A Model of Credit Card Delinquency

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Abstract

Limited commitment for the repayment of consumer debt comes from two places: formal laws granting a partial or complete discharge for debts under certain circumstances, or "bankruptcy," and informal default and renegotiation, or "delinquency." In the US, both channels are used routinely. The usefulness of each of these routes as a way out of debt depends on the costs and benefits available through the other: delinquency exposes a household to collections processes initiated by lenders, while formal bankruptcy appears to carry more visible consequences for future transactions, including restrictions to even secured forms of credit.

This paper is the first, to our knowledge, to evaluate unsecured consumer credit markets in the presence of both bankruptcy and delinquency. We show that these two options indeed interact in important ways. Specifically, we show that stricter control of delinquency, as defined by a relatively high ability to garnish wages, leads to more bankruptcy and lower welfare. Similarly, we find that eliminating the bankruptcy option altogether leads to a modest increase in delinquency. Perhaps most interestingly, we show that interest-rate ceilings, even though they have the standard effects in terms of limiting credit access, improve ex-ante welfare for all. This occurs because the inability to reprice debt after delinquency allows a useful level of "state contingency" in debt that does not increase average borrowing costs substantially. In essence, households have to pay the costs of delinquency in order to get the benefits of a low interest rate.

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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 US households each year, with greater than 1 million filings annually in each of the past 15 years. 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.

On the other hand, 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-by revising the principal and/or interest on the loan. This process of obtaining debt relief via delinquency has been termed "informal bankruptcy" by Ausubel and Dawsey (2004), who show that a nontrivial fraction of debts do get modified in this way. They found that 8.8 percent of the debtors were delinquent for at least two months, 1.3 percent entered informal bankruptcy and had their debts written off by lenders, and 1.5 percent filed formally for bankruptcy.[1] Similarly, as the US bankruptcy rate has risen substantially over the past 30 years, so has the delinquency rate. A standard definition, defined as the the fraction of households who are not meeting their current debt obligations, but who have also not formally filed for debt relief, shows a substantial rise. From 1989 to 2004, the percentage of cardholders incurring fees due to late payments of 60 days or more increased from 4.8 percent to 8.0 percent.

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

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

to informally default through delinquency may matter for the decisions of households with respect to formal bankruptcy–and vice versa. In doing so, the interaction of these options will determine the extent to which indebted households face the costs of each one. In the case of delinquency, these costs are the implicit taxes on labor supply coming from expected levels of wage garnishment, and potentially increased costs of rolling over debt. In the case of formal bankruptcy, the costs are determined by the extent to which agents face court- and stigma-related costs.

Second, the option to remain delinquent means that households still retain the ability to partially repudiate debts even when legally speaking, they are obligated to repay. This observation implies that the reach of formal bankruptcy law–and bankruptcy reform–are potentially quite limited in their ability to alter allocation. In essence, the extent of limits to commitment for debt repayment may well be insensitive to what the law notionally requires.

Agents who opt to remain delinquent and put off bankruptcy choose to face these costs because they view it 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 costs of the option, but also with the path of expected future income. Importantly, one possibility is that household 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, but more likely, may be a gamble by households that by surviving temporarily via delinquency, they will receive better income draws that will allow them to avoid any fixed 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 have currently large debts. Ex-ante, this constellation of outcomes is unlikely, but this shows that the interaction of these options may be important for the dates, states, and extent to which households repudiate debt.

The potential limitations on the ability of bankruptcy reform to affect real allocations in the presence of delinquency is obviously of entirely practical concern. In 2005, there was a sweeping reform of bankruptcy law (BAPCPA) that in principle, made legally-binding debt relief substantially more difficult to obtain. Under the reform, a measure of households that would have previously qualified for a discharge from their unsecured debts would now be forced–if they took the route of bankruptcy, to reschedule a portion of that debt. Of course, households could also simply stop paying, and obtain debt relief. To the extent that this was seen as better, the bite of the reform would be limited. Unfortunately, the timing of the reform coincided with the deepest financial crisis and recession since the Great Depression, confounding meaningful empirical inference about its effect. Nonetheless, recent work is suggestive that the relative of costs of default matter in a related manner. Li, White, and Zhu (2010), Ashcraft, Astrid, and Morgan (2007), 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.

A second reason to allow for a meaningful delinquency option is that almost without exception, existing work aimed at measuring the role played by bankruptcy in altering outcomes has concluded that, from an ex-ante welfare perspective, punishments so harsh as to completely rule out any possibility of debt default are always preferable to policies that allow repudiation. In fact, barring the case where households obtain insurance from bankruptcy because they face shocks large enough to render their budget sets empty, Athreya, Tam, and Young (2009) show that for a very wide constellation of preferences and endowment processes, allowing default leads to worse allocations than "banning it."

The problem is that "banning it" may simply not be a reasonable policy implication. Societies seem uninterested in creating, not to mention imposing, draconian penalties. One reason could simply because the models miss something important in their specification of preferences and endowments, but as noted, this is not an easy intuition to validate with standard models. The other reason is that societies may suspect that the real tradeoff is *not* between harsh bankruptcy and lax bankruptcy law at all–as all existing work has emphasized, but rather between "(more) bankruptcy vs. (less) delinquency."

The preceding suggests that a harsh bankruptcy policy may simply generate higher delinquency rates, and unless one views the latter as less socially costly (at least ex-post), there may be little gain, and possibly loss, from this. Conversely, a harsh regime of garnishment for those opting to remain delinquent may simply lead the majority of such households to declare bankruptcy, and do immediately upon receipt of any relatively bad shock to labor income. Thus, the relative costs borne by individuals, and society–through both the deadweight losses coming from each of these two routes,

and the implications of each for the pricing of debt (and hence access to credit)—are what will determine the desirability of any level of *relative* harshness in bankruptcy law.

In this paper, we contribute by taking the preceding logic seriously. We provide, to our knowledge, the first analysis of consumer credit in the presence of both formal bankruptcy, and informal bankruptcy or "delinquency." To do so requires us to endow the household with an extra option absent in received work, and to work backward to determine the role played by delinquency and bankruptcy in limiting or enhancing the attractiveness of the other option. Our goal is to better isolate and understand the nature of the relationship between the two empirically most relevant ways in which households alter repayment relative to ex-ante agreements. To this end, we will study several controlled counterfactual experiments in which we alter the costs of each option, sometimes holding one fixed, and at other times letting both vary. In the case of bankruptcy, we consider two regimes, the first allowing its presence subject to costs calibrated to current observations, followed by its elimination. In the case of delinquency, we will vary the costs through a series of increasingly stringent "wage garnishment" regimes.

From an empirical perspective, there are at least two important payoffs to our approach. First, our inclusion of delinquency is that we provide an explanation for the apparently low formal filing rates first identified by Fay, Hurst, and White (1998); many households choose delinquency initially, some of whom eventually become solvent, some never repay and are effectively written off, and some formally file for debt relief. On this point, we show that in broad terms, bankruptcy and delinquency are "substitutes," with changes in the costs of one option substantially altering use of the other. We also

show that indeed, many who eventually declare bankruptcy "pass through" delinquency first. We show that increases in the stringency of delinquency via high permissible levels of garnishment are rather counterproductive in either lower credit losses to lenders, or more importantly, helping household risk management and welfare. We also find that delinquency is likely to be of help to household temporarily dealing with large transitory shocks, as such events are by definition, hard to deal with without some delay in repayment, but unlikely to last long enough to justify paying the costs of formal bankruptcy.

Second, our expansion of default possibilities allows us to accommodate the intuition that the availability of informal bankruptcy is relevant not only for the analysis of personal bankruptcy policies, but also influences the *interpretation* one gives to data on loan interest rates being charged to and paid by households in different situations. With respect to the latter, many have argued that the data contain "punitive" rates on defaulters (see e.g. Ausubel, Baranov, and Dawsey, 2010). We show that while this is not possible under competitive conditions, the on-equilibrium-path interest rates paid by delinquent households may well be higher than the rest of the population. And because lenders in the model understand that agents may refuse to pay ex-post, such constraints on the manner in which debts can be repriced upon delinquency do matter both for pricing ex-ante and ex-post

An interesting implication of this is that while any limit on interest rates that can be charged immediately places a limit on the debts that agents can incur up front, something else happens. We show that when delinquency is incorporated, an interest rate ceiling can help credibly tie the hands of a lender against repricing debt in a manner that makes those with large debts face substantially higher repayment

burdens. In particular, while it does lower credit use, it also ensures that those who *do* borrow, especially those who borrow large amounts, can more cheaply reschedule their debts via delinquency–even though a lender can "use" the cost of bankruptcy as leverage to extract more resources ex-post. Ex-ante, this group is likely to be composed disproportionately of those expecting higher future income but for whom these expectations *did not materialize*. Hence, for these households, borrowing was, ex-ante, quite useful. In turn, delinquency stays cheap, bankruptcy rates fall and delinquency rates rise. The risk-sharing benefits of easy refinancing of debt, along with the relative deadweight and non-deadweight costs of both options, turns out to be such that ex-ante welfare rises. This finding highlights the potential relevance of delinquency in helping account for the prevalent (certainly, as a historical matter) practice of limits on interest-rate ceilings, without any appeal to "behavioral" features or other frictions.

2 Model

We introduce delinquency into an otherwise standard (see e.g. Athreya, Tam, and Young, 2009) quantitative model of lifecycle consumption-savings with bankruptcy; delinquency is a means of delaying the option of bankruptcy, which requires a fixed cost and a period of legal exclusion to exercise. We endogenously determine the interest rate on delinquent accounts by allowing lenders to "mark up" or "charge off" delinquent accounts, but their ability to (and interest in) do so is limited both by the option to declare bankruptcy and by the presence of potential entrants; interest rates on new loans are competitively determined by zero-profit conditions. We then use the model to address a variety of facts about unsecured credit (e.g., the fraction of negative net worth households, debt-income ratios among borrowers, etc), and those pertaining

to formal bankruptcy (e.g., filing rates, debt discharged via bankruptcy, etc), and delinquency (e.g. delinquency rates, delinquency histories, etc).

2.1 Endowments

Households live for $j = 1, 2, ..., J$ periods, and receive stochastic endowments as a function of their permanent "type" y (human capital level). Let the mean of log endowments at age-j for a type-y household be given by $\omega_{j,y}$. Households face risk to their incomes that arise from both persistent components, $e_{j,y}$, and transitory components $\nu_{j,y}$. Lastly, in each period, households face a risk that directly reduces available resources by an amount χ. At any age-j, a household wishing to borrow may issue one-period debt with a face value b_j. Households issue all debt to a single lender. In the following period, the household can do one of three things: they can repay their debts as promised, they can file for formal bankruptcy protection that immediately relieves them of any obligations to repay their debt, or, as will be emphasized here, they can simply not repay the debt as promised. The last option is what we refer to as "delinquency."

Let $\mathbb{I} = (y, e, \nu, \chi, \lambda, j)$, denote a household's characteristics. Given existing debt that is currently due b_{-1}, and b the new borrowing. The ability to avoid a full repayment when it is due in the following period implies that the household's debt will be discounted relative to its face value with price $q(b, \mathbb{I}) : b \times \mathbb{I} \longrightarrow [0, 1)$. We now detail the effects of each option on current resources, and then turn to the differing dynamic consequences of each.

2.2 Budget Constraints

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

$$c_j + q(b_{j+1}, I)b_{j+1} = b_j + \omega_{j,y} e_{j,y} \nu_{j,y} - \chi \tag{1}$$

A household that formally declares bankruptcy is, as 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 must therefore set consumption equal to its income, net of the costs of bankruptcy Δ.

$$c_j = \omega_{j,y} e_y \nu_y - \chi - \Delta \tag{2}$$

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 ψ is garnished, the household is left with current period consumption:

$$c_j = (1 - \psi)\left(\omega_{j,y} e_{j,y} \nu_{j,y} - \chi\right), \tag{3}$$

In terms of current consequences for available resources, then, the difference between bankruptcy and delinquency is simply the difference between paying a fixed cost Δ, and paying the amount $\psi(\omega_{j,y} e_{j,y} \nu_{j,y} - \chi)$. However, there are consequences for the effect of expenditures on the utility of current consumption, as well as differing dynamic consequences, as we now describe.

2.3 Value Functions

It is easiest to describe the household's problem in recursive terms. First, let $\mathbb{I}' = (y, e', \nu', \chi', \lambda', j+1)$, n_j is the effective size of the household in adult-equivalents, σ is the coefficient of relative risk aversion, $s_{j,y}$ is a household's one-period ahead conditional survival probability. Let the indicator $d = \{0, 1, 2\}$ denote complete repayment, delinquent, and bankruptcy, respectively.

For a household that chooses to repay debt normally, the optimal solution of the household's problem satisfies:

$$v^{d=0}(b_{-1}, \mathbb{I}) = \frac{n_j}{1-\sigma}\left(\frac{c_j}{n_j}\right)^{1-\sigma} + \beta s_{j,y} \sum_{e',\chi',\lambda'} \pi\left(e'|e\right)\pi\left(\chi'|\chi\right)\pi\left(\lambda'|\lambda\right) v\left(b, \mathbb{I}'\right), \quad (4)$$

subject to (1).

Turning next to the lifetime utility of a delinquent household is the solution to the functional equation

$$v^{d=1}(b_{-1}, \mathbb{I}) = \frac{n_j}{1-\sigma}\left(\frac{\delta c_j}{n_j}\right)^{1-\sigma} + \beta s_{j,y} \sum_{e',\chi',\lambda'} \pi\left(e'|e\right)\pi\left(\chi'|\chi\right)\pi\left(\lambda'|\lambda\right) v\left(h\left(b_{-1}, \mathbb{I}\right), \mathbb{I}'\right) \quad (5)$$

subject to (3),

We see here that the household not only faces wage garnishment in each period, but also derives less utility from any given expenditure on consumption, as given by $\delta < 1$. In the following period, the household faces a revised debt obligation $h(b_{-1}, \mathbb{I})$.

Lastly, when a household invokes formal bankruptcy protection, the continuation

payoff is given by the solution to

$$v^{d=2}\left(b_{-1},\mathbb{I}\right)=\frac{n_j}{1-\sigma}\left(\frac{\lambda c_j}{n_j}\right)^{1-\sigma}+\beta s_{j,y}\sum_{e',\chi',\lambda'}\pi\left(e'|e\right)\pi\left(\chi'|\chi\right)\pi\left(\lambda'|\lambda\right)v\left(0,\mathbb{I}'\right), \quad (6)$$

subject to (2).

The key advantage of bankruptcy relative to delinquency is that the household will enter to the next period with *no debt*—as seen in the term $\nu(0,\mathbb{I}')$. However, in the current period, we see that household expenditures generate a lower level of utility, by a proportion λ, than they would otherwise. For calibration purposes, we assume that λ follows a two-state Markov chain with persistence parameter ρ_λ and realizations λ_{lo} and λ_{hi}, reflecting low and high costs of bankruptcy respectively.

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

$$v\left(b_{-1},\mathbb{I}\right)=\max\left\{v^{d=0}\left(b_{-1},\mathbb{I}\right),v^{d=1}\left(b_{-1},\mathbb{I}\right),\mathbb{I}\right),v^{d=2}\left(b_{-1},\mathbb{I}\right).$$

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 $\widehat{b}$ 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, $\mathbb{I}$, be given by $h(\cdot)$:

$$h\left(b_{-1},\mathbb{I}\right)=\max_{\hat{b}}\left\{\hat{b}q\left(\hat{b},\mathbb{I}\right)\right\}. \quad (7)$$

This function is key in our analysis because it determines the evolution of the face value of debt in the case of delinquency. More importantly, the revision of debt implies an interest rate that we will give attention to.

The problem that determines h is essentially a take-it-or-leave-it bargaining game, where the lender makes the offer. However, since the borrower has the option to do nothing (that is, to remain delinquent) and also to go bankrupt, it is not obvious that the lender has a significant amount of bargaining power.

2.4 Pricing Function

The price function will, of course, be very important for our analysis. They are very simple in the case of saving, $b \geq 0$,

$$q\left(b, \mathbb{I}\right) = \frac{s_{j,y}}{1+r}, \tag{8}$$

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

$$q\left(b, \mathbb{I}\right) = s_{j,y} \frac{\mathbb{Q}}{1+r+\phi}, \tag{9}$$

where ϕ is a transaction cost, and $\mathbb{Q}$ is

$$\begin{aligned} \mathbb{Q} = \sum_{e', \chi', \lambda'} & \pi\left(e'|e\right) \pi\left(\chi'|\chi\right) \pi\left(\lambda'|\lambda\right) \times \\ & \left(1\left(d=0\right) + 1\left(d=1\right)\left[\psi\left(\omega_{j,y} e_y \nu_y - \chi\right) + \frac{q\left(h, \mathbb{I}'\right) h\left(b_{-1}, \mathbb{I}\right)}{b}\right]\right). \end{aligned}$$

The last equation should be carefully considered. This is the price function for debt with risk of bankruptcy and risk of delinquency. First, consider the case of repayment, denoted by the case $d = 0$. In this case, lenders get one dollar per dollar lent. Next,

consider the role of bankruptcy ($d = 2$). Given that lenders obtain nothing in case of bankruptcy, no terms referring to that state are explicitly included. Notice that this state happens implies that both $d \neq 0$ and $d \neq 1$. Therefore, the RHS of the preceding equation collapses to zero in all states (e',χ',λ') next period in which bankruptcy is declared. Finally, and more interestingly, focus on delinquency. This state has $d = 1$, implying that the final term on the RHS is activated. In this case lenders can garnish part of the household's income. This is reflected in the term $\psi(\omega_{j,y} e_y \nu_y - \chi)$. But lenders of 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 per dollar lent, $q(h, \mathbb{I}')\, h(b_{-1}, \mathbb{I})/b$, where the choice of h was described in equation (7). Thus, we have a recursive representation for the evolution of debt and interest rates *along the path* in which in households remain delinquent.

3 Calibration and Model Performance

We now study the quantitative properties of the model. To maintain comparability to existing work, wherever possible, the parameters are taken from previous estimations. Notably, the income process follows Hubbard, Skinner, and Zeldes (1994), while the expenditure shock considered follows the work of Livshits, MacGee, and Tertilt (2007).

Other parameters are calibrated to match specific targets regarding borrowing and bankruptcy. The parameters calibrated in this manner are: β, preference discount factor; δ, cost of delinquency; λ_{lo}, low value of the cost of bankruptcy; λ_{hi}, high value of the cost of bankruptcy; and ρ_λ, persistence of the low and high values of the cost of bankruptcy. The targets and its counterpart in the model are presented in Table 1. The model can replicate these moments remarkably well. Table 2 presents the value of

the parameters that were calibrated to match specific targets. All of these parameters are in the range of values used in previous studies.

Table 1: Calibration Targets and Model Performance

Statistics	Model	Data
Bankruptcy Rate, households with less than high school	0.98%	1.23%
Bankruptcy Rate, households with high school	1.04%	1.31%
Bankruptcy Rate, households with college	0.90%	0.82%
Mean debt / Mean income, households with less than high school	0.10	0.08
Mean debt / Mean income, households with high school	0.11	0.11
Mean debt / Mean income, households with college	0.16	0.15
Charge-off Rate	2.38%	2.68%
Mean debt discharged / Mean income	0.38	0.43
Mean income of delinquent borrowers / Mean income all borrowers	0.75	0.87
Mean income of bankruptcy filers / Mean income all borrowers	0.90	0.83
Median age of bankruptcy filers	37	41

Sources: number of households, US Census. Mean debt discharge and the decomposition of bankruptcy rate by education, Sullivan, Warren, and Westbrook (2000). Mean households income from the US Census. Debt is equal to negative net worth for households with negative net worth and zero otherwise. It was obtained from the 2004 SCF. Median age of bankruptcy filers, Thorne, Warren, and Sullivan (2008). Charge-off rate, Federal Reserve Statical Release (2004). The ratio of mean income between delinquent/bankrupt borrowers and all net borrowers comes from Ausubel and Dawsey (2004).

Table 2: Calibrated Parameters

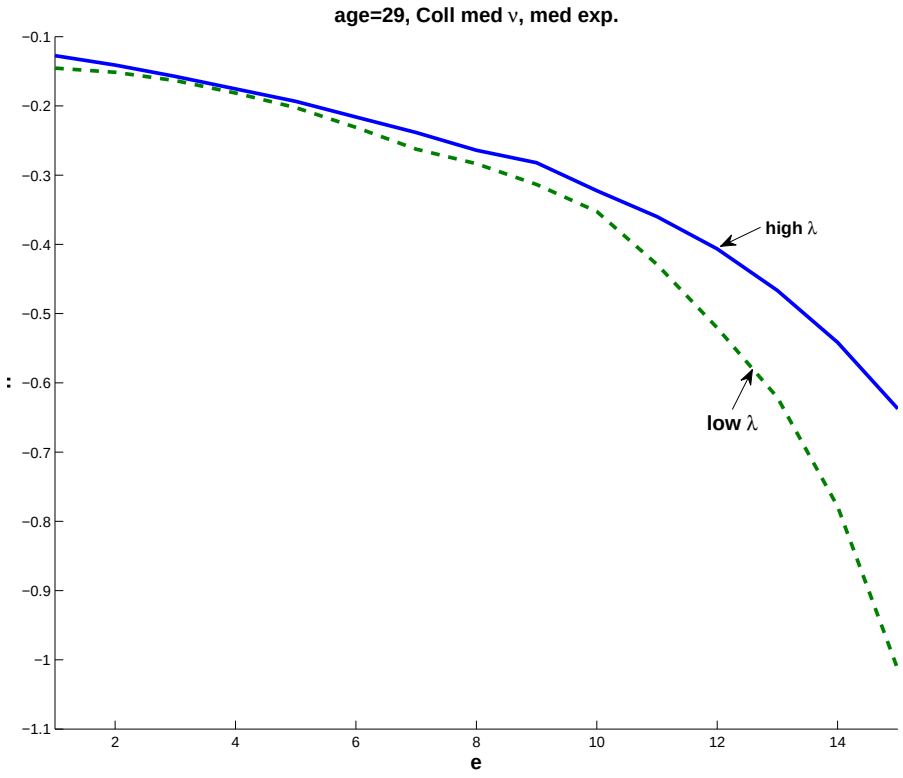
Parameter	Interpretation	Value
β	preference discount factor	0.956
δ	cost of delinquency	0.917
ρ_λ	persistence of cost of bankruptcy	0.944
λ_{lo}	low cost of bankruptcy	0.782
λ_{hi}	high cost of bankruptcy	0.661

One of the key innovation of the theory is the introduction of the function h, which determines the amount a delinquent household will have to pay back in the next period. Figure 1 shows how the amount lenders charge to delinquent borrowers increases (more negative means more debt) with the persistent component of income, e. This

happens because lenders choose h to maximize what they can recover from the delinquent borrower and households with higher e are more likely to repay (everything else equal). This figure also show that as the cost of formal bankruptcy is increases (lambda is smaller), lenders can charge more to delinquent borrowers. Thus, the bankruptcy option is key to determine the bargaining power of delinquent borrowers.

Figure 1: Lenders, delinquent debt, and the shape of h

h as a function of e and λ



There are two questions about the performance of the model that will be discussed now. The first important question is: Does the model generate delinquency as an equilibrium outcome? While our model allows for it, there is no guarantee that it will be used in equilibrium. Table 3 shows that the model does predict that some households will enter, and remain, delinquent. The table presents statistics of delinquency generated with the benchmark model. The percentage of accounts in delinquency is 2 percent. This rate is similar to, but somewhat lower than, the measure of delinquency reported by the Federal Reserve: between 2004 and 2007 the 30-day delinquency rate is 4 percent for credit cards and 3 percent for all consumer loans.[2] The fact the delinquency rate is lower in the model than in the data is expected because a period in the model is a year, so the ideal measure of delinquency would be a more restrictive one, which would be obviously smaller. In particular, to the extent that delinquency is a transitory phenomena, our model will miss those transitions lasting less than one year. Table 3 also presents other measures of delinquency, as the percentage of debt in delinquency. These statistics show that delinquency is actually important in the model. However, we should note that it is not straightforward to determine a clear empirical counterpart for this set of statistics.

Table 3: Incidence of Delinquency in the model

Statistics	Model
Percentage of Accounts in delinquency	2.04%
Percentage of Debt in delinquency	4.50%
Recovery Rate delinquency Debt that Charged by Lenders (h)	12.76%
Recovery Rate for delinquency Debt	29.52%
Recovery Rate for the Origin Debt	37.88%

[2]http://www.federalreserve.gov/releases/chargeoff/delallsa.htm.

The second relevant question is: does the model generate high interest rates? Table 4 presents the mean of interest rate spreads for all borrowers and delinquent borrowers. Two things are worth noticing. First, interest rates are of similar magnitude in the data. The spread for non-delinquent borrowers was about 7 percent in 2008, and it is between 6 and 9 percent in our model.[3] Second, delinquent borrowers pay very high interest rates, about 15 percent. This is consistent with data from Ausubel, Baranov, and Dawsey (2010) that report interest rates between 24 and 30 percent. This means spreads between 19 and 25 percent.

Table 4: Mean Rate Spread, $r - rf$

	less than high school	high school	college
Normal Borrowers	9.44%	8.10%	6.01%
Delinquent Borrowers	15.30%	15.50%	15.06%

Finally, we consider the role of expenditure shocks in delinquency and bankruptcy. Table 5 presents information on the probability of delinquency and bankruptcy for different values of the expenditure shocks. The key message of this table is that for all education groups having a medium or high expenditure shock is needed to enter bankruptcy and mainly delinquency. For instance, the unconditional probability of delinquency for college educated households is 0.1 percent. This jumps to 36 percent, and 80 percent if they have a low, medium, and high expenditure shock, respectively.

[3]The measure in the data is computed as credit card interest rate from http://www.federalreserve.gov/releases/g19/Current/ minus banks prime loans from http://www.federalreserve.gov/releases/H15/data.htm.

Table 5: Bankruptcy, Delinquency, and Expenditure Shock (χ) Distribution

	less than high school			high school			college		
	χ^{lo}	χ^{med}	χ^{hi}	χ^{lo}	χ^{med}	χ^{hi}	χ^{lo}	χ^{med}	χ^{hi}
prob(delinquency$\|\chi$, edu)	0.004	0.599	0.854	0.002	0.465	0.692	0.001	0.357	0.801
prob(bankruptcy$\|\chi$, edu)	0.002	0.138	0.244	0.003	0.157	0.273	0.003	0.089	0.199

3.1 Trajectories toward delinquency and bankruptcy

To better understand the role of delinquency and bankruptcy, we now study household trajectories *preceding* delinquency and bankruptcy. We first analyze how the probability of delinquency is affected by a previous bankruptcy. Table 6 contains information about the share of households that is delinquent at period $t+k$ by their bankruptcy decision at period t. Among households that have less than high school education, about 2.8 percent of those bankrupt at period t will be delinquent at period $t+5$. By contrast, only 0.4% of those not bankrupt as of period t will enter delinquency at period $t+5$. This indicates not simply that bankruptcy is a rare event, but also that there is substantial persistence in financial condition of households. More interesting is the fact that bankruptcy does not appear to provide such an obvious "Fresh Start" in the sense that a recent bankruptcy seems disproportionately The same pattern is also present in other education groups.

Table 6: Effect of bankruptcy on delinquency

	Share delinquent at $t+k$ by state at t, percent					
	Less than high school		High school		College	
State at t	bankrupt	not bankrupt	bankrupt	not bankrupt	bankrupt	not bankrupt
$k=1$	0.8	0.1	1.4	0.1	0.0	0.0
$k=2$	0.8	0.2	2.2	0.2	0.1	0.0
$k=3$	0.9	0.2	2.3	0.2	0.2	0.1
$k=4$	1.9	0.3	1.6	0.3	0.4	0.1
$k=5$	2.8	0.4	1.1	0.4	1.0	0.1

We now employ the model to assess the extent to which delinquency may allow an indebted household to "wait for conditions to improve" so that they can avoid the potentially larger costs associated with bankruptcy. Table 7 presents evidence that this is is actually a role that delinquency may play, i.e. acting as a stop on the way to bankruptcy. Among the households with high school education that were delinquent at period t, about 4.9 percent were bankrupt 5 periods ahead. This rate is more than one order of magnitude higher than the same measure for those that were not delinquent at period t, which was only 0.3 percent. As before, this pattern exists across all education groups.

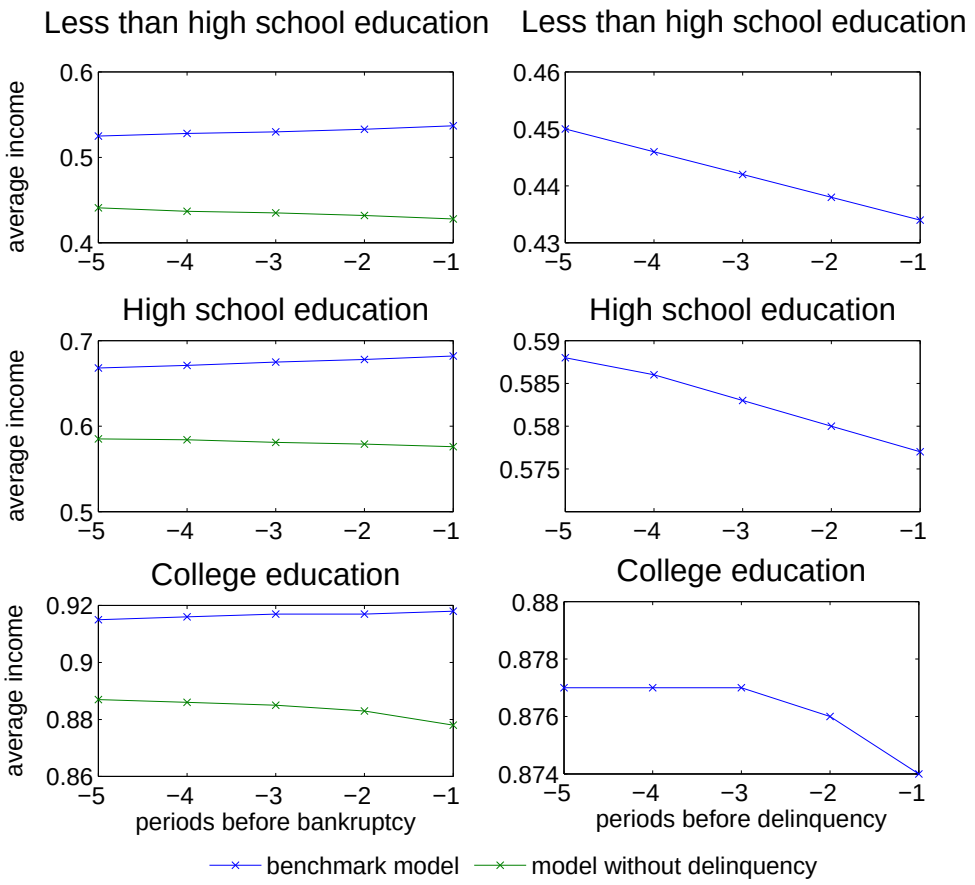
Table 7: Effect of delinquency on bankruptcy

	Share bankrupt at $t+k$ by state at t, percent					
	Less than high school		High school		College	
State at t	delinquent	not delinquent	delinquent	not delinquent	delinquent	not delinquent
$k=1$	0.8	0.1	2.6	0.1	0.3	0.0
$k=2$	1.3	0.2	3.7	0.2	0.6	0.1
$k=3$	1.8	0.3	4.5	0.3	1.1	0.1
$k=4$	2.5	0.3	4.8	0.3	1.8	0.1
$k=5$	3.1	0.3	4.9	0.3	2.6	0.2

We now consider the evolution of income in the periods before delinquency and bankruptcy. First, the right panel of Figure 2 shows the trajectory of average income for the households delinquent in period t in the 5 previous periods. Income is decreasing during these periods, but changes are very small. In the cases of high school education and college education, average income decreases less than 1 percent. The decline is slightly larger in the case of households with less than high school education, but smaller than 5 percent.

Second, we consider the evolution of income in the periods preceding bankruptcy. The left panel of Figure 2 contains the average income in the benchmark model and

Figure 2: Income trajectories preceding bankruptcy and delinquency



also in the model without delinquency. In the three panels it is clear that the average income in the years previous to bankruptcy is higher in the benchmark model than in the model without delinquency. This occurs because in the benchmark model, with delinquency, very poor households prefer delinquency to bankruptcy. Some of those households transition from delinquency to bankruptcy as their income increase to reorganize their financial condition.

4 Policy experiments

Having noted the benchmark calibration generates reasonable outcomes, and moreover, readily produces relatively high *competitive* interest rates on delinquent accounts, we turn now to the main classes of counterfactuals that we employ to delineate the relationship between bankruptcy and delinquency.

4.1 Stronger Garnishment: More Bankruptcy, Higher Credit Costs, Lower Welfare

The first policy experiment that we consider is our primary one, and is aimed at understanding the role of allowing for delinquency. As described earlier, delinquency regimes are defined in our model by the extent of lenders' ability to attach or garnish the labor incomes of debtors, as captured by the parameter ψ. We consider allocations and prices under four levels of garnishment, i.e $\psi = \{0, 0.01, 0.05, 0.01\}$. The results are given in Table 8.

Table 8: Aggregate Statistics and income garnishment during delinquency

$\psi =$	0.000	0.010	0.050	0.100
Debt / Income, hhds. with less than high school	0.098	0.100	0.102	0.096
Debt / Income, hhds. with high school	0.113	0.113	0.112	0.105
Debt / Income, hhds. with college	0.160	0.162	0.158	0.155
Interest Rate on borrowing, hhds. with less than high school	13.92%	13.82%	13.71%	13.55%
Interest Rate on borrowing, hhds. with high school	13.21%	13.05%	12.37%	12.15%
Interest Rate on borrowing, hhds. with college	10.33%	9.96%	8.97%	8.92%
Bankruptcy, hhds. with less than high school	0.98%	1.29%	2.00%	2.68%
Bankruptcy, hhds. with high school	1.04%	1.36%	1.82%	2.32%
Bankruptcy, hhds. with college	0.91%	0.95%	1.28%	1.42%
Delinquency Rate, hhds. with less than high school	2.82%	2.34%	0.12%	0.04%
Delinquency Rate, hhds. with high school	2.18%	1.72%	0.09%	0.01%
Delinquency Rate, hhds. with college	1.24%	1.05%	0.03%	0.01%
Bankruptcy, hhds. with less than high school and delinquent at t-1	3.81%	3.87%	3.83%	1.38%
Bankruptcy, hhds. with high school and delinquent at t-1	4.12%	3.61%	3.27%	0.73%
Bankruptcy, hhds. with college and delinquent at t-1	3.54%	4.21%	1.65%	0.40%
Charge-off, hhds. with less than high school	1.91%	2.51%	4.63%	6.74%
Charge-off, hhds. with high school	2.26%	2.95%	4.62%	6.57%
Charge-off, hhds. with college	2.66%	2.79%	3.93%	4.75%

While largely self-explanatory, it is worth emphasizing the following. First, the results make fairly clear that the intuition presented at the outset is likely to be quantitatively relevant: bankruptcy and delinquency interact. In particular, we can see clearly that higher rates of garnishing are strongly linked with higher rates of bankruptcy. In other words, making delinquency harsh simply leads many to choose bankruptcy. This response is strongest for the least skilled, as we bankruptcy rates among the less than high school households nearly *triple* from 0.98% to 2.68% as garnishing rises even to just 10%. For high-skilled agents (college), the response is substantially smaller, moving from 0.91% to 1.42%. In part, this occurs because this group simply defaults less to begin with. Figure the left panel of Figure 3 shows that this pattern arises from a more granular pattern in the *life-cycle* behavior of bankruptcy: higher garnishment regimes result in monotonically higher bankruptcy rates from entry into the labor market until retirement. And as seen in the right panel of Figure 3, exactly the reverse occurs over the life-cycle for delinquency rates.

An interesting thing that appears to be at work here is that, while garnishment regimes do not alter the total debt for any skill group (see the debt/income ratio in Table 8), they generate larger losses for creditors as a result of bankruptcy. Tough garnishing regimes appear to result in substantially larger levels of overall debt discharged, as measured by the chargeoff rate–which rises systematically and substantially with increases in the garnishment level. And this risk, in turn, is clearly reflected in the average interest rates households pay–rising with garnishment rates. It is also reflected in a key conditional probability where we measure bankruptcy rates among who were delinquent one period earlier. We see that as garnishment rises, this fraction falls. In essence, what happens is that under harsh garnishment regimes, household more

readily file for bankruptcy directly; they do not wait to see if they will be resurrected by a (relatively) high income shock.

Importantly, notice that harsher garnishment regimes increase bankruptcy rates to such an extent that average *interest rates rise* nontrivially. This is consistent with the fact that as ψ rises, the chargeoff-rate rate for all three educational groups rises substantially, with the largest increases being in the less than high school (unskilled) category. Thus, to reemphasize, our model suggests that measures that essentially make it harder to stay delinquent (by raising the ability of lenders to garnish), rather the helping expand credit access and lower creditor losses, do little for the former, and the opposite for the latter.

An important question, aside from the quantities presented so far is the normative one: are households better or worse off under a relatively strict garnishment regime? The answer is "no." Welfare falls as we introduce garnishment into the economy, and it falls by more the more garnishment that is allowed (see Table 9). Lastly, garnishment hurts the least skilled most, and the most skilled least. Intuitively, what is occurring is that the overall attractiveness of bankruptcy, all else equal rises, and to the extent that it is invoked, creditors immediately lose the entire value of their loan. As a result, loan pricing is higher for many households, and higher in ways that affect them markedly enough, as we saw, to show up in the interest rates they pay on the equilibrium path being higher.

In summary, in this section, we show that our model can answer a useful policy question that previously could not have been addressed: "Would tougher forms of garnishment yield effective repayment of debt and superior outcomes?" The model suggests that the answer to both is a clear "no."

Table 9: Welfare gains of increasing the income garnishment of delinquent borrowers

	less than high school	high school	college
$\psi = 0.00 \rightarrow \psi = 0.01$	-0.123%	-0.083%	-0.029%
$\psi = 0.00 \rightarrow \psi = 0.05$	-0.440%	-0.327%	-0.115%
$\psi = 0.00 \rightarrow \psi = 0.10$	-0.602%	-0.434%	-0.139%

4.2 Useful Interest-Rate Ceilings?

At the outset, we noted that the implications of an interest-rate-ceiling (IRC) were substantially less clear once delinquency was allowed. This is because ceilings change the ability of lenders to reprice in delinquency, and that while this might be predicted to lower credit access at the outset, what is important for credit pricing and credit access at the outset is the likelihood of such an event, and the loss to creditors conditional on this having occurred. In particular, a tight interest rate ceiling might well make borrowing *more* attractive as the low-interest rate rollover of debt would be possible in a select set of states of the world that were, ex-ante, unlikely, and hence unimportant for the pricing of debt at the outset. In this sense, interest rate ceilings can change the relative attractiveness of delinquency over bankruptcy. This channel is novel in terms of the ability of models to allow them, but seems rather natural as a force that might be operative in the data.

Table 10 summarizes the the behavior of the same set of aggregates examined in the previous section. We see that as interest rate ceilings are progressively relaxed, credit access rises, sometimes quite substantially. Figure 4, for example, demonstrates that for a prototypical households, a higher ceiling means more access to credit. This is a very standard result, and combining it with households' clear willingness to *use* this increased access, as seen by the average debt level and interest-rate paid by borrowers,

Table 10: Aggregate Statistics and interest-rate ceilings

$\xi =$	$+\infty$	11.11%	17.65%	33.33%
Debt / Income, hhds. with less than high school	0.098	0.071	0.080	0.097
Debt / Income, hhds. with high school	0.113	0.046	0.102	0.111
Debt / Income, hhds. with college	0.160	0.040	0.156	0.160
Interest Rate on borrowing, hhds. with less than high school	13.92%	9.06%	12.48%	13.88%
Interest Rate on borrowing, hhds. with high school	13.21%	8.01%	12.43%	13.20%
Interest Rate on borrowing, hhds. with college	10.33%	7.19%	10.03%	10.33%
Bankruptcy, hhds. with less than high school	0.98%	0.02%	0.42%	0.91%
Bankruptcy, hhds. with high school	1.04%	0.02%	0.69%	0.96%
Bankruptcy, hhds. with college	0.91%	0.00%	0.85%	0.91%
Delinquency Rate, hhds. with less than high school	2.82%	4.45%	3.61%	2.09%
Delinquency Rate, hhds. with high school	2.18%	4.19%	2.70%	2.27%
Delinquency Rate, hhds. with college	1.24%	3.75%	1.42%	1.24%
Bankruptcy, hhds. with less than high school and delinquent at t-1	3.81%	6.84%	5.37%	3.45%
Bankruptcy, hhds. with high school and delinquent at t-1	4.12%	7.24%	3.76%	3.79%
Bankruptcy, hhds. with college and delinquent at t-1	3.54%	33.33%	2.75%	3.54%
Charge-off, hhds. with less than high school	1.91%	0.00%	0.94%	1.67%
Charge-off, hhds. with high school	2.26%	0.00%	1.69%	2.10%
Charge-off, hhds. with college	2.66%	0.00%	2.59%	2.67%

suggests that households value the access. Next, we see that as the ceiling is increased and then done away with, bankruptcy rates rise systematically, while delinquency rates fall steadily. This is natural: a low ceiling is one where delinquency is a valuable alternative to retain–and household invoke it when it is cheap. A related feature to note is that as the ceiling is made progressively larger, the bankruptcy rate, among even those who had just been delinquent falls substantially, and does so for households from all educational groups. Taken as a whole, it can be said that interest rate ceilings lower credit access quite generally. So, what about consumer welfare? Arguably our most striking, and surprising result, is here. It is that despite their fairly standard-looking effects (at the level of the aggregates in Table 10) on credit markets, ex-ante welfare, as seen in Table 11, *rises* with interest rate ceilings for all three educational categories! Most interestingly, the gain in welfare is highest from a move to the "tightest" ceiling. This is a key finding, and makes clear once again that households may well be willing to accept restrictions on credit, as long as they retain the ability to have favorable

terms in certain ex-ante unlikely, but ex-post very bad, states of the world.

Table 11: Welfare Gains and Interest-Rate Ceilings

	less than high school	high school	college
$\xi = +\infty \to \xi = 11.11\%$	0.638%	0.707%	0.580%
$\xi = +\infty \to \xi = 17.65\%$	0.160%	0.107%	0.040%
$\xi = +\infty \to \xi = 33.33\%$	0.017%	0.010%	0.000%

For comparison, and to see that delinquency appears important for interest-rate-ceilings to play a beneficial role, see Table 12. This table presents welfare implications of imposing a fairly tight interest rate ceiling in a standard model where bankruptcy is the only option for debt default. We see that in this case, all agent-types are worse off, with the least skill losing the most from the imposition of a ceiling. This is natural–the latter has significant income risk, and relatively low income growth prospects. As a result, a tight ceiling makes smoothing across states of nature difficult. By contrast, the relatively skilled agents pose systematically less default risk than others, and so do not find an interest-rate ceiling as frequently likely to bind.

Table 12: Welfare Gains in the model with only the bankruptcy option

	less than high school	high school	college
	With Expenditure Shock		
$\xi = +\infty \to \xi = 11.11\%$	-0.774%	-0.623%	-0.428%
	Without Expenditure Shock		
$\xi = +\infty \to \xi = 11.11\%$	-0.006%	-0.002%	-0.001%

[guysm what facts/stats we should add for more intuition here?]

4.3 Eliminating Bankruptcy while Leaving Delinquency On the Table

The final question we address is that of the value of eliminating bankruptcy protection altogether. This is a now-standard question in models that do *not* allow delinquency as an option (see e.g. Athreya, Tam, and Young (2009), and Athreya (2008)), but as noted at the outset, such an experiment is not likely to be a practical one to carry out. By contrast, in our set-up, because it allows for delinquency, this *is* a practicable proposal–one can simply make it impossible by fiat to ask for legally-binding debt relief. We conduct this experiment by preserving the garnishment regime at its benchmark value $\psi = 0.05$.

Table 13: Aggregate Statistics and the elimination of Bankruptcy

Regime	BK	NBK
Debt / Income, hhds. with less than high school	0.098	0.124
Debt / Income, hhds. with high school	0.113	0.137
Debt / Income, hhds. with college	0.160	0.201
Interest Rate on borrowing, hhds. with less than high school	13.92%	13.39%
Interest Rate on borrowing, hhds. with high school	13.21%	11.75%
Interest Rate on borrowing, hhds. with college	10.33%	9.05%
Delinquency Rate, hhds. with less than high school	2.82%	3.12%
Delinquency Rate, hhds. with high school	2.18%	2.64%
Delinquency Rate, hhds. with college	1.24%	1.72%
Charge-off Rate, hhds. with less than high school	1.91%	0.01%
Charge-off Rate, hhds. with high school	2.26%	0.01%
Charge-off Rate, hhds. with college	2.66%	0.01%

Table 13 presents the aggregate outcomes. In this case, we see that when formal bankruptcy is ruled out, borrowing and informal bankruptcy both rise. However, the overall delinquency rate does not rise by a great deal. This is telling as it suggests that use of delinquency is intimately related to its potential for getting the household relief from creditors by making formal bankruptcy a "threat point." In particular, once

bankruptcy is ruled out as a legal matter, and creditors have the ability to extract concessions in delinquency, there is not much the household will obtain by doing so. Notice that overall losses to creditors fall precipitously. What is important about this finding is that it shows how the costs of bankruptcy matter fundamentally for the behavior of households considering default–once bankruptcy is removed a threat, treatment in delinquency can be tough. From a normative perspective, the model once again echoes the message of models that abstract from delinquency–that ex-ante welfare falls, for all agent-types, as bankruptcy is eliminated as an option, as shown in Table 14.

Table 14: Welfare Gains

	less than high school	high school	college
Bankruptcy → No Bankruptcy	−0.353%	−0.202%	−0.041%

As with the other two experiments we have studied in this paper, self-insurance appears to work well enough to maintain smooth consumption, at least at the aggregated level presented here. In this sense, the availability of delinquency as an option does not seem to change the basic (high) willingness of agents to trade the insurance of bankruptcy protection for the improved ability to smooth consumption intertemporally via lower interest rates.

4.3.1 How does garnishment matter when formal bankruptcy is not allowed?

The preceding presented results from the benchmark setting in which garnishment was not allowed–and hence where lenders were limited in their ability extend credit even though households lacked formal bankruptcy as an outlet. Table 15 shows that

this restriction is important. First, by comparing the level of household borrowing that comes from the elimination of bankruptcy alone, but where garnishment is ruled out–recall the results in Table 13. The increases in debt in this case were on the order or 20%. Now observe the much larger increases in borrowing–accompanied by a systematic fall in interest rates, as garnishing is allowed. Indeed, we see that the even as the delinquency rate falls as garnishing gets more severe (compare, e.g. $\psi = 0.01$ with $\psi = 0.10$), the total amount of debt rises very substantially (essentially doubling). In a nutshell, what is occurring is this: when formal bankruptcy is ruled out, but delinquency allowed with no creditor garnishment, households can avoid repayment which, all else, is valuable at time. However, knowing this, creditors, while increasing credit access relative to the case where bankruptcy was allowed (but garnishment disallowed) are not willing to increase it to the levels seen when they can extract more significant amounts of resources from households.

Table 15: Aggregate Statistic and garnishment with no bankruptcy

No bankruptcy, $\psi =$	0.00	0.01	0.05	0.10
Debt / Income, hhds. with less than high school	0.124	0.130	0.160	0.188
Debt / Income, hhds. with high school	0.137	0.148	0.177	0.200
Debt / Income, hhds. with college	0.201	0.214	0.282	0.387
Interest Rate on borrowing, hhds. with less than high school	13.39%	13.01%	11.53%	9.98%
Interest Rate on borrowing, hhds. with high school	11.75%	11.22%	8.84%	6.80%
Interest Rate on borrowing, hhds. with college	9.05%	8.30%	6.38%	5.94%
Delinquency Rate, hhds. with less than high school	3.16%	2.94%	2.04%	1.41%
Delinquency Rate, hhds. with high school	2.64%	2.40%	1.47%	0.84%
Delinquency Rate, hhds. with college	1.72%	1.49%	0.86%	0.54%
Charge-off Rate, hhds. with less than high school	0.01%	0.01%	0.01%	0.01%
Charge-off Rate, hhds. with high school	0.01%	0.01%	0.01%	0.00%
Charge-off Rate, hhds. with college	0.01%	0.01%	0.02%	0.10%

Lastly, the welfare implications of increased garnishment, shown in Table 16, are as before: it lowers welfare, with the largest losses coming from a move from the

benchmark (i.e. no-garnishment regime) to a relatively strict regime where $\psi = 0.10$.

Table 16: Welfare Gains of garnishment with no bankruptcy

	less than high school	high school	college
Bankruptcy, $\psi = 0.00 \rightarrow$ No Bankruptcy, $\psi = 0.00$	-0.353%	-0.202%	-0.041%
Bankruptcy, $\psi = 0.00 \rightarrow$ Bankruptcy, $\psi = 0.01$	-0.123%	-0.083%	-0.029%
No Bankruptcy, $\psi = 0.00 \rightarrow$ No Bankruptcy, $\psi = 0.01$	-0.116%	-0.142%	-0.083%
Bankruptcy, $\psi = 0.00 \rightarrow$ Bankruptcy, $\psi = 0.05$	-0.440%	-0.327%	-0.115%
No Bankruptcy, $\psi = 0.00 \rightarrow$ No Bankruptcy, $\psi = 0.10$	-0.662%	-0.492%	-0.141%
Bankruptcy, $\psi = 0.00 \rightarrow$ Bankruptcy, $\psi = 0.10$	-0.602%	-0.434%	-0.139%
No Bankruptcy, $\psi = 0.00 \rightarrow$ No Bankruptcy, $\psi = 0.10$	-1.047%	-0.584%	-0.399%

5 Concluding remarks

Delinquency, whereby borrowers do not repay as initially promised, is different than bankruptcy protection. In the data, both delinquency and bankruptcy are used frequently as ways to alter, ex-post, obligations agreed to earlier. 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 under competitive conditions, reflect the fact that household continues to hold bankruptcy as an option.

Ours is the first model of consumer borrowing that incorporates both the option to delay, and the option to have debts removed. Our model sheds light on the role played by the costs and benefits from 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, e.g. Athreya, 2008), our work suggests that this conclusion depends on the alternatives available, notably, the alternative to simply remain delinquent. We show that stricter

control of delinquency, as defined by a relatively high ability to garnish wages, leads to more bankruptcy and lower welfare. Similarly, we find that eliminating the bankruptcy option altogether leads to a modest increase in delinquency. Perhaps most interestingly, we show that interest-rate ceilings, even though they have the standard effects in terms of limiting credit access, improve ex-ante welfare for all.

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Figure 3: Life-cycle of bankruptcy and delinquency

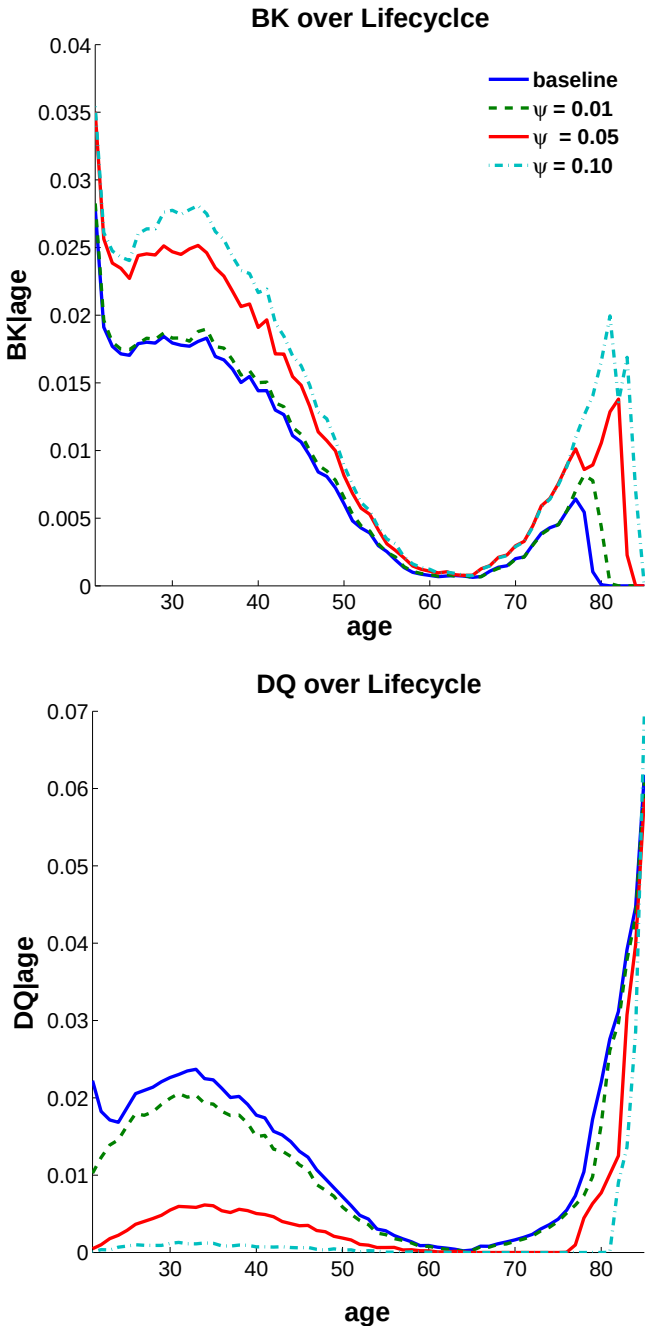

Figure 4: Pricing Functions and Interest-Rate Ceilings