Consumer Bankruptcy: the Role of Financial Frictions*

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Abstract

This paper aims to provide a quantitative framework to evaluate the welfare effects of consumer default policies with a novel distinction between consumer protection and credit supply. To this end, I develop an Aiyagari-type model with consumer default and an endogenous banking leverage constraint. The borrowing prices of consumer loans are determined by idiosyncratic default premia and aggregate banking capitalization. Frictional financial intermediation results in higher borrowing costs, thus leading to declines in household debt and firm investment. To inform the policy debates in consumer credit markets, I evaluate the welfare implications of several policy counterfactuals. I find that stricter bankruptcy regimes, through either higher wage garnishment or longer borrowing exclusion, result in aggregate welfare gains. The welfare sensitivity to bankruptcy strictness depends positively on the degree of financial friction.

Keywords: Consumer Credit, Bankruptcy, Default, Financial Frictions

JEL Classifications: D14, E44, K35

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1 Introduction

Consumer credit markets have been of great policy attention. On the one hand, the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) was intended to discipline household default behavior via increased out-of-pocket filing costs. On the other hand, a lenient debt relief program or alike has been often put forward whenever indebted households encounter economic disruption. In addition to the gains and losses of consumers from bankruptcy reforms (consumer protection view), how and to what extent these legal changes impact liquidity provision in the financial system also matters since it subsequently affects the policy effects on consumers (credit supply view). However, the welfare conclusions of these policy proposals are still ambiguous and the current literature focus is only on consumer protection.

This paper aims to provide a quantitative framework to evaluate the welfare effects of these policy proposals with a distinction between consumer protection and credit supply. The key novelty is extending an otherwise consumer default model with financial frictions that prevail in the banking system. In my model, idiosyncratic default premia and aggregate banking capitalization jointly determine the borrowing price of a consumer loan. Large-scale individual bankrupts lead to the deterioration of banking net worth and banks thus become more leveraged. The liquidity provision from the credit market is accordingly tightened via increasing borrowing costs of all borrowers. This negative externality of massive consumer default on borrowing prices shapes the welfare assessment of consumer credit regulations.

I extend the workhorse model of consumer credit and default in Chatterjee, Corbae, Nakajima, and Ríos-Rull (2007). They study a heterogeneous agent model with consumer default. Households receive stochastic labor productivity and face preference shocks. If hit by a preference shock, a household becomes impatient with a lower discount factor. She thus takes up a larger loan than she would have taken with the baseline (higher) discount factor. Households can file for bankruptcy at default costs, including wage garnishment in the filing period and bad credit history in the subsequent periods. Households with a bad credit history are excluded from borrowing markets, but their flags could be erased with a certain probability per period. Following Chatterjee, Corbae, Dempsey, and Ríos-Rull (2020), I introduce extreme value shocks to default decisions to capture the effects of other unobservable heterogeneity that are not modeled under my framework.

Banks have full information about households and thus charge each borrower her risk-based interest price. Crucially, there is no friction in financial intermediation, and banks can be entirely financed with external deposits.

I extend their framework by adding financial frictions. In particular, I focus on the one proposed by Gertler and Kiyotaki (2010) and Gertler and Karadi (2011) (hereafter, the GK-type frictions).[1] They assume that an agency problem exists between banks and creditors (i.e., savers) since banks may default by diverting assets if the continuation value for banks is lower than the diverting benefits. The benefits are larger if banks have more external funding via deposits. Household savers lose their savings at banks in the event of bank default. An incentive constraint thus comes into effect to limit banks' ability to manage assets and prevent banks from diversion. Therefore, banks face an endogenous leverage constraint and must accumulate sufficient net worth to conduct lending services. The degree of financial friction is governed by the fraction of assets that banks can divert and the exit rate of banks. A larger diverting fraction and a higher exit rate correspond to a higher degree of financial friction because banks are more tempted to default in both cases. Banks use deposits and net worth to issue loans to firms and households. Firms commit to repayment, but households may default.[2] To my knowledge, I am the first to explicitly model consumer default and financial frictions under a heterogeneous agent framework.

In my model, borrowing prices depend on loan size, household characteristics, and aggregate banking net worth. A household's assessed default risk is high if she takes a large loan or has a bad future income prospect. As a result, banks charge her a high borrowing interest rate today to compensate for the potential default loss in the future. In addition, when banks possess little net worth and thus become highly leveraged, they have higher incentives to default. In order to prevent the deviation of banks from continuing, an extra incentive premium endogenously arises for all loans. As a result, future asset returns increase, and diverting the claims on these assets today becomes less profitable for banks. I contribute to the consumer finance literature by considering the endogenous effects of aggregate banking capitalization on individual borrowing costs.[3]

[1] In the following, I will use the terms financial frictions and the GK-type frictions interchangeably.

[2] The assumption that firms cannot default is meant to keep the model tractable and focus on consumer default. In practice, firms can default under Chapter 11, for example.

[3] Lee, Luetticke, and Ravn (2020) also introduce the GK-type frictions into a heterogeneous agent model. However, endogenous consumer default risk is absent under their framework.

To understand the effects of financial frictions on consumer credit markets, I calibrate my model to the U.S. economy in 2004 to avoid the effects of the 2005 BAPCPA. Most parameters are exogenously determined by direct empirical evidence or estimates from the literature. I internally calibrate the dispersion of the extreme value distribution and the probability of preference shocks to match the Chapter 7 default rate and the banking leverage ratio in the data. My calibrated model can account for several untargeted data moments, such as the average credit card interest rate and debt-to-earnings ratio.

Compared to the frictionless economy, frictional financial intermediation entails higher borrowing costs, thus leading to fewer household debt and lower production. These effects are amplified as the degree of financial friction increases. Under the benchmark calibration, the incentive constraint binds in equilibrium, and an incentive premium emerges to compromise the incentive conflicts between banks and depositors. However, the extra premium causes borrowing prices to increase and results in a decline in household debt. I label this mechanism as the incentive channel. On the other hand, firms reduce capital investment due to higher borrowing costs. Therefore, production and wages decrease. This mechanism is denoted as the divestment channel. In addition, when a higher degree of financial friction is confronted in the economy, a larger incentive premium must be charged to mitigate the worse agency problem. The effects of incentive and divestment channels are thus intensified. Therefore, households borrow further less from banks. Firms reduce their investment further, thus leading to much lower production and wages. Both channels thus adversely influence households because higher borrowing prices and lower wages worsen the ability of households to smooth consumption.

Consumer credit and its effects on households have been a crucial policy subject in the U.S. For example, the most significant reform in recent years was the 2005 BAPCPA which limited the provision of personal bankruptcy via increased out-of-pocket filing costs (Albanesi and Nosal, 2020). The Consumer Financial Protection Bureau (CFPB) was established in 2011 and aims to protect consumers in consumer finance markets (Consumer Financial Protection Bureau, 2011). Many papers in the literature have evaluated the welfare effects of several policy proposals. However, I am the first to inform the effects of consumer credit regulations under a theoretical framework that features both consumer default and financial frictions. Importantly, I also consider the transition dynamics of policy changes for the welfare evaluation of households.[4] Therefore, the welfare evaluation

[4] This consideration is important because households are infinite-lived and have different initial states when

of a policy change depends on the policy per se, the transition dynamics of households to the new policy, and the degree of financial friction.

First, to understand the interplay between the first two components, I conduct the policy experiments of wage garnishment and borrowing exclusion while holding the degree of financial frictions fixed at the benchmark calibration. Higher garnishment and longer exclusion correspond to stricter bankruptcy regimes, whereas lower garnishment and shorter exclusion denote more lenient rules. I find that stricter (more lenient) regulations increase (decrease) overall welfare when financial frictions exist, regardless of the exact policy instruments. Higher default costs make it more difficult for households to *smooth consumption across states* by defaulting, while easier to *smooth consumption over time* by borrowing at lower interest costs due to lower default premia (Zame, 1993). In equilibrium, households prefer smoothing over time in lieu of smoothing across states for three reasons: (1) the effective disposable incomes of households are almost always positive since there are no expenditure risks in my model,[5] (2) preference shocks cause more households to over-borrow than to default in the first place,[6] and (3) the adverse effects that result from the incentive and divestment channels are attenuated under a stricter regime. Under a stricter legal regime, lower default risks give rise to lower default premia charged by banks. The over-borrowing problem triggered by preference shocks is thus mitigated because impatient households can pay fewer interest expenses for borrowing. A stricter code also decreases borrowing prices relative to savings, thus leading to fewer deposits in equilibrium. As a result, banks become less leveraged with external funding and thus face a milder agency tension with depositors. As the adverse effects of financial frictions are mitigated, households thus benefit from a lower incentive premium and higher wages. The quantitative results suggest that the gains from lower borrowing costs (either lower default premia or decreased incentive premium) and higher wages combined are greater than the insurance loss from higher default costs under a stricter rule, and vice versa.

However, there is heterogeneity across households under the counterfactual of longer borrowing exclusion: households with good credit history gain, while those with bad

confronting policy reform. As a result, the welfare effects are often heterogeneous across households. Refer to Section 6 for details.

[5] To be specific, the effective disposable income is defined as the sum of wage earnings and either savings revenues or loan payments. Under a model where households face significant expenditure risks, a more lenient bankruptcy rule is beneficial in terms of welfare, e.g., see Livshits, MacGee, and Tertilt (2007).

[6] Preference shocks are i.i.d. and they are 8.6% of households who are indebted in equilibrium.

credit history lose. As discussed, households should benefit significantly from lower borrowing prices and higher wages for consumption smoothing under stricter bankruptcy laws. So, why are households with a bad credit history worse off under longer exclusion? This is because the reform directly impacts those households already with bankruptcy flags. Although they can benefit from lower interest costs when regaining access to borrowing markets in the future and higher wages since the onset of the new policy, they must first endure longer exclusion from borrowing markets than they would have to under the benchmark policy. For this subgroup of households, it turns out that under the counterfactual of longer borrowing exclusion, the loss of borrowing ability in the short run outweighs the benefits from lower default premia and the attenuated agency problem in the long run.

Second, I explore how and to what extent financial frictions shape the previous welfare conclusions, focusing on the interactions between financial frictions and legal changes. I begin by comparing the welfare implications of the proposed policy experiments with and without financial frictions. I find that the welfare sensitivity to bankruptcy strictness with financial frictions is larger than the one without financial frictions. This difference results from the extra adverse effects of bankruptcy rules on borrowing costs and wages through the incentive and divestment channels. Under a more lenient regime, higher default risks give rise to higher relative prices of borrowing in terms of saving. Therefore, banks receive more deposits and face a higher leverage ratio. However, when financial frictions exist, banks must charge a higher incentive premium to mitigate the increased incentive conflicts with depositors. As a result, the higher incentive premium leads to increased borrowing costs and decreased wages via the incentive and divestment channels in equilibrium. Both price changes work against household benefits and thus cause extra welfare losses. On the contrary, a stricter code yields additional welfare gains from lower borrowing costs and higher wages. These extra effects on borrowing costs and wages are absent without financial frictions. Therefore, financial frictions significantly impact to what extent welfare is affected by the strictness of bankruptcy rules through their adverse effects on borrowing costs and wages.

To further gauge the extent to which financial frictions shape the welfare assessment of a policy change, I evaluate the welfare implications of the policy proposals with different degrees of financial frictions. I find that: (1) stronger financial frictions strengthen the negative welfare effects of a more lenient rule but attenuate the positive welfare effects of a stricter code, and (2) weaker financial frictions lead to the opposite results. These findings arise because the effects of incentive and divestment channels on borrowing prices and wages are related positively to the degree of financial friction. A higher degree of financial friction implies a more severe agency problem. Ceteris paribus, banks have to charge a higher incentive premium to align their incentives with depositors. Accordingly, borrowing costs increase further, and wages fall lower. Both price changes worse the ability of households to smooth consumption. As a result, these extra negative effects partially offset the welfare gains from a stricter rule and aggravate the welfare losses from a more lenient regime. In contrast, weaker financial frictions result in lower borrowing costs and higher wages in equilibrium. Both price variations are beneficial to households and lead to extra positive welfare effects. Therefore, a more lenient code becomes less welfare-reducing, and a stricter rule yields larger welfare gains.

The rest of the paper is organized as follows. I begin in section 2 by giving an overview of the related literature. Section 3 presents the theoretical framework. Section 4 discusses the calibration of the model. In Section 5, I explore the effects of financial frictions in consumer credit markets. Section 6 studies the role of financial frictions in the welfare evaluations of consumer bankruptcy regulations. Section 7 concludes with potential avenues for further research.

2 Related Literature

In this section, I discuss the literature related to this paper. I begin with papers in the consumer finance and financial frictions literature that are close to my theoretical framework. Then, I focus on the literature about the welfare implications of consumer bankruptcy regulations.

My theoretical framework is based on the consumer default workhorse models developed by Chatterjee et al. (2007) and Livshits et al. (2007). In their papers, households are allowed to file for bankruptcy to insure themselves against idiosyncratic shocks—for instance, income and expenditure uncertainty. Both Chatterjee et al. (2007) and Livshits et al. (2007) assume that financial intermediaries are funded fully with deposits from household savers. In addition, intermediaries can fulfill any liquidity needs of household borrowers through the expansion of their balance sheets. It implies that intermediaries do not possess any internal funding and thus have an infinite leverage ratio. I depart from this assumption by introducing a more realistic modeling of financial intermediation into a canonical model of consumer default.

My paper is also closely related to the literature on financial frictions. There are many types of financial friction in the macro literature. The most relevant one for the paper is the one developed by Gertler and Kiyotaki (2010) and Gertler and Karadi (2011) For example, Lee et al. (2020) study the implications of the GK-type frictions on individual's marginal propensity to consume (MPC) in a heterogeneous agent New Keynesian (HANK) model. Arslan, Guler, and Kuruscu (2020) build a mortgage default model with the GK-type frictions to study the boom and bust in housing markets. My contributions to this strand of literature include: (1) developing a heterogeneous agent framework that features both consumer default and the GK-type frictional financial intermediaries, and (2) studying the implications of personal bankruptcy regimes under the innovative framework.

The welfare effects of consumer bankruptcy laws have been studied in the literature. First, most papers focus on the role of credit-demand factors, whereas no work has been done to quantify the credit-supply effects. In addition to idiosyncratic income heterogeneity, Livshits et al. (2007) emphasize the importance of expenditure risks and life-cycle earnings profile in the welfare assessment of alternative bankruptcy rules. Nakajima (2017) study the welfare implications of the 2005 bankruptcy reform in a model with household temptation and self-control. Chatterjee et al. (2020) develop a consumer default model with asymmetric information between borrowers and lenders to investigate the role of borrower reputation in credit markets. Exler, Livshits, MacGee, and Tertilt (2020) analyze consumer credit markets with behavioral households who are over-optimistic about their income realizations. Sun (2022) study the role of intra-household insurance via spousal earnings in the welfare outcomes of consumer bankruptcy regulations. Compared to these papers, I focus on financial frictions and quantify their effects on consumer borrowing and default behavior.

Second, several papers have explored the welfare consequences of several policy proposals to regulate consumer finance markets. For example, Athreya (2002) and Li and Sarte (2006) find welfare gains from abolishing personal bankruptcy. Both Athreya (2002) and Chatterjee et al. (2007) find positive welfare effects of means-testing. Livshits et al. (2007) compare the welfare outcomes between the Chapter 7 bankruptcy code versus long-term repayment plans. Chen and Zhao (2017) and Exler (2019) study the effects of repayment plans via wage garnishment on endogenous labor supply. Chatterjee and Gordon (2012) compare the effects of bankruptcy and wage garnishment laws. Chen and Corbae (2011) investigate the welfare consequences of removing bankruptcy flags and find marginal welfare gains of erasing the flag after one year. Herkenhoff, Phillips, and Cohen-Cole (2021) also find that bankruptcy flag removal results in welfare gains for households to obtain liquidity for their businesses. Gordon (2015) studies the role of aggregate risks in the welfare evaluation of bankruptcy laws. See also Exler and Tertilt (2020) for a recent survey. I contribute to the literature by exploring the welfare effects of wage garnishment and the removal of bankruptcy flags while taking into account financial frictions. Moreover, I solve the transition dynamics for each household towards the new policy equilibrium, along with the aggregate leverage adjustment by financial intermediaries. Hence, I can evaluate the welfare gain or loss from the beginning of a policy change for each household.

3 The Model

Time is discrete and infinite. I follow the convention of dynamic programming where the time subscript is removed, and the next-period variable is expressed with prime $'$. The market is incomplete. There is a unit continuum of households. In addition, there exist firms and banks. Both operate in perfectly competitive markets. Firms produce homogeneous goods using a constant-returns-to-scale technology. Banks offer saving and lending services in one-period assets and unsecured loans, respectively.

In each period, households survive at rate ρ, and those who die are replaced by newborn households. Household labor productivity e is composed of three components: (1) the permanent labor productivity e_1 is fixed at birth; (2) the persistent labor productivity e_2 is drawn from a stationary finite-state Markov process $Q^{e_2}(e_2'|e_2)$, and (3) the transitory labor productivity e_3 is determined by an i.i.d. process $Q^{e_3}(e_3)$. The total household labor productivity is defined as $e = e_1 \times e_2 \times e_3$. Newborns draw their labor productivity from the initial distributions $G^{e_1}(e_1)$, $G^{e_2}(e_2)$, and $G^{e_3}(e_3)$. All the realization of labor productivity is independent across households. For brevity, I use $Q^e(e'|e)$ to denote the evolution of total labor productivity and $G^e(e)$ for the newborn distribution in the following discussions. In addition, households face i.i.d. preference shocks $\nu \sim Q^{\nu}(\nu)$ that temporarily affect households' time preference measured by discount factors β. Household credit history h summarizes household payment history in financial markets.

Households are risk-averse and derive utility from consumption c. They supply their labor force in the efficiency unit inelastically and receive wages earnings $w \cdot \exp(e)$. Households with good credit history $h = 0$ can either borrow or save an amount a' at the discount price q with banks. If a household with good credit history has any debt $a < 0$, she can choose to repay $d = 0$ or file for bankruptcy $d = 1$. If defaulting, she can discharge her debt $a = 0$ but her wage earnings are subject to garnishment at rate η and her credit history turns bad $h' = 1$. In addition, neither saving nor borrowing is allowed in the filing period. Households with bad credit history $h = 1$ are excluded from the borrowing markets but can save at the risk-free rate r_f. A bankruptcy flag could be erased with probability $\mathbb{P}_h$. Household states are summarized as (a, e, ν, h). The cross-sectional distribution of households is denoted by $\mu(a, e, \nu, h)$.

Firms produce homogeneous goods using physical capital K and aggregate labor in the efficiency unit $E \equiv \int \exp(e)\, d\mu$ with a standard Cobb-Douglas technology of capital share α. Capital spending must be financed with bank loans and firms commit to full repayment. Capital depreciates at rate δ.

There is a unit continuum of risk-neutral banks owned by foreign investors that are not modeled in the economy.[7] Banks might exit the industry at rate $(1 - \psi)$ and pay their accumulated net worth as dividends to foreign owners. Those who leave are replaced by newly entering banks with some start-up funds ω from foreign investors. The objective of banks is to maximize the sum of future dividends discounted at r_f. To this end, banks use their internally accumulated net worth N and deposits externally from household savers S', to lend to firms K' and household borrowers L'. Since banks have full information regarding households, banks can compute risk-based discount borrowing prices $q(a', e)$, conditional on loan size a' and household characteristics e.

Crucially, financial frictions arise endogenously because of an agency problem between banks and depositors (Gertler and Kiyotaki, 2010; Gertler and Karadi, 2011). After determining asset positions $(K' + L')$, banks can sell the claims on these assets in sec-

[7] If necessary, banks can either borrow or save at r_f in the international financial markets to balance their domestic positions.

ondary frictionless markets, and abscond with a fraction θ of the asset sales. To prevent banks from diverting assets, the continuation value of banks must be greater than or equal to the gain from asset diversion. This concern translates into an incentive constraint that restricts the ability of banks to asset management. The parameterized diverting fraction of assets θ thus represents the degree of financial friction in the economy.

The rest of the section is structured as follows. Section 3.1 summarizes the timing in each period. Section 3.2 details the household problem. Section 3.3 sketches the standard firm problem. The problem of banks is presented in Section 3.4, where I introduce the set-up of financial frictions. Section 3.5 discusses the evolution of the cross-sectional household distribution. I close the section by defining the equilibrium in Section 3.6.

3.1 Timing

The timing in every period is summarized as follows:

1. Households begin each period with state (a, e, ν, h).
2. Given borrowing prices $q(a', e)$, households with good credit history $h = 0$ choose to either repay debt $d = 0$ or file for bankruptcy $d = 1$.
    - If $d = 0$, they also choose a' and consume $c = w \cdot \exp(e) + a - q(a', e) \cdot a'$.
    - If $d = 1$, they consume the leftover earnings $c = (1 - \eta) \cdot w \cdot \exp(e)$ and their credit history turns bad $h' = 1$.
3. Households may die at a rate of $(1 - \rho)$.
    - Among households who survive, e' and ν' are drawn from $Q^e(e'|e)$ and $Q^\nu(\nu')$. Bad credit history could be removed with probability $\mathbb{P}_h$.
    - Newborn households begin with no assets $a' = 0$, labor productivity e' drawn from G^e, no present bias $\nu' = 1$, and good credit history $h' = 0$.

3.2 Households

Households take as given the bank discount pricing function $q(a', e)$. At the beginning of each period, households with good credit history $h = 0$ can choose between full repayment $d = 0$ and filing for bankruptcy $d = 1$.

Following Chatterjee et al. (2020), I introduce the action-specific utility shocks. These shocks are i.i.d. across time and households. For each household and action between repayment and default d, an unobservable additive utility shock ϵ^d is drawn from an extreme value distribution. These shocks capture other unobservable heterogeneity that affects household default decisions in a reduced but tractable way.[8]

The value function of households with good credit history is thus given by:

$$V(\epsilon, a, e, \nu, h = 0) = \max_{d} \left[V^{d=0}(a, e, \nu, h = 0) + \epsilon^{d=0}, V^{d=1}(q, e, \nu, h = 0) + \epsilon^{d=1} \right], \quad (1)$$

where ϵ^d is drawn from the following extreme value distribution $EV(\epsilon^d)$:

$$EV(\epsilon^d) = \exp\left\{ -\exp\left(-\frac{\epsilon^d - \mu_\epsilon}{\zeta} \right) \right\}, \quad (2)$$

where $\zeta > 0$ determines the variance of the shock and $\mu_\epsilon = -\zeta \cdot \gamma_E$ makes the shock mean zero and γ_E is the Euler's constant.

The conditional value function of repayment is given by:

$$\begin{aligned} V^{d=0}(a, e, \nu, h = 0) = \max_{a'} \Big[& u\left(w \cdot \exp(e) + a - q(a', e) \cdot a'\right) \\ & + \nu \cdot \beta \cdot \rho \cdot \sum_{(e', \nu')} Q^e(e'|e) \cdot Q^\nu(\nu') \cdot V(a', e', \nu', h' = 0) \Big], \end{aligned} \quad (3)$$

where the utility function defined on consumption $u(c)$ is additively separable over time, continuous, increasing, and concave. The conditional value function of defaulting is then given by:

$$\begin{aligned} V^{d=1}(a, e, \nu, h = 0) = {} & u\left((1 - \eta) \cdot w \cdot \exp(e)\right) \\ & + \nu \cdot \beta \cdot \rho \cdot \sum_{(e', \nu')} Q^e(e'|e) \cdot Q^\nu(\nu') \cdot V(a' = 0, e', \nu', h' = 1), \end{aligned} \quad (4)$$

where recall that η denotes the wage garnishment rate. Moreover, I assume that default is restricted to households with debts larger than the respective default costs. That is, filing for bankruptcy is feasible only if $a < -\eta \cdot \exp(e)$.

Under the distributional assumption on the utility shocks in Equation 2, the default

[8] The extreme value shocks can help with numerical convergence when there are discrete choice variables. See, for example, Iskhakov, Jørgensen, Rust, and Schjerning (2017).

choice probability g_d takes the following form:

$$g_d(a,e,\nu,h=0) = \begin{cases} \frac{\exp\{V^{d=1}(a,e,\nu,h=0)/\zeta\}}{\exp\{V^{d=0}(a,e,\nu,h=0)/\zeta\}+\exp\{V^{d=1}(a,e,\nu,h=0)/\zeta\}} & \text{if } a < -\eta \cdot \exp(e); \\ 0 & \text{otherwise.} \end{cases} \tag{5}$$

The unconditional value function of households with good credit history is then given by:

$$\begin{aligned} V(a,e,\nu,h=0) &= \mathbb{E}_\epsilon V(\epsilon,a,e,\nu,h=0) \\ &= \zeta \cdot \ln\left(\exp\left\{\frac{V^{d=0}(a,e,\nu,h=0)}{\zeta}\right\} + \exp\left\{\frac{V^{d=1}(a,e,\nu,h=0)}{\zeta}\right\}\right). \end{aligned} \tag{6}$$

The value function of households with bad credit history $h=1$ is given by:

$$\begin{aligned} V(a,e,\nu,h=1) = \max_{a'\geq 0} \Bigg[& u\left(w \cdot \exp(e) + a - \bar{q}\cdot a'\right) + \nu \cdot \beta \cdot \rho \cdot \sum_{(e',z',h')} Q^e(e'|e) \cdot Q^\nu(\nu') \\ & \cdot \Big(\mathbb{P}_h \cdot V(a',e',\nu',h'=0) + (1-\mathbb{P}_h)\cdot V(a',e',\nu',h'=1)\Big)\Bigg], \end{aligned} \tag{7}$$

where $\bar{q} \equiv \rho/(1+r_f)$ denotes the discount risk-free rate and bad credit record could be removed with probability $\mathbb{P}_h$. I use $\mu(a,e,\nu,h)$ to denote the cross-sectional distribution of households.

3.3 Firms

Firms produce homogeneous goods Y using physical capital and aggregate labor in the efficiency unit with a standard Cobb-Douglas technology:

$$Y = F(K,E) = K^\alpha E^{1-\alpha}, \tag{8}$$

where α denotes capital share and aggregate labor in the efficiency unit is defined as:

$$E = \sum_{(a,e,\nu,h)} \exp(e)\cdot\mu(a,e,\nu,h). \tag{9}$$

Firms finance capital expenses via bank borrowing and commit to repaying. Profit maximization implies the gross rate of return on physical capital and wages are given by:

$$1 + r_k = F_K(K, E) + (1 - \delta), \tag{10}$$

$$w = F_E(K, E), \tag{11}$$

where δ denotes the capital depreciation rate. Equation (10) and (11) imply that firms make zero profits in equilibrium and distribute their sales revenue net of capital depreciation to banks and workers as borrowing costs and wages, respectively.

3.4 Banks

There is a unit continuum of risk-neutral banks indexed by $j \in [0, 1]$, owned by foreign investors. A bank j uses its accumulated net worth n, deposits from household savers s' to lend to firms k', and household borrowers l'. Its balance sheet constraint is given by:

$$k'_j + l'_j = n_j + s'_j + \tau'_j, \tag{12}$$

where τ' denotes the amount that a bank either borrows or lends to the international markets at r_f to balance its domestic positions.

The next-period net worth of bank j is computed as the gross returns on lending to firms and households net of the principal and interest payments to savers and the international markets. That is,

$$n'_j = (1 + r'_k) \cdot k'_j + (1 + r'_l) \cdot l'_j - (1 + r_f) \cdot (s'_j + \tau'_j), \tag{13}$$

$$= (r'_k - r_f) \cdot k'_j + (r'_l - r_f) \cdot l'_j + (1 + r_f) \cdot n_j, \tag{14}$$

where r'_l denotes the rate of return on household lending and the second equality results from plugging Equation (12).

A bank might exit the industry at rate $(1 - \psi)$ and pay its accumulated net worth as dividends to foreign owners. Taking prices as given, a bank j chooses $\{k'_j, l'_j, s'_j\}$ to maximize the discounted sum of dividends paid to foreign investors. Following Gertler and Karadi (2011), I introduce an agency problem between banks and their creditors (i.e., depositors): after determining its asset portfolio, a bank j can divert a fraction θ of total assets and transfer the benefits to foreign investors.[9] Therefore, creditors require that the banking continuation value must be greater than or equal to the diverting gain and θ represents the degree of financial friction. The optimization problem of bank j is thus given by:

$$W\left(n_j\right) = \max_{\{k'_j, l'_j, s'_j\}} \left(\frac{1}{1+r_f}\right)\left[(1-\psi)\cdot n'_j + \psi \cdot W\left(n'_j\right)\right] \tag{15}$$

$$\text{s.t.} \quad n'_j = (r'_k - r_f)\cdot k'_j + (r'_l - r_f)\cdot l'_j + (1+r_f)\cdot n_j, \tag{16}$$

$$W\left(n_j\right) \geq \theta \cdot \left(k'_j + l'_j\right), \tag{17}$$

where Equation (17) denotes the incentive constraint. Note that both θ and ψ govern the degree of financial friction. Either a larger diverting fraction or a higher exit rate implies that banks are more tempted to default due to higher diverting gain and lower continuation value, thus corresponding to a higher degree of financial friction.

Proposition 1. A solution to the constrained optimization problem from Equation (15) to (17) can be characterized by:

$$W(n_j) = \xi \cdot n_j, \tag{18}$$

$$\xi = \frac{1-\psi+\psi\cdot\xi'}{1-\lambda}, \tag{19}$$

$$\lambda = \max\left\{1 - \left(\frac{1-\psi+\psi\cdot\xi'}{\theta}\right)\cdot\left(\frac{N}{K'+L'}\right), 0\right\}, \tag{20}$$

$$\iota = \lambda\cdot\theta\cdot\left(\frac{1+r_f}{1-\psi+\psi\cdot\xi'}\right), \tag{21}$$

where ξ denotes the marginal value of banking net worth, λ stands for the multiplier on the incentive constraint, N, K', and L' are aggregate net worth and lending to firms and households, and ι denotes the incentive premium.

Proof. See Appendix A.1. □

Proposition 1 is standard in the literature, e.g., see Bocola (2016). There are four important observations: (1) ξ is independent of bank-j-specific variables, implying banks are

[9] In particular, banks can sell their claims on firm and household lending in international secondary frictionless markets. Creditors can then recover a fraction $(1-\theta)$ of total assets through a judicial process.

symmetric;[10] (2) whether the incentive constraint binds ($\lambda > 0$) or not ($\lambda = 0$) depends on the banking leverage ratio $\left(\frac{K'+L'}{N}\right)$; (3) if binding, λ decreases with N; (4) ι is proportional to λ (to what extent the incentive constraint is binding) and θ (the fraction that banks can divert) but inversely to $(1+r_f)^{-1}$, ψ, and ξ' (the degree of banks being forward-looking).

Given Proposition 1, the no-arbitrage conditions can be derived as:

$$r'_k - r_f = r'_l - r_f = \iota \geq 0. \tag{22}$$

Equation (22) shows that the excess returns on lending to firms and households equal the incentive premium ι. The explanation for the extra interest wedge is straightforward. When the diverting benefit is greater than the banking continuation value (i.e., the incentive constraint becomes binding), banks are incentivized to charge the incentive premium and attach it to the asset returns for equalizing the incentive constraint. On the one hand, higher asset returns result in an increased continuation value. On the other hand, firms and households decrease their borrowings with banks because of higher borrowing costs. As a result, total assets decrease and so does the diverting gain.

Since households can discharge their debts by defaulting and banks have full information, banks provide risk-based borrowing prices conditional on loan size and household characteristics. In particular, the expected repayment for a borrowing contract of a' can be computed as:

$$\begin{aligned} R(a',e) = \sum_{(e',\nu')} Q^e(e'|e) \cdot Q^\nu(\nu') \cdot \Big[& (1 - g_d(a',e',\nu')) \cdot (-a') \\ & + g_d(a',e',\nu') \cdot \eta \cdot w' \cdot \exp(e') \Big], \end{aligned} \tag{23}$$

where credit status h, h' are ignored for brevity as only those with good credit history can borrow. The bank loan pricing function is thus given by:

$$q(a',e) = \rho \cdot \frac{R(a',e)}{(1+r_f+\iota)\cdot(-a')}. \tag{24}$$

Note that the canonical case without financial frictions, e.g., Chatterjee et al. (2007) and Livshits et al. (2007), is nested in Equation (24) when banks are not allowed to divert any

[10] Symmetry means that all banks choose the same leverage ratio and, as a result, their asset positions are proportional to their accumulated net worth.

assets, i.e., $\theta = 0$. In this case, ι equals zero by construction.

I can derive the evolution of aggregate banking net worth, consisting of existing banks $N'_{existing}$ and newly entering banks N'_{new}. Among the existing banks, their net worth can be summed up due to the symmetry property and only a fraction ψ of them may stay. $N'_{existing}$ is thus given by:

$$N'_{existing} = \psi \cdot \left[\iota \cdot \left(K' + L'\right) + \left(1 + r_f\right) \cdot N\right]. \tag{25}$$

Each new entrant receives from foreign investors a start-up fund equal to a fraction $\left(\frac{\omega}{1-\psi}\right)$ of the total assets that banks have managed (Gertler and Karadi, 2011). The aggregate net worth of new entrants is thus given by:

$$N'_{new} = \omega \cdot \left(K' + L'\right). \tag{26}$$

Therefore, the evolution of aggregate banking net worth is defined as:

$$N' = \psi \cdot \left[\iota \cdot \left(K' + L'\right) + \left(1 + r_f\right) \cdot N\right] + \omega \cdot \left(K' + L'\right). \tag{27}$$

Note that ω can help match the targeted banking leverage ratio. Hence, it will be chosen such that the targeted ratio is supported and there is no international lending or borrowing $T = \int \tau_j \, dj$ in equilibrium.

3.5 Evolution of the Household Distribution

The probability for an individual to move from state (a, e, ν, h) to (a', e', ν', h') is governed by the following mapping:

$$\begin{aligned} T(a', e', \nu', h' | a, e, \nu, h) = & \rho \cdot \mathbb{I}_{[a' = g_a(a,e,\nu,h)]} \cdot Q^e(e'|e) \cdot Q^\nu(\nu') \cdot Q^h(h'|h) \\ & + (1 - \rho) \cdot \mathbb{I}_{[a'=0]} \cdot G^e(e') \cdot \mathbb{I}_{[\nu'=1]} \cdot \mathbb{I}_{[h'=0]}, \end{aligned} \tag{28}$$

where $g_a(a, e, \nu, h)$ denotes the policy function of households for assets and $Q^h(h'|h)$ characterizes the evolution of credit history consistent with $g_d(a, e, \nu, h)$ and $\mathbb{P}_h$. Therefore, the cross-sectional distribution of households μ evolves according to:

$$\mu'(a', e', \nu', h') = \sum_{(a,e,\nu,h)} T(a', e', \nu', h' | a, e, \nu, h) \cdot \mu(a, e, \nu, h). \tag{29}$$

3.6 Equilibrium

A stationary Recursive Competitive Equilibrium (RCE) is a set of (un)conditional value functions V^* and W^*, household policy functions g_a^* and g_d^*, factor prices r_k^* and w^*, bank loan pricing function q^* and expected repayment R^*, incentive multiplier λ^* and premium ι^*, aggregate variables N^*, D^*, L^*, and K^*, and a household distribution μ^* such that:

1. Household Optimality: $V^*(a, e, \nu, h)$, $g_a^*(a, e, \nu, h)$, and $g_d^*(a, e, \nu, h)$ satisfy Equation (3), (4), (5), (6), and (7) for all (a, e, ν, h).

2. Factor Prices: r_k^* and w^* satisfy Equation (10) and (11).

3. Bank Optimality: W^*, λ^*, ι^*, K^*, and N^* solve Equation (15), (16), (17), (21), and (27). $q^*(a', e)$ and $R^*(a', e)$ satisfy Equation (24) and (23) for all (a', e), respectively.

4. Market Clearing Conditions: L^* and D^* are consistent with g_a^* and μ^*.

5. Stationary Distribution: $\bar{\mu}^*(a, e, \nu, h)$ solves Equation (29).

Note that the banking problem involves an occasionally binding constraint (i.e., the incentive constraint). Computing the banking leverage ratio requires knowledge of the cross-sectional distribution of households. As a result, all equilibrium objects depend on the distribution via the incentive premium, and solving the model numerically becomes a daunting task. To this end, I propose a bisection-based one-loop algorithm to solve the model. In a nutshell, I adopt a bisection procedure to deal with the occasionally binding incentive constraint. The one-loop algorithm is suggested by Hatchondo, Martinez, and Sapriza (2010) to accelerate the computation for solving models with endogenous default. Refer to Appendix B for computational details.

Parameter		Value	Source / Target
Households			
CRRA coefficient	γ	2	Standard
Household survival rate	ρ	0.98	Avg. working lifespan of 50 years
Household discount factor	β	0.9592	Effective discount factor of 0.94
Production			
Capital share	α	0.36	Standard
Depreciation rate	δ	0.08	Standard
Financial market			
Risk-free rate	r_f	0.04	McGrattan and Prescott (2000)
Wage garnishment rate	η	0.25	25% of disposable income
Probability of flag removal	$\mathbb{P}_h$	0.10	Avg. exclusion of 10 years
Bank survival rate	ψ	0.8926	Avg. planning period of 10 years
Diverting fraction	θ	0.2918	25% lower than the targeted ratio
Transfer to newly entering banks	ω	0.0101	1% of total assets intermediated
Exogenous processes			
S.D. of permanent labor productivity	σ_1	0.448	Storesletten et al. (2004)
AR(1) of persistent labor productivity	ρ_2	0.957	Storesletten et al. (2004)
S.D. of persistent labor productivity	σ_2	0.129	Storesletten et al. (2004)
S.D. of transitory labor productivity	σ_3	0.351	Storesletten et al. (2004)
Support of household preferences	(ν_1, ν_2)	(0,1)	Hand-to-mouth households

Table 1: Exogenously Chosen Parameters

4 Calibration

The objective of this paper is to quantitatively investigate the implications of financial frictions for consumer bankruptcy. The model period is set to a year and calibrated to match the U.S. households in 2004 to circumvent the effects of the 2005 bankruptcy reform. My calibration strategy is threefold: (1) standard parameters are taken from the literature; (2) parameters with direct empirical counterparts are exogenously calibrated; and (3) the rest are internally chosen to match targeted data moments, including banking leverage ratio and Chapter 7 default rate. Table 1 provides an overview of the parameters either with standard values or chosen exogenously. Internally calibrated parameters are presented in Table 2.

I set the CRRA parameter of the utility function γ to 2, a standard value in the macro literature. Following Nakajima and Ríos-Rull (2014), the survival probability of households ρ is set to 0.98, implying an average working life span of 50 years. I set the household discount factor β equal to 0.9592, implying an effective discount factor of 0.94 as in

Parameter		Value	Target	Data	Model
Probability of preference shocks	$\mathbb{P}_\nu$	0.01057	Banking leverage ratio	4.57	4.57
Dispersion of E.V. shocks	ζ	0.02150	Chapter 7 default rate (%)	0.61	0.61

Table 2: Internally Calibrated Parameters

Livshits et al. (2007). The capital share of the Cobb-Douglas production function α and capital depreciation δ are set respectively to 0.36 and 0.08, both of which are standard values in the macro literature. The risk-free rate r_f is set to 4%, aligned with the average return on capital reported in McGrattan and Prescott (2000). The wage garnishment rate η is set to 25% of the disposable income. The average duration of bad credit history is 10 years, consistent with the regulations in the Fair Credit Reporting Act. This implies that the probability of flag removal $\mathbb{P}_h$ is $1/10$. The bank survival rate ψ is set to 0.8926 taken from Gertler and Karadi (2011), implying average planning horizons of 10 years. The calibration for the fraction of asset diversion is suggestive. I choose $\theta = 0.2918$ such that the maximum banking leverage ratio below which the incentive constraint is always slack equals 3.43. This value is 25% lower than the targeted banking leverage ratio of 4.57. The start-up funds for new entrants to the banking industry ω are set to 1.01% of total assets that existing banks have managed in the last operational period.

The permanent, persistent, and transitory labor productivity processes are taken from Storesletten, Telmer, and Yaron (2004). I use their processes because they estimated them using labor earnings data at the household level from the Panel Study of Income Dynamics (PSID) for the same time period considered in my paper. I approximate the permanent and transitory components with two-point and three-point uniform distributions, respectively. The persistent process is discretized with a three-state Markov chain using Adda and Cooper (2003). I assume that newborn households are endowed with (1) permanent labor productivity drawn randomly from the uniform distribution; (2) persistent labor productivity drawn randomly according to the stationary distribution implied by the persistent process; and (3) zero transitory labor productivity. For preference shocks, I consider a two-point i.i.d. process with support $\mathcal{V} = \{\nu_1, \nu_2\}$ and probability $\mathcal{P}_\nu = \{\mathbb{P}_\nu, 1 - \mathbb{P}_\nu\}$. For computational simplicity, ν_1 and ν_2 are set to zero and unity. Hence, ν_1-type households spend all incomes on consumption (i.e., hand-to-mouth) and ν_2-type households are forward-looking without present bias.

I then internally calibrate the probability of preference shocks $\mathbb{P}_\nu$ and the dispersion parameter of the extreme value distribution ζ jointly by matching the banking leverage ratio and the Chapter 7 default rate. The banking leverage ratio in the data is calculated as the ratio of total assets to banking net worth among commercial banks in the U.S. over 2001-2004 using the Federal Board of Governors' seasonally adjusted H.8 series.[11] The Chapter 7 default rate in the data is computed as the total number of non-business Chapter 7 filings from the American Bankruptcy Institute divided by the total number of U.S. households in 2004. Both the probability of preference shocks and the dispersion parameter of the extreme value distribution are accordingly set to 0.01057 and 0.02150, respectively. The former implies that in each period there are around 1% of households who are hand-to-mouth. The small latter term indicates that the equilibrium default rate is explained mostly by the structural factors in my model instead of the extreme value shocks.

In addition, I evaluate the model fit on a set of untargeted moments that are standard in the consumer finance literature. This set includes the fraction of households in debt, the debt-to-earnings ratio, and the average borrowing interest rate. The first two statistics describe household borrowings at the extensive margin (whether to borrow) and the intensive margin (to what extent conditional on taking up a loan), respectively. The data and model moments are summarized in Table 3. For the fraction of households in debt in the data, I calculate the share of households with a negative net worth in the 2004 Survey of Consumer Finances (SCF). In particular, I use the SCF-calculated net worth because it is aligned with the consolidated asset position of households in my model. I consider households with heads aged between 20 to 70 to be consistent with the calibration of household life expectancy and given my model does not account for childhood and retirement. I also exclude households with negative net worth greater than 120% of total income because these debts result most likely from entrepreneurial activity following Chatterjee et al. (2007). The debt-to-earnings ratio at the aggregate level in the data is also computed using the 2004 SCF. Debts are measured using the same SCF-calculated net worth as above and earnings are computed as wage income. The average borrowing interest rates are taken from Exler and Tertilt (2020). They compute the average interest rates for two types of unsecured consumer borrowings over 1995-1999 reported in the Federal Board of Governors G.19 series, adjusted by one-year ahead CPI inflation from the U.S. Bureau of Labor Statistics. The calibrated model does match these untargeted moments

[11] To be specific, banking net worth is defined as the difference between total assets and liabilities.

Moment (in %)	Data	Model
Fraction of households in debt	7.05	8.63
Debt-to-earnings ratio	2.56	1.87
Average borrowing interest rate	10.93 – 12.84	12.18

Table 3: Untargeted Moments: Data v.s. Model

Notes: The fraction of households in debt and the debt-to-earnings ratio are computed using the 2004 SCF. The average borrowing interest rate is taken from Exler and Tertilt (2020).

fairly well.

5 Consumer Credit with Financial Frictions

The agency problem between banks and depositors limits the ability of banks to manage assets. An incentive constraint on the banking portfolio thus endogenously emerges to regulate banks' lending behavior. As such, they cannot expand their balance sheet autonomously by issuing more loans to borrowers. Under the baseline calibration, the constraint binds in equilibrium, and financial frictions come into play. The binding economy illustrates several new insights that arise from the interplay between household finance behavior and financial frictions. For example, compared to the economy without financial frictions, the average borrowing interest rate is higher when banks are confronted with financial frictions, ceteris paribus. Household debt decreases as a result. In addition, the higher borrowing cost reduces the lending from banks to firms used for capital investment. The reduction in investment results in lower production and decreased wage earnings for all households.

The rest of the section is organized as follows. Section 5.1 presents the equilibrium outcomes with and without financial frictions. Section 5.2 explores the effects of changing the degree of financial friction.

5.1 Benchmark v.s. Frictionless Economy

I begin by demonstrating the results with and without financial frictions to assess the importance of financial frictions in affecting the equilibrium outcomes. Table 4 collects the equilibrium aggregates highly related to consumer credit markets under the base-

Variable	Benchmark	Frictionless
Levels		
Incentive premium (%)	0.6264	0.0000
Avg. borrowing interest rate (%)	12.1829	10.6505
Fraction of HHs in debt (%)	8.6335	9.0770
Debt-to-earnings ratio (%)	1.8748	1.9551
Conditional default rate (%)	7.0445	6.0182
GDP	1.8028	1.8552
Wage	1.1538	1.1873
Household debt	0.0183	0.0200
HH debt-to-GDP ratio (%)	1.0169	1.0802
% change w.r.t. benchmark		
Incentive premium	-	-100.0000
Avg. borrowing interest rate	-	-12.5789
Fraction of HHs in debt	-	5.1374
Debt-to-earnings ratio	-	4.2824
Conditional default rate	-	-14.5683
GDP	-	2.9035
Wage	-	2.9035
Household debt	-	9.3075
HH debt-to-GDP ratio	-	6.2232

Table 4: Effects of Financial Frictions on Equilibrium Outcomes

Notes: The conditional default rate is defined as the fraction of households choosing to default conditional on having any loans. The upper panel "Levels" reports model moments in levels under the benchmark and the counterfactual without financial frictions. The bottom panel "% change w.r.t. benchmark" demonstrates the percentage variations of the variables under the frictionless counterfactual compared to the benchmark.

line calibrated economy and the counterfactual without financial frictions. The column "Benchmark" reports the benchmark results when financial frictions are present. The column "Frictionless" reports the results when financial frictions are deactivated artificially by setting $\theta = 0$, i.e., impossible for banks to divert any assets.

The two economies exhibit distinct equilibrium outcomes as shown in Table 4. Under the benchmark, financial frictions exist, and the incentive constraint binds in equilibrium. Consequently, banks are incentivized to charge an extra incentive premium uniformly for all loan contracts.[12] In particular, banks charge a positive equilibrium incentive pre-

[12] This results from the optimal banking behavior because the expected returns on either asset in equilibrium must be identical; otherwise, banks can make profits by shifting funding to the asset with a higher rate of return, i.e., the no-arbitrage conditions.

mium of 0.63% in the benchmark economy while zero in the frictionless economy. The extra premium yields a higher average borrowing interest of 12.18% under the benchmark compared to 10.65% in the absence of financial frictions. Higher borrowing costs cause aggregate household borrowings to decrease at both extensive and intensive margins: the fraction of households in debt and the debt-to-earnings decline from 9.08% and 1.96% in the frictionless economy to 8.63% and 1.87% in the benchmark, respectively. The conditional default rate rises from 6.02% in the frictionless case to the benchmark level at 7.04%. These observations suggest that financial frictions result in a riskier composition of household borrowers: although aggregate household debts decline at both margins, loans are granted to households with higher default risks.

On the other hand, financial frictions lead to lower production and wages. Since firm investments are financed solely through bank lending, higher borrowing costs result in reduced investment, decreased production, and lower wages. In particular, gross domestic product (GDP) and wages increase by 2.9% due to the removal of financial frictions.[13] In addition, household debt responds more greatly to financial frictions than GDP. The reduction in household debt outweighs the GDP decline, thus implying a decreased household debt-to-GDP ratio in the benchmark economy. Conversely, when financial frictions are gone, there is no restriction on the banking asset portfolio. Therefore, no extra incentive premium arises in equilibrium, and production reverts upward to the level implied by the risk-free rate. Households thus benefit from the more efficient allocation via higher wage earnings.

As demonstrated, frictional financial intermediation entails declined household borrowings at both intensive and extensive margins, as well as lower production and wages. In addition to the existing mechanisms in a canonical consumer default model (Chatterjee et al., 2007; Livshits et al., 2007), financial frictions bring two new mechanisms into play: incentive and divestment channels. First, the agency problem between banks and depositors limits the ability of banks to acquire external funding via deposits. In order to mitigate agency tension, banks are incentivized to charge an extra premium attached uniformly to the returns on all assets in the next period. I call this premium the **incentive premium**. As such, it becomes more costly for banks to divert the claims on these assets today, and banks thus prefer continuation to collect higher returns. The extra incentive premium thus

[13] GDP moves in lockstep with wages because of the assumptions of homothetic production technology and inelastic labor supply.

leads to increased borrowing costs for households and firms. This mechanism is labeled as the **incentive channel**. Second, higher borrowing costs result in firms reducing capital investment. Production and wages accordingly decrease. This mechanism is denoted as the **divestment channel**.

5.2 Varying Degree of Financial Frictions

The benchmark calibration of financial frictions is regarded as suggestive, given the limited data access to the direct measures of financial frictions. To understand to what extent financial frictions shape household finance behavior and the aggregate economy, I further explore the effects of varying the degree of financial friction. In my economy, two parameters govern the degree of financial frictions: the fraction of assets banks can divert secretly θ and the probability that banks exit the industry ψ. In a nutshell, higher θ and ψ correspond to a higher degree of financial friction because banks either can divert more assets or are more present-biased, i.e., a lower value from continuation for banks.

First, I simulate the counterfactuals where θ varies from values of 2% lower to 2% higher than the benchmark calibration while holding all other parameters fixed. A higher θ means banks can divert a larger fraction of assets and thus reflects a higher degree of financial friction. The results of these experiments are reported in Table 5, where each table column presents the outcomes under the given θ in the first row. Since the agency problem between banks and depositors is strengthened with the degree of financial friction, a higher incentive premium must arise to equalize the incentive conflicts between banks and depositors. As shown in Table 5, banks will charge a higher incentive premium if facing higher θ, and vice versa. The average borrowing interest rate accordingly increases with θ. Household borrowings at both margins correspondingly decrease with the degree of financial friction, while the conditional default rate is positively related to θ. Firms also reduce investment and production further in response to higher borrowing costs owing to a higher θ. As a result, wages fall to a lower extent mechanically. The household debt-to-GDP ratio declines as household debt is more sensitive to the variation in θ.

Second, I vary the average banking planning horizon from seven to eleven years by setting the exit rate ψ to the corresponding values while all other parameters remain the

Variable	$\theta = 0.2859$	$\theta = 0.2888$	$\theta = 0.2918$	$\theta = 0.2947$	$\theta = 0.2976$
Consumer credit markets					
Avg. borrowing interest rate (%)	12.0957	12.1411	12.1829	12.2221	12.259
Fraction of HHs in debt (%)	8.6709	8.6511	8.6335	8.6175	8.6006
Debt-to-earnings ratio (%)	1.8852	1.8796	1.8748	1.8705	1.8667
Conditional default rate (%)	0.6064	0.6073	0.6082	0.6090	0.6097
Incentive & divestment channels					
Incentive premium (%)	0.5581	0.5935	0.6264	0.6570	0.6857
GDP	1.8083	1.8055	1.8028	1.8004	1.7981
Wage	1.1573	1.1555	1.1538	1.1522	1.1508
Household debt	0.0185	0.0184	0.0183	0.0183	0.0182
HH debt-to-GDP ratio (%)	1.0242	1.0203	1.0169	1.0139	1.0111

Table 5: Effects of Varying Degree of Financial Frictions by θ

Notes: The conditional default rate is defined as the fraction of households choosing to default conditional on having any loans. Each column reports model moments under the given θ in the first row.

same.[14] A shorter average banking planning horizon implies that banks are less forward-looking and have lower continuation values. Ceteris paribus, the myopia of banks aggravates the agency problem with depositors, thus resulting in a higher degree of financial friction. Table 6 show the outcomes of these experiments. Similar to the conclusion drawn from the exercises of θ, the incentive premium positively correlates with the degree of financial friction (or equivalently inversely with ψ). The average borrowing rate thus increases inversely with ψ. Household borrowings at both margins decline as ψ decreases. Production, wages, and the household debt-to-GDP ratio all increase with ψ.

6 Regulation of Consumer Credit Markets

Consumer credit markets are often regulated through bankruptcy laws by policymakers. However, the welfare implications of bankruptcy strictness are unclear *ex-ante* and depend on the canonical efficiency-insurance trade-off discussed in Zame (1993). On the one hand, households can default to insure themselves against idiosyncratic risks. In other words, default helps them *smooth across states*. On the other hand, bankruptcy leniency prompts banks to charge higher borrowing prices to compensate for larger default risks. Higher interest costs make it more difficult for households to *smooth over time*.

[14] To be specific, $\psi = 1 - \frac{1}{\text{average banking planning horizon}}$.

Variable	$\psi = 0.9091$	$\psi = 0.9000$	$\psi = 0.8889$	$\psi = 0.8750$	$\psi = 0.8571$
Consumer credit markets					
Avg. borrowing interest rate (%)	11.8810	12.0933	12.2303	12.4218	12.6524
Fraction of HHs in debt (%)	8.8426	8.6720	8.6143	8.5274	8.4265
Debt-to-earnings ratio (%)	1.9602	1.8855	1.8697	1.8514	1.8304
Conditional default rate (%)	0.5969	0.6064	0.6091	0.6129	0.6149
Incentive & divestment channels					
Incentive premium (%)	0.4670	0.5562	0.6635	0.8102	1.0141
GDP	1.8157	1.8085	1.7998	1.7882	1.7724
Wage	1.1621	1.1574	1.1519	1.1445	1.1343
Household debt	0.0195	0.0185	0.0182	0.0179	0.0175
HH debt-to-GDP ratio (%)	1.0740	1.0244	1.0133	1.0000	0.9850

Table 6: Effects of Varying Degree of Financial Frictions by ψ

Notes: The conditional default rate is defined as the fraction of households choosing to default conditional on having any loans. Each column reports model moments under the given ψ in the first row.

Since credit provision is affected by fictional financial intermediation, financial frictions play a critical role in the welfare assessment of consumer bankruptcy laws. For instance, under a lenient regime, banks charge higher default premiums to break even, and households thus face higher borrowing costs, ceteris paribus. A higher borrowing price in terms of savings results in an increased propensity to save for households. As a result, banks receive more deposits and have a greater incentive to divert assets. In order to mitigate agency tension, banks are incentivized to charge an extra premium for all assets. As a result, banks find it more costly to divert the claims on assets today and prefer continuation to collect higher returns. However, the increased borrowing costs make it harder for households to smooth consumption by borrowing from banks. Also, higher borrowing prices cause firms to reduce investment and thus production. Therefore, households are worse off in terms of welfare due to lower wage earnings for consumption.

To quantitatively investigate the impact of financial frictions on the welfare evaluation of consumer credit regulations, I consider two sets of bankruptcy rules highly relevant in consumer credit markets: (1) short-term monetary bankruptcy costs via wage garnishment; and (2) long-term punishment via the exclusion from borrowing markets. Generally speaking, the aggregate and welfare effects of a policy change are involved with the transition dynamics of each household to the new policy and at the same time interact with financial frictions. To better understand how each component contributes to the welfare analysis, I focus on the first step of the interplay between the legal change and the household transition dynamics by analyzing the welfare implications of these policy proposals under the benchmark calibration. These exercises are crucial for grasping how the proposed policy experiments primarily influence the aggregate economy and household welfare when financial frictions exist. In the second step to decipher the interaction between bankruptcy laws and financial frictions, I further explore how and to what extent financial frictions shape the previous benchmark welfare conclusions by changing the degree of financial frictions.

The rest of the section is structured as follows. Section 6.1 defines the welfare metrics that incorporate the transition dynamics of a policy change. Section 6.2 and 6.3 present the policy experiments of wage garnishment and borrowing exclusion under the benchmark calibration of financial frictions, respectively. Section 6.4 investigates how and the what extent financial frictions affect the welfare implications of consumer bankruptcy laws.

6.1 Welfare Measures

To evaluate the welfare effects of unanticipated policy reform, I adopt two metrics: (1) percentage gain/loss compared to the benchmark in the consumption equivalent variation (CEV) unit; and (2) fraction of households in favor of the policy reform (i.e., majority rule). In addition, I take into account the transition dynamics of policy changes because the policy effects are heterogeneous conditional on household initial states.[15] For convenience, I use superscripts *old* and *new* to denote the equilibrium objects under the old and new policies in the following discussions.

First, I measure the lifetime percentage change in flow consumption since an unanticipated policy change.[16] The welfare gain/cost $\tau(i)$ for household i owning to an unanticipated new policy at $t = 1$ is defined as:

$$\mathbb{E}_1 \left[\sum_{t=1}^{\infty} \nu_t \cdot (\beta\rho)^{t-1} \cdot u\left(\left(1 + \frac{\tau(i)}{100}\right) \cdot c_t^{old}(i) \right) \right] = \mathbb{E}_1 \left[\sum_{t=1}^{\infty} \nu_t \cdot (\beta\rho)^{t-1} u\left(c_t^{new}(i)\right) \right]. \quad (30)$$

Positive $\tau(i)$ means household i prefers the new policy, and vice versa. Given CRRA

[15] Solving the transition dynamics is not trivial in my model with financial frictions because a policy change prompts banks to adjust their leverage ratios over time to the new equilibrium level. This process takes time and affects aggregate prices, including the incentive premium and wages.

[16] This consumption-based welfare measure is standard in the literature of business cycles dating back to Lucas (1987). See, for example, Mukoyama (2010) for applications under heterogeneous agent frameworks.

utility function with coefficient γ, $\tau(i)$ can be solved as:

$$\tau(i) = \left[\left(\frac{\widetilde{V}_1(i)}{V^{old}(i)} \right)^{\frac{1}{1-\gamma}} - 1 \right] \times 100, \tag{31}$$

where $\widetilde{V}_1(i)$ denotes the transition value for household i at $t = 1$ and $\widetilde{V}_t(i)$ converges to $V^{new}(i)$ when t is sufficiently large.

In addition, I calculate the percentage of households in favor of the new policy as follows.

$$\sum_i \left[\mathbb{I}_{[\tau(i)>0]} \cdot \mu^{old}(i) \right] \times 100, \tag{32}$$

where $\mathbb{I}$ denotes the indicator function which equals one if $\tau(i) > 0$ and zero otherwise; recall that μ denotes the cross-sectional distribution of households in equilibrium. When the new policy is introduced (i.e., at the beginning of $t = 1$), households are still distributed according to μ^{old}. Thus, the idea is to check how many households prefer the new policy similar to the majority rule. This measure can thus speak to political decision-making.

6.2 Wage Garnishment

One of the bankruptcy regulation tools is the bankruptcy fees in the filing period. I model this cost using the wage garnishment rate to keep borrowers acting in good faith. To examine how wage garnishment rates affect the equilibrium outcomes with financial frictions, I simulate two counterfactuals where wage garnishment rates, relative to the benchmark value of 0.25, are decreased by 0.05 to 0.20 and increased by 0.05 to 0.30, respectively. The key equilibrium results of these policy experiments are summarized in Table 7. The column "Benchmark" reports the results in the calibrated model. The column "Lower Garnishment" shows the results of the policy counterfactual where bankruptcy law becomes more lenient due to a lower wage garnishment rate of 0.20. The column "Higher Garnishment" instead presents the results of the case where bankruptcy law becomes stricter due to a higher wage garnishment rate of 0.30.

Compared to the benchmark, a lower wage garnishment rate leads to an increased default rate because of lower default costs in the filing period. As a result, the average

Variable	Lower Garnishment	Benchmark	Higher Garnishment
Levels			
Consumer credit markets			
Default rate (%)	0.6652	0.6082	0.4322
Avg. borrowing interest rate (%)	14.3035	12.1829	8.9899
Fraction of HHs in debt (%)	6.7959	8.6335	11.2935
Debt-to-earnings ratio (%)	1.2858	1.8748	2.7372
Incentive & divestment channels			
Banking leverage ratio	4.8967	4.5652	4.1773
Incentive premium (%)	0.7071	0.6264	0.4893
Wage	1.1497	1.1538	1.1609
% change w.r.t. benchmark			
Incentive & divestment channels			
Banking leverage ratio	7.2613	-	-8.4961
Incentive premium	12.8781	-	-21.8868
Wage	-0.3576	-	0.6160

Table 7: Policy Counterfactual of Wage Garnishment: Equilibria Comparison

Notes: The upper panel "Levels" reports model moments in levels under the benchmark and the policy experiments of wage garnishment. The bottom panel "% change w.r.t. benchmark" shows the percentage variations of the selective moments related to the incentive and divestment channels under the policy experiments compared to the benchmark.

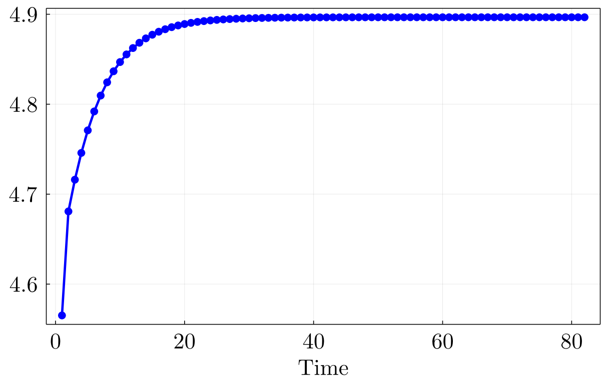
borrowing interest rate rises from 12.18% in the benchmark to 14.30%. Due to higher borrowing costs, both the fraction of households in debt (extensive margin) and the debt-to-earnings ratio (intensive margin) drop significantly. In addition, rising borrowing costs result in higher borrowing prices relative to savings, leading to fewer unsecured loans and more deposits in equilibrium. Accordingly, banks become more externally financed with deposits and have a higher leverage ratio.[17] Therefore, the incentive premium increases by 12.88%, and wages decrease by 0.36% through the incentive and divestment channels mentioned previously in Section 5.2. In the case of a higher wage garnishment rate, all of these changes move in the opposite direction.

The converged transition paths of the banking leverage ratio for both policy counterfactuals are visualized in Figure 1, where Figure 1a plots the transition from benchmark to lower garnishment and 1b shows the transition from benchmark to higher garnishment.

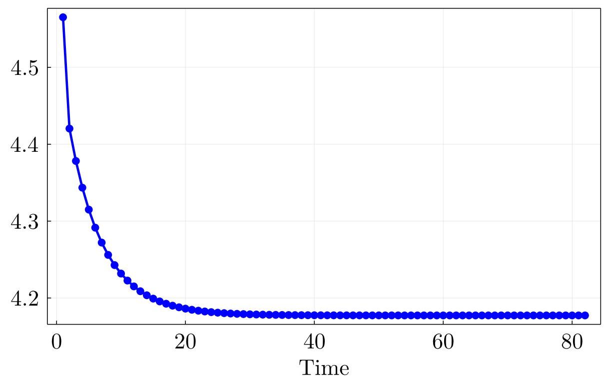
[17] Recall that the banking leverage ratio is computed as the ratio of total assets to banking net worth. Therefore, a higher leverage ratio means that banks are more leveraged with external funding, i.e., deposits from household savers, and not financed by their internally accumulated net worth.

Figure 1: Transition Paths of Banking Leverage Ratio

(a) From Benchmark to Lower Garnishment



(b) From Benchmark to Higher Garnishment



Notes: The unit of time is a year. The policy reform is unexpectedly announced at $t = 1$. The banking leverage ratio remains in the old equilibrium at $t = 0$ and converges to the new equilibrium at $t = 80$. The left figure illustrates the transition from benchmark ($\eta = 0.25$) to lower garnishment ($\eta = 0.20$). The right figure plots the transition from benchmark ($\eta = 0.25$) to higher garnishment ($\eta = 0.30$).

In both cases, the banking leverage ratio gradually converges to the new leverage ratios under the respective policy reforms. For example, the banking leverage ratio decreases from 4.57 to 4.18 under the policy experiment of higher garnishment. In addition, one can see that there are salient discrete jumps in banking leverage ratios in the first period. This is because more (less) households default in response to an unexpected policy change of a more lenient (stricter) bankruptcy rule. Furthermore, borrowing prices and wages vary with the transition path of the banking leverage ratio through the incentive and divestment channels. For instance, under the counterfactual of lower garnishment, the banking leverage ratio increases gradually to the higher equilibrium level. The incentive constraint thus becomes increasingly binding, and the incentive premium accordingly rises over time. As a result, households face progressively higher borrowing costs and lower wages along with the transition.

The welfare results of these policy counterfactuals under the benchmark calibration of financial frictions are summarized in Table 8, where I distinguish households from initial credit history, indebtedness, and the degree of patience. The column "HH Proportion" describes the initial household distribution when the policy reform is announced. The column "CEV" reports the CEV in the percentage of the policy change relative to the benchmark. The column "Favor Reform" reports the percentage of households in favor of the new policy.

Variable (in %)		Lower Garnishment		Higher Garnishment	
	HH Proportion	CEV	Favor Reform	CEV	Favor Reform
Total	100.0000	-0.1845	1.3450	0.2760	99.4748
Good credit history	94.9490	-0.1889	1.4165	0.2810	99.5030
Indebted	9.0928	-0.4267	15.5785	0.5917	94.5346
Not indebted	90.9072	-0.1566	0.0000	0.2391	100.0000
Patient	98.9653	-0.1868	1.4259	0.2791	99.5000
Impatient	1.0347	-5.4868	0.5207	5.7604	99.7932
Bad credit history	5.0510	-0.1062	0.0000	0.1866	98.9430

Table 8: Policy Counterfactual of Wage Garnishment: Welfare Implications

Notes: All results are measured when the policy reform is announced. The column "HH Proportion" describes the initial household distribution. The column "CEV" reports the CEV in the percentage of the policy change relative to the benchmark. The column "Favor Reform" reports the fraction of households in favor of the new policy in percentage. The row "Total" shows the aggregate results. The rows "Good credit history"/"Bad credit history" illustrate the results conditional on households with good/bad credit history. The rows "Indebted"/"Not indebted" present the results among households with good credit history who have debts/no debts. The row "Impatient" shows the results conditional on households with good credit history hit by preference shocks.

The welfare effects of decreasing or increasing wage garnishment rates are the opposite: a more lenient law through a lower wage garnishment rate is overall welfare-reducing for all households, whereas a stricter law through a higher wage garnishment rate is overall welfare-improving. The reasons are twofold. First, stricter bankruptcy regulation via higher default costs results in lower default premia but makes bankruptcy declaration more costly in response to bad shocks. Second, the agency problem is mitigated under a stricter regime, as discussed in Table 7. Banks thus charge a lower incentive premium, thus leading to lower borrowing costs for firms and households. Firms thus increase capital investment, produce more, and raise wages. Hence, lower borrowing costs and higher wages allow households to better smooth consumption. In my model, the benefits from lower borrowing costs (either through lower default or incentive premium) and higher wages outweigh the losses from bankruptcy insurance through higher default costs under a stricter code. The results are the opposite under a more lenient legal environment. Therefore, a stricter (more lenient) bankruptcy regime results in a welfare gain (loss). In particular, impatient households benefit significantly from a stricter code because they can borrow at lower interest costs to mitigate the higher interest expenses due to the over-borrowing triggered by preference shocks.

However, one might find it counter-intuitive that households with a bad credit history also prefer stricter bankruptcy regulation. Given that they have defaulted in the past with lower wage garnishment, the current imposed legal change of a higher garnishment rate does not directly impact those already with bad credit history. Although they are temporarily excluded from the borrowing markets, they can regain borrowing access in the future due to the removal of bad credit history and benefit from lower borrowing costs to smooth consumption by then. They also gain higher wages due to the reduced agency tension under a stricter legal environment. The quantitative results suggest that, for this subgroup, the gain from smoothing consumption at lower borrowing costs in the long run and higher wage earnings combined is greater than the insurance loss of higher default costs due to a stricter law.

In terms of the majority rule, almost all households prefer a higher garnishment rate, while some indebted households prefer a lower rate. Why do not indebted households support a stricter bankruptcy reform unanimously as households with good credit history but without debts do? This is because this group of households has borrowed at lower interest costs under the benchmark policy and, after the implementation of a more lenient bankruptcy law, they can thus benefit timely from discharging debts at lower default costs if hit by bad shocks in the subsequent period. Consequently, a lower wage garnishment rate is advocated by more indebted households compared to other household subgroups.

6.3 Exclusion from Borrowing Markets

Another approach to regulation in the consumer credit market is to keep track of consumer credit history. A flag or bad record of bankruptcy filing remains on a credit report for a certain period of time. During this period, consumer borrowing ability is forbidden. In my model, this exclusion regulation is captured by the probability of flag removal $\mathbb{P}_h$. Recall that the benchmark calibration for $\mathbb{P}_h$ is set to $1/10$, implying an average exclusion duration of 10 years. This period length of exclusion is consistent with the Fair Credit Reporting Act. For brevity, the converged transition paths of borrowing exclusion policy experiments are reported in Appendix C.

To examine the equilibrium and welfare effects of a shorter or longer duration of ex-

Variable	Shorter Exclusion	Benchmark	Longer Exclusion
Levels			
Consumer credit markets			
Default rate (%)	0.6480	0.6082	0.5753
Avg. borrowing interest rate (%)	12.3257	12.1829	11.9688
Fraction of HHs in debt (%)	8.6259	8.6335	8.6814
Debt-to-earnings ratio (%)	1.8252	1.8748	1.9334
Incentive & divestment channels			
Banking leverage ratio	4.5832	4.5652	4.5443
Incentive premium (%)	0.6315	0.6264	0.6203
Wage	1.1535	1.1538	1.1541
% change w.r.t. benchmark			
Incentive & divestment channels			
Banking leverage ratio	0.3960	-	-0.4580
Incentive premium	0.8223	-	-0.9696
Wage	-0.0229	-	0.0271

Table 9: Policy Counterfactual of Probability of Flag Removal: Equilibria Comparison

Notes: The upper panel "Levels" reports model moments in levels under the benchmark and the policy experiments of borrowing exclusion. The bottom panel "% change w.r.t. benchmark" shows the percentage variations of the selective moments related to the incentive and divestment channels under the policy experiments compared to the benchmark.

clusion from borrowing markets with financial frictions, I simulate two counterfactuals where the probability of flag removal is increased to 1/5 and decreased to 1/15, respectively. They correspond to an average exclusion duration of 5 and 15 years. The equilibrium results of these policy counterfactuals are summarized in Table 9 and the welfare outcomes in Table 10. The column "Shorter Exclusion" denotes the counterfactual where bankruptcy law becomes more lenient due to a higher probability of flag removal equal to 1/5. The column "Longer Exclusion" denotes the counterfactual where bankruptcy law becomes stricter due to a lower probability of flag removal equal to 1/15.

In Table 9, one can see that longer (shorter) exclusion results in lower (higher) default risks and thus lower (higher) borrowing interest rates. As a result, borrowings at extensive and intensive margins both rise (drop). In addition, banks become less (more) leveraged via less (more) deposits. A higher (lower) banking leverage ratio leads to higher (lower) incentive premia and lower (higher) wages. These results are qualitatively analogous to the findings of wage garnishment rates in Table 7. This similarity is not surprising because both a lower wage garnishment rate and a decreased probability of flag removal represent stricter bankruptcy laws, and vice versa. The major difference between these two policy tools is the timing: wage earnings are garnished only in the filing period, whereas households with a bad credit history are excluded from the borrowing markets until their records are erased at the probability of flag removal.

Regarding the welfare implications, the predictions of borrowing exclusion are qualitatively similar to the one of wage garnishment. A stricter code is overall welfare-improving, while a more lenient one is overall welfare-reducing. In terms of the effects of financial frictions, a stricter (more lenient) regime results in eased (greater) incentive conflicts, thus leading to lower (higher) inventive premia and higher (lower) wages. However, the welfare implications of borrowing exclusion are heterogeneous across household types of credit history and level of indebtedness.

Focusing first on the case of shorter exclusion in Table 10, one can see that the households with good credit history have lower welfare, whereas households with bad credit history have higher welfare. Moreover, this policy proposal is advocated by 80% of households with bad credit history, while by less than 1% of households with good credit history. The reasons for these differences are intuitive. First, for households with a good credit record, the loss of lower borrowing costs and higher wages outweighs the gain from better bankruptcy insurance through a shorter exclusion from borrowing markets. In contrast, this proposal helps households get rid of the bad record on their credit reports faster than in the benchmark, thus resulting in a direct positive welfare impact on those already with bad credit history. Second, among households with good credit history, 9% of indebted households favor a more lenient bankruptcy regime, while not a single household without debt appreciates bankruptcy leniency. This is because the proposed policy provides higher insurance value for indebted households by defaulting: they can discharge their debts at lower default costs in the shortfalls as they could regain access to the borrowing markets within a shorter period. In the case of longer exclusion, these welfare conclusions shift in the opposite direction.

6.4 Welfare Effects of Varying Financial Frictions

To understand how and to what extent financial frictions affect the welfare implications of policy experiments, I first iterate the simulations of the previous policy counterfactu-

Variable (in %)		Shorter Exclusion		Longer Exclusion	
	HH Proportion	CEV	Favor Reform	CEV	Favor Reform
Total	100.0000	-0.0106	4.9921	0.0092	94.9358
Good credit history	94.9490	-0.0164	0.8210	0.0127	99.3963
Indebted	9.0928	-0.0429	9.0294	0.0331	93.3606
Not indebted	90.9072	-0.0128	0.0000	0.0099	100.0000
Patient	98.9653	-0.0162	0.8296	0.0126	99.3904
Impatient	1.0347	-0.4652	0.0000	0.1608	99.9551
Bad credit history	5.0510	0.0925	83.4012	-0.0519	11.0879

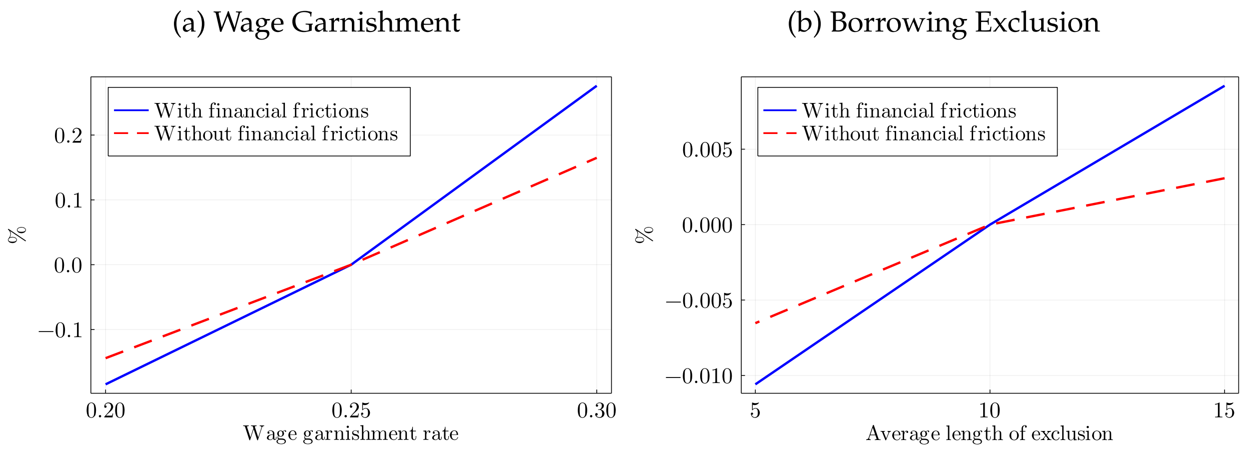
Table 10: Policy Counterfactual of Probability of Flag Removal: Welfare Implications

Notes: All results are measured when the policy reform is announced. The column "HH Proportion" describes the initial household distribution. The column "CEV" reports the CEV in the percentage of the policy change relative to the benchmark. The column "Favor Reform" reports the fraction of households in favor of the new policy in percentage. The row "Total" shows the aggregate results. The rows "Good credit history"/"Bad credit history" illustrate the results conditional on households with good/bad credit history. The rows "Indebted"/"Not indebted" present the results among households with good credit history who have debts/no debts. The row "Impatient" shows the results conditional on households with good credit history hit by preference shocks.

als without financial frictions and compare this set of results with the previous welfare outcomes with financial frictions. This comparison is presented in Figure 2, where Figure 2a plots the aggregate welfare results of wage garnishment rates and Figure 2b displays the ones of borrowing exclusion from consumer credit markets. The solid line denotes the welfare outcomes in the CEV unit relative to the benchmark when financial frictions exist. The dashed line depicts similar welfare results but without financial frictions.

Under both policy experiments, one can see in Figure 2 that the aggregate welfare effects of a stricter (more lenient) bankruptcy regime are positive (negative) both with and without financial frictions, regardless of policy instruments. More interestingly, the magnitudes of welfare variations are relatively larger when financial frictions exist. So, why is the welfare sensitivity to bankruptcy strictness with financial frictions larger than those without financial frictions? This is because there are extra effects triggered by the incentive and divestment channels that come along with financial frictions. As shown in Table 7 and 9, bankruptcy leniency leads to higher default risks and higher borrowing interest costs. As a result, the relative price of borrowing in terms of saving rises, given the constant risk-free saving rate. Accordingly, banks receive more deposits and become more leveraged

Figure 2: Welfare for Total Households



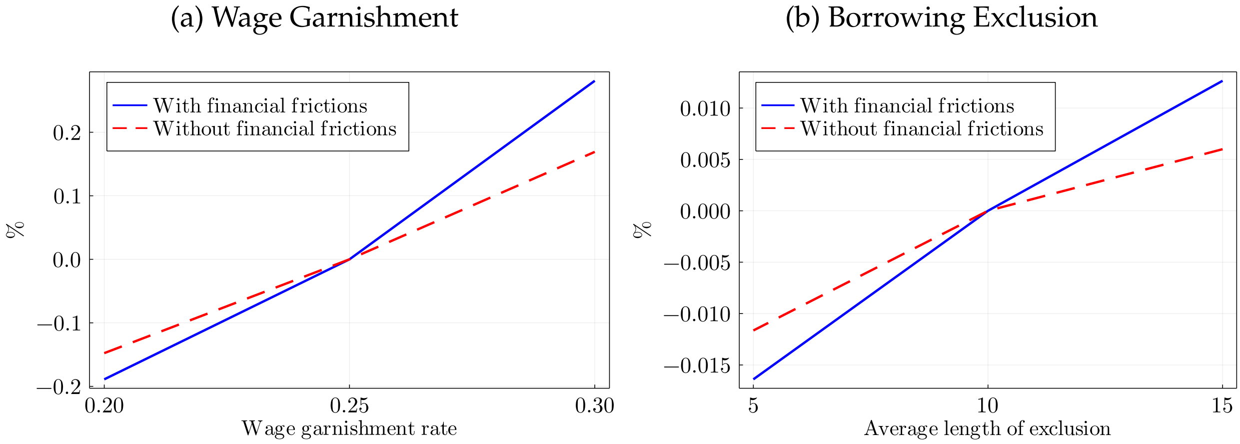
Notes: These figures show the aggregate welfare results of wage garnishment and borrowing exclusion counterfactuals with and without financial frictions. Welfare is measured in CEV units relative to the benchmark policy in percentage points. The solid and dashed lines denote the welfare results with and without financial frictions, respectively.

with external funding. A higher banking leverage ratio thus causes the incentive premium and wages to increase and decrease via the investment and divestment channels, respectively. A higher incentive premium makes borrowing more expensive, and lower wages lead households to less consumption. These extra negative effects do not exist if there are no financial frictions as illustrated in Table 4. On the contrary, under a stricter code, the borrowing price relative to saving falls. Banks thus receive fewer deposits, implying a lower leverage ratio. As a result, the incentive premium decreases while wages increase. Hence, households benefit additionally from lower borrowing costs and higher consumption. This result implies that varying the degree of bankruptcy strictness results in relatively more considerable welfare effects with financial frictions.[18]

In addition, the same set of results conditional on households with either good or bad credit history are shown in Figure 3 and 4, respectively. The conclusion drawn above holds across almost all household subgroups and policy experiments, except for households with bad credit history under the borrowing exclusion counterfactual in Figure 4b. Recall in Section 6.3 that shortening the exclusion duration yields welfare gains for households with bad credit history because they can access consumer credit markets faster than in the benchmark. The extra negative effects caused by the investment and divestment channels offset the welfare gains from the shorter exclusion. In contrast, longer exclusion results

[18] To be precise, the welfare effects refer to the welfare variations under policy counterfactuals relative to the respective benchmark, either with or without financial frictions.

Figure 3: Welfare for Households with Good Credit History



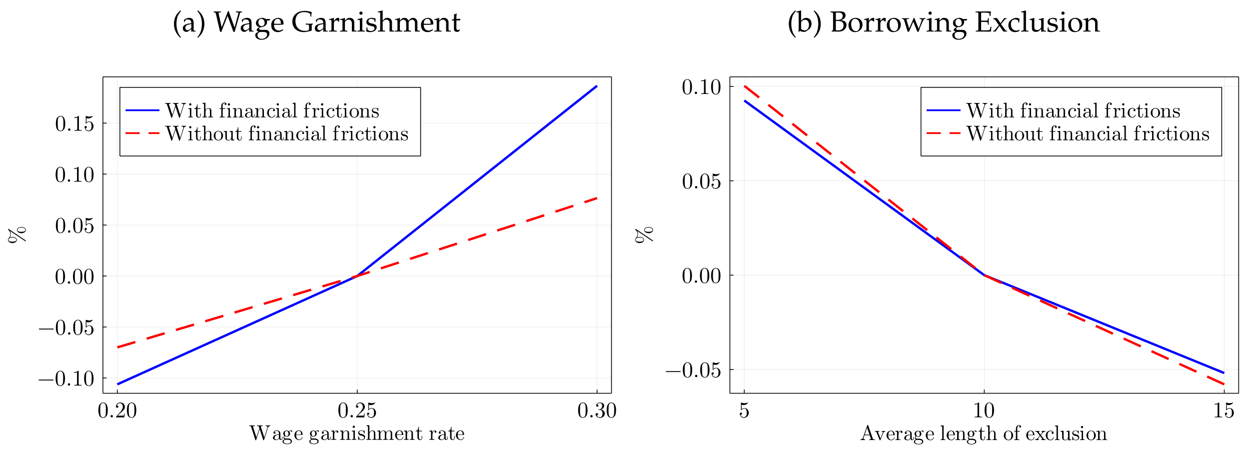
Notes: These figures show the welfare results of wage garnishment and borrowing exclusion counterfactuals for households with good credit history with and without financial frictions. Welfare is measured in CEV units relative to the benchmark policy in percentage points. The solid and dashed lines denote the welfare results with and without financial frictions, respectively.

in welfare losses for households with bad credit history since they remain excluded from the borrowing markets for longer than the benchmark. The extra positive effects from the investment and divestment channels thus mitigate the welfare losses in this case. As a result, the magnitudes of welfare gains (losses) are relatively larger without financial frictions.

To further explore the relationship between the welfare sensitivity to bankruptcy strictness and the degree of financial frictions, I redo the simulations of the wage garnishment counterfactual. However, I assume these policy changes now co-occur with different degrees of financial frictions by changing the diverting fraction θ.[19] In particular, I consider two cases: (1) banks can divert a larger fraction θ^H of total assets by 1% compared to the benchmark calibration θ^B, i.e., $\theta^H = 1.01 \times \theta^B$; and (2) banks can instead divert a lower fraction θ^L of total assets by 1% than they can in the benchmark, i.e., $\theta^L = 0.99 \times \theta^B$. I then compare the new welfare results with the benchmark results. The comparison of aggregate welfare is visualized in Figure 5, where the solid line shows the benchmark outcomes θ^B, the dashed line presents the ones under weaker financial frictions θ^L, and the dash-dotted line denotes the case of stronger financial frictions θ^H. Refer to Appendix C for the converged transition paths under these policy counterfactuals and Appendix D

[19] The policy experiment of borrowing exclusion is omitted here because it generates similar qualitative results as wage garnishment, e.g., see Section 6.2 and 6.3. θ and ψ also deliver qualitatively comparable results as displayed in Section 5.2, so the latter is omitted here.

Figure 4: Welfare for Households with Bad Credit History



Notes: These figures show the welfare results of wage garnishment and borrowing exclusion counterfactuals for households with bad credit history with and without financial frictions. Welfare is measured in CEV units relative to the benchmark policy in percentage points. The solid and dashed lines denote the welfare results with and without financial frictions, respectively.

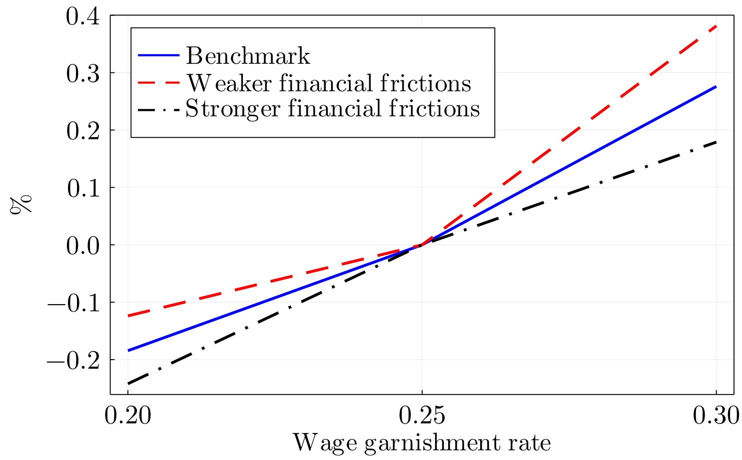
for the equilibrium and welfare outcomes with θ^L and θ^H in details.

In Figure 5, one can see that under weaker financial frictions, a higher wage garnishment rate results in larger welfare gains, whereas a lower rate leads to fewer welfare losses compared to the benchmark results. In contrast, stronger financial frictions yield fewer welfare gains from a higher rate while greater welfare losses from a lower rate. These results are not surprising because the effects of incentive and divestment channels are dampened and strengthened under weaker and stronger financial frictions, respectively. This idea is presented in Table 11, where I compute the percentage variations in the incentive premium and wages compared to the benchmark under all cases. The column "$\Delta\iota$" reports the percentage variation in the incentive premium compared to the benchmark. The column "Δw" shows the percentage variation in wages relative to the benchmark.[20] Recall that: (1) a stricter rule results in a lower banking leverage ratio, and vice versa; (2) the higher the banking leverage ratio, the larger the distorted effects via the incentive and divestment channels in financial markets; and (3) under benchmark calibration, households prefer a stricter regime for smoothing consumption.

Under weaker financial frictions, the distorted effects are mitigated. For example, a

[20] The divestment channel refers to firms reducing investment because of higher borrowing costs. Lower investments lead to less production and wages. The reason why wages are emphasized here is that the focus is on understanding the effects of financial frictions on household welfare. From the perspective of households, they care about only their consumption which is determined by their wage earnings and borrowing capacity from banks. As a result, they would prefer higher wages and lower borrowing costs.

Figure 5: Aggregate Welfare (CEV) v.s. Financial Frictions



Notes: This figure plots the aggregate welfare results of wage garnishment counterfactuals with benchmark/weaker/stronger financial frictions. Welfare is measured in CEV units relative to the benchmark policy in percentage points. The solid/dashed/dash-dotted lines denote the welfare results with benchmark/weaker/stronger financial frictions, respectively.

Variable (in %)	**Lower Garnishment**		**Higher Garnishment**	
	$\Delta\iota$	Δw	$\Delta\iota$	Δw
Benchmark	12.8781	-0.3576	-21.8868	0.6160
Weaker financial frictions	8.7732	-0.2440	-29.3179	0.8276
Stronger financial frictions	16.7534	-0.4645	-15.0701	0.4230

Table 11: Distorted Effects of Incentive and Divestment Channels v.s. Financial Frictions

Notes: This table reports the variations in incentive premium and wages relative to the benchmark policy in percentage points under the wage garnishment experiment across benchmark/lower/higher degrees of financial frictions. The row “Benchmark”/“Weaker financial frictions”/“Stronger financial frictions” denotes the results with benchmark/lower/higher degrees of financial frictions, respectively.

stricter rule gives rise to a larger drop in the incentive premium by 29.32% and a larger increase in wages by 0.83% under weaker financial frictions compared to 21.89% and 0.62% in the benchmark, respectively. On the other hand, a more lenient code yields a smaller increase in the incentive premium by 8.77% (a smaller decrease in wages by 0.24%) compared to 12.88% (0.36%) in the benchmark. These price changes in both policy experiments work in favor of households. As a result, weaker financial frictions result in larger positive welfare effects of a stricter rule and smaller negative effects of a more lenient code compared to the benchmark. Analogously, stronger financial frictions aggravate the distorted effects. Therefore, under stronger financial frictions, a stricter rule yields smaller welfare gains, and a more lenient code leads to larger welfare losses relative to the benchmark.

7 Conclusion

What are the effects of financial frictions under a heterogeneous agent framework with consumer default? To what extent are the welfare implications of consumer bankruptcy laws affected by frictional financial intermediation? To this end, I build an Aiyagari-type model of consumer default and financial friction. Households can file for bankruptcy to insure themselves against labor productivity and preference risks. Default costs include short-term wage garnishment and long-term exclusion from borrowing markets. Firms borrow from banks to finance capital spending. Banks use net worth and deposits from household savers to lend to firms and household borrowers. However, banks are tempted to divert the claims on total assets if highly leveraged with deposits. In equilibrium, banks are thus incentivized to have skin in the game by charging an incentive premium on asset returns. Compared to a canonical consumer default model, household borrowing prices under my framework depend on idiosyncratic default risks and aggregate banking net worth.

Under benchmark calibration, the incentive and divestment channels emerge endogenously due to financial frictions. The incentive channel captures the direct positive effects of the incentive premium on borrowing prices. The divestment channel refers to the indirect negative effects on the wage earnings of households. Compared to the economy without financial frictions, frictional financial intermediation results in higher borrowing interest rates, leading to declines in household debt and firm investment. Production and wages accordingly decrease. All these effects are amplified as the degree of financial friction increases.

The welfare evaluation of a policy change depends on the policy per se, the transition dynamics of households to the new policy, and the degree of financial friction. I conduct a series of policy experiments and explore the role of financial friction to understand the role of each component. The quantitative results indicate that Stricter bankruptcy rules are welfare-improving, whereas more lenient ones result in welfare losses, regardless of the exact policy tools. However, the welfare implications are heterogeneous across household types. For example, impatient households favor bankruptcy strictness because they can benefit significantly from the lower borrowing costs in smoothing consumption. On the other hand, households with bad credit history find longer borrowing exclusion significantly welfare-reducing. More importantly, financial frictions affect welfare sensitivity to bankruptcy strictness. A higher degree of financial friction results in greater distorted effects on borrowing prices and wages through the incentive and divestment channels. These adverse effects thus dampen the welfare gains or aggravate the welfare losses from a proposed policy. The results suggest that ignoring financial frictions could lead to biased policy conclusions in consumer credit markets.

In the future, a natural extension is to introduce the general equilibrium (GE) effects into the current framework by solving the endogenous saving rate under which financial markets clear. The interaction between the GE effects and financial frictions could lead to distinct welfare implications of personal bankruptcy provision. In addition, estimating the model using the simulated method of moments could make the conclusions more robust, especially given that the current calibration of financial frictions is somewhat suggestive. However, this extension will be computationally intensive due to the occasionally binding incentive constraint. Another exciting avenue for future research is to incorporate aggregate uncertainty into my framework to study the business cycles of consumer credit and bankruptcy because my model features the interaction between consumer default and an endogenous banking leverage constraint.

References

ADDA, J. AND R. W. COOPER (2003): *Dynamic Economics: Quantitative Methods and Applications*, Cambridge: MIT Press.

ALBANESI, S. AND J. NOSAL (2020): "Insolvency after the 2005 Bankruptcy Reform," NBER Working Paper No. 24934.

ARSLAN, Y., B. GULER, AND B. KURUSCU (2020): "Credit Supply Driven Boom-Bust Cycles," BIS Working Papers No, 885.

ATHREYA, K. (2002): "Welfare implications of the Bankruptcy Reform Act of 1999," *Journal of Monetary Economics*, 49, 1567–1595.

BOCOLA, L. (2016): "The Pass-Through of Sovereign Risk," *Journal of Political Economy*, 124, 879–926.

CHATTERJEE, S., D. CORBAE, K. P. DEMPSEY, AND J.-V. RÍOS-RULL (2020): "A Quantitative Theory of the Credit Score," NBER Working Paper No. 27671.

CHATTERJEE, S., D. CORBAE, M. NAKAJIMA, AND J.-V. RÍOS-RULL (2007): "A Quantitative Theory of Unsecured Consumer Credit with Risk of Default," *Econometrica*, 75, 1525–1589.

CHATTERJEE, S. AND G. GORDON (2012): "Dealing with consumer default: Bankruptcy vs garnishment," *Journal of Monetary Economics*, 59, S1–S16.

CHEN, D. AND D. CORBAE (2011): "On the welfare implications of restricting bankruptcy information," *Journal of Macroeconomics*, 33, 4–13.

CHEN, D. AND J. ZHAO (2017): "The impact of personal bankruptcy on labor supply decisions," *Review of Economic Dynamics*, 26, 40–61.

CONSUMER FINANCIAL PROTECTION BUREAU (2011): "Building the CFPB: a progress report," Available at: https://www.consumerfinance.gov/wp-content/uploads/2011/07/Report_BuildingTheCfpb1.pdf (Accessed: 24.07.2022).

EXLER, F. (2019): "Personal Bankruptcy and Wage Garnishment," Unpublished Manuscript, University of Vienna.

EXLER, F., I. LIVSHITS, J. MACGEE, AND M. TERTILT (2020): "Consumer Credit with Over-Optimistic Borrowers," CEPR Discussion Paper No. DP15570.

EXLER, F. AND M. TERTILT (2020): "Consumer Debt and Default: A Macro Perspective," *Oxford Research Encyclopedia of Economics and Finance*.

GERTLER, M. AND P. KARADI (2011): "A model of unconventional monetary policy," *Journal of Monetary Economics*, 58, 17–34.

GERTLER, M. AND N. KIYOTAKI (2010): "Chapter 11 - Financial Intermediation and Credit Policy in Business Cycle Analysis," in *Handbook of Monetary Economics*, ed. by B. M. Friedman and M. Woodford, Elsevier, vol. 3, 547–599.

GORDON, G. (2015): "Evaluating default policy: The business cycle matters," *Quantitative Economics*, 6, 795–823.

HATCHONDO, J. C., L. MARTINEZ, AND H. SAPRIZA (2010): "Quantitative properties of sovereign default models: Solution methods matter," *Review of Economic Dynamics*, 13, 919–933.

HERKENHOFF, K. F., G. M. PHILLIPS, AND E. COHEN-COLE (2021): "The impact of consumer credit access on self-employment and entrepreneurship," *Journal of Financial Economics*, 141, 345–371.

ISKHAKOV, F., T. H. JØRGENSEN, J. RUST, AND B. SCHJERNING (2017): "The endogenous grid method for discrete-continuous dynamic choice models with (or without) taste shocks," *Quantitative Economics*, 8, 317–365.

LEE, S., R. LUETTICKE, AND M. RAVN (2020): "Financial Frictions: Macro vs Micro Volatility," CEPR Discussion Paper No. DP15133.

LI, W. AND P.-D. SARTE (2006): "U.S. consumer bankruptcy choice: The importance of general equilibrium effects," *Journal of Monetary Economics*, 53, 613–631.

LIVSHITS, I., J. MACGEE, AND M. TERTILT (2007): "Consumer Bankruptcy: A Fresh Start," *American Economic Review*, 97, 402–418.

LUCAS, R. E. (1987): *Models of business cycles*, vol. 26, Oxford: Basil Blackwell.

MUKOYAMA, T. (2010): "Welfare effects of unanticipated policy changes with complete asset markets," *Economics Letters*, 109, 134–138.

NAKAJIMA, M. (2017): "Assessing bankruptcy reform in a model with temptation and equilibrium default," *Journal of Public Economics*, 145, 42–64.

NAKAJIMA, M. AND J.-V. RÍOS-RULL (2014): "Credit, Bankruptcy, and Aggregate Fluctuations," NBER Working Paper No. 20617.

STORESLETTEN, K., C. TELMER, AND A. YARON (2004): "Cyclical Dynamics in Idiosyncratic Labor Market Risk," *Journal of Political Economy*, 112, 695–717.

SUN, J. (2022): "The Role of Marital Status for the Evaluation of Bankruptcy Regimes," Unpublished Manuscript, University of Mannheim.

ZAME, W. R. (1993): "Efficiency and the Role of Default When Security Markets are Incomplete," *American Economic Review*, 83, 1142–1164.

A Model Details

A.1 Bank Optimization

Aggregate variables are defined as:

$$L' = \sum_{(a'<0,a,e,\nu)} q(a',e)\cdot(-a')\cdot \mathbb{I}_{[a'=g_a(a,e,\nu,h=0)]}\cdot \mu(a,e,\nu,h=0), \tag{33}$$

$$D' = \sum_{(a'>0,a,e,h)} q(a',e)\cdot a'\cdot \mathbb{I}_{[a'=g_a(a,e,\nu=1,h)]}\cdot \mu(a,e,\nu=1,h), \tag{34}$$

$$K' = N + D' - L', \tag{35}$$

where note that only households with good credit history can borrow and impatient households do not save. Bank j's optimization problem is given by:

$$W(n_j) = \max_{k_j',l_j',s_j'} \left(\frac{1}{1+r_f}\right)\cdot\left[(1-\psi)\cdot n_j' + \psi\cdot W(n_j')\right] \tag{36}$$

$$\text{s.t.}\quad k_j' + l_j' = n_j + s_j' + \tau_j, \tag{37}$$

$$n_j' = (1+r_k')\cdot k_j' + (1+r_l')\cdot l_j' - (1+r_f)\cdot(s_j'+\tau_j), \tag{38}$$

$$W(n_j) \geq \theta\cdot(k_j'+l_j'), \tag{39}$$

where the aggregate return on lending to households is defined as:

$$1+r_l' \equiv \frac{\rho\cdot\sum_{(a'<0,e,\nu)} R(a',e)\cdot \mathbb{I}_{[a'=g_a(a,e,\nu,h=0)]}\cdot\mu(a,e,\nu,h=0)}{L'}. \tag{40}$$

Conjecture $W(n_j) = \xi\cdot n_j$ which will be verified shortly. With the conjecture, the above optimization problem can be rewritten as:

$$W(n_j) = \max_{k_j',l_j'} \Lambda'\left[(r_k'-r_f)\cdot k_j' + (r_l'-r_f)\cdot l_j' + (1+r_f)\cdot n_j\right] \tag{41}$$

$$\text{s.t.}\quad \xi\cdot n_j \geq \theta\cdot(k_j'+l_j') \tag{42}$$

where $\Lambda' = \frac{1-\psi+\psi\cdot\xi'}{1+r_f}$ denotes the bank adjusted discount factor. The first-order conditions with respect to k_j', l_j' and the Kuhn-Tucker condition are given by:

$$\Lambda'\cdot(r_k'-r_f) = \lambda\cdot\theta, \tag{43}$$

$$\Lambda' \cdot (r'_l - r_f) = \lambda \cdot \theta, \tag{44}$$

$$\lambda \cdot \left(\xi \cdot n_j - \theta \cdot (k'_j + l'_j)\right) = 0, \tag{45}$$

where λ denote the multiplier on the incentive constraint. It entails the following non-arbitrage conditions:

$$r'_k - r_f = r'_l - r_f = \frac{\lambda \cdot \theta}{\Lambda'} = \lambda \cdot \theta \cdot \left(\frac{1 + r_f}{1 - \psi + \psi \cdot \xi'}\right) \equiv \iota \geq 0, \tag{46}$$

where ι denote the incentive premium. Plugging the conjecture of bank value function and first-order conditions to the objective function yields:

$$\xi \cdot n_j = \lambda \cdot \xi \cdot n_j + \Lambda' \cdot (1 + r_f) \cdot n_j. \tag{47}$$

It follows that:

$$\xi = \frac{\Lambda' \cdot (1 + r_f)}{1 - \lambda} = \frac{1 - \psi + \psi \cdot \xi'}{1 - \lambda}. \tag{48}$$

It confirms our conjecture and indicates that banking leverage ratio dose not depend on bank-specific elements. As a results, banks are symmetric and all subscripts j can be disregarded. If the incentive constraint is binding ($\lambda > 0$), then the banking leverage ratio LR can be derived as:

$$LR \equiv \frac{\xi}{\theta} = \frac{k'_j + l'_j}{n_j} = \frac{K' + L'}{N}, \tag{49}$$

where the capital letters denote the aggregate variables of their idiosyncratic counterparts, and the second equality results from the symmetry property. Plugging Equation (49) into (48) yields:

$$\lambda = \max\left\{1 - \left(\frac{1 - \psi + \psi \cdot \xi'}{\theta}\right) \cdot \left(\frac{N}{K' + L'}\right), 0\right\}. \tag{50}$$

Thus, Proposition 1 has been proved.

A.2 Equilibrium Conditions

Given λ^* and $E^* = 1$, the equilibrium conditions for aggregate variables are given by:

$$\xi^* = \frac{1-\psi}{1-\lambda^*-\psi}, \tag{51}$$

$$\Lambda^* = \frac{1-\psi+\psi\cdot\xi^*}{1+r_f}, \tag{52}$$

$$LR^* = \frac{\xi^*}{\theta}, \tag{53}$$

$$\iota^* = \frac{\lambda^*\cdot\theta}{\Lambda^*} = r_k^* - r_f = r_l^* - r_f, \tag{54}$$

$$K^* = \left(\frac{\alpha}{r_k^*+\delta}\right)^{\frac{1}{1-\alpha}} E^* = \left(\frac{\alpha}{r_k^*+\delta}\right)^{\frac{1}{1-\alpha}}, \tag{55}$$

$$w^* = (1-\alpha)\left(\frac{K^*}{E^*}\right)^{\alpha} = (1-\alpha)\left(K^*\right)^{\alpha}. \tag{56}$$

B Computation Details

B.1 Grid Specifications

Variable	Symbol	# of Points	Value / Range
Borrowing	$a < 0$	101	$[-6.0, 0.0]$
Saving	$a > 0$	101	$[0.0, 400.0]$
Permanent labor productivity	e_1	2	$\{-0.448, 0.448\}$
Persistent labor productivity	e_2	3	$\{-0.4851, 0.0, 0.4851\}$
Transitory labor productivity	e_3	3	$\{-0.4299, 0.0, 0.4299\}$
Preference	ν	2	$\{0.0, 1.0\}$
Credit history	h	2	$\{0.0, 1.0\}$

Table 12: Grids Used for Model Computation

I choose the upper and lower bounds for bank assets to ensure that the optimal choices for all states are included. I consider an equally-spaced grid for borrowing of 101 points from -6.0 to 0.0 and an exponentially-spaced grid for saving of 101 points from 0.0 to 400.0. The permanent and transitory components are appoximated with two-point and three-point uniform distributions, respectively. The persistent process is discretized with a three-state Markov chain using Adda and Cooper (2003).

B.2 Algorithm for Solving Stationary Equilibrium

1. Set parameters and tolerances for convergence ε.

2. Create grids for $(a, e_1, e_2, e_3, \nu, h)$ with lengths $(n_a, n_{e_1}, n_{e_2}, n_{e_3}, n_\nu, n_h)$.

3. Initializations:

   (a) $V^0(a, e_1, e_2, e_3, \nu, h) = 0$, $V^{d=0,0}(a, e_1, e_2, e_3, \nu) = 0$, and $V^{d=1,0}(a, e_1, e_2, e_3, \nu) = 0$ for all a, e_1, e_2, e_3, ν, and h. Note that both $V^{d=0,0}$ and $V^{d=1,0}$ do not depend on credit history h as only households with good credit history can default.

   (b) $g_d^0(a, e_1, e_2, e_3, \nu) = 0$ for all a, e_1, e_2, e_3, and ν. This implies that zero default premia for all loans, i.e., household borrowers do not default at all.

   (c) $R^0(a', e_1, e_2) = -a'$ for all a', e_1, and e_2 as households do not default.

   (d) $q^0(a', e_1, e_2) = \frac{\rho}{1+r_f}$ for all a, e_1, and e_2. That is, the borrowing prices equal the inverse of the constant risk-free rate, aligned with the no default initialization.

   (e) $\mu^0(a, e_1, e_2, e_3, \nu, h) = \frac{1}{n}$ for all a, e_1, e_2, e_3, ν, and h, where $n \equiv n_a \times n_{e_1} \times n_{e_2} \times n_{e_3} \times n_\nu \times n_h$.

   (f) $\lambda^{\min} = 0$ and $\lambda^{\max} = 1 - \sqrt{\psi}$. The latter denotes the upper bound of the incentive multiplier such that the associated incentive premium is positive in equilibrium.

4. Set up the one-loop algorithm for given λ^*:

   (a) Solve for the implied LR^*, ι^*, and w^* according to (53), (54), and (56).

   (b) Solve for V^1 and g_d^1 taking V^0, q^0, and w^* as given.

      i. For each (a, e_1, e_2, e_3, ν), compute $V^{d=0,1}(a, e_1, e_2, e_3, \nu)$ and $V^{d=1,1}(a, e_1, e_2, e_3, \nu)$ according to (3) and (4).

      ii. For each (a, e_1, e_2, e_3, ν), compute $g_d^1(a, e_1, e_2, e_3, \nu)$ according to (5).

      iii. For each (a, e_1, e_2, e_3, ν), compute $V^1(a, e_1, e_2, e_3, \nu, h = 0)$ according to (6).

      iv. For each (a, e_1, e_2, e_3, ν), compute $V^1(a, e_1, e_2, e_3, \nu, h = 1)$ according to (7).

   (c) Solve for q^1 taking V^1, g_d^1, and ι^* as given.

      i. For each (a', e_1, e_2), compute $R^1(a', e_1, e_2)$ according to (23).

      ii. For each (a', e_1, e_2), compute $q^1(a', e_1, e_2)$ according to (24).

(d) Assess convergence of V and q.

i. If $\|V^1 - V^0\| < \varepsilon$ and $\|q^1 - q^0\| < \varepsilon$, let $V^* = V^1$ and $q^* = q^1$ and continue to the next step.

ii. Otherwise, update the initial values for V and q with relaxation and return to step (4b).

(e) Solve for μ^* according to (29).

(f) Solve for aggregate variables E^*, K^*, L^*, D^*, and N^*.

(g) Compute $\mathcal{E}(\lambda^*) = LR^* - \frac{K^*+L^*}{N^*}$.

5. Stationary equilibrium with the occasionally binding incentive constraint:

(a) $\mathcal{E}(\lambda^{\min}) > 0$ implies the incentive constraint is slack and stop.

(b) $\mathcal{E}(\lambda^{\max}) < 0$ implies the incentive constraint cannot be satisfied and stop.

(c) Otherwise, set $\lambda^L = \lambda^{\min}$ and $\lambda^U = \lambda^{\max}$. Using the standard bisection routine to find $\lambda^{ss} \in [\lambda^L, \lambda^U]$ such that $|\mathcal{E}(\lambda^{ss})| < \varepsilon$.

6. Compute aggregate variables of interest.

B.3 Algorithm for Solving Transition Dynamics

1. Set parameters and tolerances for convergence ε.

2. Compute the initial equilibrium under the old policy E^{old} and the final equilibrium under the new policy E^{new}.

3. Set T to a sufficiently large number.

4. Initializations:

(a) A bold variable $\boldsymbol{X}$ denote a $T \times 1$ vector and $\boldsymbol{X_t}$ refers to the t-th element.

(b) $\boldsymbol{LR^0} = \left\{LR^{old} + t \cdot \frac{LR^{new} - LR^{old}}{T}\right\}_{t=1}^{T}$, implying $\boldsymbol{LR^0_T} = LR^{new}$.

(c) $\boldsymbol{V^0} = (0, ..., 0, V^{new})$.

(d) $\boldsymbol{q^0} = (0, ..., q^{new}, q^{new})$.

(e) $\boldsymbol{\mu^0} = (\mu^{old}, 0, ..., 0, \mu^{new})$.

5. Given $\boldsymbol{LR^0}$, compute $\boldsymbol{\lambda^0}$, $\boldsymbol{\iota^0}$, and $\boldsymbol{w^0}$ according to (50), (46), and (11).

6. Given $\boldsymbol{w^0}$, $\boldsymbol{V^0}$, and $\boldsymbol{q^0}$, solve the household problem backward from $t = T$ to $t = 1$ using the one-loop algorithm in Appendix B.2 to obtain $\boldsymbol{V^1}$ and $\boldsymbol{q^1}$.

7. With the decision rules implied by $\boldsymbol{V^1}$, simulate the economy forward from $t = 1$ to $t = T$ to obtain $\boldsymbol{\mu^1}$ and compute $\boldsymbol{LR^1}$.

8. If $\left\|\boldsymbol{LR^1} - \boldsymbol{LR^0}\right\| < \varepsilon$, set $\boldsymbol{LR^*} = \boldsymbol{LR^1}$ and stop. Otherwise, update the initial values for $\boldsymbol{LR}$ with relaxation and return to step (5).

9. Compute the transition path for each aggregate variable of interest.

C Transition Paths of Banking Leverage Ratio

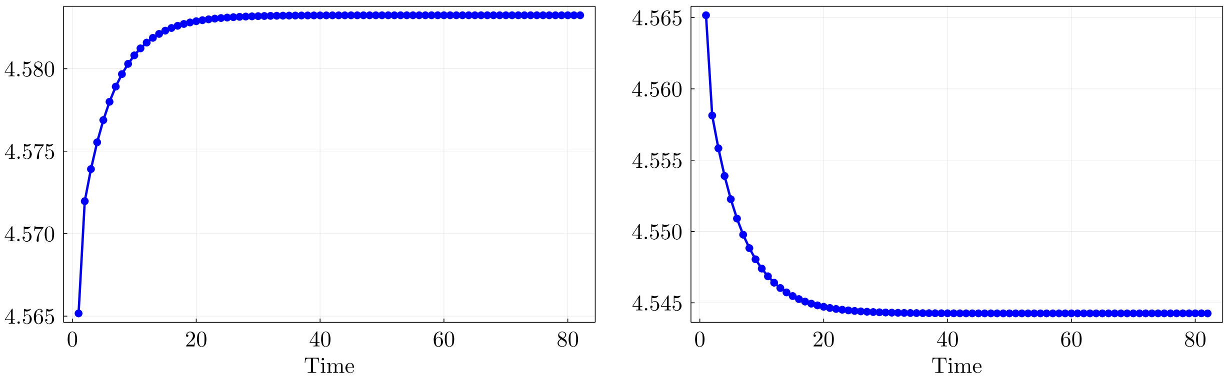
All transition paths of banking leverage ratio for the policy counterfactuals considered in the paper are collectively visualized here. The unit of time is a year. Conceptually, when the policy is unanticipated implemented at the beginning of $t = 1$, more (less) households unexpectedly file for bankruptcy under a more lenient (stricter) bankruptcy code. This results in a sharp decrease (increase) in banking net worth, thus leading to a salient discrete increased (decreased) banking leverage ratio. Afterwards, banks adjust their portfolios to gradually achieve the new equilibrium. Recall that lower garnishment and shorter exclusion both denote a more lenient bankruptcy regime, while higher garnishment and longer exclusion both denote a stricter rule. Figure 1a, 6a, 7a, and 8a show the results for more lenient regimes. Figure 1b, 6b, 7b, and 8b instead present the results for stricter regimes.

D Robustness Check: Degree of Financial Frictions

In the section, I report the results of the wage garnishment counterfactual with different degrees of financial frictions in Section 6.4. To be specific, I consider two cases where the fraction θ of total assets that banks can divert either decreases or increases by 1% compared to the benchmark calibration. That is, $\theta^L = 0.99 \times \theta^B$ and $\theta^H = 1.01 \times \theta^B$. The equilibrium and welfare results for θ^L are summarized in Table 13 and 14, respectively. The ones for θ^H are presented in Table 15 and 16, respectively.

Figure 6: Transition Paths of Banking Leverage Ratio

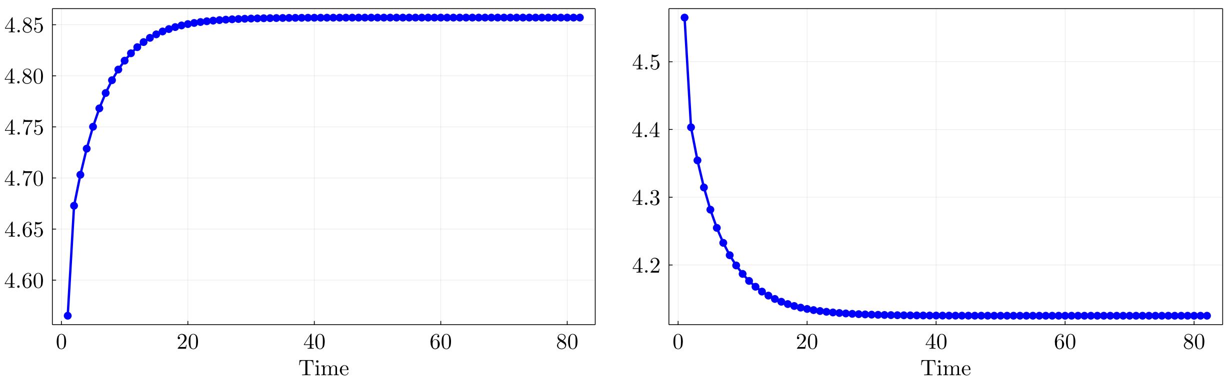
(a) From Benchmark to Shorter Exclusion (b) From Benchmark to Longer Exclusion



Notes: The unit of time is a year. The policy reform is unexpectedly announced at $t = 1$. The banking leverage ratio remains in the old equilibrium at $t = 0$ and converges to the new equilibrium at $t = 80$. The left figure illustrates the transition from benchmark ($\mathbb{P}_h = 1/10$) to shorter exclusion ($\mathbb{P}_h = 1/5$). The right figure plots the transition from benchmark ($\mathbb{P}_h = 1/10$) to longer exclusion ($\mathbb{P}_h = 1/15$).

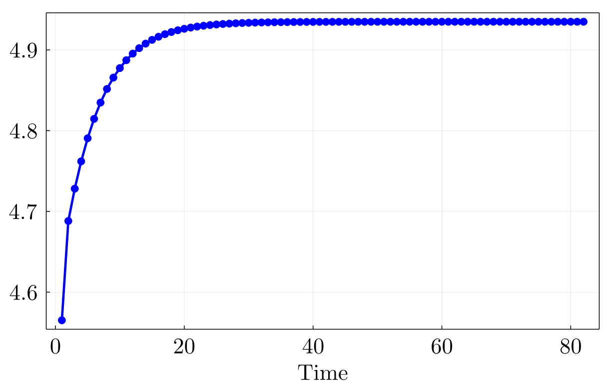
Figure 7: Transition Paths of Banking Leverage Ratio with θ^L

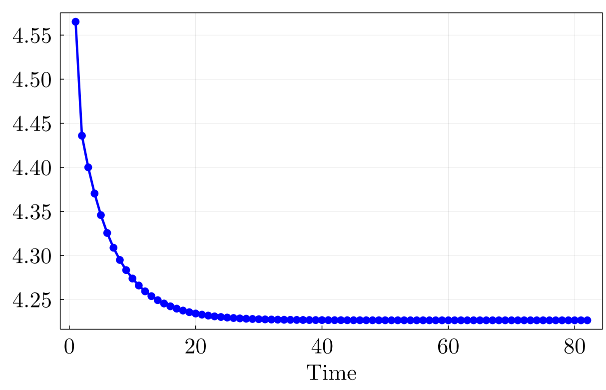
(a) From Benchmark to Lower Garnishment (b) From Benchmark to Higher Garnishment



Notes: The unit of time is a year. The policy reform is unexpectedly announced at $t = 1$. The banking leverage ratio remains in the old equilibrium at $t = 0$ and converges to the new equilibrium at $t = 80$. The left figure illustrates the transition from benchmark ($\eta = 0.25$) to lower garnishment ($\eta = 0.20$) with a lower degree of financial frictions ($\theta^L = 0.99 \times \theta^B$). The right figure plots the transition from benchmark ($\eta = 0.25$) to higher garnishment ($\eta = 0.30$) with a lower degree of financial frictions ($\theta^L = 0.99 \times \theta^B$).

Figure 8: Transition Paths of Banking Leverage Ratio θ^H





Notes: The unit of time is a year. The policy reform is unexpectedly announced at $t = 1$. The banking leverage ratio remains in the old equilibrium at $t = 0$ and converges to the new equilibrium at $t = 80$. The left figure illustrates the transition from benchmark ($\eta = 0.25$) to higher garnishment ($\eta = 0.20$) with a lower degree of financial frictions ($\theta^H = 1.01 \times \theta^B$). The right figure plots the transition from benchmark ($\eta = 0.25$) to higher garnishment ($\eta = 0.30$) with a higher degree of financial frictions ($\theta^H = 1.01 \times \theta^B$).

Variable	**Lower Garnishment**	**Benchmark**	**Higher Garnishment**
Levels			
<u>Consumer credit markets</u>			
Default rate (%)	0.6577	0.6082	0.4318
Avg. borrowing interest rate (%)	14.2709	12.1829	8.9363
Fraction of HHs in debt (%)	6.8215	8.6335	11.3245
Debt-to-earnings ratio (%)	1.2888	1.8748	2.7475
<u>Incentive & divestment channels</u>			
Banking leverage ratio	4.8570	4.5652	4.1251
Incentive premium (%)	0.6814	0.6264	0.4428
Wage	1.1510	1.1538	1.1633
% change w.r.t. benchmark			
<u>Incentive & divestment channels</u>			
Banking leverage ratio	6.3925	-	-9.6396
Incentive premium	8.7732	-	-29.3179
Wage	-0.2440	-	0.8276

Table 13: Policy Counterfactual of Wage Garnishment with θ^L: Equilibria Comparison

Notes: The upper panel "Levels" reports model moments in levels under the benchmark and the policy experiments of wage garnishment with a lower degree of financial frictions ($\theta^L = 0.99 \times \theta^B$). The bottom panel "% change w.r.t. benchmark" shows the percentage variations of the selective moments related to the incentive and divestment channels under the policy experiments compared to the benchmark.

Variable (in %)		Lower Garnishment		Higher Garnishment	
	HH Proportion	**CEV**	**Favor Reform**	**CEV**	**Favor Reform**
Total	100.0000	-0.1238	27.3511	0.3815	99.4962
Good credit history	94.9490	-0.1283	26.9135	0.3865	99.5257
Indebted	9.0928	-0.3638	16.2729	0.7035	94.7835
Not indebted	90.9072	-0.0963	27.9777	0.3437	100.0000
Patient	98.9653	-0.1262	27.1894	0.3846	99.5229
Impatient	1.0347	-5.4828	0.5207	5.7872	99.7932
Bad credit history	5.0510	-0.0438	35.5772	0.2932	98.9430

Table 14: Policy Counterfactual of Wage Garnishment with θ^L: Welfare Implications

Notes: All results are measured when the policy reform is announced. The column "HH Proportion" describes the initial household distribution. The column "CEV" reports the CEV in the percentage of the policy change relative to the benchmark. The column "Favor Reform" reports the fraction of households in favor of the new policy in percentage. The row "Total" shows the aggregate results. The rows "Good credit history"/"Bad credit history" illustrate the results conditional on households with good/bad credit history. The rows "Indebted"/"Not indebted" present the results among households with good credit history who have debts/no debts. The row "Impatient" shows the results conditional on households with good credit history hit by preference shocks.

Variable	**Lower Garnishment**	**Benchmark**	**Higher Garnishment**
Levels			
Consumer credit markets			
Default rate (%)	0.6653	0.6082	0.4320
Avg. borrowing interest rate (%)	14.3251	12.1829	9.0285
Fraction of HHs in debt (%)	6.7815	8.6335	11.2654
Debt-to-earnings ratio (%)	1.2832	1.8748	2.7261
Incentive & divestment channels			
Banking leverage ratio	4.9349	4.5652	4.2265
Incentive premium (%)	0.7313	0.6264	0.5320
Wage	1.1484	1.1538	1.1587
% change w.r.t. benchmark			
Incentive & divestment channels			
Banking leverage ratio	8.0981	-	-7.4182
Incentive premium	16.7534	-	-15.0701
Wage	-0.4645	-	0.4230

Table 15: Policy Counterfactual of Wage Garnishment with θ^H: Equilibria Comparison

Notes: The upper panel "Levels" reports model moments in levels under the benchmark and the policy experiments of wage garnishment with a higher degree of financial frictions ($\theta^H = 1.01 \times \theta^B$). The bottom panel "% change w.r.t. benchmark" shows the percentage variations of the selective moments related to the incentive and divestment channels under the policy experiments compared to the benchmark.

Variable (in %)		Lower Garnishment		Higher Garnishment	
	HH Proportion	CEV	Favor Reform	CEV	Favor Reform
Total	100.0000	-0.2421	0.8999	0.1790	99.4477
Good credit history	94.9490	-0.2464	0.9478	0.1841	99.4745
Indebted	9.0928	-0.4863	10.4233	0.4887	94.2212
Not indebted	90.9072	-0.2138	0.0000	0.1429	100.0000
Patient	98.9653	-0.2443	0.9522	0.1821	99.4712
Impatient	1.0347	-5.4907	0.5207	5.7323	99.7932
Bad credit history	5.0510	-0.1654	0.0000	0.0886	98.9430

Table 16: Policy Counterfactual of Wage Garnishment with θ^H: Welfare Implications

Notes: All results are measured when the policy reform is announced. The column "HH Proportion" describes the initial household distribution. The column "CEV" reports the CEV in the percentage of the policy change relative to the benchmark. The column "Favor Reform" reports the fraction of households in favor of the new policy in percentage. The row "Total" shows the aggregate results. The rows "Good credit history"/"Bad credit history" illustrate the results conditional on households with good/bad credit history. The rows "Indebted"/"Not indebted" present the results among households with good credit history who have debts/no debts. The row "Impatient" shows the results conditional on households with good credit history hit by preference shocks.