

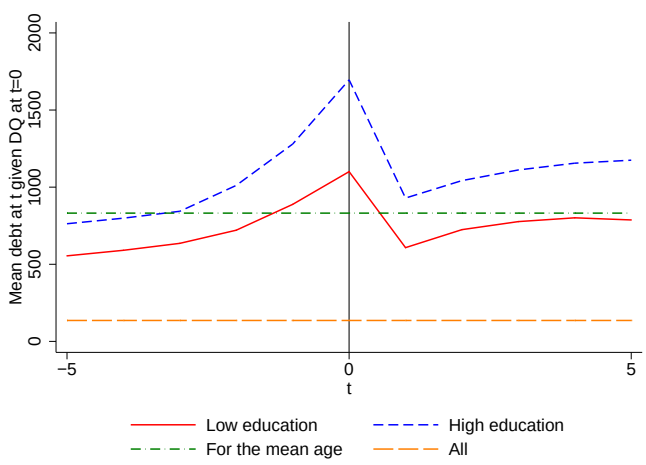

Figure 15: Debt around BK

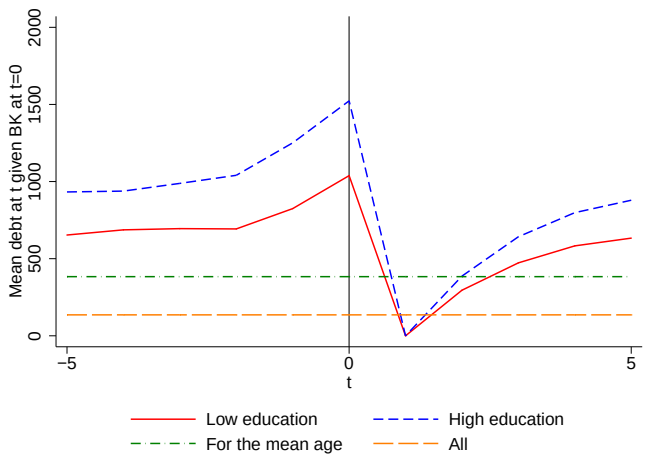

Figure 16: Share in Debt around DQ

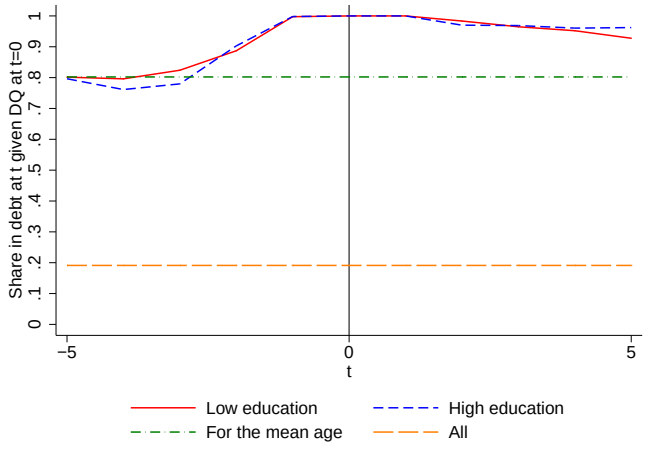

Figure 17: Share in Debt around BK

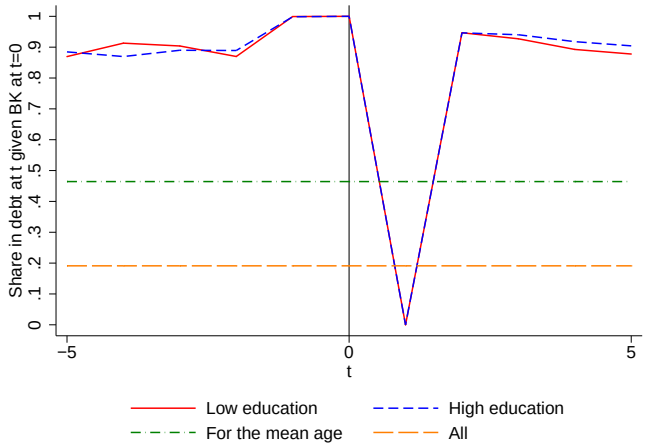

Figure 18: DQ and garnishment

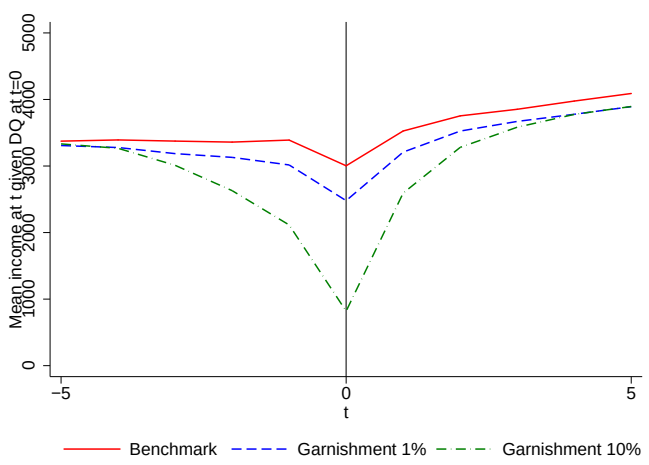

Figure 19: BK and garnishment

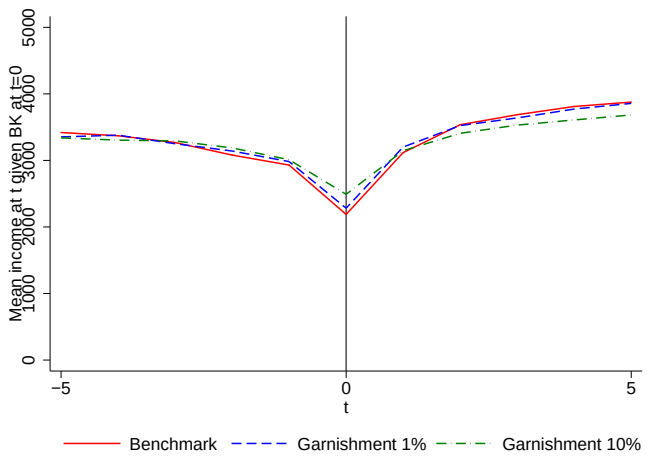

Figure 20: DQ and garnishment

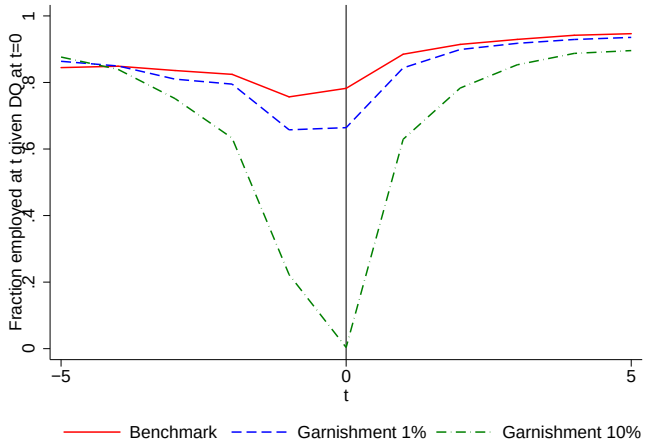

Figure 21: BK and garnishment

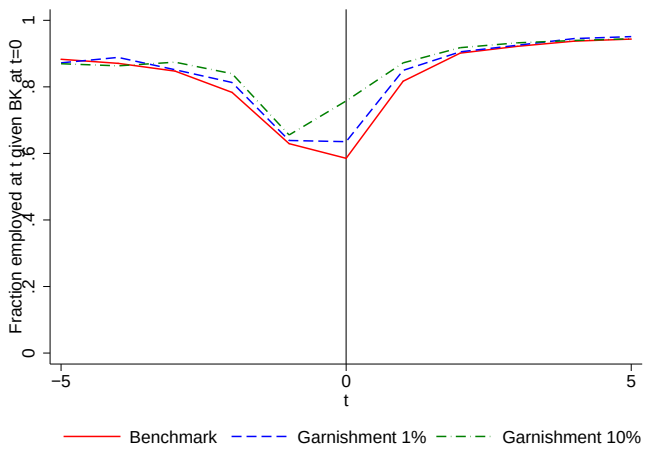

Figure 22: DQ and garnishment

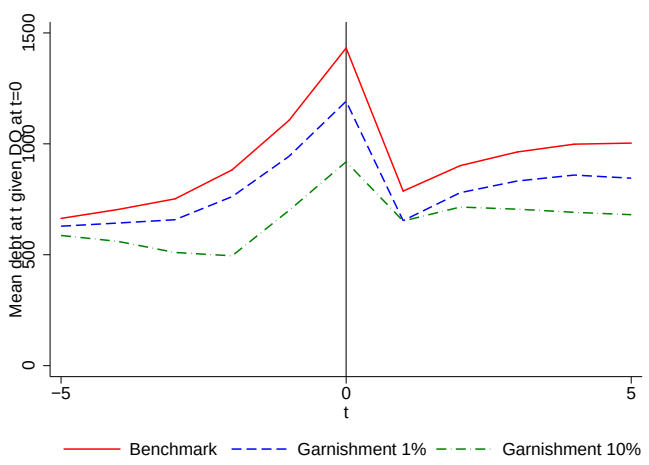

Figure 23: BK and garnishment

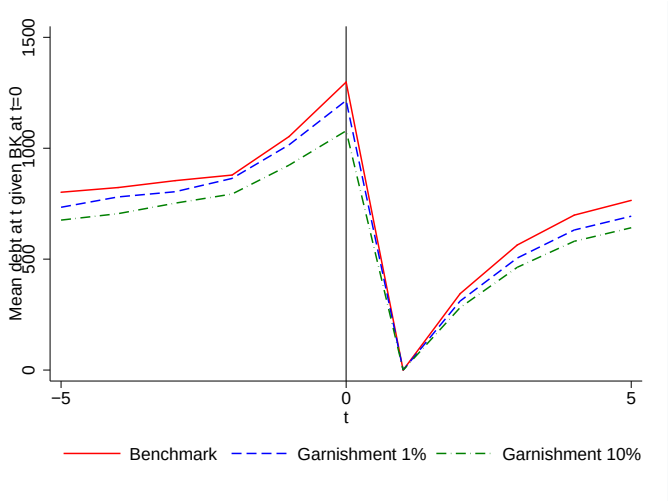

Figure 24: Welfare gains of increasing garnishment