Working Papers 2019 21

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JANUARY 2020
The analyses, opinions and findings of these papers represent the views of the authors, they are not necessarily those of the Banco de Portugal or the Eurosystem

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Lisbon, 2019 • www.bportugal.pt

Working Papers | Lisbon 2019 • Banco de Portugal Av. Almirante Reis, 71 | 1150-012 Lisboa • www.bportugal.pt •
Edition Economics and Research Department • ISBN (online) 978-989-678-707-3 • ISSN (online) 2182-0422

Tighter Credit and Consumer Bankruptcy Insurance

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March, 2021
First release December, 2019

Abstract
How does bankruptcy affect the dynamics of aggregate consumption? We quantify the trade-off between the insurance and creditworthiness effects of bankruptcy in response to tighter credit. We show that bankruptcy dampens the effect of tighter credit on aggregate consumption on impact because it allows borrowers to sustain consumption, but statutory exclusion from the credit market reduces consumption smoothing over time and slows the recovery. Default costs play a crucial role in bankruptcy decisions and also shape consumption dynamics. We find that the 2005 BAPCPA reform, by making bankruptcy more costly, worsened the negative welfare effects of the subsequent credit tightening.

JEL: E2, E5, G1

Keywords: Financial Shocks, Aggregate Consumption Dynamics, Chapter 7, BAPCPA, Bank-Intermediated Credit, Transitional Dynamics.

Acknowledgements: We thank Florin Bilbiie, Christopher Carroll, Russell Cooper, Isabel Correia, Wouter den Haan, Gauti Eggertsson, Urban Jermann, Grey Gordon, Kyle Herkenhoff, Igor Livshits, Kurt Mittman, Ben Moll, Makoto Nakajima, Lukas Nord, Johannes Poeschl, Giorgio Primiceri, Pedro Teles and seminar and conference participants at Brown University, University of Illinois Urbana-Champaign, Bank of Portugal, European Central Bank, Riksbank, 2018 ECB Workshop on Household Heterogeneity and Macroeconomics, SAET 2019, 2020 Central Bank Macro Modelling Workshop and 2020 EEA Invited session on The Micro and Macro of Consumer Credit for helpful comments and suggestions. The opinions expressed herein are of the authors and do not necessarily reflect those of Banco de Portugal, the ECB or the Eurosystem. All errors are our own.

1. Introduction

The 2007-2009 financial crisis confronted the global economy with a severe disruption in the intermediation capacity of banks which depressed economic activity on a scale never witnessed before. Bankruptcy filings and credit spreads spiked and the reduction in the volume of debt was not only driven by a decline in new borrowing, but also by default on existing obligations. The aggregate and redistributive effects of a credit crunch have attracted a great deal of attention (see, among others, Bassetto et al. 2015; Guerrieri and Lorenzoni 2017; Jermann and Quadrini 2012; Justiniano et al. 2019). Still, there is little analysis of how bankruptcy affects aggregate dynamics in response to tighter credit. This paper makes progress along this dimension by focusing on unsecured consumer debt.

Three observations sparked our interest in understanding the interaction between credit tightening and consumer bankruptcy. First, as shown in Figure 1 (top panel), debt discharged by means of Chapter 7 reached remarkable shares of GDP by the end of 2010, for total (solid line) and unsecured (dashed line) debt. This is not surprising as bankruptcy acts as an insurance mechanism against severe financial distress. The option to file for Chapter 7 of the U.S. Bankruptcy Code, by allowing discharge of certain types of debt, enables a 'fresh start'.

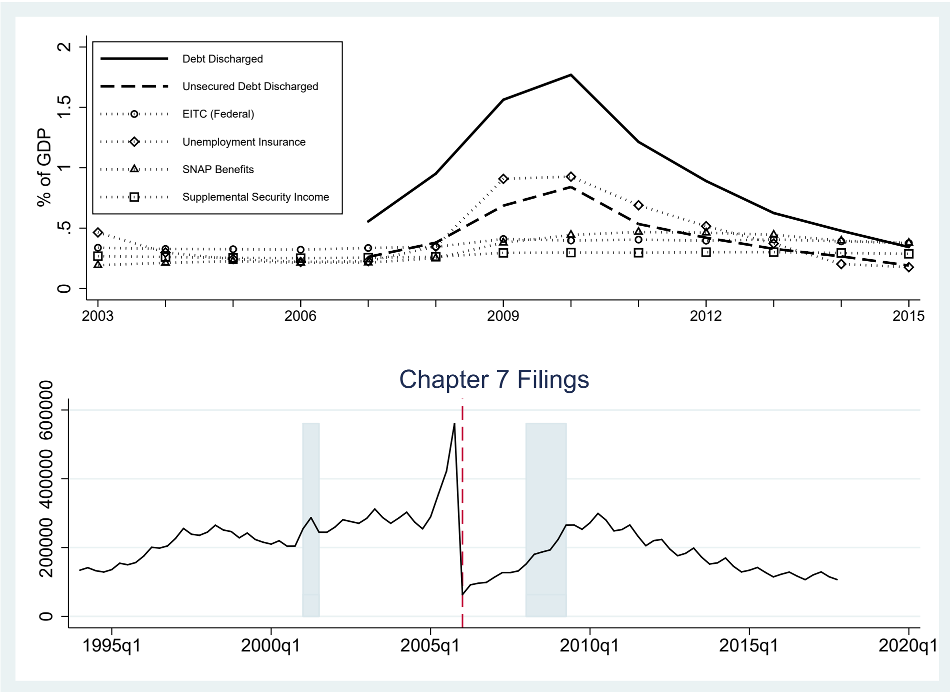
Second, the insurance provided by bankruptcy is actually large relative to other social insurance programs in the U.S. Although unsecured consumer credit represents a modest fraction of total household debt, the share of unsecured consumer credit discharged to GDP is comparable to government expenditures on unemployment insurance, and exceeds other, arguably more widely studied, insurance programs reported in Figure 1 (top panel).

Third, the number of yearly filings for Chapter 7 also increased dramatically over the 1994 - 2018 period, from about 50,000 to 300,000 at its peak in 2010. However, pre-2005 data show that the numbers of filings for bankruptcy spiked two years before the financial crisis, when the U.S. Bankruptcy Code was modified by the Bankruptcy Abuse Prevention and Consumer Protection Act (BAPCPA) which made filing for bankruptcy more difficult.[1] As shown in Figure 1 (bottom panel), in anticipation of costlier bankruptcy, there is a sharp spike in the number of bankruptcy filings immediately prior to the enactment of BAPCPA.

Two questions arise from these observations. Does the insurance provided by bankruptcy affect the dynamics of aggregate consumption in response to tighter credit? And, if so, how did the 2005 BAPCPA reform interact with the subsequent credit tightening in shaping consumption dynamics during the global financial crisis?

We address the above questions by developing a tractable quantitative general equilibrium model of consumer credit and Chapter 7 bankruptcy, which allows us

1. The purpose of the BAPCPA was to prevent abuse of the system. The reform was passed in Congress in April 2005 and applied to cases filed on or after October 17, 2005.



Top Panel: Total (solid line) and unsecured (dashed line) debt discharged; total Federal expenditures in each category of insurance mechanism: Earned Income Tax Credit (dotted-circle line), Unemployment Insurance (dotted-diamond line), Supplemental Nutrition Assistance Program (dotted-triangle line), and Supplemental Security Income (dotted-square line). All series reported GDP shares. Bottom panel: Quarterly number of Chapter 7 bankruptcy filings. The red-dashed line marks the quarter when the BAPCPA reform took effect (October 17, 2005).

Figure 1: Bankruptcy as an Insurance Mechanism and Consumer Credit

to explore the aggregate and redistributive implications of bankruptcy protection during the transition to tighter credit. We show that individual bankruptcy decisions have important effects for the magnitude and persistence of the slowdown in aggregate consumption during a credit crunch. Tighter credit, by restricting access to new borrowing, leads to a drop in aggregate consumption on impact. Bankruptcy exacerbates the severity of the deleveraging. However, it also dampens the impact of credit tightening on aggregate consumption at the cost of a slower recovery. The bankruptcy code establishes how costly it is to declare bankruptcy and, hence, is crucial to determine the willingness of consumers to default and to shape aggregate consumption dynamics. Our results suggest that BAPCPA, by making filing for bankruptcy more difficult, worsened the effects on consumption of the subsequent credit tightening.

Our analysis exploits the usual bankruptcy trade-off between consumption smoothing *across states* versus *over time* (e.g. Zame 1993). Individuals can resort to bankruptcy in response to adverse shocks, hence helping to smooth consumption *across states*. But bankruptcy also has negative consequences for their creditworthiness: upon default individuals typically get excluded from credit markets for a certain period. This reduces their ability to smooth consumption *over time*.[2] The overall effects on individual consumption depend on which side of the trade-off prevails. Our contribution is to quantify this trade-off during the transition to tighter conditions in the credit market. In doing so, we also explore the interaction with the BAPCPA reform.

Our environment is based on a heterogeneous agent model with incomplete markets (Bewley 1977; Huggett 1993; Aiyagari 1994) augmented with defaultable unsecured debt (Chatterjee et al. 2007) and perfectly competitive banks which intermediate funds between savers and borrowers. Individuals are subject to idiosyncratic risk in the form of both income and expense (e.g. divorce, children, medical expenses) shocks and can decide to default on unsecured debt in accordance with the U.S. Chapter 7 Bankruptcy Code. Banks set the lending terms under perfect information. The endogenous pricing of loans takes into account the riskiness of each borrower, giving rise to a *risky spread*, which endogenously limits the ability of each consumer to borrow.

We calibrate the model to match key micro and macro features of consumer bankruptcy in the U.S. data. Then, we use it as a laboratory to study the transition to tighter credit. We depart from the standard way of modelling a credit tightening through exogenous changes in borrowing limits (Eggertsson and Krugman 2012; Guerrieri and Lorenzoni 2017). Borrowing limits are endogenously determined in our model. We capture more restrictive aggregate conditions in the bank's lending terms by assuming an exogenous component in the lending spreads, which works as an aggregate credit supply shifter in our model. This generates endogenous movements in the borrowing constraints as well as in the average credit spread.

We show that in response to tighter credit, consumers decrease their new borrowing and, in many cases, also default on existing credit. This results in deleveraging and in a drop in aggregate consumption. A key prediction of our model is that the effect is larger on credit quantities than on the average lending spread. This is due to a *selection effect* in the composition of borrowers. In our model, the default probability is endogenous and is priced by the financial intermediaries. More restricted access to credit implies that lower quality borrowers—those with high likelihood of bankruptcy—face greater difficulty in obtaining new loans. Thus, over time credit shifts towards less risky borrowers and the risky spread declines. Consequently, the effects of the credit tightening on the average lending spread is mitigated, with an implied long-run pass-through rate of about 80 percent.

Our results also suggest that the effects of a credit tightening are not evenly distributed across heterogeneous households: the adverse consumption and welfare effects are especially harsh for households at the bottom of the wealth distribution.

2. A Chapter 7 bankruptcy stays on an individual's credit report for 10 years, in practice hindering access consumer credit.

Low income individuals borrow and default to smooth the effect of negative shocks. Upon default, they lose access to the credit market, possibly for several years. This reduces their ability to smooth consumption over time. Their consumption declines sharply and recovers only slowly. In contrast, high income households tend to be savers. Thus, they can draw down deposits to offset bad shocks and are less prone to default. As a consequence, they do not experience the same adverse effect of a tightening in credit. The essential difference is that bankruptcy is the main way in which borrowers insure against severe expenditure shocks, while savers can often self-insure. Hence, the dynamics of aggregate consumption are driven by the sizable and negative effects of the shock on consumers at the bottom of the asset distribution.

Finally, motivated by the 2005 BAPCPA reform which increased the cost of filing for bankruptcy before the global financial crisis, we provide novel results on the interaction between credit shocks and bankruptcy reforms. We show that the reform had two important effects. First, the anticipation effect generated a rapid increase in bankruptcy on the eve of the implementation of BAPCPA, leading to adverse effects on aggregate consumption on impact.

Second, by making filing for bankruptcy more difficult, BAPCPA reduced the ability of borrowers to default in response to the negative credit shock, hence amplifying the drop in aggregate consumption. An assessment of the change in the bankruptcy code in terms of welfare suggests that overall BAPCPA exacerbated the negative effects of the subsequent credit tightening. Higher bankruptcy costs reduce the willingness of consumers that cannot self-insure to use default as an insurance mechanism to smooth consumption. Hence, this leads to a larger drop in consumption on impact.

Robustness analysis highlights some interesting results regarding the role of the bankruptcy code in shaping the response of aggregate consumption to tighter credit. We show that eliminating the cost of filing for bankruptcy has a sizable stabilizing effect on the response of consumption to tighter credit. However, the model displays some asymmetry. Increasing the bankruptcy cost by the same amount has a larger (negative) impact on consumption dynamics. In the extreme case in which at the time of a credit tightening default is so costly that it becomes unavailable, the drop in aggregate consumption on impact is two times larger than the baseline.

In addition, longer exclusion from the credit market reduces consumers' ability to smooth consumption over time and implies a more persistent effect of credit tightening on aggregate consumption. In the extreme case in which upon bankruptcy consumers do not lose access to the credit market, aggregate consumption recovers in half of the time compared to the baseline scenario. Our results validate the important role of consumer bankruptcy as a stabilization mechanism to aggregate financial shocks.

1.1. Related Literature

The global financial crisis gave rise to an increasing number of papers that study the effects of shocks to the financial sector. Several studies provided important insights on the impact of shocks to borrowing limits for the aggregate economy (Eggertsson and Krugman 2012; Jermann and Quadrini 2012; Justiniano et al. 2019) and the allocation of credit across firms and consumers (Khan and Thomas 2013; Bassetto et al. 2015; Guerrieri and Lorenzoni 2017). We share with Guerrieri and Lorenzoni (2017) the focus on the aggregate and redistributive effects of a credit crunch on consumption in a model of unsecured debt. We contribute to previous findings by exploring the channels through which bankruptcy protection affects aggregate consumption dynamics in response to tighter credit.

We introduce in the debate on the real and redistributive effects of a credit crunch a number of relevant elements. First, we quantify the stabilizing role of bankruptcy in response to tighter credit. From a methodological point of view we share the explicit modeling of bankruptcy with previous works on unsecured consumer credit and bankruptcy (e.g., Athreya 2006; Chatterjee et al. 2007; Livshits et al. 2007; Gordon 2015; Herkenhoff 2019). Differently from other papers on consumer bankruptcy we focus on the economy's transitional dynamics.[3] This approach is particularly useful for the purpose of our paper as it allows us to provide insights on how BAPCPA contributed to the dynamics of consumption and bankruptcy during the transition to tighter credit.

Second, we consider the interaction of the credit tightening with other phenomena that also affect credit market outcomes, such as changes in the bankruptcy code. By assessing the joint effect of BAPCPA and the credit tightening, we complement previous papers on the effects of the reform (Athreya et al. 2015; Mitman 2016). To our knowledge this is the first study that investigates the joint effect of BAPCPA and credit tightening in a general equilibrium framework.

Our model's implications on the stabilizing effects of eliminating the cost of filing for bankruptcy are in line with the empirical cross-sectional evidence on the importance of the leniency of the bankruptcy system for aggregate demand during the Great Recession (e.g. Auclert et al. 2019).

Third, we depart from the standard way of modelling a credit tightening through exogenous changes in borrowing limits and, instead, study the role of disruptions that originate directly in the financial intermediation sector. In this respect, our paper connects to the empirical literature which documents the importance of changes in bank lending standards (Bassett et al. 2014; Maddaloni and Peydró 2011; Low and Morgan 2006). By exploring the channels through which changes in the supply of bank intermediated credit have important redistributive and real

3. Work by Nakajima and Ríos-Rull (2014), MacGee et al. (2016) and, more recently, Dempsey and Ionescu (2019) uses bankruptcy models that also feature a wedge between borrowing and savings rate. However, these papers abstract from considerations related to transitional dynamics and changes in the bankruptcy code.

effects, our paper also provides useful directions for the growing literature on heterogeneous agents (Kaplan and Violante 2009; Auclert 2019) that has so far abstracted from the role of shocks to financial intermediation.

The paper proceeds as follows. Section 2 outlines the model and Section 3 maps the model to U.S. data. Section 4 reports the results of a quantitative exercise to assess the impact of credit tightening, including the transitional dynamics, and computes the welfare effects on heterogeneous agents. Section 5 examines how the BAPCPA affected the response to tighter credit. Section 6 further explores the role of bankruptcy protection on aggregate consumption and Section 7 presents additional results on the credit tightening. Section 8 concludes.

2. The model

Time is discrete and indexed by $t = \{1, 2, ...\}$. The economy is inhabited by a continuum of infinitely-lived households of measure one who are ex ante identical. Households face two types of idiosyncratic shocks: (i) a labor productivity shock; and (ii) an expense shock. There is no aggregate uncertainty.

Households can borrow from a financial intermediary that channels resources from saving to borrowing households and to producers. Consumer credit financing takes the form of unsecured one period debt. Borrowers can default on their obligations. Upon default, households debt is discharged and defaulting households are excluded from the credit markets for a certain number of periods. The production sector is characterized by a technology with constant returns to scale, and the produced good can be used for consumption or investment.

In each time period, the sequence of events in the economy is the following: (i) The exogenous idiosyncratic shocks are revealed; (ii) capital and labor are rented, production takes place, and factors are remunerated; (iii) households decide whether to default: if they default, all debts are discharged (including the expense shock, if any), and no saving is possible; if they do not default, then they pay the expense shock (if any) and decide how much to lend or borrow; finally, (iv) consumption takes place.

The economic environment is described in detail below.

2.1. The production sector

A representative firm in any time period t converts capital, K_t, and labor, N_t, into output Y_t, according to the following constant returns to scale production technology:

$$Y_t = AK_t^{\alpha} N_t^{1-\alpha}, \ \alpha \in (0, 1), \ A > 0.$$

Competition in the production sector implies that inputs are paid according to their marginal productivity. Let w_t and r_t^K be the wage rate and the rental price of capital at period t, respectively. We have that:

$$w_t = (1-\alpha)AK_t^{\alpha}N_t^{-\alpha},$$
$$r_t^K = \alpha AK_t^{\alpha-1}N_t^{1-\alpha}.$$

Capital is rented from financial intermediaries and depreciates at rate $\delta \in (0,1)$ in each period.

2.2. The household sector

Each household has preferences defined over consumption, c_t, given by the following utility function:

$$\mathbf{E}_0\left[\sum_{t=0}^{\infty}\beta^t u(c_t)\right],\ \beta \in (0,1), \tag{1}$$

with

$$u(c) = \frac{c^{1-\sigma}-1}{1-\sigma},\ \sigma > 0.$$

Households are endowed with one unit of time in each period and supply it inelastically to the representative firm. A household hit by productivity shock z_t receives labor income $w_t z_t$. We assume that z_t follows a finite state Markov process with support $\mathcal{Z}$ and transition probability $\mathcal{P}(z,z') = \Pr(z_{t+1} = z'|z_t = z)$. Expense shocks e_t also follow a finite state Markov process with support $\mathcal{E}$ and have a transition probability given by $\mathcal{P}(e) = \Pr(e_{t+1} = e)$. We assume that these shocks are uncorrelated over time.

2.2.1. The household's problem. Households can save and borrow by means of one-period pure discount bonds intermediated by banks. Loans and deposits are defined as follows:

- A loan is a promise made by the borrower in period t to pay back $-a_{t+1} > 0$ to the bank in period $t+1$, against the immediate delivery by the bank to the household of $q_{a_{t+1},z_t} \cdot (-a_{t+1})$ units of the final good.
- A deposit is a promise made by the bank to deliver $a_{t+1} > 0$ units of the final good in period $t+1$ against a deposit by the household of $q_{a_{t+1},z_t} a_{t+1} > 0$ units of the final good during period t.

We have that $a_{t+1} \in \mathcal{A} \equiv [-\underline{b}, \overline{a}]$ and assume that $-\overline{b}$ is a large negative number. We also assume a large upper bound on assets, $\overline{a}$.[4] The implicit discount rate $q_{a_{t+1},z_t} > 0$ is a function of the loan/deposit amount, household's credit score and current household productivity. The exogenous shocks affecting the household are observable by all agents. Let $x_t = (a_t, z_t, e_t)$ denote the vector of these three state variables for a particular household.

4. In the quantitative experiments these numbers are large enough to not constrain the solutions.

Intuitively, the asset decisions a_{t+1} are made as follows: At the beginning of period t a household with access to credit and real asset holdings a_t, observes its productivity shock z_t and expense shock e_t, rents labor and receives labor income $w_t z_t$. If $a_t - e_t < 0$, the household decides whether to default or not. By defaulting, she will be banned from borrowing during the bankruptcy period (i.e., $a_{t+1} \geq 0$), but all her debts are discharged (that is, $a_t - e_t = 0$); otherwise, the household either asks for a loan to roll over its debt, in which case $a_{t+1} < 0$, or repays its debt and makes a deposit, which corresponds to $a_{t+1} \geq 0$. If $a_t - e_t \geq 0$, there is no default decision; the household either asks for a loan $(a_{t+1} < 0)$ or maintains a positive asset position $(a_{t+1} \geq 0)$. The problem of each household is formally described below.

The set of possible individual states is $\mathcal{U} = \mathcal{X} \times \{0, 1\}$, where $\mathcal{X} = \mathcal{A} \times \mathcal{Z} \times \mathcal{E}$. The last set of the product in the definition of $\mathcal{U}$ characterizes each household in terms of credit record status, where 0 corresponds to households with a good credit record and 1 corresponds to households with a bad credit record. Let Υ be the associated Borel σ-algebra. For each $B \in \Upsilon$, $\lambda(B)$ corresponds to the mass of households whose individual state vectors lie in B. The household's value function depends not only on the current idiosyncratic state, but also on aggregate measures such as the wage, the deposit interest rate, and the state contingent loan rates.

Households enter the period with either assets $(a_t \geq 0)$ or debt $(a_t < 0)$ and either a clean credit record $(s_t = 0)$ or an impaired one $(s_t = 1)$. Let $W_t(x_t, \lambda_t)$ be the current value of the problem with the option to default. Households with debt $(a_t < 0)$ and a good credit score $(s_t = 0)$ choose whether to default on their debt $(d_t = 1)$ or not $(d_t = 0)$. The bankruptcy decision of a household with a credit score $s_t = 0$ is made by choosing $d_t \in \{0, 1\}$ to maximize:

$$W_t(x_t, \lambda_t) = \max_{d_t \in \{0,1\}} \{(1 - d_t) V_t(x_t, \lambda_t) + d_t V_t^D(x_t, 0, \lambda_t)\}. \tag{2}$$

where $V_t(x_t, \lambda_t)$ and $V_t^D(x_t, 0, \lambda_t)$ correspond to the value of repaying the debt or declaring bankruptcy with state vector $x_t \in \mathcal{X}$ and credit record $s_t = 0$. When $V_t(x_t, \lambda_t) \geq V_t^D(x_t, 0, \lambda_t)$ then $d_t = 0$; otherwise $d_t = 1$. Therefore, this problem defines optimal policy function $h_{d,t}(x_t, 0, \lambda_t)$. Households who enter the period without debt $(a_t \geq 0)$ do not have a default decision to make $(d_t = 0)$.

The value of repaying the debt with a good credit record $(s_t = 0)$ is summarized by the following value function:

$$V_t(x_t, \lambda_t) = \max_{c_t \geq 0, a_{t+1} \in \mathcal{A}} \{u(c_t) + \beta \mathbf{E}_t[W_{t+1}(x_{t+1}, \lambda_{t+1})]\}, \tag{3}$$

subject to the aggregate law of motion $\lambda_{t+1} = \Lambda_t(\lambda_t)$ and

$$c_t + q_{a_{t+1}, z_t} a_{t+1} \leq a_t - e_t + w_t z_t. \tag{4}$$

Equation (3) states that the household with a good credit record chooses consumption and next period asset value in order to maximize current utility and the continuation value of utility which depends on whether or not the household declares bankruptcy in the future. Equation (4) implies that consumption plus the present value of future asset holdings and the expense shock must be less than or equal to the sum of current net wealth and labor income. This problem defines policy functions $h_{c,t}(x_t, 0, \lambda_t)$ and $h_{a,t}(x_t, 0, \lambda_t)$.

The value of declaring bankruptcy ($d_t = 1$), which requires $s_t = 0$, is given by:

$$V_t^D(x_t, 0, \lambda_t) = u(c_t) + \beta \mathbf{E}_t[\eta V_{t+1}^D(x_t, 1, \lambda_{t+1}) + (1-\eta) W_{t+1}(x_{t+1}, \lambda_{t+1})],$$

subject to the aggregate law of motion $\lambda_{t+1} = \Lambda_t(\lambda_t)$ and

$$c_t \leq (1-\gamma)\, w_t z_t - \varphi\,. \tag{5}$$

Equation (5) reflects the fact that all household debts are fully discharged under bankruptcy, and that the defaulting household cannot save ($a_{t+1} = 0$). The latter implies that any remaining assets would be seized in the bankruptcy process.

We assume that default follows the rules laid down in Chapter 7 of the U.S. Bankruptcy Code. In the model, the Bankruptcy Code is summarized by three institutional parameters (η, γ, φ), which the household takes as given. The parameter η regulates the duration of bad credit score spells following a bankruptcy case, γ represents a pecuniary wage loss associated with bankruptcy, and φ is the one-time lump-sum fixed cost of filing for bankruptcy. Upon paying the filing fee φ and discharging her debts, the household retains a bad credit record for a certain number of periods during which she cannot borrow and is subject to pecuniary losses equal to a fraction γ of her labor income. In every period, the bad credit score can revert back to normal with probability η. As a result, the household's access to the credit market is restored and she is not subject to pecuniary losses any longer (Chatterjee et al. 2007; Athreya et al. 2012).

Households with a bad credit record ($s_t = 1$) face the following problem:

$$\begin{aligned} V_t^D(x_t, 1, \lambda_t) = \max_{c_t \geq 0, a_{t+1} \geq 0} & u(c_t) + \beta \mathbf{E}_t[\eta V_{t+1}^D(x_t, 1, \lambda_{t+1}) + \\ & (1-\eta) W_{t+1}(x_t, \lambda_{t+1})], \end{aligned}$$

subject to the aggregate law of motion $\lambda_{t+1} = \Lambda_t(\lambda_t)$ and

$$c_t + q_{a_{t+1}, z_t} a_{t+1} \leq \max\{a_t - e_t, 0\} + (1-\gamma)\, w_t z_t. \tag{6}$$

During a bad credit score period, consumers can save but not borrow ($a_{t+1} \geq 0$), they are subject to the pecuniary cost $\gamma w_t z_t$, and face an exogenous probability $1-\eta$ to start next period with a good credit score. Associated with this problem are policy functions for consumption $h_{c,t}(x_t, s_t, \lambda_t)$ and asset holdings $h_{a,t}(x_t, s_t, \lambda_t)$. Notice that that $h_{d,t}(x_t, 1, \lambda_t) = 1$ whenever $a_t - e_t < 0$.

2.3. The Banking Sector

Banks intermediate funds between saving and borrowing households. We assume free entry in the banking sector. Therefore, any bank has zero profits in loans to agents of the same type. This implies that there is no cross-subsidization in loans to households.[5] Given that the banks' payoffs are affine in the decision variables and there is free entry, we assume without loss of generality that there is only one bank which holds the economy's capital. Let $A_{a_0,z_{-1}}$ denote the amount of type (a_0, z_{-1}) contracts maturing at $t = 0$. Given the initial portfolio of previous contracts, $\{A_{a_0,z_{-1}}\}_{(a_0,z_{-1})\in\mathcal{A}\times\mathcal{Z}}$, the initial amount of capital K_0, and the deposit and loan discount rates q_{a_{t+1},z_t}, the financial intermediary chooses the amount A_{a_{t+1},z_t} of type (a_{t+1}, z_t) contracts and the amount of capital K_{t+1} to hold, in order to maximize the present value of current and future cash flows, discounted at the risk free interest rate $\{r_t\}_{t=0}^{\infty}$,

$$\sum_{t=0}^{\infty} \frac{1}{\prod_{j=1}^{t}(1+r_j)}\,\pi_t, \tag{7}$$

with

$$\pi_t = (1 + r_t^K - \delta)K_t + D_{t+1} - (1+\tau)L_{t+1} - K_{t+1} - D_t + L_t. \tag{8}$$

The parameter τ represents a cost of intermediating funds and introduces an exogenous spread between borrowing and lending rates. As we see in equation (10) below, in addition to τ there is also an endogenous component of the spread, which is loan specific.

Deposits and newly extended loans are defined, respectively, as

$$\begin{aligned} D_{t+1} &= \sum_{(a_{t+1},z_t)\in\mathcal{A}\times\mathcal{Z},\ a_{t+1}\geq 0} q_{a_{t+1},z_t} a_{t+1} A_{a_{t+1},z_t}, \\ L_{t+1} &= \sum_{(a_{t+1},z_t)\in\mathcal{A}\times\mathcal{Z},\ a_{t+1}<0} q_{a_{t+1},z_t} \left(-a_{t+1}\right) A_{a_{t+1},z_t}, \end{aligned}$$

while existing deposits and loans are given by

$$\begin{aligned} D_t &= \sum_{(a_t,z_{t-1})\in\mathcal{A}\times\mathcal{Z},\ a_t\geq 0} a_t A_{a_t,z_{t-1}}, \\ L_t &= \sum_{(a_t,z_{t-1})\in\mathcal{A}\times\mathcal{Z},\ a_t<0} \left(1 - p_{a_t,z_{t-1}}\right)\left(-a_t\right) A_{a_t,z_{t-1}}\,. \end{aligned}$$

The variable $p_{a_t,z_{t-1}}$ is the probability that a type (a_t, z_{t-1}) contract maturing in period t is defaulted upon. This is given by the fraction of households that, in the current period, suffer idiosyncratic shocks such that they choose to default. As discussed previously, $p_{a_t,z_{t-1}} = 0$ whenever $a_t - e_t \geq 0$. Any sequence of deposits/loans and capital $\{A_{a_{t+1},z_t}, K_{t+1}\}_{z_t\in\mathcal{Z},t=0,\ldots,\infty}$ implies a sequence of

5. See Chatterjee et al. (2007) for a discussion.

risk-free bond holdings $\{B_t\}_{t=0,\dots,\infty}$ by the bank which satisfies $B_0 = 0$ and[6]

$$B_{t+1} = (1 + r_t)B_t + \pi_t \,. \tag{9}$$

Providing loans to households is a risky activity, and intermediaries demand compensation for such risks. In addition to a proportional intermediation cost τ, the pricing of loans also depend on the (endogenous) default probabilities. We assume that intermediaries are able to perfectly observe each households' current state, and thus they offer a household-specific loan price menu. Depending on the size of the desired loan, banks perfectly foresee the future default probabilities (which are based on the transition matrix $\mathcal{P}(z_t, z_{t+1})$ and on $\mathcal{P}(e_{t+1})$) and take into account the losses associated with default. This assumption, along with the fact that there is a continuum of households, implies that banks earn zero profits for *each* agent type (there is no cross-subsidization):

$$\begin{aligned} q_{a_{t+1},z_t}\, a_{t+1} =& \frac{1}{(1 + \tau \cdot \mathbb{I}(a_{t+1} < 0))(1 + r_{t+1})} \cdot \\ & \sum_{x_{t+1} \in \mathcal{X}} \mathcal{P}(z_t, z_{t+1})\mathcal{P}(e_{t+1})[1 - h_{d,t+1}(x_{t+1}, 0)]\, a_{t+1} \end{aligned} \tag{10}$$

In the equation above, $\mathbb{I}(\cdot)$ represents the indicator function. Equation (10) shows that for $a_{t+1} \geq 0$, investors are indifferent between holding capital, making deposits or holding risk free bonds issued by the bank. For $a_{t+1} < 0$, the loan interest rate increases with the probability of default, given the risk free discount rate. Thus, a risk premium emerges endogenously as a response to default.[7]

2.4. The service providers

The expense shocks, e, go to a services sector that includes courts, which provide legal services, and hospitals, which provide health services. If a household does not default, then service providers receive the expense shock e_t. If a household defaults, then service providers receive nothing if the household's net wealth is negative, but receive a_t when this is positive. In order to ensure zero profits in this sector we assume that service providers charge a markup m_t such that

$$\int_{\mathcal{U}} [(1 - h_{d,t}(x_t, s_t, \lambda_t))e_t + h_{d,t}(x_t, s_t, \lambda_t) \max\{0, a_t\}]d\lambda_t = \int_{\mathcal{U}} \frac{e_t}{m_t} d\lambda_t. \tag{11}$$

6. In equilibrium the interest rate on risk-free bonds and deposits will be similar and therefore to save in notation we use r_t also for risk-free bonds.

7. An equivalent formulation with ex post payment of interest rate on loans, $1 + r_{a_{t+1},z_t}$, would imply $1 + r_{a_{t+1},z_t} = \frac{1}{q_{a_{t+1},z_t}} = \frac{(1+r_{t+1})(1+\tau)}{1-p_{a_{t+1},z_t}}$.

2.5. Equilibrium

The endogenous transition probability of the households' state vector, the competitive equilibrium, and the aggregate law of motion implied by the individual decision rules are defined in Appendix A. A stationary equilibrium is an equilibrium where prices and aggregate objects are stationary over time.

3. Mapping the Model to the Data

The calibration proceeds in two steps. A first set of parameters assumes values commonly used in the literature. A second set of parameters is calibrated so that the model stationary equilibrium matches key empirical observations in the United States for the 1990-2004 period, i.e. before BAPCPA and pre-financial crisis. A model period represents one year. Table 1 reports all the parameter values resulting from our calibration.

Parameters	Values	Source
(A) Pre-set		
α	0.30	Capital income share, estimates by Gollin (2002)
δ	0.06	Capital to output ratio, $\frac{K}{Y}=3$
σ	2	Risk aversion coefficient based on micro evidence reported by Mehra and Prescott (1985)
ρ	0.98	Persistence parameter from Krueger and Perri (2005)
σ_ε^2	0.0285	Cross-sectional variance of shocks based on Krueger and Perri (2005)
η	0.9	Average bad credit score spell of 10 years; see Chatterjee et al. (2007)
(B) Calibrated		
A	0.5613	Equilibrium aggregate production is equal to 1
β	0.9273	Real interest rate on risk free asset of 4%
φ	0.012	Cost of filing for bankruptcy of about \$600
γ	0.19	Pecuniary penalty for bad credit
τ	0.02	Intermediation cost

Baseline parameterization of the model. The parameters in (B) are set to match the data moments reported in Table 2.

Table 1: Parameter Values

3.1. Preset parameters

Six parameters are set to take values commonly used in the literature. Below we describe how we choose each of them.

Production. The production function is Cobb-Douglas with the share of capital α equal to 30 percent, a value consistent with estimates in Gollin (2002). In line with other studies, the depreciation rate δ is set to 0.06, which, along with our choices for α and the targeted risk free interest rate, implies a capital to output ratio of 3.

Preferences and idiosyncratic shocks. The inverse of the intertemporal elasticity of substitution, σ equals 2; see, for instance, Mehra and Prescott (1985).

The idiosyncratic labor productivity shock follows the estimates in Krueger and Perri (2005). Using data from the Consumer Expenditure Survey and controlling for several idiosyncratic characteristics, they report a cross-sectional variance of the log of wages σ_ε^2 of 0.719. The shock is modelled as an AR(1) process with an autocorrelation parameter of $\rho = 0.98$. We use a Rouwenhorst discretization of the AR(1) process with 9 grid points; see Kopecky and Suen (2010) for details.[8]

Bankruptcy filing. We set η equal to 0.9 so that defaulting households have a bad credit record for, on average, ten years; see Chatterjee et al. (2007).

3.2. Internally calibrated parameters

We calibrate the magnitude of the expense shock, its probability, the bankruptcy penalty parameter γ, the intermediation cost parameter τ, the fixed cost parameter φ, and the discount factor β to match key data moments. We focus on unsecured consumer debt and target the debt-to-output ratio, the fraction of people in debt, the default rate, the bankruptcy filing fee. In addition, we also target the risk-free interest rate and the spread on consumer credit. Table 2 reports the calibration targets based both on micro and macro data, as well as the corresponding model values. All data moments are calculated as averages over the period 1990-2004.[9]

Moment	**Source**	**Data (%)**	**Model (%)**
Unsecured debt to output	SCF	0.62	0.63
Default Rate (Chapter 7)	ABI	0.80	0.62
% HH with negative netwealth	SCF	8.63	9.83
Risk-Free interest rate (3m Tbill)	FED	4	4
Average Spread	FED	9.44	9.11
Bankruptcy fee ($)	White (2007)	600	600

Data targets used to calibrate the model (sample period: 1990-2004) as well as corresponding model implied values. For further details see Data Appendix.

Table 2: Calibration Targets

8. The Markov transition matrix $\mathcal{P}(z, z')$ and the vector with values of $\mathcal{Z}$ are in Appendix Table C1.

9. Appendix B describes the data series and sources.

We target the proportion of consumers in debt in the stationary equilibrium to be 8.63%, computed by using the (1990-2004) Survey of Consumer Finances. Following Chatterjee et al. (2007), we compute this fraction by considering households with negative net worth, excluding debts that are likely to be due to entrepreneurial activity, i.e. negative net worth larger than 120% of average income. As in Livshits et al. (2007) we compute the percentage of filers for bankruptcy as the number of Chapter 7 non-business bankruptcy filings relative to the number of households in the U.S. that over our sample period is of 0.80%. The debt-to-output target of 0.63% is computed as the average amount of unsecured debt among all households in the Survey of Consumer Finances relative to GDP per household over the same period. We target a fixed cost of filing for bankruptcy of $600; this is in line with the pre-2005 cost of bankruptcy for a debtor under Chapter 7 reported in White (2007). The risk-free interest rate is set to 4 percent per annum. The average spread is computed as the difference between the average interest rates charged for non-secured credit and the average risk-free rate over the same period.

The bottom panel of Table 1 summarizes the values for the model's parameters. The resulting value for the intermediation cost parameter τ is 2%. This is in line with the values reported in Mehra et al. (2011) and Philippon (2013) over the same period. The parameter γ is 0.19, where γ corresponds to wage loss and $(1-\gamma)w_t z_t$ is the fraction of work income that a defaulted household can utilize. In equilibrium the amount lost by the household is very small in aggregate terms, corresponding to 0.54% of output. We treat it as a deadweight loss.

Regarding the expense shock, we assume a simple structure of only two serially uncorrelated realizations: $e = 0$ (no expense shock) and a positive value.[10] Finally, the scale parameter A is such that equilibrium aggregate production is normalized to one.

3.3. Model Properties

In addition to the data targets, Table 2 presents a summary of the model implied moments. The calibrated model matches quite closely the data targets. Table 3 presents a summary of the model-implied stationary wealth distribution of the calibrated economy and the data counterpart. The performance of the model in terms of reproducing the non-targeted wealth distribution is satisfactory. In particular, the model matches very well the wealth of the lowest two quintiles, which are most relevant to evaluate the role of bankruptcy on consumption dynamics.

Figure 2 depicts the endogenous credit limits in the stationary equilibrium of the calibrated model (black line), as a function of the realized productivity shock, along with the share of borrowers at each z (black bars). The black line

10. Appendix Table C2 presents the implied expense shock levels $\mathcal{E}$ and the Markov matrix. Livshits et al. (2007) measure directly medical bills, divorces and unplanned pregnancies and then calibrate positive levels of expenditure shocks and their respective probabilities for a three-year period. Health shocks are difficult to convert from a three-year to an annual frequency.

	(A)					(B)		
	Q1	Q2	Q3	Q4	Q5	Top 10%	Top 5%	Top 1%
Model (%)	-0.21	1.14	7.04	19.81	72.22	51.12	34.12	11.22
Data (%)	-0.20	1.37	4.99	12.35	81.50	68.49	56.47	32.79

Panel (A): model-generated and data average wealth in each quintile of the wealth distribution, as percentage of total wealth; Panel (B): average wealth of the households in the top quantiles of distribution, as percentage of total wealth. For further details see Data Appendix.

Table 3: Stationary Wealth Distribution

depicts the endogenous credit limits—i.e. maximum cash that households of a given productivity level (right axis, measured as a percentage of total savings) can obtain—whereas the bars represent the share of borrowers. The model predicts that most borrowers are concentrated among low-income earners. Low-wage earners face stringent credit limits. However, the share of borrowers in Figure 2 indicates that even though high-wage earners could obtain relatively large loans, they prefer not to do so.[11]

The asset policy and the the probability that a borrower defaults on a loan in equilibrium are reported in Appendix Figures C1 and C2.[12]

4. Credit Tightening

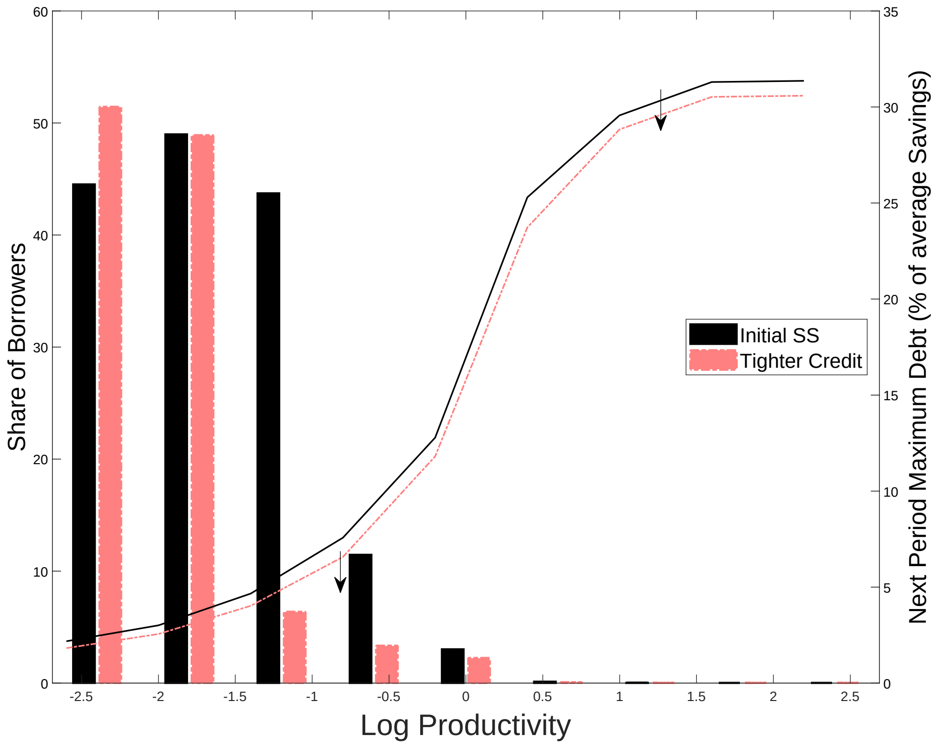
We use our quantitative model as a laboratory to explore the effects of changes from the calibrated economy (baseline) to an economy with tighter credit.

4.1. Bank-intermediated consumer credit: Key Facts

Between 2007 and 2009 the supply of bank-intermediated consumer credit experienced an unprecedented tightening. We measure credit tightening by using the changes in lending standards for consumer credit as reported on the Federal Reserve Board's Senior Loan Officer Opinion Survey on Bank Lending Practices

11. Taking into account the positive correlation between productivity and default risk (Figure C2), the patterns portrayed in Table 2 are consistent with evidence provided by Agarwal et al. (2017), who find that despite the availability of credit (high credit limits), high credit-score individuals' willingness to borrow is low.

12. Appendix Figure C1 shows that over time a borrower may become a saver and vice versa. If an agent suffers a negative productivity shock, for example $\log(z) = -2$, then if current asset holdings are low enough, it can default, which is represented by the flat region in the right panel. In contrast, a borrower with a good productivity shock, i.e. $\log(z) = 2$, can switch from borrowing to saving. Appendix Figure C2 shows that default can occur abruptly. Conditional on the realization of labor productivity, at lower levels of debt, default probabilities are small. However, for sufficiently high levels of debt the probability of default is high, and the rise is abrupt. As default probabilities are closely linked to loan pricing (equation (10)), this leads to very sharp rises in the spread due to small increments in the loan size, a pattern resembling credit card limits.



The lines depict the maximum cash that can be obtained through a loan for each household productivity level (right axis) for each stationary equilibrium. The bars represent the share of borrowers for each productivity level across equilibria, in percentage.

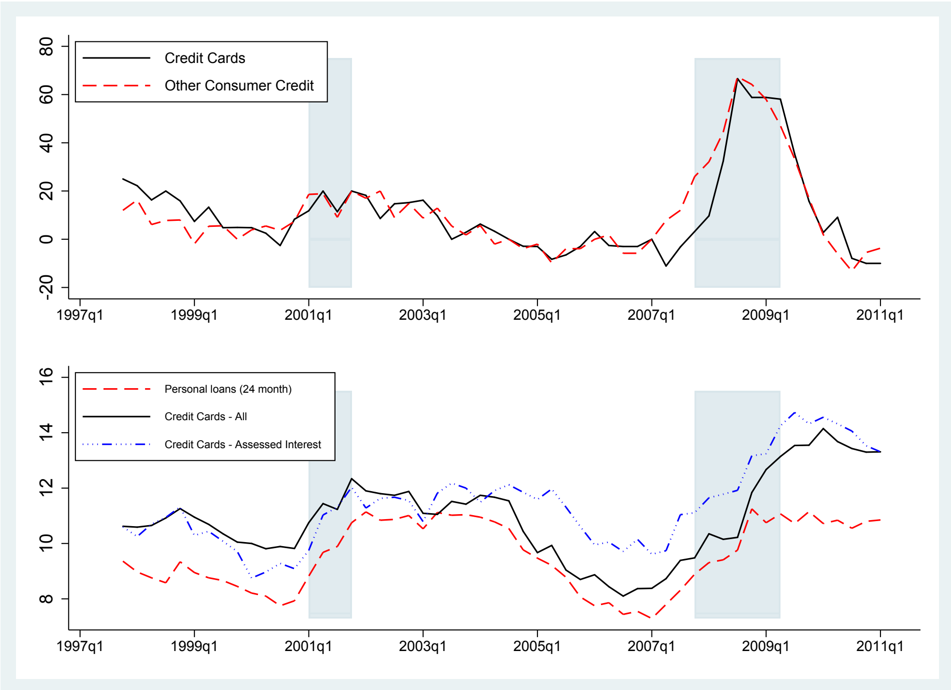
Figure 2: Credit Limits and Share of Borrowers by Productivity

(SLOOS). Figure 3 (top panel) depicts the net percentage of respondent banks tightening lending standard on credit cards (solid line) and consumer loans other than credit cards and auto loans (dashed line).[13]

The fraction of banks tightening lending standard on consumer credit increased from about 0% between 2003 and the beginning of 2007 to about 70% at its peak in 2008. This indicates a substantial tightening in the supply of bank-intermediated

13. Participating banks are asked to report their lending standards during the survey period in the following way: "Over the past three months, how have your bank's credit standards for approving applications for credit cards/consumer loans other than credit card and auto loans from individuals or households changed?" (1) tightened considerably, (2) tightened somewhat, (3) remained basically unchanged, (4) eased somewhat, and (5) eased considerably. The net percentage of banks tightening credit standards corresponds to the share of banks whose response is either (1) or (2) minus the share of banks whose response is either (4) or (5).

consumer credit during the financial crisis.[14] Figure 3 (bottom panel) depicts a sizable increase in the spread on different types of unsecured credit over the same period. This is consistent with a tightening in lending standards depicted in the top panel of the same figure.[15]



Top Panel: The Senior Loan Opinion Survey on Bank Lending. The credit tightening index is constructed as follows: let $x \in \{-1, 0, 1\}$ be the variable that represents the change in bank lending standards. It equals minus unity if a bank reports either having "tightened considerably" or "tightened somewhat" in that period. Similarly, it equals zero if standards have not change, and one otherwise. In every period, the plotted lines of the top panel represent the average of x across the surveyed banks.
Bottom Panel: Interest rates spreads on personal loans (red dashed line), all credit cards (black solid line), and credit cards with assessed interest (blue dot-and-dashed line). The spread is calculated by subtracting the 3-month Treasury bill rate from the respective consumer credit rate. See Data Appendix for data sources and construction.

Figure 3: Lending Standards and Credit Spreads

14. See also Bassett et al. (2014) for a new indicator of changes in the supply of bank-intermediated credit that combines changes in overall bank lending standards (to business and households) with other bank-specific and macroeconomic variables.

15. Charge-off rate on consumer loans also increased by about the same factor as bankruptcy discharges (Figure 1) , thus, suggesting that a large fraction of discharged debt was bank-intermediated. Appendix Figure A3 (bottom panel) reports the charge-off rate on consumer loans (black line) over the same period. Charge-offs are the value of loans removed from the books of all commercial banks measured net of recoveries.

	$\tau = 2\%$	$\tau = 4.46\%$
Unsecured debt to output	0.63	0.17
Default Rate	0.62	0.22
Perc. HH with negative netwealth	9.83	3.77
Average Spread	9.11	11.11
Aggregate Consumption	1	1.0003
% of HH with Default Probability $<$ 5%	8.8	15.7
% of HH with 5% $\leq$ Default Probability $\leq$ 10%	90.8	84.0
% of HH with Default Probability $\geq$ 5%	0.3	0.3

This table compares outcomes in the initial equilibrium ($\tau = 2\%$) and in the final one with tighter credit ($\tau = 4.46\%$). All values are in percentage or percentage points. The default rate represents the share of the entire population of households that default on their debt in a given period. The spread represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts. Aggregate consumption is normalized to one in the initial equilibrium.

Table 4: Permanent Credit Tightening: Long-run Effects

4.2. Quantitative Exercise: Tighter Credit

We model the tightening in the supply of bank-intermediated credit as an exogenous increase in τ, i.e. the parameter that controls the tightness of bank lending standards. We increase τ from 2 to 4.46 percent so that the model average spread on consumer credit matches the post-2007 average increase of 2 percentage points (p.p.) in the interest rate spreads on credit cards.

The experiment is conducted as follows:

- In period $t = 0$, the economy starts at the stationary equilibrium associated with the calibrated τ.
- For periods $t = 1, 2, 3, 4, ...$ we compute the transition to an unexpected and immediate increase in τ up to the new higher time-invariant long-run level $(\tau = 4.46)$.

Our baseline experiment assumes an immediate increase in τ that occurs unexpectedly. During the transition, the economy is not subject to any other aggregate shocks.

4.3. Long-run Effects

We start by exploring the long-run (stationary equilibrium) effects of changes in τ on key model variables. Table 4 reports the long-run effects of an increase to high τ from its calibrated value to 4.46%.[16]

A higher τ, by increasing the average cost of credit for borrowers, reduces households borrowing capacity. Thus, the fraction of households that borrow declines, as well as the debt-to-output ratio. The decline in the fraction of borrowers

16. See also Figure C3, Appendix B, for the full set of comparative statics.

and in total (unsecured) credit is remarkable, whereas the effect is less sizable in the average spread. Crucially, the model displays incomplete pass-through (around 80%) of the increase in τ to the average total spread. This happens because the default rate of borrowers declines along with the average risk spread, i.e. the part of the spread that prices in the riskiness of the borrower. Thus, the total increase in the average credit spread is lower than the increase in τ.[17]

In response to tighter credit, the model displays a *selection effect* in the composition of borrowers as lending is channeled to 'better quality' borrowers. The fraction of households with a probability of defaulting below 5 $\%$ increases remarkably whereas the fraction of borrowers with a higher probability of default declines. Figure 2 reports the endogenous credit limit for the new stationary equilibrium of the model with higher τ (red line), in addition to the baseline model (black line). The endogenous credit limit shifts downwards when τ increases, which indicates tighter credit. Interestingly, deleveraging is *not* concentrated among the lowest productivity households. This is due to households' *bunching* behavior (Saez 2010), implied by a kink in the cost of marginal debt (or, equivalently, in the benefit of marginal savings) at $a = 0$. This, however, does not necessarily mean that in the new stationary equilibrium with tighter credit, the *pool* of borrowers is riskier. In fact, the new equilibrium features a *safer* pool of borrowers, which leads to a decrease in the average default rate.

Compared to other papers that study the effects of exogenous changes in credit limits (Guerrieri and Lorenzoni 2017; Eggertsson and Krugman 2012), our model is able to generate endogenous movements in the borrowing constraints as well as in the average credit spread.

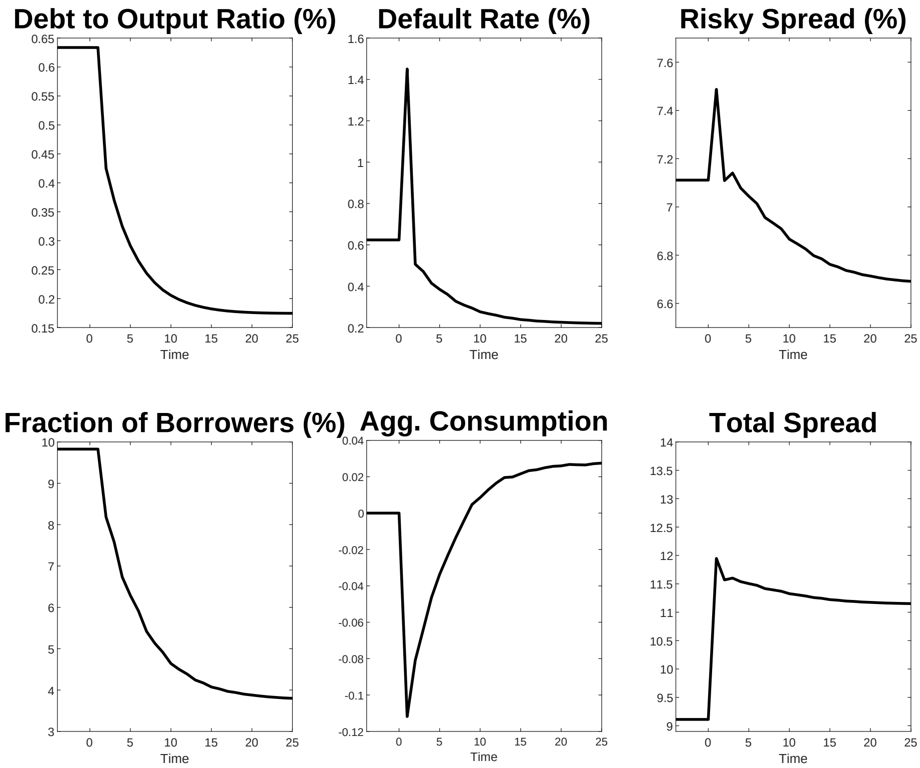
4.4. Transitional effects on allocations

In this section we examine the transition to tighter bank-intermediated credit. Figure 4 illustrates the economy's response to an increase in τ.

The fraction of borrowers gradually declines as well as the ratio of debt over GDP. In the periods after the tightening in lending standards, only consumers with lower default risk, that did not default upon the occurrence of the shock, can access the credit market. The cost of borrowing becomes too high for risky consumers. The share of less risky borrowers increases. See Figure 5. Due to this *selection effect* in the composition of borrowers, the effect of a credit tightening is larger on credit quantities than on the lending spreads. Indeed, the initially large increase in the average total spread is substantially reduced in the subsequent periods due to the decline in the risky part of the spread.

Figure 6 reports the response of aggregate consumption as well as of average consumption by wealth quantiles. The drop in aggregate consumption is driven by

17. This explains why to match an increase in the total credit spread of 2 p.p. τ needs to increase by 2.26 p.p.



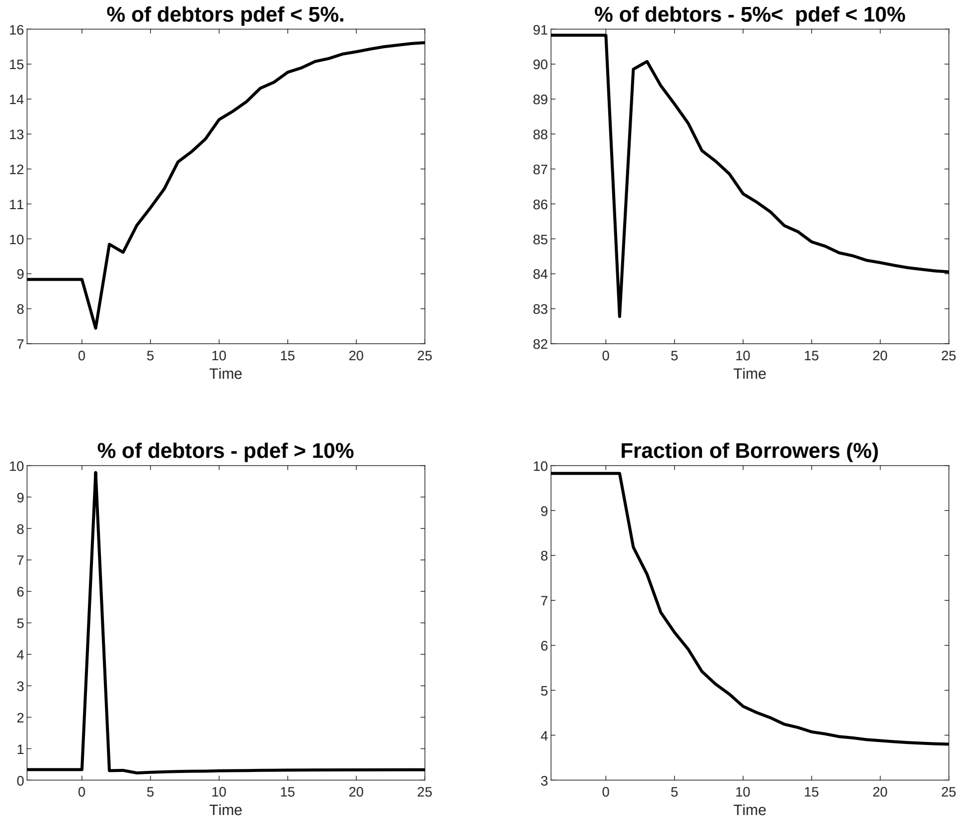
Economy's transitional dynamics in response to tighter credit. The default rate represents the share of the entire population of households that default on their debt in a given period. The total spread (in percent) represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts, while the risky spread subtracts τ from the total spread. Aggregate consumption is expressed as percentage change from the initial steady-state value.

Figure 4: Tighter Credit—Aggregate Variables

the sizable and negative effect of the shock on consumers at the bottom of the distribution. Despite the fact that in line with the data, the model features a small debt-to-output share, changes in credit conditions that directly affect borrowers translate into aggregate real effects.

The negative effect on aggregate consumption is very persistent. Crucially, default affects the creditworthiness of consumers for a certain numbers of years. This reduces their ability to smooth consumption over time and increases the persistence in the effects induced by the shock.[18]

18. While τ reaches the higher level immediately, the endogenous spread, as well as consumption and all other aggregate variables, take much longer to reach the new stationary equilibrium.



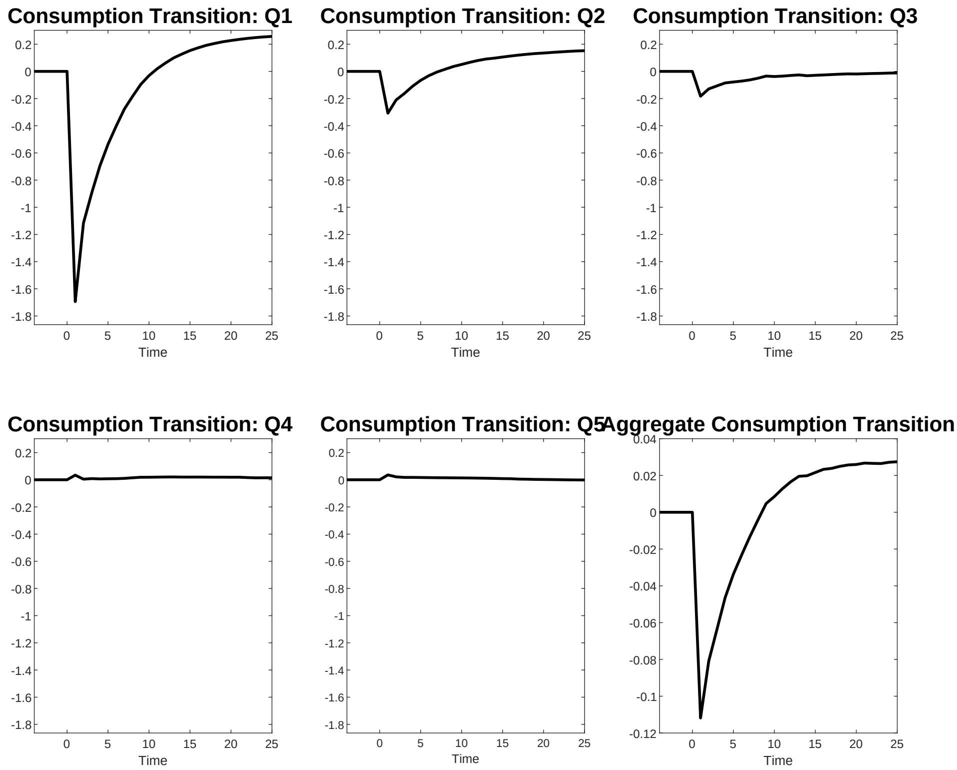
Default probability transitional dynamics in response to tighter credit. The "% of debtors pdef $< 5\%$" represents the percentage debtors whose probability of default (in the next period) is below 5%. '% of debtors $5\% <$ pdef $< 10\%$" represents the share of debtors whose next period default probabilities lie between 5% and 10%, whereas "% of debtors pdef $> 10\%$" represents the share of debtors with default probability larger than 10%.

Figure 5: Tighter Credit—Default Probabilities

4.5. Effect on welfare

Table 7 reports the average welfare effects measured by the average of the percentage change in consumption that each consumer would be willing to pay so that the expected utility in the initial stationary equilibrium equals that of the equilibrium with a higher credit spread. It also displays the average effects on the savers and borrowers and on the group of consumers belonging to different quantiles of the income distribution.[19] In assessing the welfare effects of tighter credit we take into account the transition path to the new stationary equilibrium.

19. We consider consumers belonging to each quantile before the occurrence of the shock.



Consumption transitional dynamics in response to tighter credit. The panels labeled Q1-Q5 depict the evolution of the average consumption of the respective labor income quintile. All values in percentage deviation from initial steady-state values.

Figure 6: Tighter Credit—Consumption Transition

Long-run aggregate consumption is largely unaffected by the different levels of τ. However, the welfare effects of tighter credit are heterogeneous. The long-run welfare effects are positive for the left tail of the income distribution, because the long-run rise in wages more than compensates for the increased debt burden. Despite the positive, although small, long-run effects of tighter credit on aggregate consumption and welfare, the effects including the transition are negative for all agents. In particular, the largest losses accrue to borrowers.

5. 2005 Reform of Personal Bankruptcy

We now quantify how the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 (BAPCPA) affected the response of bankruptcy and consumption to tighter credit during the financial crisis. The law made several significant changes to the U.S. Bankruptcy Code intended to make filing for bankruptcy more difficult by increasing Chapter 7 bankruptcy fees by about 50%. The first draft of the reform

(A) Income Pctile	Q1	Q2	Q3	Q4	Q5
Long Run	0.38	0.18	0.06	-0.01	-0.05
Tighter Credit	-0.28	-0.07	-0.03	-0.01	-0.02
No Default in t=1	-2.83	-0.23	-0.03	-0.01	-0.02
BAPCPA	-0.33	-0.08	-0.03	-0.01	-0.02
(B) Group	Avg. Gain	Savers	Borrowers	Def. Switchers	
Tighter Credit	-0.08	-0.04	-0.45	-0.47	
No Default in t=1	-0.62	-0.11	-5.31	-	
BAPCPA	-0.09	-0.05	-0.55	-1.00	

Welfare gains for each group are computed as the percentage point equivalent increase in steady-state consumption. Top Panel (A) represents each quintile of the labor income distribution. The first row represents the total welfare in the final stationary equilibrium relative to the first steady-state (in consumption equivalent terms). The rows label "Tighter Credit" represent the baseline credit shock scenario, where τ suddenly rises from 2% to 4.46%. The rows titled "No Default in t = 1" represent welfare changes in response to the baseline credit shock, but default is prohibited in the first transition period. The rows titled "BAPCPA" represent welfare changes in response to the same credit shock, but two periods after a bankruptcy reform increases the parameter φ by 50%. Def. Switchers refers to the households who default in the period when the credit shock materializes, but would not have filed for bankruptcy in its absence.

Table 5: Welfare Effects of Tighter Credit

goes back to 1997 and was long discussed before becoming effective: it was only approved by Congress in April 2005 and enacted in October of the same year. Both the BAPCPA and the occurrence of a credit tightening affect borrowers. Thus, they are expected to interact in affecting default incentives.

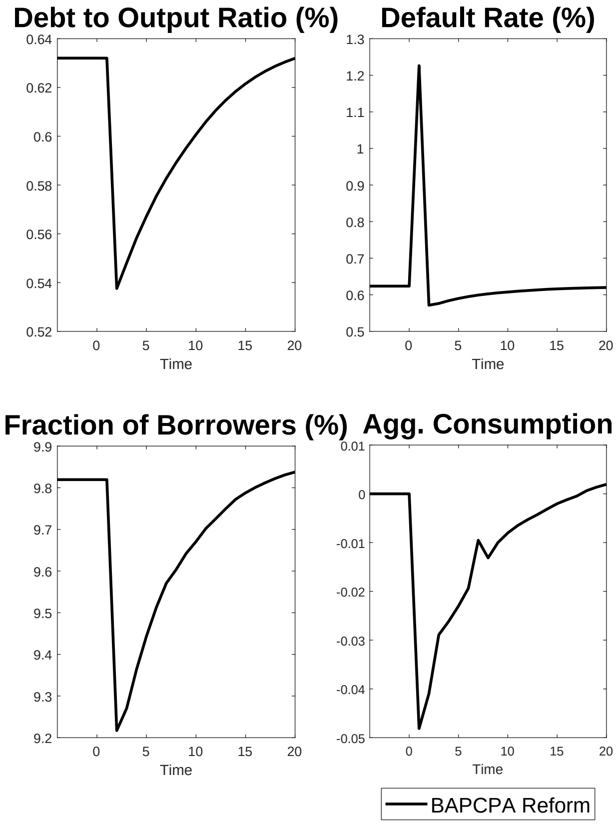
5.1. BAPCPA Transition

We start by assessing the impact of the BAPCPA reform *per se*. In doing so, we first abstract from the credit tightening. The BAPCPA experiment is conducted as follows:

- In period $t = -1$, we start the economy at the stationary equilibrium associated with the calibrated $\tau = 2\%$ and bankruptcy filing cost $\varphi = 1.2$.
- In period $t = 0$, a permanent 50% increase in the cost of filing for bankruptcy φ (BAPCPA) is announced to take place in $t = 1$.[20]
- For periods $t = 1, 2, 3, 4, ...$ we compute the transition to the anticipated increase in φ up to the new higher time-invariant long-run level ($\varphi = 1.8$).

Figure 7 shows the results. Bankruptcy increases sharply after the BAPCPA announcement. Aggregate consumption falls and the credit market shrinks. The

20. In addition to an increase in the bankruptcy filing fee, the BAPCPA also introduced a means testing for debtors with income above the median income of the debtor's state. In our model, even in the pre-BAPCPA situation, debt is mostly held by households with below-median income (see Figure 2). As a result, the means-testing requirement does not bind. Under perfect information, in the model default decisions are associated only with an adverse sequence of income and/or expense shocks.

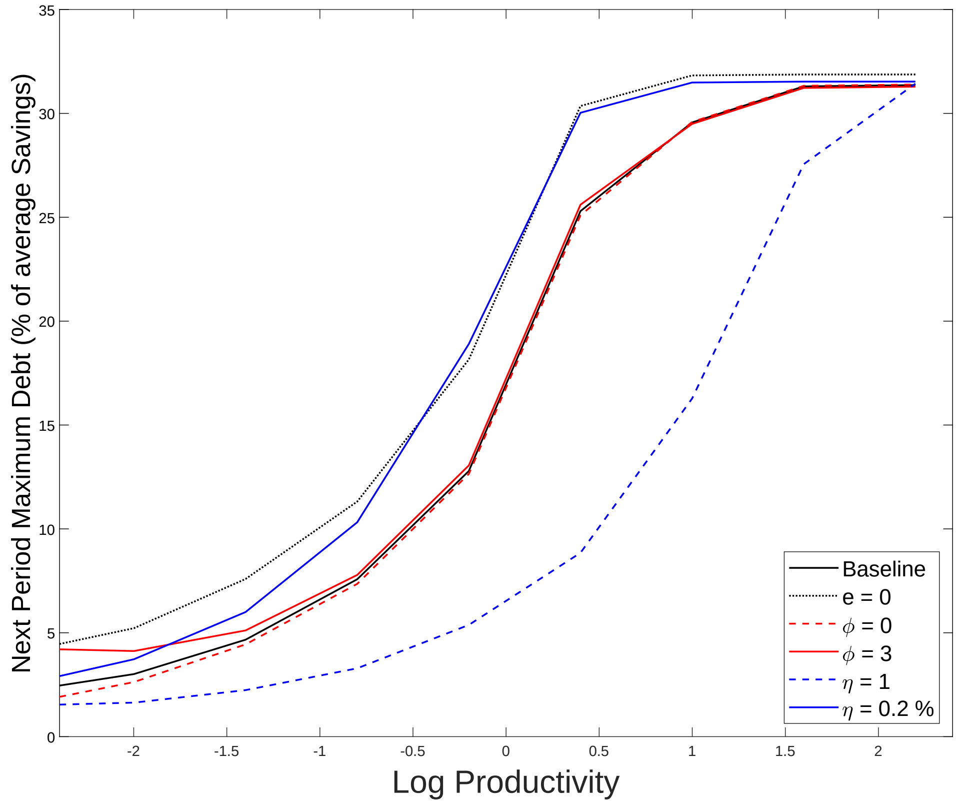


Economy's transitional dynamics in response to anticipated BAPCPA (φ increases by 50%). The default rate represents the share of the entire population of households that default on their debt in a given period. The total spread (in percent) represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts, while the risky spread subtracts τ from the total spread. Aggregate consumption is expressed as percentage change from the initial steady-state value.

Figure 7: BAPCPA Reform

fraction of more risky borrowers declines as reflected in the reduction in the average lending spread on impact. Interestingly, the reform has negligible effects on aggregate consumption in the long run.

In the new stationary equilibrium harsher bankruptcy procedures facilitate access to credit. Figure 8 shows that a higher φ (red solid line) is associated with higher credit limits (looser lending standards) for low income borrowers compared to the baseline model (black solid line). This is also reflected in a long-run risky spread below the initial level. Thus, capturing the endogeneity of the borrowing limits is crucial to properly assess the overall effects of the BAPCPA reform.



The lines depict the maximum cash that can be obtained through a loan for each household (log) productivity level for each corresponding stationary equilibrium.

Figure 8: Credit Limits

5.2. BAPCPA and Credit Tightening

Now, we assess the interaction between the credit tightening at the BAPCPA. Our results are based on the following simulations:

- In period $t = -1$, we start the economy at the stationary equilibrium associated with the calibrated $\tau = 2$ percent and bankruptcy filing cost $\varphi = 1.2$.
- In period $t = 0$, a 50$\%$ increase in the cost of filing for bankruptcy φ (BAPCPA) is announced to take place in $t = 1$.
- In period $t = 1$, the anticipated permanent increase in φ (from 1.2 to 1.8) takes place.
- In period $t = 3$, the unexpected increase in τ (from 2 to 4.46%) takes place.[21]

21. As in the baseline, the increase in τ is not anticipated and the economy is not subject to aggregate shocks.

We compare the results of the BAPCPA simulations with the baseline economy that in $t = -1, 0, 1, 2$ is at the initial stationary equilibrium ($\tau = 2\%$ and $\varphi = 1.2$) and is subject to the increase in τ only in period $t = 3$. While in the baseline case the shock hits the economy in a regime of low bankruptcy filing costs, (pre-BAPCPA $\varphi = 1.2$), in the BAPCPA case the same shock hits the economy when the bankruptcy filing cost is higher (post-BAPCPA $\varphi = 1.8$). The assumption that the two economies are identical in period $t = -1$, i.e. at the initial equilibrium characterized by the same calibrated values of φ and τ, ensures that the comparison of the effects of tighter credit with high and low bankruptcy costs is not affected by ex ante differences in the two economies.

Figure 9 displays the transition to tighter credit that also accounts for the BAPCPA (black solid line) and baseline simulations (red dashed line). The black solid line shows that while bankruptcy increases (at time $t = 0$) sharply due to the BAPCPA, the increase (at time $t = 3$) triggered by the tightening in credit is rather modest. When credit becomes tighter the economy subject to BAPCPA features a lower fraction of borrowers, although of better quality. With a lower fraction of the population directly affected by the shock, one could expect a much less sizable drop in aggregate consumption. In contrast, the economy suffers a large and persistent reduction in aggregate consumption. This is due to the fact that default is more costly compared to the baseline economy.

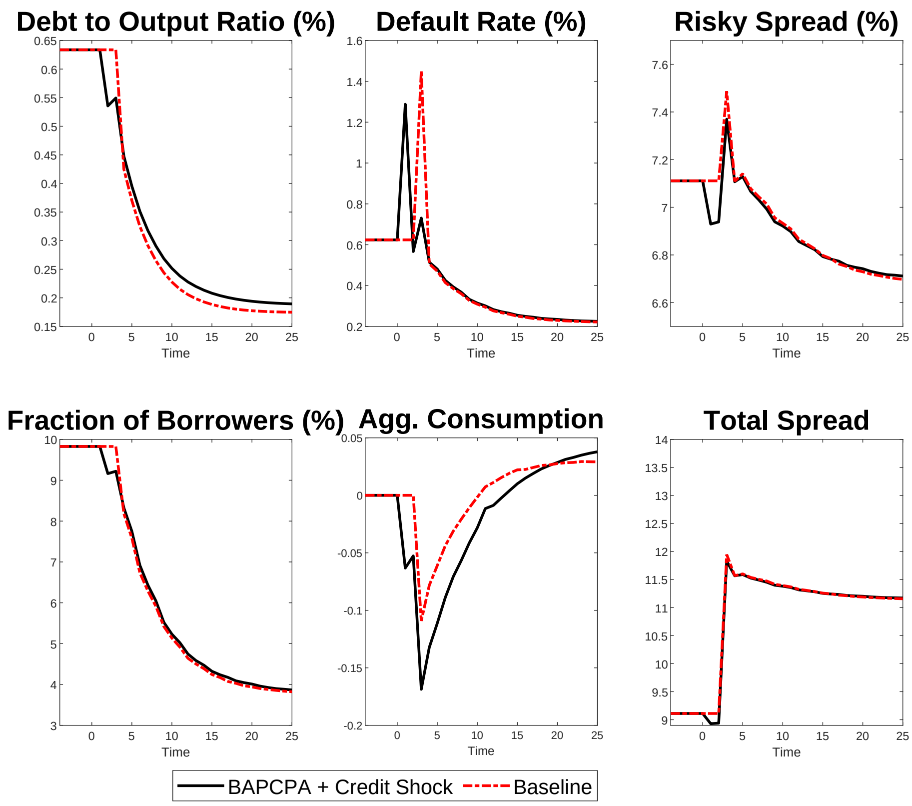
Overall, as shown in Figure 10, compared to the no-BAPCPA case the drop in consumption is larger not only for consumers in the bottom (Q1) but also in the middle (Q2-Q3) of the distribution. In addition, the welfare effects of the credit tightening are amplified by BAPCPA and are particularly worse for poor consumers and borrowers; see Table 5.

6. Role of Bankruptcy Rules

In order to understand how bankruptcy protection interacts with the response of the economy to tighter credit, we further explore the role of the cost of filing for bankruptcy (φ). In addition, we provide results on another key bankruptcy code parameter: the length of exclusion from the credit market after bankruptcy (η).

6.1. Bankruptcy Cost

Figure 11 (top left panel) plots the response of aggregate consumption to tighter credit for different values of the the bankruptcy cost (φ). We start by quantifying the response of aggregate consumption to tighter credit in the absence of a cost to file for bankruptcy $\varphi = 0$. We consider the counterfactual case in which the reform is enacted long before the credit tightening. Thus, we assume that at $t = 0$ the economy is already at the stationary equilibrium with the new $\varphi = 0$ and then at time $t = 2$ the credit tightening occurs. Easier bankruptcy makes borrowers more willing to default as it allows them to consume more when bankrupt. The aggregate

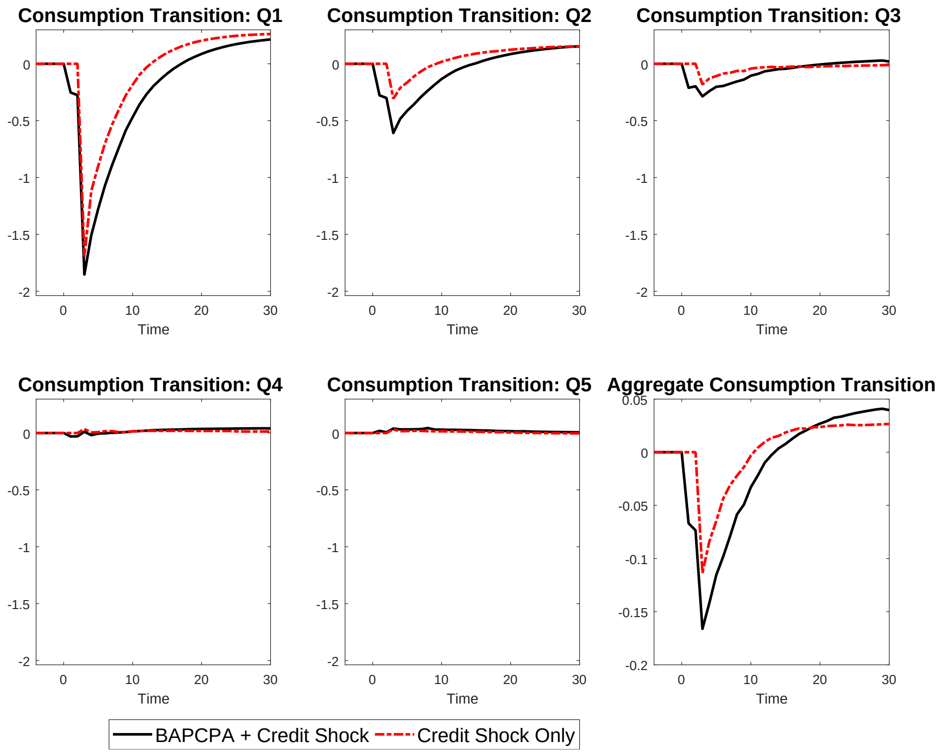


The black line depicts the transitional dynamics in response to BAPCPA (announced at t=0 and realized at t=3) and tighter credit (at t=3). The red-dashed line depicts the transitional dynamics in response to the credit tightening (at t=3) in the absence of BAPCPA. The default rate represents the share of the entire population of households that default on their debt in a given period. The total spread (in percent) represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts, while the risky spread subtracts τ from the total spread. Aggregate consumption is expressed as percentage change from the initial steady-state value.

Figure 9: BAPCPA and Credit Tightening—Aggregate Variables

consumption drops by 8% less than in the baseline ($\varphi = 1.2$). This result seems to suggest that easier bankruptcy is beneficial during a credit tightening. However, while easier bankruptcy reduces the cost of a credit crunch for borrowers, it also limits by more the ex ante access to credit. Figure 8 shows that a lower φ (red dashed line) is associated with lower credit limits (tighter lending standards) for low income borrowers compared to the baseline model (black solid line). Thus, depending on which of two effects dominates, eliminating the bankruptcy cost could be overall, more or less beneficial.

The model displays some asymmetry in the effects of bankruptcy cost. Figure 11 (top left panel) also reports the response of aggregate consumption to tighter credit for varying levels of φ. The harsher the bankruptcy code, the less willing are



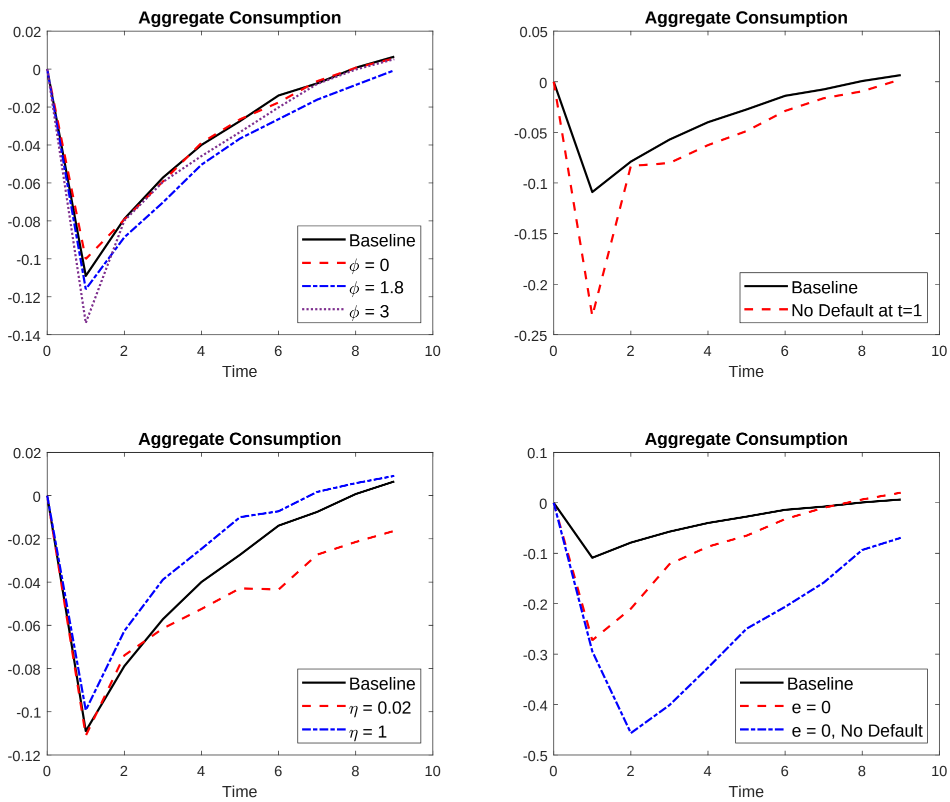
The black line depicts consumption transitional dynamics in response to response to BAPCPA (announced at t=0 and realized at t=3) and tighter credit (at t=3). The red-dashed line depicts the transitional dynamics in response to the credit tightening (at t=3) in the absence of BAPCPA. The panels labeled Q1-Q5 depict the evolution of the average consumption of the respective labor income quintile.All values in percentage deviation from initial steady-state values.

Figure 10: BAPCPA and Credit Tightening—Consumption Transition

consumers to default upon a credit shock. Doubling the filing cost increases the on-impact response of aggregate consumption by 10%.

Importantly, this relation is convex. For instance, eliminating the cost of filing for bankruptcy when starting from the current BAPCPA value ($\varphi = 1.8$) dampens the consumption response by 13%, while increasing the fee by the same amount ($\varphi = 3.6$) amplifies it by 18%. In sum, an increase in the bankruptcy cost has a larger (negative) impact on the consumption response to tighter credit than a reduction in the cost of the same size. This occurs two reasons. First, in an economy where the bankruptcy cost is larger, the risky spread is more compressed, and hence, the share of outstanding debt is larger, which makes consumers more exposed to credit shocks. Second, even conditional on the total outstanding debt, a high φ discourages default on impact, contributing to a larger drop in consumption.

As an extreme case, Figure 11 (top right panel) quantifies the aggregate implications of default by assuming that, at the time the economy is hit by



Consumption transitional dynamics response to a credit tightening (of the same magnitude) under different bankruptcy code parameters values. The top-left panel presents resents the transition under different bankruptcy cost (φ). The top-right panel compares the baseline case with one in which default in the first period of the transition is prohibited. The bottom-left panel presents the transition under different duration of the bad credit score (η). Finally, the bottom-right panel compares the baseline transition with an economy without expense shocks, along with an economy without expense shocks and where default is not available. All values are expressed as percent deviations of their steady-state values.

Figure 11: Aggregate Consumption and Bankruptcy Settings

the unanticipated increase in τ, bankruptcy is too costly and consumers cannot default.[22] The drop in consumption on impact is twice as large compared to the baseline simulations.

22. We assume that filing cost φ takes an extreme value only for one period, i.e the first period of increase in τ. Both changes are unexpected.

6.2. Credit Market Exclusion

The baseline model delivers very persistent effects of a credit tightening. While the increase in τ is immediate, most of the endogenous variables take several periods to reach the new equilibrium. The endogenous decision of consumers to declare bankruptcy in response to a tightening in credit supply, can, indeed, cause the slowdown to be persistent. Figure 11 (bottom left panel) compares the baseline response of aggregate consumption to tighter credit with an alternative setting that features no exclusion from the credit market ($\eta = 0$) as well as with an extremely long exclusion of on average 50 years ($\eta = 0.98$). The longer the average exclusion from the credit market, the more persistent the negative aggregate effects of a credit tightening. However, a longer ex post exclusion from the market is also associated with ex ante easier access to the credit market. See Figure 8 (solid blue line).

7. Additional Results

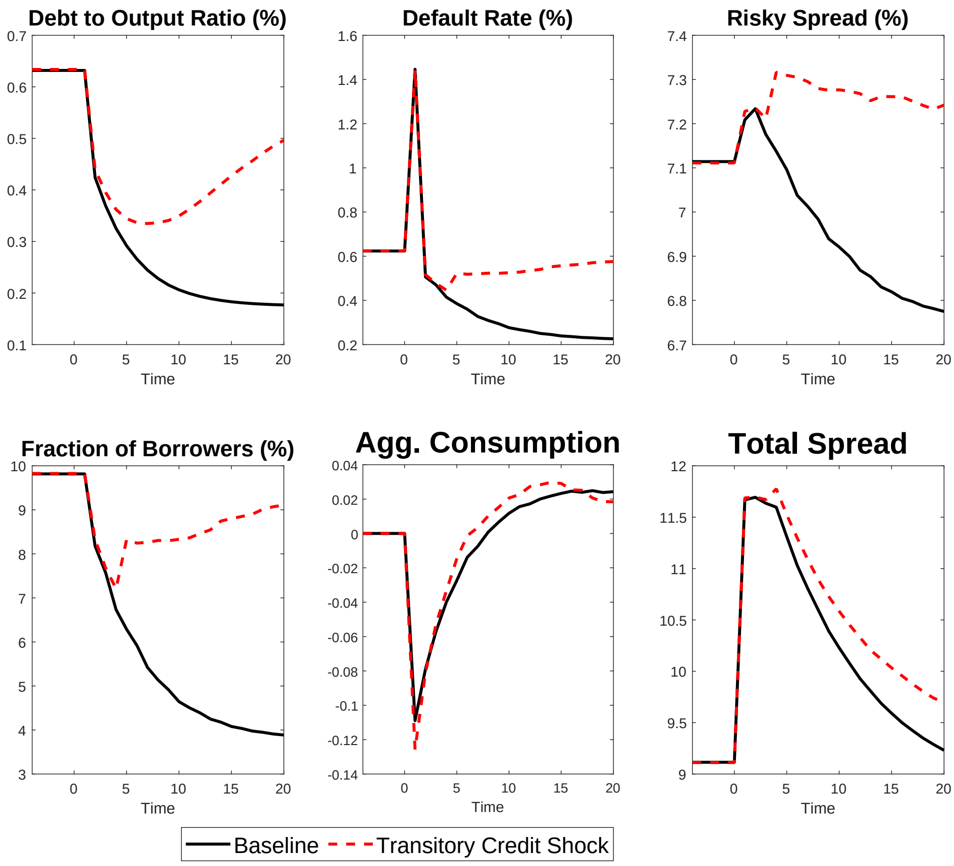
This section presents additional results on the transition to tighter credit. First, in order to further understand how bankruptcy protection interacts with the response of the economy to tighter credit, we quantify the role of the most important source of (idiosyncratic) default risk in the model: the expense shock. Finally, we study how the impact effect of the transition to tighter credit is affected by the persistence of the shock.

7.1. Expense Shocks

Figure 11 (bottom right panel) shows the model response in the absence of expense shocks during the transition to the new credit market equilibrium (red dashed line). When consumers do not face expense shocks, the drop in consumption is remarkably larger on impact. This is explained by the fact that consumers are much less risky and ex ante access to credit is easier, as depicted in Figure 8 (dotted line). Thus, the fraction of borrowers is significantly larger compared to the baseline specification. The more dramatic drop in consumption reflects the fact that a much larger fraction of agents is affected by the negative shock, and thus the deleveraging process is more severe. The credit shock produces an even harsher consumption drop (in the case with no expense shocks) when the option to default is not available. See the blue line in Figure 11 (bottom right panel). This happens because ex ante credit limits are slacker in this case, leading to more sizable borrowing and, hence, higher exposure to a credit tightening.

7.2. Temporary Credit Tightening

Our results are based on the assumption of a permanent credit tightening. In order to understand how the persistence of this effect impacts the model dynamics we



Black-solid line depicts the transitional dynamics in response to a permanent credit tightening. The dashed red line depicts the economy's response to a transitory credit tightening. The total spread (in percent) represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts, while the risky spread subtracts τ from the total spread. Aggregate consumption is expressed as percentage change from the initial steady-state value.

Figure 12: Credit Tightening—Temporary vs. Permanent Effect

now compare our baseline results of a permanent credit tightening, with a credit tightening of a temporary nature.

The red dashed line in Figure 12 depicts the economy's response to an unexpected temporary increase in τ. The experiment is conducted as follows:

- In period $t = 0$, the economy starts at the stationary equilibrium associated with the calibrated τ.
- For periods $t = 1, 2, 3, 4$ we compute the transition to an unexpected and immediate increase in τ up to the new higher time-invariant long-run level ($\tau = 4.46$).

- For periods $t = 5$ onward τ slowly reverts to the initial value at a decay rate of 0.9.[23]

The solid black line depicts the transitional dynamics in response to the baseline permanent increase in τ. The difference between the transitory and the permanent scenarios is limited, with deleveraging being naturally less pronounced in the transitory case. The latter is due to the temporary nature of the shock.[24]

8. Conclusion

We investigate the effects of a credit tightening in a quantitative model with heterogeneous households, unsecured credit and default. A sudden tightening in credit leads to a decline in the fraction of borrowers, but to a higher fraction of the less risky ones. While in the long run aggregate consumption remains roughly constant, the transition and welfare effects show large changes at the individual and aggregate consumption level. The lowest two quantiles in the income distribution experience relatively large declines in consumption during the transition and non-negligible welfare effects. In addition, the adjustment is very slow.

Our results also elucidate new policy considerations, which are often challenging in environments with heterogeneous agents and endogenous default. One of these challenges is to study the role of bankruptcy in providing insurance during a financial crisis. Less stringent bankruptcy laws can lead to credit rationing and decrease the supply of credit. However, our quantitative analysis shows that a more lenient bankruptcy system (e.g. involving a less costly bankruptcy procedure or a shorter period of exclusion from the credit market upon bankruptcy) could help to mitigate the negative and persistent effects of a credit tightening on aggregate consumption and on consumption of low asset households. Consequently, the 2005 BAPCPA, by making filing for bankruptcy more difficult, decreased the ability of relative poor households to smooth consumption and increased the welfare costs of the subsequent credit tightening.

23. The transitory but persistent nature of the shock is known after $t = 1$.

24. The drop in consumption is less pronounced in the black line due to a general equilibrium effect: a relative larger drop in the interest rate (not shown) due to the permanent shock leads to a positive consumption response, concentrated at the richer households. These are results available upon request.

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Supplementary Material
Internet Appendix

Tighter Credit and Consumer Bankruptcy Insurance

Appendix A: Appendix A: Data series and sources

Data Used in the Calibration

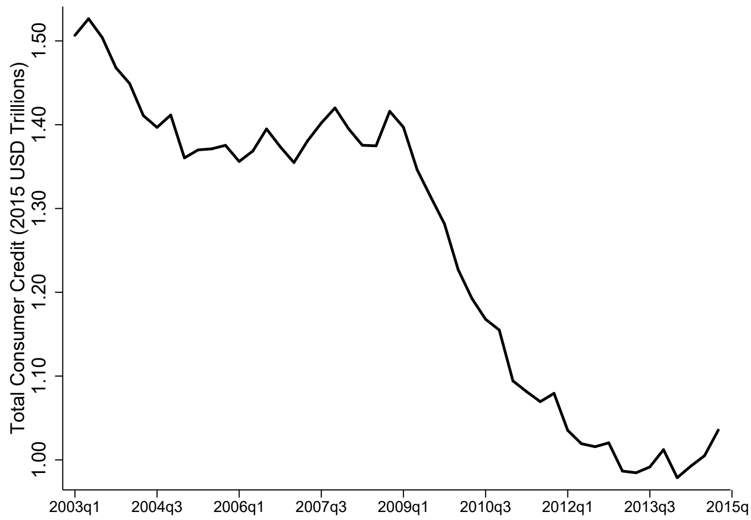
- Proportion of consumers in debt: percent of households with negative net wealth (excluding those with net worth below $120,000). Source: Survey of Consumer Finance, average over years 1990-2004.
- Unsecured debt, as a fraction of average income: average amount of debt a relative to the gross domestic output per household (Figure A3, bottom panel, red line). Sources: Survey of Consumer Finances (net worth), Bureau of Economic Analysis (Table 1.1.5, per capita income), US Census (household count), average over years 1990-2004.
- Percentage of bankruptcy filers: number of Chapter 7 non-business bankruptcy fillings relative to the number of households in the US (Figure A3, top panel). Souces: US Courts for the bankruptcy fillings and US Census via HAVER (ticker: POPH@USECON). Average over years 1990-2004.
- Consumer credit spread: Difference between the *Finance Rater on Personal Loans at Commercial Banks, 24 Month Loan* (FED Board of Governors, G19) and the *3-Month Treasury Bill: Secondary Market Rate* (H.15, FED Board of Governors), both averaged within years. Average over years 1990-2004.
- Wealth Distribution Shares, calculated using the Survey of Consumer Finances. Average over years 1990-2004.

Other

- Lending Standards (Figure 3): The Senior Loan Opinion Survey on Bank Lending; tickers: SUBLPDCLCS_N.Q (Net percentage of domestic banks tightening standards for credit card loans) and SUBLPDCLXS_N.Q (Net percentage of domestic banks tightening standards for consumer loans excluding credit card and auto loans).
- Charge-off Rates (Figure A3): Board of Governors of the Federal Reserve System (US), Charge-Off Rate on Consumer Loans, Top 100 Banks Ranked by Assets (ticker: CORCT100N), retrieved from FRED, Federal Reserve Bank of St. Louis;
  https://fred.stlouisfed.org/series/CORCT100N.
- Total Cases and Total Debt Discharged by Means of Chapter 7 (Figure A3, bottom panel); BAPCPA Tables 1A. Total Debt Discharged corresponds to

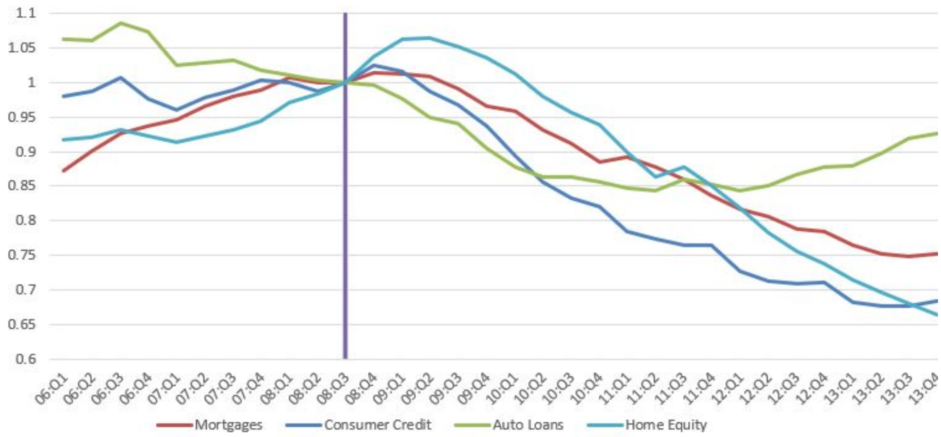
Net Scheduled Debt, ad Unsecured Debt Discharged corresponds to *Total Unsecured Debt Discharged*. Source: US Federal Courts.

- Insurance Mechanisms (Figure A1)
  - Earned Income Tax Credit Series (Annual): U.S. Department of the Treasury. Internal Revenue Service, Individual Income Tax Filing: Earned Income Credit [ENINCCTA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ENINCCTA.
  - Supplemental Nutrition Assistance Program (SNAP) Series (Annual): U.S. Bureau of Economic Analysis, Government social benefits: To persons: Federal: Supplemental Nutrition Assistance Program (SNAP) [TRP6001A027NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis;
    https://fred.stlouisfed.org/series/TRP6001A027NBEA.
  - Supplemental Security Income Series (Annual): U.S. Bureau of Economic Analysis, Government social benefits: To persons: Federal: Supplemental security income [TRP7001A027NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis;
    https://fred.stlouisfed.org/series/TRP7001A027NBEA.
  - Unemployment Insurance Series (Annual): U.S. Bureau of Economic Analysis, Personal current transfer receipts: Government social benefits to persons: Unemployment insurance [W825RC1A027NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis;
    https://fred.stlouisfed.org/series/W825RC1A027NBEA.
- Gross Domestic Product Series (U.S. Bureau of Economic Analysis, Real Gross Domestic Product [GDPC1], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDPC1.)
- Credit Volumes: New York Fed Consumer Credit Panel. The series consists of credit card debt and "other" credit categories, which includes consumer finance (sales financing, personal loans) and retail (clothing, grocery, department stores, home furnishings, gas etc) loans. The series is deflated by the CPI.
- Consumer Price Index: Organization for Economic Co-operation and Development, Consumer Price Index: Total All Items for the United States.



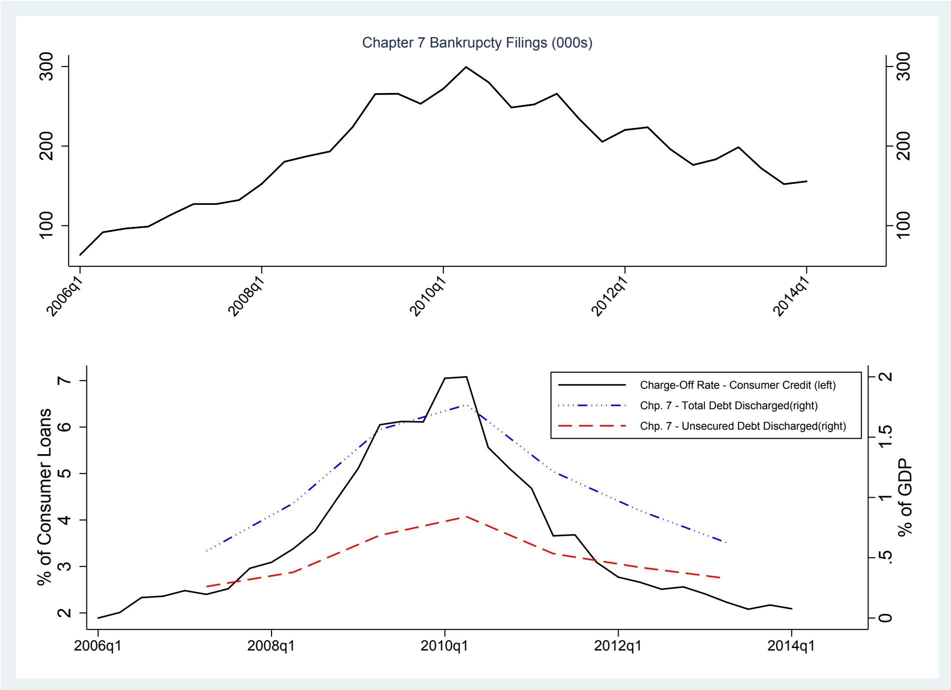
Consumer credit, measure in trillions of 2015 US dollars, CPI deflated. See Data Appendix for data sources and construction.

Figure A1: Evolution of Consumer Credit



Each line depicts the evolution of the aggregate amount of the corresponding indicator in the U.S. economy as a percentage of Gross Domestic Output, normalized to one in the outset of the financial crisis (purple-vertical line). Source: The New York FED Consumer Credit Panel.

Figure A2: Household debt



Top panel: number of Chapter 7 non-business bankruptcy fillings relative to the number of households in the US; Source in data Appendix.
Bottom panel: Charge-off rates correspond to the percentage of outstanding consumer credit balances which the largest 100 banks (by assets) write off as noncollectable. Total Debt Discharged, following the US Bankruptcy Code (28 U.S.C. 159(c)(3)(C)), corresponds to the "the aggregate amount of debt discharged in cases filed during the reporting period, determined as the difference between the total amount of debt and obligations of a debtor reported on the schedules and the amount of such debt reported in categories which are predominantly nondischargeable". Unsecured debt comprises the subset of total debt that is not backed by collateral. Typical examples of dischargeable unsecured debt are credit card debts and medical bills. Sources in data Appendix.

Figure A3: Bankruptcy and Charge-Offs

Appendix B: Appendix B: Equilibrium Conditions

Observe first that, given $h_{d,t} = h_{d,t}(x_t, s_t, \lambda_t)$, there is an endogenous transition probability from the current credit score to the future credit score that can be defined by

$$\mathcal{P}(s_t, s_{t+1}; h_{d,t}) = \begin{cases} 1 & \text{if } s_t = 0 \text{ and } s_{t+1} = 0 \text{ and } h_{d,t} = 0 \\ 0 & \text{if } s_t = 0 \text{ and } s_{t+1} = 1 \text{ and } h_{d,t} = 0 \\ 0 & \text{if } s_t = 0 \text{ and } s_{t+1} = 0 \text{ and } h_{d,t} = 1 \\ 1 & \text{if } s_t = 0 \text{ and } s_{t+1} = 1 \text{ and } h_{d,t} = 1 \\ \eta & \text{if } s_t = 1 \text{ and } s_{t+1} = 1 \\ 1-\eta & \text{if } s_t = 1 \text{ and } s_{t+1} = 0 \ . \end{cases}$$

Let $Q_t(x_t, s_t, \lambda_t, C; h_{a,t}, h_{d,t})$ be the endogenous transition probability of the households' state vector. It describes the probability that a household with state (x_t, s_t) will have a state vector lying in $C \in \Upsilon$ next period, given the current asset distribution λ_t and policy functions $h_{a,t}$ and $h_{d,t}$. Therefore,

$$Q_t(x_t, s_t, \lambda_t, C; h_{a,t}, h_{d,t}) = \sum_{(x_{t+1}, s_{t+1}) \in \mathcal{U} : (h_{a,t}, s_{t+1}) \in C} \mathcal{P}(z_t, z_{t+1}) \mathcal{P}(, e_{t+1}) \mathcal{P}(s_t, s_{t+1}; h_{d,t}) \, .$$

The aggregate law of motion implied by transition function Q_t is an object $\Lambda_t(\lambda_t, Q_t)$ that assigns a measure to each Borel set C. It can be computed as

$$\Lambda_t(\lambda_t, Q_t)(C) = \int_{\mathcal{U}} Q_t(x_t, s_t, \lambda_t, C; h_{a,t}, h_{d,t}) d\lambda_t \, . \tag{B.1}$$

We are now in a position to define the competitive equilibrium for this economy.

Definition. Given initial aggregate capital, K_0, measure of asset holdings, λ_0, bank bond holdings, $B_0 = 0$, and an exogenous spread τ, a *competitive equilibrium* consists of:

. A set of strictly positive paths for prices, $\{w_t, r_t^K, r_t\}_{t=0,\ldots,\infty}$;
. a set of non-negative paths for loan and deposit rates, and default probabilities,

$$\{q_{a_{t+1},z_t}, p_{a_{t+1},z_t}\}_{(a_{t+1},z_t) \in \mathcal{A} \times \mathcal{Z},\, t=0,\ldots,\infty} \, ;$$

. a non-negative path for the service providers markup, $\{m_t\}_{t=0,\ldots,\infty}$;
. a set of strictly positive paths for aggregate capital and labor, $\{K_t, N_t\}_{t=0,\ldots,\infty}$;
. a non-negative path for contract quantities, $\{A_{a_{t+1},z_t}\}_{(a_{t+1},z_t) \in \mathcal{A} \times \mathcal{Z},\, t=0,\ldots,\infty}$;
. a path for bank bond holdings, $\{B_t\}_{t=1,\ldots,\infty}$;
. a set of decision rules, $\{h_{a,t}, h_{c,t}, h_{d,t}\}_{t=0,\ldots,\infty}$; and
. a path for the probability measure, $\{\lambda_t\}_{t=1,\ldots,\infty}$,

such that, in every period t:

1. The decision rules $h_{a,t}$, $h_{c,t}$ and $h_{d,t}$ solve the households' optimization problem;

2. The aggregate capital K_t and labor N_t inputs solve the optimization problem of the firm;
3. Aggregate capital K_{t+1} and number of contracts A_{a_{t+1},z_t} solve the bank's optimization problem;
4. The rates of default p_{a_{t+1},z_t} are consistent with the household's default decision rule $h_{d,t}$;
5. The service providers markup m_t ensures zero profits, such that (11) is satisfied;
6. The labor market clears, $N_t = \int_X z_t d\lambda_t$;
7. The credit market clears, $\int_{\mathcal{U}} \mathcal{I}_{\{h_{a,t}(x_t,s_t,\lambda_t)=a_{t+1}\}} d\lambda_t = A_{a_{t+1},z_t}$ for all a_{t+1} and z_t;
8. The bond market clears, $B_{t+1} = 0$;
9. The goods market clears,

$$
\begin{aligned}
AK_t^{\alpha} N_t^{1-\alpha} + (1-\delta)K_t = &\int_{\mathcal{U}} h_{c,t}(x_t, s_t, \lambda_t) d\lambda_t + \int_{\mathcal{U}} h_{a,t}(x, s_t, \lambda_t) d\lambda_t \\
&+ \gamma w_t \int_{s_t=1} z_t d\lambda_t + \int_{\mathcal{U}} \frac{e_t}{m_t} d\lambda_t \, .
\end{aligned}
$$

10. The aggregate law of motion implied by the individual decision rules, $T_t(\lambda_t, Q_t)$, is consistent with the household's aggregate forecasting rule, Λ_t. That is, for every Borel set C, the measure generated by the aggregate motion equation, $\lambda^*_{t+1}(C) = T_t(\lambda_t, Q_t)(C)$, is equal to the measure associated with the aggregate forecasting rule, $\lambda_{t+1}(C)$, where $\lambda_{t+1} = \Lambda_t(\lambda_t)$.

Appendix C: Appendix C: Additional Figures and Tables

z	$\mathcal{P}(z, z')$								
0.0909	0.9227	0.0746	0.0026	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
0.1655	0.0093	0.9234	0.0653	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000
0.3014	0.0001	0.0186	0.9239	0.0560	0.0014	0.0000	0.0000	0.0000	0.0000
0.5490	0.0000	0.0003	0.0280	0.9242	0.0466	0.0009	0.0000	0.0000	0.0000
1.0000	0.0000	0.0000	0.0006	0.0373	0.9243	0.0373	0.0006	0.0000	0.0000
1.8214	0.0000	0.0000	0.0000	0.0009	0.0466	0.9242	0.0280	0.0003	0.0000
3.3174	0.0000	0.0000	0.0000	0.0000	0.0014	0.0560	0.9239	0.0186	0.0001
6.0421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0020	0.0653	0.9234	0.0093
11.0048	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0026	0.0746	0.9227

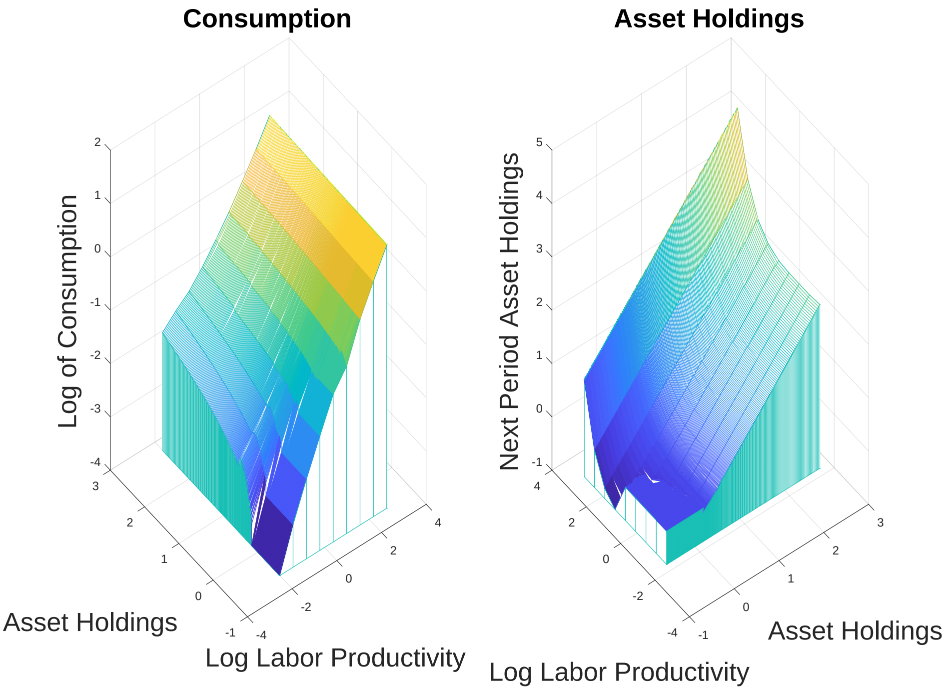
Vector with discrete values for idiosyncratic productivity and Markov matrix using Rouwenhorst's method of discretization, arranged so that the current state varies across rows and the next state varies across columns.

Table C1: Idiosyncratic Labor Productivity Shock

e	$\mathcal{P}(e, e')$	
0.0000	0.9244	0.0756
0.2830	0.9244	0.0756

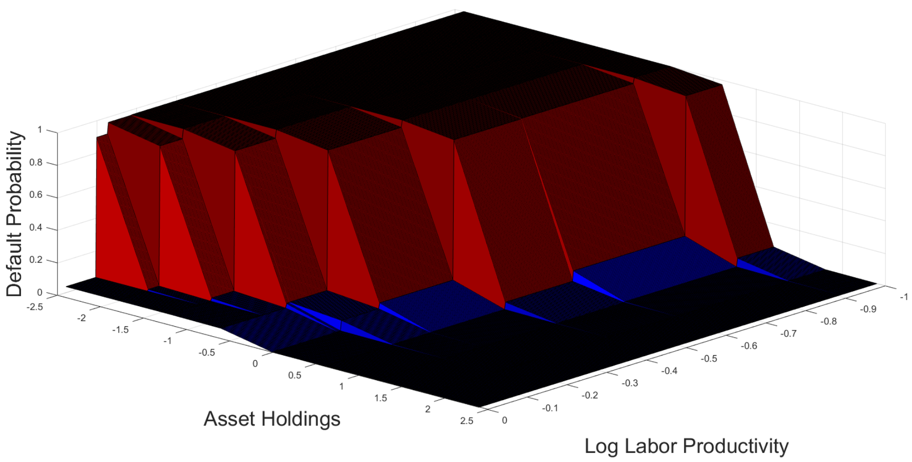
Vector with discrete values for expense shocks and Markov matrix arranged so that the current state varies across rows and the next state varies across columns.

Table C2: Expense Shock



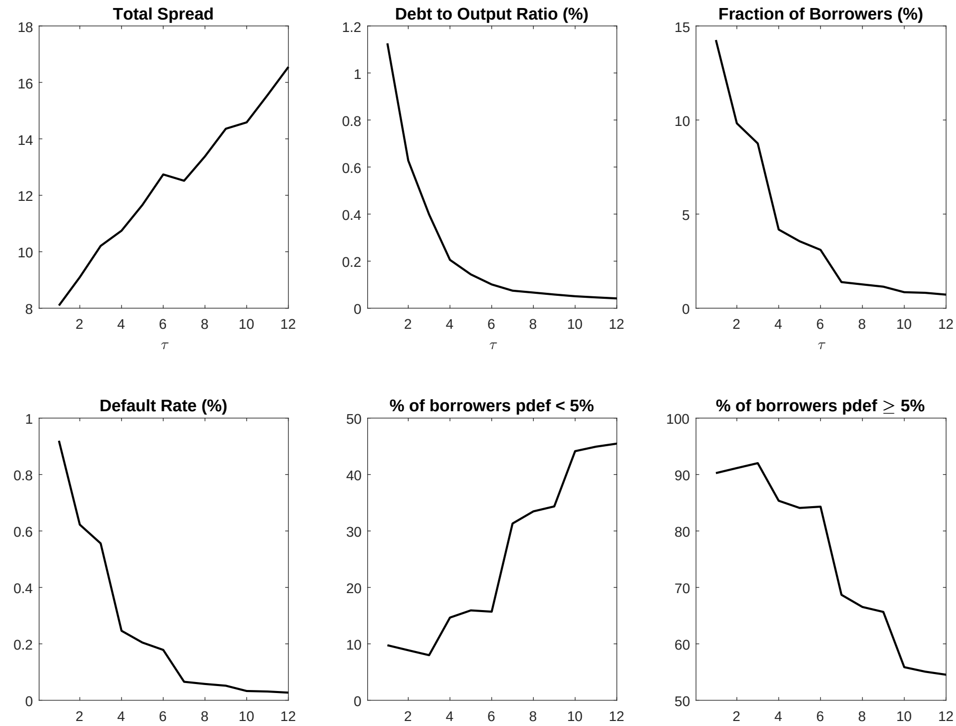
This figure plots the stationary equilibrium policy for consumption (left) and savings/loans (right), as a function of asset holdings and (the log of) labor productivity. The flat line on the right figure represents the consumers who default on their debt, and thus implicitly choose $a' = 0$.

Figure C1: Asset Policy Functions



This figure plots the next period default probabilities as a function of current assets and (the log of) labor productivity.

Figure C2: Equilibrium Default Probabilities



This figure plots outcomes of several steady-states in model economies which differ only in their intermediation cost τ. The default rate represents the share of the entire population of households that default on their debt in a given period. The total spread (in percent) represents the average difference between the loan and the risk-free rates, weighted by the number of loan contracts. The "% of borrowers pdef $< (\geq) 5\%$" represents the percentage of debtors whose next-period default probability is below (more or equal to) 5%.

Figure C3: Comparative Statics—Baseline Model

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