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Abstract

Because of the recent surge in U.S. personal defaults, Congress is currently debating bankruptcy reform legislation requiring a means test for Chapter 7 filers. This paper explores the effects of such a reform in a model where, in contrast to previous work, bankruptcy options and production are explicitly taken into account. Our findings indicate that means testing would not improve upon current bankruptcy provisions and, at best, leaves aggregate filings, output, and welfare unchanged. Put simply, given already existing provisions, the introduction of an efficient means test would not bind. However, we do find that a tightening of existing bankruptcy laws, in the form of lower Chapter 7 asset exemptions, can be welfare improving. Contrary to previous studies, the analysis also suggests that eliminating bankruptcy entirely would cause significant declines in both output and welfare.

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Keywords: Chapter 7 and Chapter 13 bankruptcy; borrowing constraints; means-testing

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1 Introduction

Between 1980 and 2000, the total number of U.S. personal bankruptcy filings rose from 331,264 to nearly 1.3 million per year, reaching a historical high in 1998 (1.4 million). The preceding increase is seen more clearly in the rate of consumer bankruptcies per 100,000 households which nearly tripled from 410 to 1197. Approximately 70 percent of these filings were recorded as Chapter 7 "total liquidation" filings rather than Chapter 13 "re-scheduling" filings.[1] Predictably, net losses to creditors grew twice as fast as consumer installment credit during the 1980s and 1990s and are now counted in the tens of billions of dollars. In response to these events, the U.S. congress is currently considering a major overhaul of the U.S. bankruptcy system. The bankruptcy reform bills under legislative discussion – the Bankruptcy Abuse Prevention and Consumer Protection Act, and the Bankruptcy Reform Act – are meant to make it more challenging to file under Chapter 7. In particular, the current bills would make it possible to file under Chapter 7 only if the following two requirements are satisfied:

- the debtor's current income does not exceed median household income.
- the debtor's estimated five-year earnings less expenses is less than 25 percent of her general unsecured debts.

Debtors who fail to meet these requirements must either repay their debts in full or file under Chapter 13.

Changes in bankruptcy provisions are likely to affect not only which chapter a debtor chooses but also the aggregate incidence of bankruptcy. Moreover, the incidence of bankruptcy affects the general riskiness of loans and, consequently, risk premia charged by competitive lenders. Since risk premia in turn help determine the rate of return to savings and investment, a careful evaluation of changes to the bankruptcy system must take into account both incentive effects and general equilibrium feedback effects on prices. In this paper, we construct a dynamic general equilibrium framework that helps us explore the various channels through which bankruptcy reforms affect credit allocation and economic efficiency.[2]

[1] Current U.S. consumer bankruptcy law possesses two separate bankruptcy procedures, known as Chapter 7 and Chapter 13. When a debtor files for bankruptcy under Chapter 7, she must give up all assets not legally sheltered from creditor seizure in exchange for a discharge of almost all pre-existing debts. Under Chapter 13, a debtor may keep all of her property in exchange for a promise to pay all or some specified part of her debts out of future earnings under a payment plan approved by the court.

[2] The existence of bankruptcy procedures helps risk-averse borrowers by providing them with insurance against unexpected declines in income or wealth. Bankruptcy in effect allows creditors to share a portion

Our findings indicate that means testing would not improve upon current bankruptcy provisions and, *at best*, leaves aggregate bankruptcy filings, output, and welfare unchanged. In essence, given already existing provisions, the introduction of an optimal means test would not disqualify households that currently choose to file for bankruptcy. Thus, our model suggests that the costs of bankruptcy, in terms of resource transfers and other non-pecuniary penalties such as exclusion from credit markets, are already high enough that the decision to file is not taken lightly.

It is possible to make the means test strict enough to eradicate Chapter 7 bankruptcies. In this case, however, Chapter 13 defaults simultaneously rise and both output and welfare decrease. In particular, because the required debt repayment plan under Chapter 13 reduces expected earnings, a higher rate of Chapter 13 bankruptcies discourages labor effort. In addition, the elimination of Chapter 7 defaults implies that creditors collect more effectively on their loans. In equilibrium, therefore, the lending rate falls which stimulates a higher volume of consumer debt. The increase in consumer debt in turn reduces the available supply of capital and, given the reduction in labor input, output falls.

While the introduction of a means test is at best non-binding, we do find that a tightening of existing bankruptcy laws, in the form of lower Chapter 7 asset exemptions, can help increase both output and welfare. Interestingly, this result emerges because lower asset exemptions perversely lead to *more* Chapter 7 but *less* Chapter 13 bankruptcies. Indeed, with a lower exemption level, the greater confiscation of assets in the event of Chapter 7 default implies a reduced incentive to save and, consequently, a higher likelihood of default. With default more likely, the borrowing premium rises which increases the burden of debt repayment under Chapter 13. As a result, Chapter 13 bankruptcies fall in equilibrium and labor input correspondingly rises. Furthermore, the higher borrowing premium induces a lower volume of consumer loans which helps raise the supply of available capital. In this case, the rise in labor input and capital leads to an increase in output.

Finally, while households in our economy can benefit from a tightening of existing bankruptcy provisions, we find that eliminating bankruptcy options entirely carry significant social costs. Hence, in contrast to previous work, notably by Athreya (2001), our framework

of the risk associated with borrowers' earnings prospects. Of course, the tacit assumption here is that consumers cannot fully insure against idiosyncratic income risk. This lack of full insurance can arise for a variety of reasons. If, for example, individual income constitutes unverifiable private information, then providing any insurance against fluctuations that agents face may not be possible. Furthermore, in the face of adverse selection problems where different groups of individuals possess different risk characteristics, insurance companies will protect themselves by penalizing entire groups rather than single individuals when these risk characteristics are not publicly observable. In such situations, some groups may find themselves unable to purchase adequate insurance (See Aiyagari 1997).

provides a partial justification for the existence of bankruptcy provisions in the first place.

In terms of modeling strategy, this paper most closely resembles those of Athreya (2001) and Li (2001). While Athreya (2001) studies bankruptcy filings only under Chapter 7, Li (2001) investigates both Chapter 7 and Chapter 13 filings but does so in a two-period framework. Neither of the two papers allows for production and, consequently, make it impossible to fully address efficiency concerns. Introducing production explicitly turns out to have significant implications for welfare calculations relative to previous studies.

Other related papers include Chaterjee, Corbae, Nakajima, and Rios-Rull (2001), Lehnert and Maki (2002), Livshits, MacGee and Tertilt (2001), Wang and White (2000), and Zha (2001). As in Athreya (2001), Chaterjee et al. (2001) analyze unsecured consumer loans but allow for default only under Chapter 7. Their innovation, however, lies in the explicit modeling of a menu of credit levels and interest rates offered by credit suppliers. Lehnert and Maki (2002) focus on Chapter 7 bankruptcy filings in an economy with aggregate risk. Livshits et al. (2001) allow for income garnishment in a partial equilibrium life-cycle framework. Neither of the above papers allows for economy-wide production that uses capital as an input. Wang and White (2000) focus on optimal bankruptcy proceedings. Here, in contrast, existing provisions are taken as given. Finally, Zha (2001) models bankruptcy as a state where borrowers cannot commit to making contractually-agreed payments.

The rest of the paper is organized as follows. Section 2 presents the theoretical framework and defines equilibrium. In Section 3, we describe the choice of parameter values that define the benchmark model and discuss our calibration results. Section 4 carries out a quantitative evaluation of the policy proposal presently before Congress. In section 5, we explore several alternative policy experiments. Section 6 offers some concluding remarks.

2 The Benchmark Model

The basic framework adopted in our study is that of the deterministic growth model modified to include a large number of households subject to uninsured idiosyncratic shocks to their labor productivity.[3] As in Chatterjee et al. (2001), Zha (2001), and others, these agents have an option to file for bankruptcy under Chapter 7. We further extend previous work in two important ways.

First, households are also given the option to file under Chapter 13 in the event of default. Indeed, one of the main features of the proposed Chapter 7 reform is that it effectively pushes households towards Chapter 13 or the full repayments of debts.

[3] See Hugget (1993), and Aiyagari (1994).

Second, production is explicitly taken into account. There are two inputs that enter the production process, capital and labor. A single good is produced every period. Capital at a given date consists of output accumulated up to that date net of loans. Households make savings, borrowing, and labor decisions in each period. We view this second feature as an important component of any discussion addressing the efficiency implications of changes in bankruptcy procedures. More specifically, whereas eliminating bankruptcy provisions entirely involve welfare gains in Athreya (2001), the absence of such provisions implies substantial welfare losses once production is introduced.[4] Taking production into consideration, therefore, helps justify the existence of bankruptcy provisions in practice.

Finally, contrary to most previous studies, households may simultaneously borrow and save at different rates in our environment. In smoothing consumption intertemporally, the presence of exemption levels under Chapter 7 implies that, in equilibrium, households will choose to borrow before drawing down their assets completely (See Li 2001).

2.1 Preferences and Endowments

Households maximize their expected sum of discounted utility $E\sum_{t=0}^{\infty}\beta^t U(c_t, l_t)$, where $0 < \beta < 1$ is the subjective time discount factor, c_t represents consumption at date t, and l_t is labor supply in period t. Household preferences are assumed to have the following form,

$$U(c_t, l_t) = \frac{[c_t^{1-\sigma}(1-l_t)^{\sigma}]^{1-\rho} - 1}{1-\rho}. \tag{1}$$

This utility function is characterized by constant relative risk aversion and an intratemporal elasticity of substitution between consumption and leisure equal to one.

In each time period, households are endowed with one unit of time that can be allocated either to work or leisure. Following Hansen (1985), and Hansen and Imrohoroglu (1992), we assume that households can choose to work a given number of hours or not at all, $h \in \{0, \widehat{h}\}$. Household income fluctuates over time as a result of stochastic labor productivity shocks denoted by ε. The labor productivity shock takes values in R_+ and follows a first order Markov process whose cumulative distribution function is $G(\varepsilon'|\varepsilon)$ with associated density function $g(\varepsilon'|\varepsilon)$.

2.2 Technology

There exists a neoclassical aggregate production function,

$$y_t = F(k_t, n_t), \tag{2}$$

[4] Without production, Athreya (2001) shows that bankruptcy provisions carry considerable deadweight costs relative to the benefits associated with increased consumption smoothing.

where y_t is total output, k_t denotes capital input, and n_t represents effective labor input. The production function exhibits constant returns to scale with respect to capital and labor. Capital depreciates at a constant rate δ, $0 \leq \delta \leq 1$, when used in production. The production function satisfies the Inada conditions with respect to inputs.

There also exists an intermediation sector that processes all deposits and loans. This sector invests any deposits net of lending as capital input in the production process. We denote the gross deposit rate by R_t. For simplicity, we assume that the lending rate is set to cover transaction costs and aggregate default risk.[5] Thus, all borrowers are charged the same rate $R_t + \tau + \gamma_t$. Here, τ is an exogenous transaction cost per unit of loan that captures the cost of servicing accounts. The endogenous risk premium required to cover potential default is denoted γ_t. When the intermediation sector is competitive, the deposit rate equals the marginal product of capital in equilibrium. Intermediaries then choose the borrowing premium, γ_t, so as to break even.

2.3 Bankruptcy Provisions

The key aspect of current U.S. personal bankruptcy law is the existence of two separate procedures, Chapter 7 and Chapter 13.[6]

Debtors who file under Chapter 7 of the U.S. bankruptcy code are not required to use future income to repay their debts but must surrender any wealth exceeding a predetermined exemption level. Put another way, Chapter 7 allows the discharge of all eligible debts and the debtor enjoys a "fresh start." We denote the level of asset exemption under Chapter 7 by x.[7]

Alternatively, debtors can file for bankruptcy under Chapter 13 which offers virtually the opposite option. Under Chapter 13, the law allows debtors to keep all property, exempt and nonexempt, in exchange for a promise to pay off their debts out of future earnings. This typically takes the form of a five-year court-approved payment plan. Let $\eta(d)$ denote the percentage of wage income that is collected by creditors in a given year when a debtor has debt d . Since the repayment period usually spans five years, we have that

$$\eta(d) = \frac{(R + \tau + \gamma)\, d}{\text{estimated five-year income}}. \tag{3}$$

[5] In principle, lending rates can be made contingent on loan amounts, income, and other household characteristics. See Chatterjee et al.(2001) for a study that incorporates these possibilities.

[6] Personal bankruptcy law focuses exclusively on non-collateralized consumer debt such as credit card debt. In this paper, therefore, we do not consider debt incurred to finance various types of capital.

[7] Exemptions can be very different across states. For simplicity, we assume that all households in our economy face the same exemption level.

Observe that Chapter 13 calls for the repayment of principal plus interest as of the time of the filing. Any interest accrued beyond that date does not have to be repaid. The above specification is consistent with the empirical observation that the burden of debt repayment under Chapter 13, $(R + \tau + \gamma)d$, increases with the level of debt, d.

Households that file under either Chapter 7 or Chapter 13 become ineligible for Chapter 7 bankruptcy within six years of their initial filing. Only households that pay their debts in full under the five-year plan offered by Chapter 13 remain eligible for Chapter 7. Nevertheless, in practice, most credit agencies do not distinguish between Chapter 7 and Chapter 13 debtors. In our model, we prevent households that default under Chapter 7 from borrowing during the six years which follow their filing. To capture the lack of discrimination between Chapter 7 and Chapter 13 debtors by credit agencies, we further restrict households that declare bankruptcy under Chapter 13 from credit during the length of the repayment period.

As in Athreya (2001), we model exclusion from credit markets using a lottery that determines the average length of time during which a household is prevented from borrowing. Specifically, in each period following bankruptcy, a household remains in the borrowing constrained state with probability λ_i, $i = 7$, 13, where λ_7 and λ_{13} correspond to a Chapter 7 and a Chapter 13 filing respectively. Hence, $1/(1 - \lambda_i)$ captures the mean waiting time needed to regain full access to credit markets following bankruptcy. While approximating the fixed duration for which a household's poor credit history is maintained by the bankruptcy code, this device also allows us to avoid having to keep track of how many periods have elapsed since an individual household last declared bankruptcy.

Finally, we assume that households that file for bankruptcy bear a utility cost of filing, denoted s. We use this non-pecuniary cost as a proxy for all expenses not directly linked to the cost of exclusion from credit markets. These expenses include court costs, lawyers' fees, and the time cost associated with preparing a clear case. In addition, many authors refer to this utility cost as "stigma," and argue that social stigma is an important factor in households' bankruptcy decisions. White (1998), for instance, found that at least 15 percent of the households in her nation-wide sample could benefit financially from bankruptcy given their assets, debt levels, and the exemptions available in their states. The personal filing rate in the U.S., however, represents only 1.2 percent of the adult population. Several other studies have uncovered evidence that a recent lessening of stigma has encouraged consumers to file for bankruptcy. These studies include Fay, Hurst, and White (2002), Gross and Souleles (1998) and Buckley and Brinig (1998).

At the beginning of each period, our economy is populated by three types of households. We denote the measure of unconstrained households (i.e. those with access to credit) by μ^{UC}, including households that have paid their debts in full and whose credit history has been re-

paired. We let $\mu^{C.\text{chap.}7}$ represent the measure of borrowing constrained households that have filed under Chapter 7. Throughout the paper, the letter "C" in the superscript "C.chap.7" stands for constrained. Thus, constrained households that have filed under Chapter 13 have measure $\mu^{C.\text{chap.}13}$. Observe that in each period, only unconstrained households can freely choose to file for bankruptcy.

2.4 The Household's Problem

Households maximize expected lifetime utility and take all prices – the deposit rate, the loan rate and the wage – as given. Since we only study stationary equilibria in which all aggregate variables are constant over time, we can treat prices parametrically in each household's optimization problem. We omit the time index to simplify notation. We distinguish between two types of households below, those with access to credit and those that are borrowing constrained.

2.4.1 Unconstrained Households

Let $V^{UC}(a, d, \varepsilon)$ denote the value function of a household with access to credit at the beginning of the period. The relevant states for this household include its asset level, $a \in A = \mathrm{R}_+$, its debt level, $d \in D = [0, \overline{d}]$, and its labor productivity draw, $\varepsilon \in \mathcal{E} = \mathrm{R}_+$. It has three options: it can either pay off its debt, file for bankruptcy under Chapter 7, or file for bankruptcy under Chapter 13. We use $V^R(a, d, \varepsilon)$ to denote the value function of the household if it repays its debt in full in the current period, $V^{\text{chap.}7}(a, \varepsilon)$ to denote its value function if it currently chooses Chapter 7, and $V^{\text{chap.}13}(a, d, \varepsilon)$ to represent the value function of the household if it files for bankruptcy under Chapter 13.

The value of repaying one's debt today is defined recursively as follows,

$$V^R(a, d, \varepsilon) = \max_{\{c, l, a', d'\}} \{U(c, l) + \beta \int_{\mathcal{E}} V^{UC}(a', d', \varepsilon') dG(\varepsilon'|\varepsilon)\} \tag{P1}$$

subject to

$$\begin{aligned} c + a' &\leq Ra + \varepsilon w l + d' - (R + \tau + \gamma)d, \\ c, a' &\geq 0, \\ 0 &\leq d' \leq \overline{d}, \\ l &\in \{0, \widehat{h}\}, \end{aligned} \tag{4}$$

where c is current period consumption, a' denotes the amount of assets carried into next period, d' represents debt, and w is the the household's wage. Equation (4) simply captures

the household's budget constraint. Note that there exists an upper bound on how much debt a household can carry into next period. Equation (P1) also shows that a household that pays off its debt in full in the current period necessarily gains unconstrained access to credit markets in the following period.

In order to define the value of filing for bankruptcy to an unconstrained household, we first need to introduce additional notation. Let $V^{C.\text{chap.}7}(a,\varepsilon)$ denote the value function of a household that has filed under Chapter 7 and that is now borrowing constrained. Let $V^{C.\text{chap.}13}(a,d,\varepsilon)$ represent the value function of an analogous household that has filed under Chapter 13. The value of filing for Chapter 7 can then be recursively defined as,

$$V^{\text{chap.}7}(a,\varepsilon) = \max_{\{c,l,a'\}} \{U(c,l) - s + \beta \int_{\mathcal{E}} V^{C.\text{chap.}7}(a',\varepsilon')dG(\varepsilon'|\varepsilon)\} \tag{P2}$$

subject to

$$\begin{aligned} c + a' &\leq \min(Ra, x) + \varepsilon w l, \\ c, a' &\geq 0, \\ l &\in \{0, \widehat{h}\}. \end{aligned} \tag{5}$$

Note that once a household chooses to file for bankruptcy under Chapter 7, all its debts are discharged and d no longer serves as a state variable. These households currently suffer a utility loss s. Moreover, as depicted in their budget constraint (5), they can only keep assets up to the exemption level x. These households are necessarily borrowing constrained in the following period and, as a result, have continuation utility $V^{C.\text{Chap.}7}(a',\varepsilon')$.

An unconstrained household that files for bankruptcy under Chapter 13 solves the following problem,

$$V^{\text{chap.}13}(a,d,\varepsilon) = \max_{\{c,l,a'\}} \{U(c,l) - s + \beta \int_{\mathcal{E}} V^{C.\text{chap.}13}(a',d,\varepsilon')dG(\varepsilon'|\varepsilon)\} \tag{P3}$$

subject to

$$\begin{aligned} c + a' &\leq Ra + [1 - \eta(d)]\varepsilon w l, \\ c, a' &\geq 0, \\ l &\in \{0, \widehat{h}\}. \end{aligned} \tag{6}$$

Once a household has filed under Chapter 13, it is allowed to keep all its assets but only a portion $1 - \eta(d)$ of its current wage.[8] Additionally, as for those filing under Chapter 7,

[8] Observe that $\eta(d) = \frac{(R+\tau+\gamma)d}{\text{Estimated five-year income}}$ acts essentially as a wage tax. In practice, courts typically base estimated five-year income on current earnings. In our model, this assumption would require that we keep track of an additional state variable, namely the level of labor productivity at the time of default. For simplicity, we use instead mean labor productivity in computing estimated five-year earnings conditional on Chapter 13 default.

this household pays the bankruptcy cost s. In the following period, households filing under Chapter 13 do not have access to credit.

Since a household authorized to borrow can choose to repay its debts or file for bankruptcy under either Chapter 7 or Chapter 13, we have that,

$$V^{UC}(a,d,\varepsilon) = \max\left\{V^{R}(a,d,\varepsilon), V^{\text{chap.7}}(a,\varepsilon), V^{\text{chap.13}}(a,d,\varepsilon)\right\}. \tag{7}$$

2.4.2 Borrowing Constrained Households

We now turn to the problem faced by borrowing constrained households. These households have defaulted on their debts in the past. A Chapter 7 defaulter who is now restricted from credit markets solves the following problem,

$$\begin{aligned} V^{C.\text{chap.7}}(a,\varepsilon) &= \max_{\{c,l,a'\}} \{U(c,l) - s + \beta \int_{\mathcal{E}} [\lambda_7 V^{C.\text{chap.7}}(a',\varepsilon') \\ &\qquad + (1-\lambda_7) V^{UC}(a',0,\varepsilon')] dG(\varepsilon'|\varepsilon)\} \end{aligned} \tag{P4}$$

subject to

$$\begin{aligned} c + a' &\leq Ra + \varepsilon w l, \\ c, a' &\geq 0, \\ l &\in \{0, \widehat{h}\}. \end{aligned} \tag{8}$$

Observe that a constrained Chapter 7 household continues to suffer a utility loss from having filed for bankruptcy. In the following period, it will carry on unable to borrow with probability λ_7 or regain access to credit with probability $1-\lambda_7$.

Likewise, a constrained household that has defaulted under Chapter 13 solves,

$$\begin{aligned} V^{C.\text{chap.13}}(a,d,\varepsilon) &= \max_{\{c,l,a'\}} \{U(c,l) - s + \beta \int_{\mathcal{E}} [\lambda_{13} V^{C.\text{chap.13}}(a',d,\varepsilon') \\ &\qquad + (1-\lambda_{13}) V^{UC}(a',0,\varepsilon')] dG(\varepsilon'|\varepsilon)\} \end{aligned} \tag{P5}$$

subject to

$$\begin{aligned} c + a' &\leq Ra + [1-\eta(d)]\varepsilon w l, \\ c, a' &\geq 0, \\ l &\in \{0, \widehat{h}\}. \end{aligned} \tag{9}$$

A household in default under Chapter 13 continues to pay off its debt out of wages. Furthermore, it cannot borrow for consumption purposes as long as it remains in the constrained

state. Analogously to Chapter 7 debtors, it suffers the current period utility loss from having filed for bankruptcy. A Chapter 13 defaulter will continue to be barred from credit markets in the following period with probability λ_{13}, or regain entry into the unconstrained pool with probability $1 - \lambda_{13}$.

2.4.3 Choosing between Chapter 7 and Chapter 13

Define the collection of value functions, $V \equiv \left\{V^R, V^{\text{chap.7}}, V^{\text{chap.13}}, V^{C.\text{chap.7}}, V^{C.\text{chap.13}}\right\}$. Observe that problems (P1), (P2), (P3), (P4), and (P5) represent a set of five functional equations in five unknown functions, and define a mapping $V^{j+1} = \Gamma(V^j)$. Figure 1 displays some properties of $V^{\text{chap.7}}$ and $V^{\text{chap.13}}$ in V that solve (P1) through (P5) (i.e. $V = \Gamma(V)$), and offers us intuition as to how households decide between filing for Chapter 7 and Chapter 13. In particular, note that $V^{\text{chap.7}}$ increases with a for $a \leq x/R$, and becomes invariant to changes in a for $a > x/R$. Moreover, $V^{C.\text{chap.13}}$ increases continuously with a and decreases continuously with d. These results are shown formally in Appendix A.

Put simply, Figure 1 tells us that the value function of a Chapter 7 debtor increases with wealth below the exemption level, and is invariant to changes in assets thereafter. Since all wealth above the exemption level must be surrendered in the event of Chapter 7 default, any assets accumulated beyond that level do not influence the value of declaring Chapter 7 bankruptcy. Furthermore, because Chapter 7 provides for the discharge of all debts, changes in d leave $V^{\text{chap.7}}$ unaffected.

Note in Figure 1 that when household wealth is relatively low, $a \leq a^*$, the value of declaring bankruptcy under Chapter 7 dominates Chapter 13 bankruptcy. The reverse is true for households whose assets are relatively high, $a \geq a^*$. Hence, if both chapter 7 and chapter 13 bankruptcies are observed in equilibrium, our model implies that Chapter 13 defaulters have higher assets than households that default under Chapter 7. In a sense, it is only natural that Chapter 13, which allows households to retain their assets, would be more attractive to households with relatively more wealth.[9] Indeed, using a random sample of Chapter 7 and Chapter 13 cases from a population of 17,565 bankruptcies, Domowitz and Sartain (1999) found that net worth levels were important factors in debtors' bankruptcy choice decisions. Higher levels of net worth relative to debt pushed debtors into Chapter 13 with a probability double that predicted for households with low equity holdings (see also Nelson 1999).

Appendix A also demonstrates that the value function of households that file under

[9] In principle, it is possible for $V^{\text{chap.7}}$ to lie everywhere below $V^{\text{chap.13}}$ in Figure 1. However, no Chapter 7 defaults would ever be observed in this case.

Chapter 13 is decreasing in debt holdings. Given the deposit rate, R, higher debts imply a higher debt burden, $\eta(d)$, by equation (3), and reduce household resources available for consumption. This is shown as the shift from $V(a, d, \varepsilon)$ to $V(a, d', \varepsilon)$ for $d' > d$ in Figure 1. It follows that the greater the debt held by a given household, the more likely it is to file under Chapter 7. In this case, the new asset threshold at which the household becomes indifferent between Chapter 7 and Chapter 13 increases to $a^{**} > a^*$. We now turn to the firm's problem.

2.5 The Firm's Problem

A representative firm in our model economy takes as given the wage, w, as well as the interest rate, R, and solves the following optimization problem,

$$\max_{\{k,n\}} \; F(k, n) - (R - 1)k - wn - \delta k. \tag{10}$$

Labor and capital inputs are chosen so as to equate the wage and the rental rate on capital with their respective marginal product. In our analysis, the production function $F(k, n)$ takes the Cobb-Douglas form, $k^{\alpha} n^{1-\alpha}$, where α captures the share of capital income in output.

2.6 Equilibrium

An equilibrium for this economy is a set of prices (the deposit rate, the borrowing rate, and the wage), household consumption, labor, and credit allocations, as well as firms' decision rules, such that i) households' decisions maximize their lifetime utility, ii) firms' decision rules maximize profits, iii) all markets clear, and iv) individual and aggregate behavior are consistent. Appendix B gives a formal description of the stochastic stationary equilibrium.

3 Parameterization of the Benchmark Model

A time period in the model corresponds to one year. There are four sets of parameters that need to be calibrated. These parameters relate to preferences, technology in both production and intermediation, bankruptcy provisions, and the stochastic process for labor productivity. We choose these parameters so as to match key U.S. economic statistics. The complexity of our model economy does not allow for the derivation of analytical solutions. Appendix C provides a description of the numerical method used to compute the model's stationary equilibrium.

3.1 Calibration

The discount factor β is chosen so as to match the annualized post-WWII real return available on T-bills, approximately 2.7 percent. As in Aiyagari and McGrattan (1998), we set the risk-aversion parameter, ρ, to 1.5 which implies slightly more curvature in utility than the logarithmic function. Following Hansen and Imrohorglu (1992), we let $\sigma = 0.67$, and set $\widehat{h}$ to 0.45. Assuming that individuals have 98 hours a week of substitutable time not spent eating, sleeping, or engaged in other personal care, this value of $\widehat{h}$ corresponds to 45 hours a week spent working and commuting for employed agents. As with many other quantitative studies on business cycles, the labor share of income is set to 0.70 which implies that $\alpha = 0.3$. Consistent with the postwar average depreciation of fixed private capital and consumer durables, we choose an annual depreciation rate δ of 0.1.

Following Athreya (2001), the transaction cost parameter τ is set to 5 percent. This value represents the difference between the deposit rate, R, and the lending rate in the absence of bankruptcy provisions, $R + \tau$. Evans and Schmalensee (1999) found that the cost of servicing credit card accounts is roughly 5.3 percent. In addition, it is important for us to match the risk spread between the deposit rate and the lending rate with default, $R + \tau + \gamma$. According to an annual report by the Board of Governors of the Federal Reserve System (http://www.federalreserve.gov /boarddocs/RptCongress/creditcard/1999), over the five years since the last major change in bankruptcy law, the Bankruptcy Reform Act of 1994, the real interest rate on unsecured loans has averaged 13.5 percent. The difference between 13.5 percent and the deposit rate, R, is the risk spread we attempt to match in the paper.

The parameters λ_7 and λ_{13} govern the average time during which households remain unable to borrow once they have filed for bankruptcy. As described earlier, according to current U.S. personal bankruptcy law, debtors whose debts are discharged under Chapter 7 are ineligible for bankruptcy during the six years which follow their filing. Under Chapter 13, debtors typically enter a five-year payment plan approved by the court. Hence, we set λ_7 and λ_{13} to 0.83 and 0.80 respectively.

Finally, we choose the remaining parameters of the model so as to match the following five U.S. economy statistics.

1) *Capital-output ratio.* Given the absence of public capital, the stock of capital in the model economy is identified with producers' equipment and structures, inventories, residential structures, and land. Investment then corresponds to fixed private investment and changes in inventories. This is consistent with the measurement of GNP in the NIPA and gives us an annual capital-output ratio of 2.5.

2) *Debt to income ratio.* According to the G.19 consumer credit release by the Board of Governors (http://www.federalreserve.gov/releases/G19/Current/), from 1995 to 2000, revolving consumer credit averaged 9 percent of total disposable income. Revolving credit consists of "open-end" unsecured loan contracts that can be extended indefinitely as long as minimum monthly payments are made. There also exists nonrevolving credit which consists of "closed-end" loans contracts that must be paid off during a predetermined period of time, including automobile, mobile home, and some credit card loans. While nonrevolving credit may include some unsecured debt, this percentage is likely to be small. Therefore, under our benchmark scenario, we match the 9 percent ratio of revolving credit to income.

3) *Gini index of income.* Using PSID data, Quadrini (2000) has calculated a U.S. Gini index of income of approximately 0.44 for both 1984 and 1989.

4) and 5) *Percentage of households that file for bankruptcy under Chapters 7 and 13.* According to statistics published by the American Bankruptcy Institute (http://www.abiworld.org/), between 1995 and 2000, the percentage of households that filed for bankruptcy in any given year averaged 1.18 percent, 70 percent of whom filed under Chapter 7.

To simplify the calibration, we make two assumptions regarding the stochastic processes describing labor productivity. First, we assume that it follows a two-state Markov chain with values in $[y, 2-y]$ so that average labor productivity is 1. Second, the transition matrix for labor productivity is assumed to be symmetric,

$$\begin{bmatrix} \pi & 1-\pi \\ 1-\pi & \pi \end{bmatrix}.$$

The following five parameters are then set to achieve our five U.S. economy statistics above: the maximum amount of debt a household can hold, $\overline{d}$, the asset exemption level that applies under Chapter 7, x, the bankruptcy stigma, s, the value of labor productivity, y, and the transition probability for labor productivity disturbances, π.[10]

The parameter values that achieve our calibration targets are summarized in Table 1. A solvent household has a borrowing ceiling of 0.98, roughly twice the average income in the economy. The asset exemption level for Chapter 7 debtors turns out to be 0.4, which matches average income. The bankruptcy stigma suffered by defaulters amounts to a 6 percent reduction in their lifetime welfare. This relatively high nonpecuniary bankruptcy cost is consistent with a large empirical literature. As pointed out earlier, White (1998)

[10] As a first approximation, we assume the natural logarithm of ε to be a first-order autoregressive process with serial correlation coefficient, ρ_ε, and standard deviation, σ_ε. We then use the procedure described in Tauchen (1986) to approximate the autoregression of $\log(\varepsilon)$ with a two-state first-order Markov chain for given values of ρ_ε and σ_ε. The values of ρ_ε and σ_ε are taken from Aiyagari (1994).

argues that pure financial incentives should lead to nationwide filing rates in excess of 15 percent, well above observed actual filing rates of 1.2 percent. Furthermore, Sullivan et al. (1989) provide a detailed discussion of the typically desperate financial circumstances of those who file for bankruptcy, arguing that few take the option lightly. Using a panel data set of credit card accounts, Gross and Souleles (2001) also find that default costs, including social, information, and legal costs, are crucial in explaining the recent trend in default rates.

[Insert Table 1 Here]

3.2 Calibration Results

We report the main properties of the benchmark model economy and their data counterparts in Table 2. As shown in the table, the model does well in reproducing the statistics our calibration set out to match. The risk spread implied by the model is 10.5 percent, close to the 10.8 percent rate observed in the data. We were also successful in replicating both the debt to income ratio as well as the percentage of defaults in the economy.

[Insert Table 2]

In addition to these statistics, our framework also performs relatively well in reproducing debt-related facts we had not specifically set out to match. Personal bankruptcy in our model results in the discharge of nearly 6 percent of total consumer debt. This matches closely the 1997 WEFA estimates indicating that bankruptcy filings led to the discharge of 42 billion dollars in consumer debt, roughly 7 percent of the 568 billion dollars held in consumer revolving debt. Approximately 70 percent of the debt that is released, both in the model and in the data, is due to Chapter 7 filings. Our framework also implies that Chapter 13 defaulters repay on aggregate about 65 percent of their debts, somewhat higher than the 57 percent repayment rate for Chapter 13 filings reported by the GAO (see the U.S. General Accounting Office, 1983, p. 43). The Gini coefficient of wealth we obtain, however, is only 0.48, below the 0.63 value that is found in U.S. data.

Another implication of the model is that, on average, Chapter 13 debtors in the economy have higher assets than those that file under Chapter 7. Moreover, Chapter 13 debtors are less likely to work after the filing. These results are consistent with related empirical findings (Nelson 1999, and Domowitz and Sartain 1999). Finally, in contrast to previous studies, our framework makes it possible for close to 15 percent of households to hold both savings and debt simultaneously.[11]

[11] Using the Consumer Expenditure Survey, Lehnert and Maki (2002) find that about 16 percent of households hold simultaneously liquid assets and unsecured debts exceeding $2000.

4 An Evaluation of the Current Proposal

Using our calibrated model economy, we now analyze the "need-based" bankruptcy relief reform proposal currently included in both the House Bill (H.R. 333), and the Senate Bill (S. 420). In particular, we study the impact of the bill on aggregate output, total bankruptcy filings, and welfare.

The "need-based" relief bill currently pending before Congress is designed to give debtors no more than the relief they need. More specifically, the provisions in the bill are intended to identify debtors who have the ability to repay some portion of their debts out of their future earnings, to deter them from obtaining relief under Chapter 7 of the Bankruptcy Code, and to relegate them to obtaining relief under Chapter 13. The House and Senate bills share two general means tests. In particular, a household that "passes" either of the following two tests would be barred from filing under Chapter 7:

- The debtor's income meets or exceeds the regional median income of households with the same number of members.
- The debtor's estimated five-year earnings less expenses represents at least 25 percent of her general nonpriority unsecured debts.

Alternatively, note that to "fail" the means test implies that a household *would* be allowed to file for Chapter 7.[12] Both the House and Senate bills take into consideration various expenses with respect to their need-based tests, with living allowances generally based on IRS Standards but not necessarily with the same accommodations.[13] Given the differences between the two bills, and the fact that court-determined expenses are likely to be subjective in nature, we experiment with different levels of expenses measured as a proportion of estimated five-year earnings and denoted by ϕ, $(0 \leq \phi \leq 1)$. When $\phi = 1$, all

[12] This (somewhat odd) way of defining what it means to "pass" or "fail" the means test is taken from the actual bills.

[13] The House bill, for example, allows a debtor to claim certain education expenses for a child under the age of 18 years as well as estimated administrative expenses and attorney fees associated with a Chapter 13 case. The House bill also authorizes a 5 percent enhancement for food and clothing expenses under certain circumstances. In contrast, the Senate bill allows a debtor to claim expenses for the care of an elderly, chronically ill, or disabled member of the debtor's household or immediate family. In addition, the Senate bill permits the debtor to claim reasonably necessary expenses incurred to maintain the safety of the debtor and the debtor's family from domestic violence. Further, the Senate bill allows a debtor to claim payments made to secured creditors, in addition to the amount required pursuant to the underlying agreement, that are needed to enable the debtor to retain possession of a primary residence, motor vehicle or other property necessary for the support of the debtor or the debtor's dependents.

of a defaulters' estimated five-year income is used in defining the means test. That is, no expenses are allowed in the second test above. As ϕ rises, it becomes increasingly difficult to "fail" the means test because fewer and fewer expenses are allowed and, therefore, it is easier for a household's income to represent 25 percent of its debts. In other words, as ϕ rises, it becomes more difficult to declare bankruptcy under Chapter 7.

Although the two bills contain many other provisions, including a need-based test for Chapter 13 debtors in the House bill, there is less consensus both in the House and in the Senate regarding Chapter 13 provisions. Furthermore, in order to facilitate comparison of our results with those of other studies, we restrict ourselves to the need-based test for Chapter 7 debtors.

Recall from equation (7) in section 2 that, in the benchmark case without means-testing, a household with access to credit can choose to repay its debt or file for bankruptcy under either chapter. With means-testing, however, equation (7) must now be altered to

$$V^{UC}(a,d,\varepsilon) = \begin{cases} \max\{V^R(a,d,\varepsilon), V^{\text{chap.7}}(a,\varepsilon), V^{\text{chap.13}}(a,d,\varepsilon)\} & \text{when the household} \\ & \text{fails the means-test,} \\ \max\{V^R(a,d,\varepsilon), V^{\text{chap.13}}(a,d,\varepsilon)\} & \text{otherwise.} \end{cases} \tag{11}$$

Put another way, when a household "passes" the means-test, it no longer has the option to file under Chapter 7.

4.1 Effects on Prices and Quantities

Table 3 presents our main findings regarding the current bankruptcy reform bill. It depicts the responses of key variables to the introduction of means testing for Chapter 7 defaulters. Observe first that relative to the benchmark case, the means test does not bind for values of ϕ that are less or equal to 0.37. Put another way, when $\phi \leq 0.37$, households that choose to file for bankruptcy absent means testing remain free to do so. In this case, Chapter 7 defaults as a percentage of the population remain as in the benchmark scenario at approximately 0.8 percent, and all other allocations as well as prices are unchanged. Of course, as ϕ rises, the means test becomes more stringent and Chapter 7 defaults can eventually be driven out. A value of $\phi = 0.40$ is enough to eliminate the benchmark percentage of Chapter 7 defaults.

As the severity of the means test increases, households that borrow are effectively left with only two options, paying off their debts or filing for Chapter 13. It is not surprising, therefore, that the incidence of Chapter 13 defaults rises significantly once Chapter 7 defaults have been eradicated. This switch in chapter choice implies that creditors are able to collect more effectively on their loans so that, in equilibrium, the default premium,γ, and the lending

rate, $R + \tau + \gamma$, both fall. In the case where $\phi > 0.40$, the lending rate falls by 17.5 basis points. Given the lower lending rate, the volume of consumer debt rises which helps reduce the supply of available capital. Observe that the aggregate stock of private capital must add up to total assets net of loans,

$$k = \int_{A,D,\mathcal{E}} (a^{UC} - d^{UC}) d\mu^{UC} + \int_{A,\mathcal{E}} a^{C.\text{chap.}7} d\mu^{C.\text{chap.}7} + \int_{A,D,\mathcal{E}} a^{C.\text{chap.}13} d\mu^{C.\text{chap.}13} \qquad (12)$$

(see Appendix B). The lower equilibrium capital stock is in turn consistent with a higher deposit rate, R.

The increase in Chapter 13 bankruptcies that prevails once Chapter 7 defaults have been eliminated also implies a lower level of labor input. Recall that the required debt repayment plan under Chapter 13 acts as a wage tax and, therefore, reduces the incentive to work. With both labor input and capital input falling as the means test becomes strict enough, output necessarily decreases.

4.2 Implications for Welfare

We define welfare as the sum of all agents' utilities in the economy. A welfare change is measured as the percent change in benchmark consumption at every date and state that equates the level of welfare in the alternative case with the reference case. There are three main factors that determine the effects of stricter Chapter 7 provisions on total welfare.

First, we have seen that a means test severe enough to eradicate Chapter 7 bankruptcies also lowers both labor and capital input so that total output falls. This leads to a corresponding decrease in aggregate consumption which has a direct negative impact on welfare.

Second, recall that each loan in our model carries a transaction cost, τ. The lower lending rate that emerges when ϕ is high enough is associated with a higher volume of loans and, consequently, an increase in aggregate transaction costs. In the case depicted in Table 3, the level of debt increases significantly given the fall in output and the noticeable rise in the debt to income ratio. As in Athreya (2001), these costs represent a pure deadweight loss and also reduce both total consumption and welfare.

Finally, as the difficulty of filing for Chapter 7 increases, marginal households with estimated five-year earnings at the threshold now only have the options to file for Chapter 13 or pay off their debts. With fewer options available, these households are unambiguously worse off.

It should be observed that the 17.5 basis point decrease in the lending rate, $R + \tau + \gamma$, shown in the third column of Table 3 does make it cheaper to borrow. Consequently, some households are now better able to smooth consumption intertemporally. However, Table 3

suggests that in equilibrium, the gain in welfare implied by these households' increased consumption smoothing falls far short of the welfare losses implied by the other forces discussed above. When the means test is made stringent enough to eliminate Chapter 7 defaults, welfare falls by a full 1 percentage point. In the end, therefore, we find that means testing does not improve upon current bankruptcy provisions and, at best, leaves output and welfare unchanged.

5 Alternative Policy Experiments

In this section, we explore the implications of two alternative bankruptcy reforms. First, we experiment with lowering asset exemption levels as an alternative way to tighten Chapter 7 provisions. We have just seen that means testing is at best non-binding relative to the current bankruptcy code. Changes in the existing code, however, will alter credit allocations and may improve economic efficiency. Second, we study the polar case in which no bankruptcy is allowed. The results are summarized in Table 4.

5.1 Lowering Asset Exemptions under Chapter 7

This section discusses the implications of lowering the level of asset exemptions, x, under Chapter 7 as an alternative to the means test proposed by the U.S. Congress.

Regarding credit allocation, lower asset exemptions lead to two forces that act in opposite directions. On the one hand, a lower exemption level implies greater confiscation of assets and, at the margin, less financial benefits from filing under Chapter 7. This effect tends to decrease Chapter 7 defaults. On the other hand, precisely because more assets are confiscated in the event of default, a lower exemption level also reduces the incentive to save and increases the incentive to borrow. Furthermore, in saving less and/or borrowing more, households find themselves at greater risk of default under Chapter 7. In equilibrium, we find that the reduced incentive to save dominates and perversely leads to *greater* Chapter 7 bankruptcies. In the example shown in Table 4, which maximizes welfare, savings for Chapter 7 defaulters decrease by 1/3 relative to the benchmark case while consumer debt for these households rises slightly. Furthermore, with a lower exemption level, the measure of additional households that file for bankruptcy under Chapter 7 increases by 0.109 percent relative to the benchmark case of 0.86 percent.

The larger incidence of Chapter 7 bankruptcies also implies a deterioration in borrower repayment rates. Consequently, in order to break even, the default premium, γ, and thus the lending rate, $R + \tau + \gamma$, must increase. Furthermore, recall from equation (3) that the

percentage of wage income that may be collected by creditors under Chapter 13, $\eta(d)$, is proportional to defaulters' debt burden, $(R + \tau + \gamma)d$. Since debt burden increases with a higher lending rate, the prospect of filing under Chapter 13 now worsens. In equilibrium, lower exemption levels under Chapter 7 actually leads to *less* Chapter 13 filings and less total defaults.

Because the rise in the loan rate also induces less consumer debt, capital input increases in equilibrium along with output. Moreover, the reduction in total consumer debt translates into smaller deadweight losses arising from transaction costs, and the decrease in aggregate filings also reduces the losses associated with non-pecuniary bankruptcy costs. The latter forces, of course, all tend to increase total consumption and welfare.

We should note, however, that reductions in Chapter 7 asset exemptions cannot lead to ever increasing welfare. Because Chapter 7 defaults continue to rise with lower asset exemptions, total filings eventually also increase as the incidence of Chapter 13 bankruptcies can only be driven down to zero. As aggregate bankruptcy filings rise, so do the deadweight losses associated with ex-post penalties that do not transfer resources such as credit market restrictions, court costs, and stigma. Furthermore, the higher lending rate associated with lower asset exemptions makes it more expensive to borrow and reduces households' ability to smooth consumption across dates. In the example depicted in Table 4, we identify the level of asset exemption that maximizes steady state welfare. Relative to the benchmark scenario, this case leads to a non-negligible 0.4 percent improvement in welfare. At that point, Chapter 13 defaults are virtually eliminated.

5.2 Eliminating Bankruptcy Provisions

Our last experiment suggested that households may benefit somewhat from a tightening of existing bankruptcy procedures and lower aggregate defaults. That is not to say that bankruptcy serves no beneficial role. In particular, while the analysis of optimal bankruptcy provisions lies beyond the scope of this paper, we now discuss the efficiency implications of eliminating bankruptcy entirely.[14]

In a setting without production, the welfare consequences of removing bankruptcy provisions may be understood in terms of three main effects. First, recall that bankruptcy is typically justified as a means of insurance for households that suffer adverse income shocks. Specifically, since households face uninsurable idiosyncratic risk in our environment, there will be states of the world in which a household's income is low. Requiring the full repayment

[14] Wang and White (2000) suggest combining Chapters 7 and 13 so that debtors filing for bankruptcy would have to use both assets and future earnings, after exemptions, to repay their debts.

of debts in this case, through the elimination of bankruptcy, would directly result in welfare losses from temporarily low consumption. Second, because lenders are always repaid when default options are eliminated, the absence of bankruptcy procedures also implies a lower lending rate and, in equilibrium, a higher volume of loans. Since each loan carries a service cost, τ, the elimination of bankruptcy is associated with larger deadweight losses linked to credit transactions. The third effect acts in an opposite direction and can yield substantial welfare gains. In fact, without bankruptcy, Athreya (2001) shows that the ensuing reduction in bankruptcy costs associated with exclusion from credit markets and other non-pecuniary penalties can significantly outweigh the welfare losses stemming from decreased consumption smoothing. Absent production, eliminating bankruptcy can yield welfare gains ranging of up to 0.7 percent (Athreya 2001). The challenge, of course, then lies in explaining the existence of bankruptcy provisions in the first place. Table 4 indicates that a possible answer to this question lies in the explicit modeling of production.

The third column of Table 4 shows that removing the option of bankruptcy leads to a sharp fall in the lending rate, by approximately 4.8 percent from 13 percent to just 8.14 percent, and a corresponding increase in consumer debt. Here, the debt to income ratio rises by 34 percent. In addition, because households now find it cheaper to borrow, the need for precautionary savings decreases which induces a rise in the deposit rate, in this case by roughly 60 basis points. While these features also emerge when abolishing bankruptcy provisions in an endowment economy, both the increase in debt and the rise in the deposit rate are now further associated with a significant decrease in the stock of capital available for production. Moreover, the fall in aggregate capital leads to an inward shift in labor demand and, in equilibrium, both wages and labor input fall. In our framework, and contrary to most previous studies, the sharp decline in both capital input and labor input reduces production of the final good, total consumption, and welfare. In particular, relative to the benchmark case, we find that getting rid of bankruptcy leads to a 4.4 percent reduction in total output and as much as a 3.3 percent decrease in welfare.

6 Concluding Remarks and Directions for Future Research

The recent surge in U.S. personal bankruptcy filings has prompted several reform proposals revolving around the issue of consumer bankruptcy choice. Specifically, a central question has been whether households should be encouraged to choose Chapter 13 over Chapter 7? This paper draws on the existing literature and provides a quantitative analysis of several

policy alternatives in a dynamic general equilibrium model with both bankruptcy options and production.

Our analysis indicates that the reform bills currently pending before Congress would not help improve economic efficiency or social welfare. Given current bankruptcy provisions, an efficient means test is, at best, non-binding. However, a tightening of already existing bankruptcy procedures, in the form of lower Chapter 7 asset exemptions, may prove effective in terms of increasing both total output and welfare. Furthermore, in our experiment, we saw that Chapter 7 bankruptcies perversely rose in response to lower asset exemption levels in spite of total filings coming down. We conclude that to focus on curbing Chapter 7 filings exclusively, as in the current House and Senate bills, may be misleading. Finally, contrary to recent studies, the introduction of production showed that, while stricter bankruptcy provisions could increase both output and welfare in the long-run, completely eliminating default options proved substantially costly.

An important policy analysis issue relates to the transition from one policy regime to another. Indeed, our study relied on a comparison between different stationary equilibria and did not capture potential efficiency changes during the transition. Because of the difficulties involved in tracking the distribution of wealth as an endogenous state variable, we leave this matter to future research.[15] Another omission in our analysis, as in all existing studies, lies in the consideration of housing. Although the main residences of those who file for bankruptcy are mostly exempt under current provisions, it has been shown empirically that home ownership plays key a role both with respect to the decision to file and the choice of bankruptcy chapters. The inclusion of home ownership, therefore, seems to be a natural next step in this research agenda.

[15] See Krusell and Smith (1998) for a possible approach to this problem.

Appendix A.

This appendix derives some useful properties of the value functions in $V \equiv \{V^R, V^{\text{chap.7}}, V^{\text{chap.13}}, V^{C.\text{chap.7}}, V^{C.\text{chap.13}}\}$.

Consider the mapping defined in the text, $V^{j+1} = \Gamma(V^j)$. By applying the Theorem of the Maximum, note first that the operator Γ maps functions in V^j that are continuous in a, d and ε into functions in V^{j+1} that are also continuous in a, d and ε. Because Γ also satisfies Blackwell's sufficient conditions, namely monotonicity and discounting, it defines a contraction mapping in the space of continuous functions with the uniform norm. Hence value functions in V exist and are continuous functions of a, d and ε.

We now wish to show that the operator Γ maps functions in V that are nondecreasing in a into functions in V that are weakly increasing in a. In particular, as in Figure 1, we demonstrate why $V^{\text{chap.7}}$ increases with a for $a \leq x/R$ while it is invariant to a thereafter. To this end, from (P2), let

$$U^{\text{chap.7}}(a, \varepsilon, a', l) = U(\min(Ra, x) + \varepsilon w l - a'),$$

$$Q^{\text{chap.7}}(a', \varepsilon) = \int V^{C.\text{Chap.7},j}(a', \varepsilon') dG(\varepsilon'|\varepsilon),$$

and consider two asset levels $a_1 < a_2$. Suppose first that $a_1 < a_2 \leq x/R$. Then, under the assumption that $U(.)$ is increasing,

$$\begin{aligned} V^{\text{chap.7},j+1}(a_1, \varepsilon) &= \max_{a',l} \left\{U(Ra_1 + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \\ &< \max_{a',l} \left\{U(Ra_2 + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \equiv V^{\text{chap.7},j+1}(a_2, \varepsilon). \end{aligned}$$

Next, consider the case where $a_1 \leq x/R < a_2$. Then,

$$\begin{aligned} V^{\text{chap.7},j+1}(a_1, \varepsilon) &= \max_{a',l} \left\{U(Ra_1 + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \\ &\leq \max_{a',l} \left\{U(x + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \equiv V^{\text{chap.7},j+1}(a_2, \varepsilon). \end{aligned}$$

Finally, when $x/R \leq a_1 < a_2$, we have that

$$\begin{aligned} V^{\text{chap.7},j+1}(a_1, \varepsilon) &= \max_{a',l} \left\{U(x + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \\ &= \max_{a',l} \left\{U(x + \varepsilon w l - a') + \beta Q^{\text{chap.7}}(a', \varepsilon)\right\} \equiv V^{\text{chap.7},j+1}(a_2, \varepsilon). \end{aligned}$$

Using similar arguments, it can be established that $V^{\text{chap.13},j+1}(a_1, d, \varepsilon) < V^{\text{chap.13},j+1}(a_2, d, \varepsilon)$ whenever $a_1 < a_2$. In this case, from problem (P3), define

$$U^{\text{chap.13}}(a, d, \varepsilon, a', l) = U(Ra + [1 - \eta(d)]\varepsilon w l - a'),$$

and

$$Q^{\text{chap.13}}(a', d, \varepsilon) = \int V^{C.\text{Chap.13},j}(a', d, \varepsilon')dG(\varepsilon'|\varepsilon).$$

Furthermore, because $\eta(d)$ increases with d by equation (3), we have that $V^{\text{chap.13},j+1}(a, d_1, \varepsilon)$ $> V^{\text{chap.13},j+1}(a, d_2, \varepsilon)$ when $d_1 < d_2$.

Appendix B.

Description of equilibrium.

We denote a household's payment decision by z, where $z = 1$ if the household pays off its debts, $z = 2$ if the household files for bankruptcy under Chapter 7, and $z = 3$ if the household files for bankruptcy under Chapter 13.

Given the bankruptcy provisions characterized by the asset exemption level under Chapter 7, x, the wage payment share under Chapter 13, $\eta(d)$, and non-pecuniary costs incurred from having filed for bankruptcy, s, a stochastic stationary equilibrium in our economy is described by:

i) a set of prices consisting of the deposit rate, R, the lending rate, $R + \tau + \gamma$, and the wage, w

ii) a set of decision rules for unconstrained borrowers, $\{c,\ l,\ a,\ d,\ z\}^{UC}$, for Chapter 7 defaulters without access to credit, $\{c,\ l,\ a\}^{C.\text{chap.}7}$, and for borrowing constrained Chapter 13 defaulters, $\{c,\ l,\ a\ \}^{C.\text{chap.}13}$

iii) firms' demand for capital and labor, $\{k, n\}$

iv) a set of value functions, $\{V^{UC},\ V^{R},\ V^{\text{chap.}7},\ V^{\text{chap.}13},\ V^{C.\text{chap.}7},\ V^{C.\text{chap.}13}\}$

v) and a set of probability measures, $\{\mu^{UC},\ \ \mu^{C.\text{chap.}7},\ \mu^{C.\text{chap.}13}\}$

such that,

a) Households' decision rules solve the maximization problems described in section 2.4.

b) the labor market clears,

$$n = \int_{A,D,\mathcal{E}} \varepsilon l^{UC} d\mu^{UC} + \int_{A,\mathcal{E}} \varepsilon l^{C.\text{chap.}7} d\mu^{C.\text{chap.}7} + \int_{A,D,\mathcal{E}} \varepsilon l^{C.\text{chap.}13} d\mu^{C.\text{chap.}13}. \qquad (13)$$

Here, the left-hand side of equation (13) represents total labor supply by unconstrained households, borrowing constrained Chapter 7 debtors, and constrained Chapter 13 debtors. The right-hand side of the equation is simply labor demand. The second integral is defined only over $A \times \mathcal{E}$ since the debts of Chapter 7 defaulters are entirely discharged.

c) the market for capital clears,

$$k = \int_{A,D,\mathcal{E}} (a^{UC} - d^{UC}) d\mu^{UC} + \int_{A,\mathcal{E}} a^{C.\text{chap.}7} d\mu^{C.\text{chap.}7} + \int_{A,D,\mathcal{E}} a^{C.\text{chap.}13} d\mu^{C.\text{chap.}13}. \qquad (14)$$

The left-hand side of equation (14) captures total savings net of loans while the right-hand side represents firms' capital demand.

d) financial intermediaries break even,

$$R\int_{A,D,\mathcal{E}}\left(d^{UC}\right)d\mu^{UC}=(R+\gamma)\int_{A,D,\mathcal{E}}d[1(z=1)]d\mu^{UC}$$
$$+\int_{A,D,\mathcal{E}}\max(0,Ra-x)[1(z=2)]d\mu^{UC}$$
$$+\int_{A,D,\mathcal{E}}\eta(d)\varepsilon wl^{UC}[1(z=3)]d\mu^{UC}$$
$$+\int_{A,D,\mathcal{E}}\eta(d)\varepsilon wl^{C.\text{chap.}13}d\mu^{C.\text{chap.}13}. \tag{15}$$

In the above equation, 1(.) is an indicator function which takes the value 1 if the statement inside the parenthesis is true and 0 otherwise. The left-hand side of the equation denotes payments intermediaries must make to their depositors. These payments correspond in effect to the costs of making loans. The right-hand side captures payments from borrowers. The first term on the right-hand side represents payments from unconstrained households that repay their debts in full, the second term captures assets seized from households that choose to default under Chapter 7, while the third term are the payments collected from current Chapter 13 debtors. The last term in equation (15) represents payments collected from previous Chapter 13 debtors.

e) given the subsets $S_a \in A$, $S_d \in D$, and $S_\varepsilon \in \mathcal{E}$, the distribution of households $\mu=[\mu^R,\mu^{C.\text{chap.}7},\mu^{C.\text{chap.}13}]$ is a fixed point of the mapping described by the following three functional equations:

$$\mu^{UC}(S_a,S_d,S_\varepsilon)=\int_{S_a,S_d,S_\varepsilon}\left\{\int_{A,D,\mathcal{E}}1(a'\in S_a,d'\in S_d,\varepsilon'\in S_\varepsilon,z=1)g(\varepsilon'|\varepsilon)d\mu^{UC}+\right.$$
$$\int_{A,\mathcal{E}}1(a'\in S_a,d'\in S_d,\varepsilon'\in S_\varepsilon)(1-\lambda_7)g(\varepsilon'|\varepsilon)d\mu^{C.\text{chap.}7}+$$
$$\left.\int_{A,D,\mathcal{E}}1(a'\in S_a,d'\in S_d,\varepsilon'\in S_\varepsilon)(1-\lambda_{13})g(\varepsilon'|\varepsilon)d\mu^{C.\text{chap.}13}\right\}da'dd'd\varepsilon' \tag{16}$$

In equation (16), the measure of households authorized to borrow next period, $\mu^{UC}(S_a,S_d,S_\varepsilon)$, consists of three groups. First, those in state (a,d,ε) who repay their debts in the current period and who choose an asset level, $a'\in S_a$, a debt level, $d'\in S_d$, and whose labor productivity draw is $\varepsilon'\in S_\varepsilon$ in the following period. These households have measure $1(a'\in S_a,d'\in S_d,\varepsilon'\in S_\varepsilon,z=1)g(\varepsilon'|\varepsilon)d\mu^{UC}$. Second, Chapter 7 debtors who are able to regain access to credit markets and whose measure is $1(a'\in S_a,d'\in S_d,\varepsilon'\in S_\varepsilon)(1-\lambda_7)g(\varepsilon'|\varepsilon)d\mu^{C.\text{chap.}7}$. Finally, households permitted to borrow next period also include current Chapter 13 debtors who are able to leave the constrained state and whose

measure is $1(a' \in S_a, d' \in S_d, \varepsilon' \in S_\varepsilon)(1-\lambda_{13})g(\varepsilon'|\varepsilon)d\mu^{C.\text{chap.}13}$. The next two equations relate to the accounting of constrained households. First, we have that

$$\mu^{C.\text{Chap.}7}(S_a, S_\varepsilon) = \int_{S_a, S_\varepsilon} \left\{ \int_{A,D,\mathcal{E}} 1(a' \in S_a, \varepsilon' \in S_\varepsilon, z=2) g(\varepsilon'|\varepsilon) d\mu^{UC} + \right.$$
$$\left. \int_{A,\mathcal{E}} 1(a' \in S_a, \varepsilon' \in S_\varepsilon) \lambda_7 g(\varepsilon'|\varepsilon) d\mu^{C.\text{chap}7} \right\} da' d\varepsilon'. \quad (17)$$

Put more simply, the measure of Chapter 7 defaulters restricted from credit next period, $\mu^{C.\text{Chap.}7}(S_a, S_\varepsilon)$, consists of unconstrained households that file under Chapter 7 in the current period as well as previous Chapter 7 defaulters that continue in the constrained state. Likewise for borrowing constrained Chapter 13 debtors next period, we have that

$$\mu^{C.\text{chap13}}(S_a, S_d, S_\varepsilon) = \int_{S_a, S_d, S_\varepsilon} \left\{ \int_{A,D,\mathcal{E}} 1(a' \in S_a, d' \in S_d, \varepsilon' \in S_\varepsilon, z=3) g(\varepsilon'|\varepsilon) d\mu^{UC} + \right.$$
$$\left. \int_{A,D,\mathcal{E}} 1(a' \in S_a, d' \in S_d, \varepsilon' \in S_\varepsilon) \lambda_{13} g(\varepsilon'|\varepsilon) d\mu^{C.\text{chap13}} \right\} da' dd' d\varepsilon'. \quad (18)$$

Appendix C.

Computation Method

We use successive approximations of the different value functions in order to solve for a stationary equilibrium. The iterative procedure consists of two main steps.

1) We begin with a guess for the prices (the deposit rate, the lending rate and the wage). Given that the aggregate production function exhibits constant return to scale, from equation (10) we have that

$$\frac{R+\delta-1}{w} = \left(\frac{\alpha}{1-\alpha}\right)\left(\frac{n}{k}\right).$$

Therefore, since the deposit rate and the wage are linked by the capital to labor ratio, we need only guess this ratio. Given the guesses for prices, we then use value iteration to solve the functional equations defined in the households' problems.

In this step, we discretize the state space by choosing a grid of feasible asset and debt holdings. The minimum asset level is set to zero, and the maximum level is chosen so as to always exceed households' asset position in the following period. Furthermore, the minimum debt level is set to zero and the maximum debt level, $\overline{d}$, is set to match the economy-wide debt to income ratio as described in the main text of the paper.

We choose the total number of grid points in A to be 200 and the number of grid points in D to be 50. We approximate the different value functions between different nodes using a Chebyshev algorithm outlined in Judd (1999, page 238). The interpolation nodes are chosen optimally based on the interpolation error formula with the Chebyshev minmax property (Judd 1999, page 221-22). The optimal value functions and decision rules for the finite state discounted dynamic programming problems described in the text are found by successive approximations. This approach involves starting with initial guesses for the value functions, and using these guesses to obtain subsequent approximations by computing the right side of the value functions. This process continues until the sequence of value functions has converged.

2) The invariant distribution corresponding to the decision rules generated by households' problems is found by iterating on equations (16), (17) and (18). Together with the household decision rules, the invariant distribution is used to check market-clearing conditions. New guesses for the prices are chosen according to whether markets revealed excess supply or excess demand at the previous prices. Specifically, the algorithm is based on the conjecture that excess demand for credit decreases in the deposit rate and that excess demand for labor is a decreasing function of the wage.

To compute the invariant distribution in this step, we begin with an initial approximation and evaluate the right-hand side of equations (16), (17) and (18) using the decision rules associated with households' problems. The resulting distribution on the left-hand side of these equations is then used as the next candidate and the process is repeated until successive approximations are sufficiently close. Once the invariant distribution is found, the market clearing constraints are evaluated and new candidate prices are chosen. With new prices in hand, we repeat steps 1) and 2) until all markets clear.

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Table 1. *Calibrated Parameters*

Parameter		Value
Preference		
β	Time discount rate	0.93
ρ	Coefficient of relative risk aversion	1.5
σ		0.67
$\widehat{h}$	Indivisible labor supply	0.45
Technology		
α	Capital income share	0.3
δ	Capital depreciation rate	0.1
ε	Labor productivity shock	$[0.25, 1.75]$
$g(\varepsilon'\|\varepsilon)$	Transition matrix for labor productivity	$\begin{bmatrix} 0.9 & 0.1 \\ 0.1 & 0.9 \end{bmatrix}$
τ	Cost of servicing loans	0.05
$\overline{d}$	Upper bound on borrowing	0.98
Bankruptcy Provisions		
s	Non-pecuniary filing cost	0.89
x	Chapter 7 asset exemption level	0.4
$1/(1-\lambda_7)$	Average length of exclusion from credit markets after Chapter 7	6
$1/(1-\lambda_{13})$	Average length of exclusion from credit markets after Chapter 13	5

Table 2. *The Benchmark Model Economy*

Statistics	U.S. Data	Model
Risk premium (%)	10.8	10.5
Capital/output	2.5	2.4
Debt/income	0.09	0.10
Gini index of income	0.44	0.45
Percentage of defaults (%)		
Total	1.18	1.25
Chapter 7	0.83	0.86
Chapter 13	0.35	0.39

Table 3. *Implementing the Bill: Means-testing for Chapter 7 Filers*

Statistics	Benchmark	Efficient Means Testing ($\phi \leq 0.37$)	Driving Out Chapter 7 Defaults ($\phi \geq 0.40$) (*% change from benchmark*)
Deposit rate (%)[(1)]	2.516	2.516	+0.011
Lending rate (%)	13.008	13.008	−0.175
Debt/income	0.104	0.104	+4.047
Savings	1.412	1.412	+0.008
Capital	1.366	1.366	−0.264
Labor	0.392	0.392	−0.114
Output	0.570	0.570	−0.171
Welfare	−0.761	−0.761	−1.010
Chapter 7 filings (%)	0.860	0.860	−0.860
Chapter 13 filings (%)	0.386	0.386	+0.708
Total filings	1.246	1.246	−0.151
Wealth Gini	0.484	0.484	+0.207

Note 1. For the deposit rate, as well as all variables already expressed in percent, changes from the benchmark are in levels.

Table 4. *Alternative Policy Changes*

Statistics	Benchmark ($x = 0.4$)	Tightening asset exemptions under Chapter 7 ($\overline{x} = 0.375$)[(2)] (% change from benchmark)	Eliminating bankruptcy provisions entirely (% change from benchmark)
Deposit rate (%)	2.516	−0.023	+0.596
Lending rate (%)	13.008	+0.027	−4.867
Debt/income	0.104	−6.013	+34.146
Savings			
Total	1.412	−0.046	+1.873
Ave. Chap. 7 filer	0.003	−33.33	N/A
Ave. Chap. 13 filer	0.160	−0.125	N/A
Consumer debt			
Ave. Chap. 7 filer	0.167	+0.119	N/A
Ave. Chap. 13 filer	0.196	−0.101	N/A
Capital	1.366	+0.326	−8.989
Labor	0.392	+0.053	−2.430
Output	0.570	+0.133	−4.447
Welfare	−0.761	+0.421	−3.330
Chap. 7 filings (%)	0.860	+0.109	N/A
Chap. 13 filings (%)	0.386	−0.375	N/A
Total filings (%)	1.246	−0.265	N/A
Gini (wealth)	0.484	−0.206	+1.240

Note 2. The case $\overline{x} = 0.375$ maximizes steady state welfare.

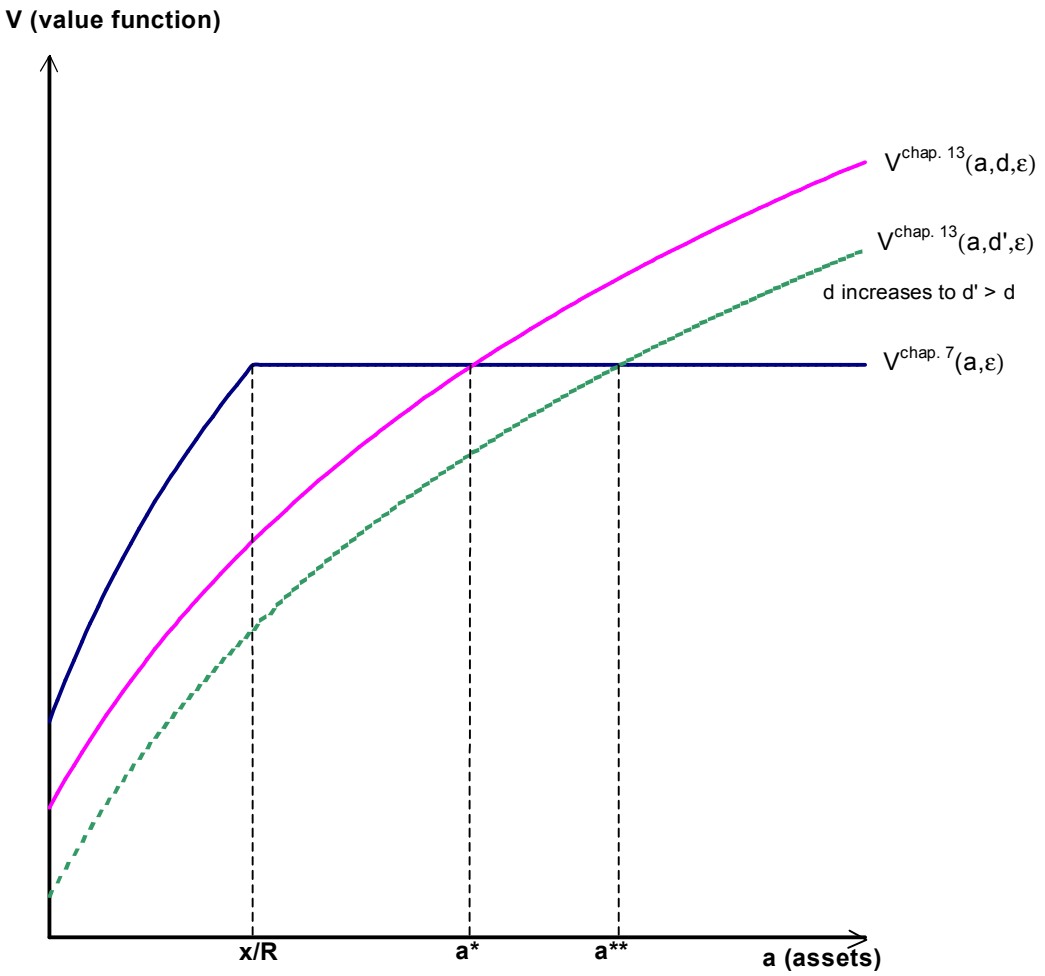

Figure 1. The Effects of Assets and Debt on Bankruptcy Choice