Aggregate Fluctuations, Consumer Credit and Bankruptcy*

Preliminary and Incomplete

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Abstract

There are large countercyclical fluctuations in U.S. bankruptcy filings and real credit card interest rates, while unsecured credit is pro-cyclical. To asses whether these observations are consistent with standard theory, we introduce aggregate fluctuations into a heterogeneous agent life-cycle incomplete market model calibrated to match key features of the U.S. economy and bankruptcy system. Household borrowing is priced by competitive financial intermediaries who can observe households' earnings, age and current asset holdings. Aggregate fluctuations change the probability of persistent shocks to household earnings, with negative shocks being more likely in recessions. This leads to asymmetric effects of credit pricing on different household types over the business cycle, since interest rates vary endogenously with borrowers' default risk. When the only source of aggregate uncertainty is income fluctuations, the calibrated model dramatically understates the volatility of bankruptcies and borrowing interest rates, and generates countercyclical borrowing. The increase in aggregate debt during recessions is largely accounted for by the extensive margin, as more households choose to borrow as a result of negative income shocks. The introduction of intermediation shocks which increase the cost of lending rate during recessions reduces the gap between model and data, and can generate pro-cyclical borrowing and increase the volatility of both filings and interest rates. However, the benchmark model still significantly understates the volatility of bankruptcy filings.

Keywords: Consumer Bankruptcy; Unsecured Credit; Business Cycles.

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1 Introduction

Despite a large and growing literature that examines how default possibilities influence credit market outcomes and consumer welfare, little attention has been paid to how cyclical fluctuations in bankruptcies interact with lenders' credit granting decisions and households borrowing. This is surprising, as the recent recession saw both a rapid rise in consumer bankruptcies, and broad concern about the potential implications of high consumer debt levels for aggregate consumption.

We address this gap in two ways. First, we document the historical cyclical relationships between different measures of U.S. consumer credit market behavior – delinquencies, charge-offs, bankruptcies, interest rates – and consumption. Second, we construct, and analyze a quantitative model of consumer borrowing and bankruptcy where agents' idiosyncratic income shocks and financial intermediation costs are affected by aggregate shocks. We use the model to decompose the driving forces behind cyclical fluctuations in the consumer credit market and their impact on defaults. In particular, we seek to identify the impact of changes in the composition of borrower risk on average interest rate and borrowing.

Our empirical analysis documents that fluctuations in consumer bankruptcies and charge-offs are large and counter-cyclical. Our proxy for the borrowing interest faced by consumers, the average (real) credit card interest rate, is counter-cyclical over 1973-2012, but exhibits a small positive correlation with GDP since 1993. Importantly, unsecured consumer borrowing is pro-cyclical, although measures such as revolving credit (primarily credit card debt) exhibit countercylical fluctuations during the Great Moderation (1993-2006).

Our quantitative approach extends a standard small-open economy incomplete market model with bankruptcy to incorporate aggregate shocks. This framework allows for borrowing constraints to move endogenously with income risk, and thus can potentially produce pro-cyclical debt without intermediation shocks. However, for reasonable parameter values, we find that aggregate fluctuations in income generates counter-cyclical debt despite matching the cyclicality of filings and consumption in the data. In addition to missing on the cyclicality of debt, the benchmark model implies cyclical volatilities in filing, interest rates and debt well below the data.

We find that introducing "intermediation shocks" – exogenous counter-cyclical shocks to the cost of funds for lenders – moves the model predictions closer to the data.[1] This

[1]Recently, (Jermann and Quadrini 2012) argue that real and financial variables are affected by "finan-

generates pro-cyclical debt, and the volatility of filings and interest rates rise closer to the data. This suggests that counter-cyclical intermediation shocks may play an important role in consumer credit markets.

The model is a heterogenous agent life-cycle model with incomplete markets, which builds upon Livshits, MacGee, and Tertilt (2007).[2] Each period, households face idiosyncratic uncertainty regarding their income and expenses. Aggregate shocks impact the probability of income shocks, as well as the risk-free rate of interest. After the realization of the aggregate state (and the individual shocks), households decide whether or not to file for bankruptcy, given some bankruptcy rules. If bankruptcy is not declared, households can borrow (and save) via one-period non-contingent bonds with perfectly competitive financial intermediaries. When making loans, financial intermediaries can observe each household's earnings process, age, current asset holdings and aggregate state. Therefore, in equilibrium, bond prices vary with income, age, total borrowing of the debtor and aggregate state.

Closest in focus to our work are Nakajima and Rios-Rull (2014), Nakajima and Rios-Rull (2005) and Gordon (2013). Nakajima and Rios-Rull (2005) introduce aggregate fluctuations into the Chatterjee et al. (2007) framework.[3] One limitation of their approach is that they assume that all shocks are realized (known) before households make borrowing decisions. As a result, all of aggregate fluctuations are fully priced into the ex ante lending schedule faced by borrowers. In contrast, under our timing, lenders set interest rates before the aggregate state is realized. Our model predicts counter-cyclical fluctuations in bankruptcy, whereas their literature predicts the opposite.[4] Nakajima and Rios-Rull (2014) extends Nakajima and Rios-Rull (2005) to a production economy where households supply labour. They find that the model can generate countercyclical borrowing, and conclude that aggregate consumption volatility would be reduced if borrowing was not permitted. Gordon (2013) also extends the Livshits, MacGee, and Tertilt (2007) framework to include aggregate shocks. Unlike our paper, he focuses on how aggregate income risk impacts the welfare gains from alternative bankruptcy regimes, whereas we focus on the extent to which the model can match key cyclical patterns

cial shocks," which affect one's ability to raise capital. They find these shocks to be counter-cyclical.

[2]This environment builds on the competitive theory of equilibrium default pioneered by Eaton and Gersovitz (1981) and adapted to analyze consumer bankruptcy by Chatterjee et al. (2007) and Livshits, MacGee, and Tertilt (2007).

[3]Recent work by Mitman (2015) extends the Chatterjee et al. (2007) framework to include a durable good (housing) and secured debt so as to examine how households debt portfolios are shaped by bankruptcy exemptions, as well as the choice between Ch. 7 and Ch. 13.

[4]The handbook of macro (Chapter 2) summarizes work on the impact of contractionary monetary shocks on consumer borrowing.

observed in the data.

Motivated by empirical studies on the cyclical variability of consumption and the relationship between consumer borrowing and aggregate consumption, several papers have sought to quantify the impact of exogenous shocks to borrowing constraints.[5] Ludvigson (1999) finds that introducing exogenous variations in borrowing constraints in a model with infinitely lived consumers helps the model to more closely match cyclical fluctuations in aggregate consumption. Krusell and Smith (1998) match the secular and cyclical properties of U.S. consumption and borrowing using a model economy with a mix of patient (standard) and impatient (borrowing constrained) households. Unlike Krusell and Smith (1998), the model abstracts from capital accumulation, and there is no trend growth in income.

There is empirical evidence that unsecured credit markets are impacted by shocks to household incomes. Sullivan (2008) uses quarterly data from the SIPP that tracks household unsecured borrowing from April 1996 to March 2000 (1996 Panel) and February 2001 to January 2004 (2001 Panel). He finds that while the lowest income households (bottom decile of income), do not use unsecured credit to smooth earnings lose, those in the second and third deciles do – with a point estimate of 11.5 to 13.4 cents per dollar of earnings lost due to unemployment, while highest earning households run down savings in response to unemployment.[6] Using data provided by a major credit card lender, Agarwal and Liu (2003) find that variations in county level unemployment rates help account for delinquency rates on credit cards between January 1994 and December 2001. Herkenhoff (2015) finds that access to unsecured credit extends the length of job search by unemployed households.

The remainder of the paper is organized as follows. We summarize background information on consumer bankruptcy in Section 2, and key cyclical properties of consumer credit markets in Section 3. The basic environment for evaluating the predictions of the standard model is presented in Section 4. Section 5 presents our results, and the final section offers a brief conclusion.

[5]Bacchetta and Gerlach (1997) use the degree of excess sensitivity of aggregate consumption as a proxy for credit constraints. They examine data from the U.S., Canada, U.K., Japan and France from 1970-1995 for consumption, disposable income and mortgage credit. Bacchetta and Gerlach (1997) extend the excess sensitivity and liquidity constraints literature by explicitly adding credit variables (real mortgage credit and real consumer credit) and lending rate spreads (borrowing/lending) to the regression analysis.

[6]Hurst and Stafford (2004) look at the use of home equity to smooth consumption for households with low levels of liquid assets. They find that this is used by households to smooth consumption.

2 Consumer Bankruptcy in the U.S.

American households can choose between two bankruptcy procedures: Chapter 7 and Chapter 13.[7] Under Chapter 7, all unsecured debt is discharged in exchange for non-collateralized assets above an exemption level, and debtors are not obliged to use future income to repay debts.[8] Chapter 13 permits debtors to keep their assets in exchange for a promise to repay part of their debt over the ensuing 3 to 5 years.[9]

Most bankrupts file under Chapter 7 (approximately 70 percent), which is the focus of our paper. Debtors who file under Chapter 7 are not permitted to refile under Chapter 7 for six years, although they may file under Chapter 13. Filers must pay the bankruptcy court filing fee of $200 and fees for legal advice that typically range from $750 to $1,500 (Sullivan, Warren, and Westbrook (2000)). In addition, a debtor filing for bankruptcy has to submit a detailed list of all creditors, amounts owed, all assets, monthly living expenses as well as the source and amount of income. A typical Chapter 7 bankruptcy takes about 4 months from start to completion.

Despite the dramatic secular increase in bankruptcy filings, the typical bankrupt today is remarkably similar to the typical bankrupt of twenty years ago (Sullivan, Warren, and Westbrook (2000), Warren (2002)). A typical bankrupt is lower middle-class (with income roughly 30-50% lower than that of the average household), in their thirties with an extremely high debt-to-income ratio and more unsecured debt, especially credit card debt, than the median household.

3 Cyclical Patterns of Credit, Consumption and Defaults

We examine annual data on consumer debt, consumption and bankruptcies from 1973-2012.[10] We detrend each series with a Hodrick and Prescott (1997) filter, and report the relationships between the cyclical deviations from trend. We set the smoothing parameter to 6.25 as argued to be appropriate for annual data by Ravn and Uhlig (2002).[11] We

[7]See Mecham (2004) for a detailed description of consumer bankruptcy law in the United States.

[8]The 2005 bankruptcy reform requires households with income above a threshold to enter into a payment plan. (See White (2007) for details on the 2005 reforms.)

[9]Legal actions by creditors and most garnishments are halted upon filing for bankruptcy, including phone calls and letters from creditors seeking repayment.

[10]The data we use is reported in the Appendix in Table 6.

[11]Using growth rates instead of filtering the data produces quantitatively similar results.

analyze logged data, so that deviation from trend approximate percentage differences. Given our interest in bankruptcy, we focus on the unsecured consumer credit.

Table 3 reports the correlations between measures of credit market variables and consumption. Given the substantial rise in consumer debt since the 1970s, as well as the development and growth of products such as credit cards and home equity lending, we compute correlations for the 1973-2012 period as well as before (i.e., 1973-1992) the Great Moderation (which we identify as 1993 to 2006) and after (i.e., the Great Recession).

There are several key relationships worth noting. First, bankruptcy filings are counter-cyclical (see Table 3 and the Figures). Cyclical fluctuations in credit discharge rates are similar to bankruptcy filings, which is not surprising as the discharge of debt via bankruptcy filings accounts for a large share of credit card discharges. As a proxy for the borrowing interest faced by consumers, we use the average (real) on credit cards[12] While credit card rates are counter-cyclical for the 1973-2012 period, they have a small positive correlation with GDP since 1993.

Consumer debt tends to be procyclical, although some debt measures shifted were countercyclical over 1993-2006. The narrowest measure of consumer credit we examine is revolving credit, which primarily consists of outstanding credit card balances. This is pro-cyclical, with the exception of the 1993-2006 period when it is counter-cyclical. A practical question – which also arises in mapping the model to the data – is how to account for charge-offs when measuring the cyclicality of debt. When we adjust the stock of revolving credit using the credit card charge-off rate over 1985-2012, we find that the correlation between revolving credit and GDP changes from -0.05 to -0.34.[13]

We consider several other proxies for unsecured consumer credit. Consumer credit (as defined by G.19) includes both revolving and non-revolving credit, where the later includes autoloans as well as consumer installment loans. This debt measure is pro-cyclical, with the exception of the "great moderation." One concern is that this shift in cyclical patterns may reflect the growth of home equity lines of credit, which has become a substitute for traditional consumer lending. This leads us to add home equity lending (which is available since 1990) to consumer credit. The correlation of this debt measure with GDO declines to -0.09 from -0.20 over 1993-2006, and becomes more strongly procyclical for the 2007-12 period..

Since the carrying cost of consumer debt needs to be evaluated relative to disposable income, we consider whether normalizing consumer credit by disposable income

[12]The rate is the unweighed average credit card rate on all balances less inflation.

[13]The published charge-off series we use begins in 1985.

Table 1: Correlations with GDP[1]

	73-92	93-06	07-12	73-12
Filings/HH	-0.61	-0.44[2]	-0.90	-0.46
Charge-Offs[3]	-0.91	-0.55	-0.87	-0.74
Consumption	0.89	0.88	0.98	0.91
Consumer Credit	0.82	-0.20	0.42	0.63
Revolving Credit	0.64	-0.24	-0.03	0.51
Consumer Debt + Home Equity Loans	0.68	-0.09	0.96	0.62
Cons. Credit/Disposable Income	0.68	-0.33	0.06	0.43
Credit Card Interest Rates	-0.72	0.06	0.15	-0.59
Disposable Income	0.84	0.52	0.97	0.81

Notes. 1. Annual data detrended with an HP-filter. 2. Excludes 05 and 06. 85 Onwards.

changes the cylicality. However, this has a relatively small impact on the correlations.

We also examine quarterly correlations. Specifically, we compute the correlations between GDP along with it's leads and lags. Overall, we see similar patterns as in Table 3. However, lagged consumer credit is weakly counter-cyclical while the lead of consumer debt to income is pro-cyclical. Real credit card interest rates counter-cyclically lead GDP.

Table 3 displays the volatilities of the credit market variables, debt and consumption relative to GDP. As Figure 3 immediately shows, filings are extremely volatile as they differ by more than a factor of 10. Similarly, charge-offs and real credit card interest rates are very volatile relative to GDP. For the most part, there are no trends in volatility. The exceptions are debt and real credit card interest rates, which appears to have become less volatile over time.

4 Environment

In this section, we outline the model, and describe our benchmark parametrization which serves as a starting point for the numerical experiments.

Table 2: Quarterly Correlations with GDP

	Y(-2)	Y(0)	Y(2)
Filings/HH	-0.44	-0.45	-0.25
Charge Offs	-0.65	-0.74	-0.57
Real Consumption	0.74	0.92	0.71
Consumer Credit	-0.42	0.17	-0.04
Revolving Consumer Credit	0.39	0.02	-0.29
Debt/Inc	0.14	-0.07	-0.14
Real Credit Card Interest Rates	0.10	-0.08	-0.36

Table 3: Volatility Relative to GDP: $\frac{\sigma}{\sigma_y}$[1]

	73-92	93-06	07-12	73-12
Filings/HH	5.9	11.9[2]	8.5	11.7
Charge-Offs[3]	9.9	16.9	17.2	15.6
Consumption	0.8	0.8	0.8	0.8
Consumer Debt	2.6	2.9	1.8	2.5
Revolving Credit	6.4	3.2	2.1	5.6
Consumer Debt + Home Equity Loans	2.6	2.2	1.3	2.6
Consumer Credit/Disposable Income	2.2	3.1	1.7	2.2
Credit Card Interest Rates	12.5	7.0	5.2	11.1
Disposable Income	1.2	1.2	1.4	1.2

Notes. 1. Annual data detrended with an HP-filter. 2. Excludes 05 and 06. 85 Onwards.

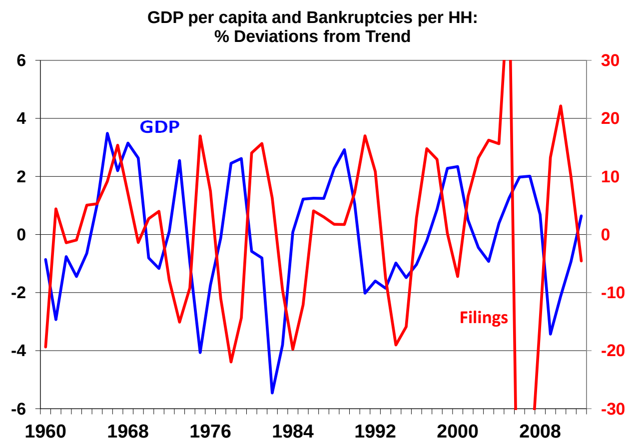


Figure I: GDP and Insolvency Filings

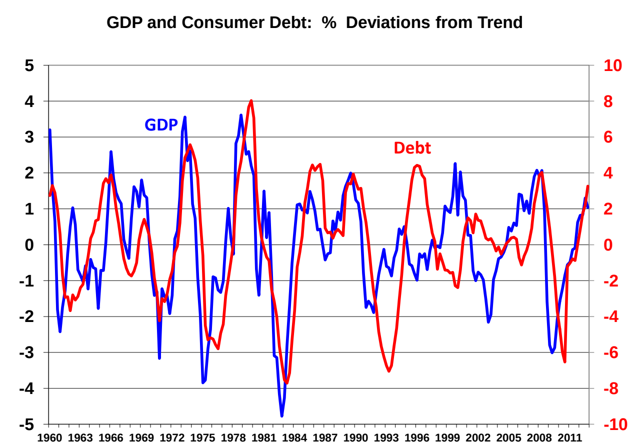


Figure II: GDP and Total Consumer Credit

4.1 The Model

We extend the "Fresh Start" model of consumer bankruptcy of Livshits, MacGee, and Tertilt (2007) by incorporating an earning process and lending cost (interest rate) which vary with the aggregate state. These extensions allow us to evaluate the contributions of these two aggregate risk channels to cyclical fluctuations in unsecured consumer borrowing and bankruptcies.

The model economy is populated by overlapping generations of J-period lived households. Each generation is comprised of measure 1 of households facing idiosyncratic and aggregate uncertainty. Markets are incomplete, with agents borrowing using non-contingent person-specific one-period bonds and saving at an exogenously given interest rate.[14] Households have the option to declare bankruptcy.

4.1.1 Households

Households maximize expected discounted life-time utility from consumption:

$$E\sum_{j=1}^{J}\beta^{j-1}u\left(\frac{c_j}{n_j}\right), \tag{4.1}$$

where β is the discount factor, c_j is household consumption and n_j is the size of a household of age j in equivalence scale units.

The labor income of a household i of age j is the product of an age-dependent labor endowment and productivity shocks:

$$y_j^i = \overline{e}_j z_j^i \eta_j^i, \tag{4.2}$$

where $\overline{e}_j$ is the deterministic endowment of efficiency units of labor, z_j^i is a persistent shock to the household's earnings, and η_j^i a transitory shock.

The probabilities of the persistent income shocks vary with the realization of the aggregate state ω. The aggregate shock impacts the distribution of idiosyncratic shocks in the current period, and thus, shifts the riskiness of income the following period if the aggregate state is persistent.

[14] As this paper focuses on the market for unsecured debt (which comprises a small fraction of total borrowing in the United States), significant feedback effects on the aggregate risk-free interest rate seem unlikely. Given the significant computational burden associated with closing the model, we assume that the aggregate capital market takes the form of a small open economy.

Besides the persistent and transitory income shocks, households face another form of idiosyncratic uncertainty: they are subject to possible expense shocks $\kappa \geq 0$. An expense shock directly changes the net asset position of a household. Expense shocks are independently and identically distributed, and are independent of income shocks (and hence do not vary with the aggregate shocks). We assume that the set of possible expense shocks K is finite. The probability of shock κ_i is denoted by π_i.

A household can file for bankruptcy. As in Chapter 7, upon filing all debts are discharged, and the household enters the following period with a balance of zero (unless hit by an expense shock that period).[15] Filers also face several types of "punishment" which proxy for specific features of Chapter 7. First, bankruptcy cannot be declared two periods in a row. Second, to capture the requirement that borrowers make a good faith effort to repay their debt, we force bankrupt households to repay a fraction γ of their earnings during the period in which they file.[16] Since we lack a direct measure of these implicit constraints on bankruptcy, we calibrate this bankruptcy cost parameter so as to match the debt facts.

The timing is as follows. At the beginning of the period, each household realizes its productivity and expense shocks. If the household receives an expense shock, then the debt of the household is increased (or savings decreased) by the amount of the shock. The household then decides whether to file for bankruptcy or not. If bankruptcy is declared, creditors garnishee labor income and the consumer is allowed to spend the remaining income. Filers are not allowed to save or borrow, thus, they consume all earnings net of debt-recovery γ (and "burning"). Households who do not declare bankruptcy decide on their asset holdings for the following period and their current consumption.

[15]This means that bankrupts cannot save or borrow during the default period because all assets are seized during a Chapter 7 bankruptcy. Given our period length of three years, one might wonder if the restriction to not allow savings constitutes a significant punishment. It turns out that the no-savings constraint is binding only for a very small fraction of households and that results do not change significantly when this assumption is relaxed.

[16]The U.S. bankruptcy code specifies that borrowers must act in "good faith", so that someone who borrows and immediately files for bankruptcy risks having their petition denied. Prior to 1984, courts had the implicit right to dismiss a case based on "bad faith" behavior by the debtor. The Bankruptcy Amendments and Federal Judgeship act of 1984 and the 1986 amendments to section 707(b) of the Code formalized this by explicitly allowing bankruptcy trustees to make a motion for dismissal for substantial abuse. While the interpretation of "substantial abuse" has varied across courts, the ability to repay a significant fraction of one's debt has often played a large role in courts' decisions to dismiss debtors' bankruptcy petitions (see Cain (1997) and Wells, Kurtz, and Calhoun (1991)).

4.1.2 Financial Intermediaries

Financial markets are perfectly competitive. Intermediaries accept deposits from savers and make loans to borrowers. The risk-free savings rate $r^s(\omega)$ is given exogenously, and varies with the aggregate state. Loans take the form of one period non-contingent bond contracts. However, the bankruptcy option introduces a partial contingency by allowing filers to discharge their debts. The face value of a loan to be repaid next period is denoted by d'. Savings are denoted by $d' < 0$. Intermediaries incur a proportional transaction cost of making loans, τ.

Intermediaries have complete information about borrowers: They observe the total level of borrowing d', the current persistent productivity shock z, the aggregate state ω and the borrower's age j.[17] This allows intermediaries to accurately forecast the default probability of a borrower, $\theta(d', z, \omega, j)$, and price the loan accordingly.

4.1.3 Equilibrium

In equilibrium, perfect competition and complete information imply that intermediaries make zero expected profit on each loan and that cross subsidization of interest rates across different types of borrowers does not occur. Therefore the individual bond price is determined by the default probability of the issuer and the risk-free bond price. Without debt-recovery, without usury law and with full discharge of debt, the zero profit condition is $q^b(d', z, j, \omega) = (1 - \theta(d', z, \omega, j))\overline{q}^b(\omega)$, where $\overline{q}^b \left(= \frac{1}{1+r^s(\omega)+\tau}\right)$ is the price of a bond with zero default probability.

For positive levels of debt-recovery, this formula needs to be adjusted. The *unrestricted bond price under debt recovery* is

$$q^{ub}(d', z, \omega, j) = (1 - \theta(d', z, \omega, j))\overline{q}^b(\omega) + \theta(d', z, \omega, j))E\left(\frac{\gamma y}{d' + \kappa'}\right)\overline{q}^b(\omega) \tag{4.3}$$

where $E\left(\frac{\gamma y}{d'+\kappa'}\right)$ is the expected rate of recovery, assuming that when a household defaults, the amount recovered is allocated proportionately to expense debt and personal loans.

[17] The realizations of the transitory shock η and the expense shock κ do not contain any additional information on the default risk.

Lastly, taking into account the interest rate ceiling $\bar{r}$, the *equilibrium bond price* is

$$q^b(d', z, \omega, j) = \begin{cases} q^{ub}(d', z, \omega, j) & \text{if } q^{ub}(d', z, \omega, j)) \geqslant \frac{1}{1+\bar{r}} \\ 0 & \text{otherwise} \end{cases} \tag{4.4}$$

Households take the bond price schedule as given when making decisions. The problem of a household is defined recursively using three distinct value functions. V is the value of a "normal period," while $\bar{V}$ is the value of declaring bankruptcy. Although bankruptcy cannot be declared two periods in a row, households have the option to default when they are ineligible for bankruptcy.[18] If a household chooses this option, they face the same proportional costs as if they were able to file for bankruptcy. However, unlike in bankruptcy, no debt is discharged. Given that households in default no longer are borrowing from the market, we assume their debt is rolled over at a fixed interest rate r^r. Note that the only debt such a household holds is debt arising from an expense shock. After the forced repayments and applying interest rate r^r, next period's debt for this case is equal to $(\kappa - \gamma \bar{e}_j z\eta)(1 + r^r)$. The value function for a household defaulting in the period following bankruptcy is denoted by W. The value functions are given by:

$$\begin{aligned} V_j(d, z, \omega, \eta, \kappa) = & \max_{c,d'} \left[u\left(\frac{c}{n_j}\right) + \beta E \max \left\{ V_{j+1}(d', z', \omega', \eta', \kappa'), \bar{V}_{j+1}(z', \omega', \eta') \right\} \right] \\ & \text{s.t. } c + d + \kappa \leqslant \bar{e}_j z\eta + q^b(d', z, \omega, j)d' \end{aligned} \tag{4.5}$$

$$\begin{aligned} \bar{V}_j(z, \omega, \eta) = & \; u\left(\frac{c}{n_j}\right) + \beta E \max \left\{ V_{j+1}(0, z', \omega', \eta', \kappa'), W_{j+1}(z', \omega', \eta', \kappa') \right\} \\ & \text{s.t. } c = (1-\lambda)(1-\gamma)(\bar{e}_j z\eta - \phi) \end{aligned} \tag{4.6}$$

$$\begin{aligned} W_j(z, \omega, \eta, \kappa) = & \; u\left(\frac{c}{n_j}\right) + \beta E \max \left\{ V_{j+1}(d', z', \omega', \eta', \kappa'), \bar{V}_{j+1}(z', \omega', \eta') \right\} \\ & \text{s.t. } c = (1-\lambda)(1-\gamma)\bar{e}_j z\eta, \qquad d' = (\kappa - \gamma \bar{e}_j z\eta)(1 + r^r) \end{aligned} \tag{4.7}$$

An equilibrium is a set of value functions, optimal decision rules for the consumer,

[18] We need to introduce this option to deal with the possibility that a household may not be able to repay the realized value of an expense shock in the period immediately following bankruptcy. In practice, this is not of much importance in the model since this situation rarely arises.

default probabilities, and bond prices, such that equations (4.5)-(4.7) are satisfied, and the bond prices are determined by the zero profit condition, taking the default probabilities as given. The model can be solved numerically by backwards induction.

4.2 Benchmark Calibration

Our approach is to choose parameters to match the US economy during the nineties, and then modify the income process and interest rates to match cyclical movements. Our discussion of how we choose long-run parameters is brief since we largely follow Livshits, MacGee, and Tertilt (2010).

4.2.1 Long-Run Averages

The non-cyclical parameterization consists of household and financial parameters. We summarize this parameterization in Table 4.

Household Parameters Households are born into the economy at age 20 and die at age 74. During the first 45 periods (ages 20-65) households receive a stochastic endowment, while the final period corresponds to a nine year retirement in which households do not face any uncertainty. The period utility function is $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$. We set the annual discount factor equal to 0.94 and the degree of risk aversion σ equal to 2.[19] Household size measured in equivalence units is taken from Livshits, MacGee, and Tertilt (2007).

The expense shocks are calibrated using data on expenses that are both unexpected and frequently cited by bankrupts as the cause of their bankruptcy. We consider three different sources of shocks: medical bills, divorces, and unplanned pregnancies. In our experiments, the expense shocks can take on three values: $\kappa \in \{0, \kappa_1, \kappa_2\}$. To calibrate the medical expense shock, we use data from the 1996 and 1997 Medical Expenditure Panel Survey (MEPS) and from the US Health Care Financing Administration (HCFA). MEPS provides detailed data on out-of-pocket medical expenses in 1996 and 1997 for a random sample of 7,435 households. We combine our estimate of these medical expenses with estimates of the cost of divorces and of an unplanned or unwanted child. Our calculations generate one shock that is 26.4 percent of (one model period) average

[19]We have also investigated somewhat higher and lower degrees of risk aversion ($\sigma = 1.5$ and 2.5) and found that our results are robust to this modification.

Table 4: Non-Cyclical Parameterization

Parameter	Target/Source
Periods (J)	45 Working Years + Retirement
Utility	$\frac{1}{1-\sigma}[c^{1-\sigma} - 1]$
Risk-aversion (σ)	2
Savings interest rate	Municipal Bonds
Age-profile of Earnings	Gourinchas and Parker '02
AR(1) Income Process	Storesletten, Telmer and Yaron '04
Expense Shocks (η)	Livshits, MacGee and Tertilt '07 Medical bills (MEPS 1996-97) Divorce (US Vital Stats, Equiv. Scale) Unwanted children (US Vital Stats, USDA)
Discount Factor (β) Transaction cost (τ) Garnishment (γ)	0.83% Chapter 7 filings 12.4% Average borrowing int. rate 9% Unsecured Debt/Income ratio 4.8% Charge-off Rate

income in the economy. The other shock is equal to 82.18 average income in the economy. The probabilities of being hit by these shocks are 7.1 percent and 0.46 percent, respectively (newly born and retired households are not subject to expense shocks).

The life-cycle profile of labor income is based on Gourinchas and Parker (2002). To incorporate aggregate fluctuations in the stochastic income process we modify an AR(1) income process used to calibrate the steady-state model. A large literature has estimated the volatility of log earnings using the following structure: $\log y^i = z^i + \eta^i + g(X^i)$, where $g(X)$ captures the deterministic component of earnings, and z and $\eta \sim N(0, \sigma_\eta^2)$ are respectively persistent and transitory random components. The log of the persistent idiosyncratic shock follows an AR(1) process, $z_j^i = \rho z_{j-1}^i + \epsilon_j^i$, where $\epsilon_j^i \sim N(0, \sigma_\epsilon^2)$. We set the benchmark value of $\rho = 0.95$, $\sigma_\epsilon^2 = 0.025$ and $\sigma_\eta^2 = 0.05$. These values are within the range of values reported by Storesletten, Telmer, and Yaron (2004), Hubbard, Skinner, and Zeldes (1994), and Carroll and Samwick (1997). To feed these values into our model for the steady-state calibration, we discretize the idiosyncratic income shocks using the Tauchen method outlined in Adda and Cooper (2003). The persistent shock is discretized as a five state Markov process, and the initial realizations for newly-born households are drawn from the stationary distribution. When discretizing the transitory shock, we assume that 10% of the population receives a positive (negative) transitory shock each period, and choose the value of the support to match the variance.

We assume that the (exogenous) income of a retired household is the sum of two parts: an autonomous income of 20% of average earnings in the economy and an additional income of 35% of their own persistent earnings realization in the period before retirement. This leads to a progressive retirement income system with an average replacement rate of 55%, which is within the range of numbers reported in Butrica, Iams, and Smith (2004). Note that total retirement income is higher as households also have private savings.

Financial Market Parameters The savings interest rate is set equal to 3.44%, as in Gourinchas and Parker (2002). The rollover interest rate r^r is set to 20% annual. The three remaining parameters — the debt recovery rate γ, transaction cost τ, and the interest rate ceiling $\bar{r}$ — are chosen to match the facts from Table 4. This leads to a transactions cost of making loans of 2.56% annually. Together with the risk-free savings rate of 3.44%, the annual risk-free lending rate is 6%. The interest rate ceiling is set to a (high) value of 75% annually.[20]

[20] As discussed in Livshits, MacGee, and Tertilt (2010), the failure to impose an interest rate ceiling leads to artificially high average interest rates.

The γ implied by this calibration is 0.319. It is worth emphasizing that this parameter captures many features of the default option introduced by bankruptcy, and that we do not interpret γ as mapping directly into what is recovered by lenders *after* a borrower has defaulted. Instead, this is intended to capture the fact that borrowers typically make a sequence of payments on unsecured debt before defaulting. As discussed in Livshits, MacGee, and Tertilt (2010), there is no direct empirical counter to determine if our parameter is too high (or low).

4.3 Cyclical Income Process

To incorporate aggregate fluctuations in the income process, we keep the income support fixed from the steady state calibration, and vary the persistent transition matrix with the aggregate state. We choose to model the aggregate shock process as a two state process, where the economy spends roughly 75% of the time in expansions and the probability of remaining in a recession ("bad" aggregate state) is one-third. Then, the transition probabilities (good,bad) in the good state are [7/9, 2/9], and [2/3, 1/3] in the bad state.

We choose two transition matrices which imply that aggregate income falls by 3% during bad times, and rise by 1% during expansions, relative to the steady-state income process. We pick a single parameter which increases the probability of receiving a lower-level income level compared to the transition matrix from Section 4.2.1. Specifically, we use the λ such that a transition matrix

$$\begin{pmatrix} (\frac{1-\lambda\sum_{j=2}^{5} z_{1,j}}{\sum_{j=2}^{5} z_{1,j}})z_{1,1} & \lambda z_{1,2} & \lambda z_{1,3} & \cdots & \lambda z_{1,5} \\ (\frac{1-\lambda\sum_{j=2}^{5} z_{2,j}}{\sum_{j=2}^{5} z_{2,j}})z_{2,1} & \lambda z_{2,2} & \lambda z_{2,3} & \cdots & \lambda z_{2,5} \\ (\frac{1-\lambda\sum_{j=3}^{5} z_{3,j}}{\sum_{j=3}^{5} z_{3,j}})z_{3,1} & (\frac{1-\lambda\sum_{j=3}^{5} z_{3,j}}{\sum_{j=3}^{5} z_{3,j}})z_{3,2} & \lambda z_{3,3} & \cdots & \lambda z_{3,5} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ (\frac{1-\lambda z_{5,5}}{z_{5,5}})z_{5,1} & (\frac{1-\lambda z_{5,5}}{z_{5,5}})z_{5,2} & \cdots & (\frac{1-\lambda z_{5,5}}{z_{5,5}})z_{5,4} & \lambda z_{5,5} \end{pmatrix}$$

matches the change in the aggregate level relative to steady state distribution.

The initial realizations for newly born households are drawn from the stationary distribution. During a recession, individuals receive less income at the beginning of their life. We choose λ' such that the first-period distribution is such that

$$D = [\frac{1}{5} + \frac{\lambda'}{5}, \frac{1}{5} - \frac{\lambda'}{5^2}, \ldots, \frac{1}{5} - \frac{\lambda'}{5^2}, \frac{1}{5} - \frac{2\lambda'}{5^2}]$$

there is a 3% drop in income during the first-period of their life and a 1% increase during expansions.

4.4 Quantitative Experiments

We use the calibrated model to assess the importance of the two aspects of aggregate shocks — changes in distribution of income shocks, and shocks to financial intermediation — for the cyclical behaviour of consumer debt and bankruptcies; and to assess whether the standard model is capable of replicating the stylized facts. Table 5 reports the results from our quantitative experiments.

In our first experiment, we model the aggregate state as affecting only the income process, and not the cost of funds. We find that changes in income shocks alone cannot generate the volatilities we see in the data and miss the cyclicality of consumer debt. Introducing intermediation shocks in the second experiment helps address both of this shortcoming, at least qualitatively. The model still struggles to match the volatilities observed in the data.

4.4.1 Experiment 1 - Income Shocks

We first analyze the quantitative impact of income shocks in our benchmark economy. While our benchmark replicates several key empirical observations, income shocks alone fail to generate filing and consumption cyclicality observed in the data. The implied volatility of bankruptcies (and thus, interest rates) are also well below those observed in the data.

A further issue is that aggregate income risk leads to countercyclical – not procyclical – debt. In response to a rise in transitory (negative) income shocks, households increase their borrowing to smooth consumption. This leads to a rise in aggregate debt in during "recessions" in the model, driven primarily by an extensive margin, as more households borrow as a result of negative income shocks.

Why does this environment fail to generate large cyclical swings in bankruptcy filings? A key factor is that over the cycle borrowing constraints do not tighten very much

Table 5: Experiments

Series	Data σ	Data $\rho(\cdot, Y)$	Constant Interest σ	Constant Interest $\rho(\cdot, Y)$	Counter-cyclical σ	Counter-cyclical $\rho(\cdot, Y)$
GDP	1.98	1	1.87	1	1.78	1
Consumption	1.78	0.87	1.11	0.98	1.58	0.78
Filings	19.2	-0.40	1.25	-0.73	2.70	-0.55
Debt	11.5	0.58	1.4	-0.41	2.36	0.29
Avg. int. rate	22.96	-0.31	0.06	-0.89	15.9	-0.43

during the recession. In Figure III, we plot the bond prices during a recession or an expansion. As one can see, the debt level where borrowers are likely to default does not change. If lenders perceived enough increased risk to making a loan, they would tighten they would endogenously tighten their borrowing constraints which would trigger more defaults.

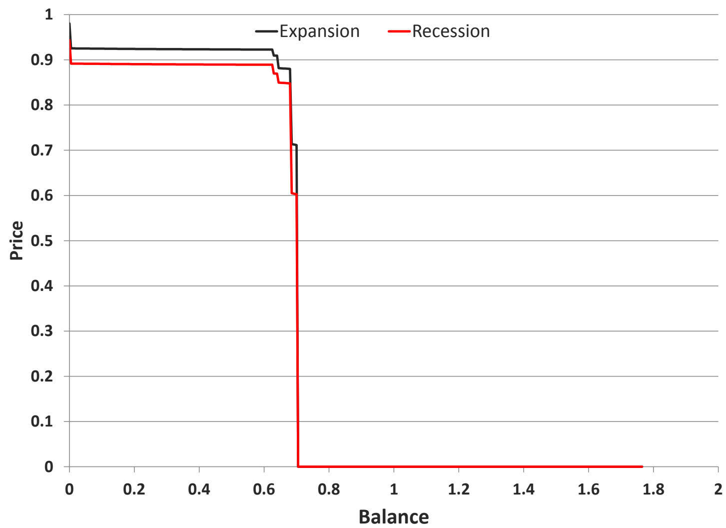
4.4.2 Experiment 2 - Income Shocks + Intermediation Shocks

In an attempt to reconcile the standard model with the empirical observations, we introduce intermediation shocks. In the second experiment, we vary the risk-free cost of saving between 2% and 6% with aggregate state. This variation in the cost of borrowing is not calibrated to any particular fact in the data, but simply intended to represent a large change in financial system during recessions which will drive up the cost of borrowing.

We show the results in the last column of Table 5. The increased borrowing costs makes it more difficult to borrow during recessions, as a result there are more defaults. This type of shock reduces the gap between the model and the data. Indeed, intermediation shocks can generate pro-cyclical borrowing. It also increases the volatility of both filings and interest rates, albeit somewhat mechanically.

This experiments demonstrates the potential importance of the lending market dur-

Figure III: Bond Prices: Expansion vs. Recession



ing recession for consumers. However, the benchmark model still understates the volatility of bankruptcy filings.

4.4.3 Summary

A standard quantitative model modified to include a cyclical income process generates filing and consumption cyclicality consistent with the data. However, this simple model cannot generate pro-cyclicality of consumer debt observed in the data. The model also dramatically understates the cyclical volatility of filings and interest rates. The basic reason for both these failures is that most households in the model are able to weather mild income shocks induced by a recession by borrowing to smooth consumption over time. Thus, recessions in such a model are accompanied by an increase in debt and only very mild increase in bankruptcy filings. And since bankruptcy rates in the model are very stable, so are the interest rates, as can be seen in Figure III. One way of thinking about this failure of the model is that the endogenous lending standards in the model do not respond enough to the aggregate shocks.

Introducing financial intermediation shocks (exogenously increasing the cost of funds during recessions) enables the basic model to reproduce pro-cyclicality of consumer debt observed in the data. Mechanically, increasing the cost of borrowing during recessions limits ability of households to smooth their idiosyncratic shocks over time, and leads to both fall in debt and an increase in bankruptcy filings in a recession. Furthermore, this exogenous mechanism directly affect variability of interest rates. Yet, even with the exogenous financial intermediation shocks, the model struggles to generate large volatility of bankruptcy filings.

5 Conclusion and Future Work

We document the historical cyclical behaviour of several key characteristics of the consumer credit market. We find that unsecured debt is (mostly) pro-cyclical, while delinquencies, charge-offs, bankruptcies, and average interest rates are counter-cyclical and very volatile. We construct and analyze a quantitative model of consumer borrowing and bankruptcy, where agents face idiosyncratic income and expense shocks and the economy is subject aggregate income distribution and financial intermediation shocks, to explain the facts. We calibrate the model and compare its predictions to the data. We use the model to decompose the driving forces behind cyclical fluctuations in the consumer credit market and their impact on defaults. The most standard model (without intermediation shocks) misses the data in two key dimensions. First, our quantitative experiments reveal that the standard model generates counter-cyclical debt despite matching the cyclicality of filings and consumption in the data. Second, the standard model fails to generate the large cyclical volatilities of filings and interest rates observed in the data.

The model's ability to match the data is greatly improved by introducing "intermediation shocks." Jermann and Quadrini (2012) argue that real and financial variables are affected by "financial shocks," which affect ones ability to raise capital. Jermann and Quadrini (2012) find these shocks to be counter-cyclical. To match this, we exogenously vary the cost of funds borrowers face. Incorporating these intermediation shocks into the benchmark model generates pro-cyclical debt. Furthermore, the cyclical volatilities of filings and interest rates become closer to the data. Thus, we argue that counter-cyclical intermediation shocks may play an important role in consumer credit markers.

This work highlights a key challenge for future research. First, the model with intermediation shocks still struggles to reproduce the volatility of filings. The quantitative model studied in this chapter suggests that cyclical variation in idiosyncratic income shocks cannot generate large volatility of bankruptcy filings, not even when combined with intermediation shocks. But this is inconsistent with the empirical findings of the previous chapter, which documents that unemployment rates are very important to explaining bankruptcy rates. Reconciling these findings is an important avenue for future research.

Our data analysis also uncovers a period where the cyclicality of debt switches. While credit is mostly pro-cyclical, this pattern does not hold in the 1990s. It is possible that the secular changes in the consumer credit market, which lead to the dramatic rise in personal bankruptcies and consumer credit, explain this phenomenon. Further research is needed to establish whether the cyclicality of debt could have switched during transition to the new steady state.

Table 6: Data Sources

Variable	Source	Note
GDP	BEA	Real, Billions
Personal Disposable Income	BEA	Nominal, Billions
Unemployment Rate	BLS	
Employment Rate	BLS	
Population	Census	Resident Population
Households	Statistical Abstracts	Thousands
CPI (Urban US)	BLS	
Bankruptcy Filings	ABI	
Revolving & Nonrevolving Credit	BOG -G19	Millions
Interest Rate	BOG -G19	Annual
Charge-off rates, credit card	FDIC	
Delinquencies, credit card	BoG - FFIEC	
Federal fund rate	BOG - H15	
Consumption	BEA	Billions
LIBOR	IMF-IFS	3 Month
3 Month T-Bills	BOG - H15	
Treasury securities	BOG - H15	5 year
Consumer Liabilities	BOG Z.1	Nominal
Mortgage Liabilities	BOG Z.1	Nominal

6 Appendix - Data Sources

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