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Financial Deregulation, Inequality, and
Indebtedness*

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Abstract

Over the last thirty years the U.S. experienced a surge in income inequality coupled with increasing levels of borrowing. We model an OLG economy populated by two types of household that care about how their consumption compares to that of their peers. In this framework individual debt-to-income ratios decrease with income, increases in consumption of rich households lead to increases in consumption of the rest, and aggregate borrowing increases with income inequality. We calibrate our model to evaluate the welfare implications of the process of financial liberalization that began in the 1980s. Our analysis suggests that some of the financial developments that lead to the recent expansion of credit may have decreased, rather than increased, welfare.

JEL Classification:

Key words: relative consumption; indebtedness; inequality; credit constraints.

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1 Introduction

Over the last three decades the U.S. financial service sector grew enormously, partly as a result of the process of financial deregulation that began in the 1980s. At its peak in 2006 value added in this sector contributed 8.3% to GDP compared to 4.9% in 1980. Over the same period income inequality and household borrowing surged. As shown in Figure 1, the share of income of the top 5% of the U.S. income distribution that was around 21% in 1980 rose to 34% by 2010. Over these thirty years real median income grew at an annual rate of 0.7%, while real average income of the top 5% increased by a factor of 2.5 as the richest 5% of U.S. households captured 54% of the real increase in U.S. GDP. Over the same period the ratio of total household debt to GDP doubled, increasing roughly from 0.49 to 0.96.¹ Furthermore this increase in indebtedness was concentrated in the bottom 95% of U.S. households. Figure 2 illustrates the divergence in debt-to-income ratios across the top 5% and the rest of U.S. income distribution. In view of this evidence it is natural to ask the following questions. Are the trends in inequality and borrowing related? Are households in the bottom 95% borrowing to compensate for the ground they have lost in terms of income relative to the top 5%? Did the process of financial liberalization that facilitated this credit expansion improve welfare?

The objective of this paper is to provide some tentative answers to these questions. We proceed in three steps. First, using the Survey of Consumer Finances (SCF) we document that debt-to-income ratios systematically decrease across the income distribution. We confirm that this gradient is not driven by consumption smoothing in the face of transitory income shocks or by demographic variation across income groups. Furthermore, we verify that the divergent patterns illustrated in Figure 2 are not driven by compositional changes in different waves of the SCF. Second, we present a simple model of interpersonal comparisons that is consistent with the evidence summarized in the previous two figures. Third, we calibrate this model to replicate some key features of the U.S. economy before the 1980s, specifically the level of labor income inequality and the variation in debt-to-income ratios between the top 5% and the bottom 95% of U.S. households. We use this calibrated economy as the ground to evaluate the welfare implications of the process of financial liberalization that began in the early 1980s. Interestingly, our results suggest that some of the financial developments that lead to the recent expansion of credit may have decreased, rather than increased, welfare.

¹This increase in debt-to-income ratios is not only driven by slower income growth but rather reflects genuine increases in indebtedness, since the growth rate of average real debt accelerated in the early 1980s.

We model an OLG economy populated by two types of households, the rich and the rest. Both types live for three periods and care about how their consumption compares to that of their peers including those above them in the income distribution. The strength of these interpersonal comparisons declines through the life cycle. Financial markets are imperfect in the sense that the need for monitoring borrowers to prevent default induces a borrowing-lending spread and that low-income households face a borrowing limit. In this context we characterize analytically several interesting results. First, individual debt-to-income ratios decrease with income. Second, increases in income of rich households lead to increases in (first- and second-period) consumption by the rest of the income distribution, trickle-down consumption as in Bertrand and Morse (2013). Third, keeping the timing of income unchanged, increases in (lifetime) income inequality lead to increases in the aggregate debt-to-income ratio. Fourth, the effects of financial liberalization on welfare are non-monotonic, for instance as the borrowing-lending spread falls welfare first decreases and then increases. This is so because the distortions associated with interpersonal comparisons induce households to devote an inefficiently large fraction of resources to consumption in the first period of life at the expense of consumption in later periods. This intertemporal reallocation of resources is made possible by borrowing. In this context, the reduction in borrowing associated with financial frictions prevents households from engaging in conspicuous consumption increasing welfare.

Additionally, our analysis highlights the role of inequality and financial deregulation as two important factors behind the increase in U.S. debt-to-income ratios. Understanding the determinants of indebtedness is important for several reasons. First, increases in debt, either private (Eggertsson and Krugman, 2012; Kumhof, et al., 2013) or public (Reinhart and Rogoff, 2011), seem to play an important role in the development of financial crises and the pace of subsequent recoveries. Second, greater indebtedness affects the sensitivity of household spending to changes in the interest rate and therefore the effectiveness of monetary policy. And third, highly-indebted households are more exposed to shocks to asset prices through greater leverage in their balance sheets.

Different aspects of this project are closely related to Christen and Morgan (2005), Becker and Rayo (2006), Alvarez-Cuadrado and Long (2012), Kumhof, et al. (2013), Bertrand and Morse (2013), Coibin, et al. (2014) and Frank, et al. (2014). Christen and Morgan (2005) provide evidence that rising income inequality through its effect on conspicuous consumption has contributed to increased consumer borrowing, particularly credit card debt. Becker and Rayo (2006) present a theoretical model where a consumer participating in the status

race, who wishes to smooth her consumption over time, must increase her level of debt in order to finance the necessary durables. Our modeling approach extends the framework in Alvarez-Cuadrado and Long (2012) to allow for borrowing and credit market imperfections. Kumhof, et al. (2013) present a theoretical model with two types of agents, top and bottom earners, where higher leverage arises endogenously in response to growing inequality. Their analysis emphasizes the role of indebtedness and default on the onset of financial and real crises. Bertrand and Morse (2013) find that, consistent with a status-driven explanation, rising income and consumption at the top of the income distribution induce households in the lower tiers of the distribution to consume a larger share of their income. In contrast to this view that emphasizes the importance of demand for credit for the increase in indebtedness, Coibin, et al. (2014) present evidence that suggests that the observed increase in indebtedness is mainly driven by developments in the supply side of the credit market. Our model incorporates both channels. Upward-looking interpersonal comparisons increase the demand for credit after an increase in top-income inequality and financial liberalization shifts out the supply of credit. Finally, Frank, et al. (2014) present a static model of status that gives rise to expenditure cascades, i.e. increases in consumption at the top induce increases in consumption in the rest of the income distribution.

Our paper also complements the growing literature on interdependent preferences, which includes Corneo and Jeanne (1998), Ljungqvist and Uhlig (2000), Liu and Turnovsky (2005), and Alonso-Carrera, et al. (2008) among others, by exploring the implications of interpersonal comparisons for borrowing. Our paper is also related to the recent literature on income and consumption inequality and draws on the abundant literature on the recent history of the U.S. financial liberalization. We will briefly discuss these streams of literature in the next section.

The rest of the paper is organized as follows. Section 2 documents some recent developments in the U.S. and discusses some of the relevant literature. Section 3 sets out the basic model and characterizes the competitive solution. Section 4 uses a simplified version of the model to explore the interaction between inequality and indebtedness. Section 5 presents a numerical analysis of the welfare changes associated with financial deregulation. Section 6 offers some concluding remarks, while the Appendix provides some technical details.

2 Recent trends in the U.S.

The objective of this section is twofold. First, we explore the robustness of the patterns documented above. Specifically, we confirm that the cross-sectional gradient in debt-to-income

ratios is not an artifact purely driven by consumption smoothing in the face of transitory income shocks or by demographic variation across the income distribution. Furthermore, we verify that the time-series evolution of the debt-to-income ratios is not driven by compositional changes in the SCF samples. Second, we briefly discuss two developments that turn out to influence some of our modeling choices; the nature of the increase in inequality and the expansion of the financial industry.

2.1 The evolution of debt-to-income ratios

In a seminal paper, Dynan, et al. (2004) find a strong positive relationship between saving rates and measures of lifetime income. We follow a similar approach to explore the robustness of the patterns illustrated in Figure 2. We proceed with our analysis in two phases. First, we explore the differences in debt-to-income ratios between the top 5% and the bottom 95%. Second, we document its time-series evolution. We use eight waves of the SCF from 1989 to 2010.² Our benchmark measure of debt includes principal residence debt, other lines of credit, debt for other residential property, credit card debt, installment loans, and other debt. The denominator of the debt-to-income ratio, total income minus capital gains, includes wages, self-employment and business income, taxable and tax-exempt interest, dividends, food stamps and other support programs provided by the government, pension income and withdrawals from retirement accounts, and Social Security income. We will also explore the robustness of our results to narrower measures of debt and income. We restrict our sample to households with heads between 30 and 59 years of age. As a result we avoid dealing with issues relevant to very young households, such as liquidity constraints, and to very old ones, such as retirement or acute health problems. We also drop households with income below \$1,000 or above \$4,000,000 (both in 2010 dollars) or debt-to-income ratios abnormally high (above 10). For each wave of the survey and for each 10-year age group separately we classify families into the top 5% and the bottom 95% of the income distribution. We estimate median regressions with different measures of the debt-to-income ratio as the dependent variable and a constant term and dummies for the top 5%, age and education of the head of the household, and household size, as independent variables. Both Dynan and Kohn (2007), for the U.S., and Bover et al (2014), for a sample of 11 E.U. countries, document the importance of these socio-demographic variables to account for the variation of debt-to-income ratios. The estimated coefficient on the constant term corresponds to the median debt-to-income ratio for households in the bottom 95% of the income distribution with one to four members

²See Bucks, et al. (2006) for a detailed description of this dataset. Our results remain unchanged when we exclude the last wave of the survey that took place in the aftermath of the financial crisis.

and with heads between 40 and 49 years old who hold a college degree, the most numerous category in our sample. Bootstrapped standard errors for the coefficients, based on 500 replications, are shown in parentheses.

Column 1 of Table 1 indicates that the median borrowing rate of the bottom 95% exceeds that of the top 5% by roughly 60%. One may think that these results are driven by mortgage debt, since arguably for households in the bottom 95% home values represent a larger fraction of their income than for those in the top 5% and home purchases are typically financed with debt. Column 2 casts doubts on this explanation. Although mortgage debt is the most important component of total debt, using a measure of debt that excludes mortgages we find that the median debt-to-income ratio of the bottom 95% exceeds that of the top 5% by even a larger factor. In line with the findings in Dynan and Kohn (2007) and Bover, et al. (2014) our estimates suggest that debt-to-income ratios fall for older households and increase with educational attainment and, to some extent, with household size. Nonetheless, any economist trained to see the world through the permanent income hypothesis will regard these results with caution. At the end of the day borrowing, together with saving, are the most important tools for households to smooth consumption in the face of transitory income shocks. The main contribution of Dynan, et al. (2004) involves the use of IV techniques to deal with the measurement error induced by transitory income shocks in the context of the saving-income relationship. Next, we extend their analysis to the relationship between borrowing and income. These authors instrument for permanent income using the reported value of owned vehicles (a measure of consumption), lagged income exploiting the 1983-89 SCF panel, and education. We use the first two instruments and abstract from the third one since it has been well documented that education has an independent effect on debt-to-income ratios. Starting in 1995, the SCF includes a measure of the value of income that the household would expect to receive in a "normal" year, normal income. Besides the instruments from Dynan, et al. (2004) we also include normal income both as an instrument and as a direct measure, or a proxy, for permanent income.

We follow a two-stage estimation procedure. In the first stage, we regress current income on one of the instruments and the set of control variables. We use the fitted values of this regression to classify households, for each 10-year age group separately, into the top 5% and the bottom 95% of the distribution of permanent income. In the second stage, we estimate median regressions as in the exercise that uses current income. When the value of vehicles is used as an instrument, we exclude from our measure of debt the outstanding value of loans used to finance vehicles. Columns 3 to 10 of Table 1 report the results of these exercises.

The basic message is consistent across specifications; households in the bottom 95% of the distribution of permanent income have debt-to-income ratios larger than those at the top 5%.

Next we turn to explore the time-series evolution of debt-to-income ratios for both income groups. For this purpose we expand the previous specifications introducing a time trend and an interaction between this trend and the top 5% dummy. If the patterns in Figure 2 are robust one would expect a positive coefficient in the time trend, capturing the secular increase in the median debt-to-income ratio of the bottom 95%, and a negative coefficient in the interaction that captures the slower increase in the debt-to-income ratio of the top 5%. This slower increase turns into a decrease if the sum of both coefficients is negative. Table 2 reports the results of these exercises using measures of current and permanent income. The signs of the two relevant coefficients are as expected and in all specifications their sum suggests that the median debt-to-income ratio of the top 5% increased much slower than that of the bottom 95% over the last 20 years. For instance, using total debt as the measure of borrowing and normal income as an instrument for permanent income (column 4), the estimates suggest that the median debt-to-income ratio of the bottom 95% increased by roughly 20 percentage points (0.009×21 years) between 1989 and 2010 an increase three times larger than that of the top 5%. Since these exercises control for education, age, and family size, it is unlikely that changes in the demographic composition of the U.S. population over the sample period lie behind the patterns illustrated in Figures 1 and 2.

Finally, Table 3 summarizes the results of some additional verifications. For compactness, we abstract from the time-series component and we focus on total debt reporting only results for current income and normal income as an instrument for permanent income. Specifications that abstract from mortgage debt, use other instruments, or include the time-series component do not change the qualitative nature of the results. Although all specifications include controls for age, education, and household size these coefficients are not reported since they are consistent with those in the previous tables. Since our income measure includes capital income one might suspect that the classification of families into the bottom 95% and the top 5% is determined by systematic differences in borrowing (or saving) propensities across individuals. Columns 1 and 2 reproduce our benchmark exercise using only labor income, wages, to classify households into income groups. Columns 3 and 4 report results using a narrower measure of debt, consumption loans. In both exercises, the benchmark result remains unchanged. The next specification includes a dummy for home ownership. The coefficient on this dummy is large, positive, and significant, suggesting that home ownership

is an important determinant of debt-to-income ratios. Nonetheless, borrowing rates of the bottom 95% exceed those of the top 5% for both home-owners and renters. In the last two columns of Table 3, we report the results of median regressions of debt-to-income ratios on a continuous measure of income and a dummy for those households in the bottom quintile of the income distribution where the fraction of credit-constrained individuals is likely to be high (Jappelli, 1990). The coefficient on the measure of income is negative and significant suggesting that the differences in borrowing rates are not restricted to the bottom 95%-top 5% partition of the income distribution but are a more general phenomenon. Additionally, all these results are robust in a sample that excludes households that derive their income from self-employment.³

All these results suggest that the patterns documented in Figure 2 are not an artifact of our choice of debt or income measures, or of demographic changes in the composition of the US population, or of systematic (non-income related) differences between the top 5% and the bottom 95%, but rather genuine differences in the borrowing choices between these two income groups.

2.2 Income inequality

Income inequality in the U.S. increased markedly over the past three decades. Most of this increase can be traced back to gains made by those near the top of the income distribution. Autor, et al. (2008) find that, since the 1980s, upper tail U.S. wage dispersion has increased significantly while lower tail dispersion has actually declined. Piketty and Saez (2003) further document the importance for inequality of changes at the very upper-end of the income and wage distributions.

At a fundamental level there are two alternative approaches to introduce income heterogeneity in aggregate models. First, following Bewley (1977) and Aiyagari (1994) agents have identical endowments and heterogeneity emerges as a result of idiosyncratic transitory shocks, i.e. variation in the transitory component of earnings. Second, along the lines of Stiglitz (1969), heterogeneity results from variation in endowments across individuals, i.e. variation in the permanent component of earnings.⁴ In the spirit of the former, Krueger and Perri (2006) and Iacoviello (2008) explore the interaction between income inequality and

³Carr and Jayadev (2013) document similar patterns in the Panel Study of Income Dynamics for the period 1999-2009. After dividing the sample into income tertiles they find that, in the lower tertile debt grew around 10 percentage points. In contrast the high income tertile deleveraged over the period, with a cumulative reduction of about 5 percentage points.

⁴Whether a change in inequality is driven by transitory or permanent income components has important welfare implications.

borrowing. Krueger and Perri (2006) use a standard incomplete markets model to account for the divergent patterns in consumption and income inequality that they document using the Consumer Expenditure Survey (CEX). They conclude that the increase in household borrowing is consistent with an increase in income inequality driven by increases in the dispersion of transitory income shocks. Iacoviello (2008) interprets the recent increase in the U.S. aggregate debt-to-income ratio as the optimal response of households to increases in the volatility of transitory income shocks. Nonetheless, recent empirical evidence casts important doubts on these interpretations of the recent increase in inequality. Primiceri and van Rens (2009) use CEX repeated cross-section data to decompose changes in income into permanent and transitory components. They find that changes in the permanent component explain all of the increase in inequality in the 1980s and 1990s. Using Social Security Administration longitudinal earnings data, Kopczuk, et al. (2010) find that virtually all of the increase in the variance in annual (log) earnings since 1970 is due to increases in the variance of the permanent component of earnings. Debacker, et al. (2013) using a large panel of tax returns find that the entire increase in cross-sectional inequality in male labor earnings over the period 1987-2009 was driven by an increase in the dispersion of the permanent component of earnings. All this evidence aligns with the second theoretical approach that emphasizes the importance of endowments as a source of inequality. As a result, our analysis will follow this approach abstracting from transitory income shocks and social mobility.

2.3 The democratization of credit

During the 30 years leading to the Great Recession the U.S. financial service sector grew enormously. At its peak in 2006 value added in this sector contributed 8.3% to GDP compared to 4.9% in 1980 implying an average growth rate twice that of the preceding 30 years (Greenwood and Scharfstein, 2013). In particular more than one-quarter of this growth can be attributed to increases in credit intermediation activities. Aside from changes in the demand for credit, there are several supply-side factors that have contributed to this process sometimes referred to as the "democratization of credit" (Black and Morgan, 1999; Dynan and Kohn, 2007).

First, financial innovation allowed for the expansion of credit supply relaxing borrowing constraints. A salient example is the process of securitization and the development of the "originate-to-distribute" model of credit (Mayer, 2011), under which mortgage brokers originate loans and then sell them to institutions that securitize them. Since brokers do not bear the ultimate costs of default, they have incentives to extend credit to marginal

applicants that previously were credit constrained. Mian and Sufi (2009) provide extensive evidence along these lines; in particular they find that after 2002 the mortgage denial rates for subprime ZIP codes fell disproportionately coinciding with an almost doubling of the fraction of originated mortgages sold to non-government-sponsored entities. Their preferred interpretation suggests that moral hazard on behalf of originators is a key determinant behind this expansion of credit. Levitin and Wachter (2012) find that between 2003 and 2007 the spread of private-label mortgage backed securities over maturity-matched Treasuries fell substantially even as mortgage risk, non-prime loans, increased. They interpret this negative relation between risk and the risk premium as caused by a shift in the supply of mortgage finance.

Second, the expansion of credit bureaus and innovations in information technology, such as computerized credit scoring models or automated underwriting systems, also contributed to the outward shift in credit supply. Athreya, et al. (2012) find that improvements in information on borrowers' default risk account for all of the increase in unsecured credit between 1983 and 2004. In the context of mortgage loans, the gains in efficiency associated with these innovations lead to reductions in the price charged by lenders. For instance, the fees associated with 30-year-fixed-rate mortgage fell from 2.5% of the principal in 1985 to about 0.5% in 2005 (U.S. Department of Housing and Urban Development, 2006).

Third, a series of regulatory changes also contributed to the expansion of credit. Rajan (2010) argues that a political response to the surge in income inequality was to expand credit to low-income groups to support their consumption levels in the face of stagnant levels of income.⁵ A few examples along these lines may include the 1978 Marquette decision, the Garn-St. Germain Depository Institutions Act, the Second Mortgage Market Enhancement Act, or the 1992 Housing and Community Development Act. In the Marquette decision the U.S. Supreme Court effectively abolished state usury laws allowing the extension of credit to high-risk and low-income borrowers (Moss and Johnson, 1999). The Garn-St. Germain Depository Institutions Act of 1982 deregulated savings and loan associations raising the ceiling on interest they can pay on deposits, providing them with Federal Deposit Insurance, and allowing them to enter new lines of business like commercial real estate and consumer lending. In 1984, with the support and leadership of the financial industry, the administration passed the Second Mortgage Market Enhancement Act which declared AA-rated mortgage-backed securities to be legal investments equivalent to Treasury securities for

⁵In contrast to Rajan (2010) where weaker credit standards result from political pressures of low-income households, Mian, et al. (2010) and Acemoglu (2011) provide evidence suggesting that these weaker standards resulted from the increasing lobbying efforts of the financial industry.

federally chartered banks state-chartered financial institutions, and Department of Labor-regulated pension funds. The Housing and Community Development Act of 1992 reduced capital requirements for Fannie Mae and Freddie Mac and over the 1990s the Federal Housing Administration expanded its loan guarantees to cover bigger mortgages with smaller down-payments.⁶

All this evidence suggests that an outward shift in credit supply is an important factor contributing to the increase in household borrowing. As a result, our theoretical analysis incorporates a simple mechanism that aims to capture these changes in the credit conditions.

3 The Model

Consider a closed economy populated by overlapping generations of households. Time is discrete and infinite with $t = 0, 1, 2, \dots \infty$.

3.1 Production

Every period firms produce a composite good that can be consumed or invested. Output, Y_t , is produced combining physical capital, K_t , labor, L_t , and labor-augmenting technology, A_t . The production function takes the familiar Cobb-Douglas specification,

$$Y_t = K_t^\alpha (A_t L_t)^{1-\alpha}, \quad (1)$$

where $0 < \alpha < 1$ measures the elasticity of output to capital. Technology grows at an exogenous rate, $\frac{A_{t+1}}{A_t} = 1 + g$. Since markets are competitive, factors are paid their marginal products,

$$w_t = (1 - \alpha) K_t^\alpha (L_t)^{-\alpha} A_t^{1-\alpha} \quad (2)$$

$$r_t = \alpha K_t^{\alpha-1} (A_t L_t)^{1-\alpha} - \delta, \quad (3)$$

where capital is assumed to depreciate at the exponential rate δ . Finally, we denote the gross return to capital by $R_t \equiv 1 + r_t$.

⁶In a similar vein, the risk-based capital regulation introduced by the 1988 Basel Accord offered banks a capital incentive to invest in mortgage-backed securities. With a risk weight of 20% for Fannie and Freddie securities and 50% for individual residential mortgage whole loans, financial institutions were allowed to increase their leverage by two to five times. This made mortgages a very attractive asset type.

3.2 Households

Individuals live for three periods: "youth", "middle-age", and "old-age". At the end of each period a new generation is born and therefore there are three generations alive at any point in time. Each generation is composed of a continuum of mass 1 of individuals. All generations are identical.

Within a generation, there are two types of individuals, denoted by the superscripts H and L , who differ in their productive endowment with $l^H > l^L > 0$. There is a fraction $0 < \mu < 1$ of type- H individuals with the remaining being type- L individuals. When $\mu = 0.05$ type- H households represent the top 5% of the income distribution and one can think of changes in their productive endowments as driving the permanent component of inequality discussed in the pervious section.

Each individual works in the first two periods of his life being retired in the third period. Let's focus on a type $i = \{H, L\}$ individual born in period t . His labor earnings when young are given by $w_{t,t}^i \equiv l^i w_t$, where the first subscript indicates his generation and the second one refers to the timing of income. As a result, his first-period budget constraint is given by

$$c_{t,t}^i = w_{t,t}^i + b_{t,t}^i \quad (4)$$

where we denote by $c_{t,t}^i$ and $b_{t,t}^i$ his levels of consumption and one-period borrowing respectively.

Labor earnings in the second period of his life are given by $w_{t,t+1}^i = h l^i w_{t+1}$ where $h > 1$ is an exogenous measure of the productive effect of experience which is common across types. Therefore, his second-period budget constraint is given by

$$c_{t,t+1}^i + R_{t+1}^x b_{t,t}^i = w_{t,t+1}^i + b_{t,t+1}^i \quad (5)$$

where the superscript $x = \{b, l\}$ denotes whether an individual was a borrower or a lender (saver) in the first period.

In the third period of his life the type i individual born in period t is retired. In this period his only source of income is the gross return on his middle-age savings which, in the absence of a bequest motive, is fully consumed in this last period. As are result his old-age budget constraint is given by⁷

$$c_{t,t+2}^i = -R_{t+2} b_{t,t+1}^i. \quad (6)$$

⁷As we will see middle-age households always choose a positive amount of saving, $b_{t,t+1}^i < 0$, and therefore we omit the superscript $x = \{b, l\}$ on the third-period budget constraint.

In order to capture the outward shift in credit supply, we will consider two types of financial market imperfections. First, although we assume individuals can lend any amount at the lending interest rate given by (3), $r_t^l \equiv r_t$, we introduce a distinction between firms that can borrow at this rate and households that need to pay a default premium. We follow Galor and Zeira (1993) by assuming that households can evade debt payments with a cost. Financial intermediaries can avoid such defaults by monitoring borrowers, but these activities are costly. Assume that if a financial intermediary spends an amount z in monitoring a borrower, this borrower can still evade re-payment but only at a cost πz , where $\pi > 1$. As we will see, these costs create a capital market imperfection, where households can borrow only at a rate that exceeds the lending rate, $r_t^b > r_t^l$. If a household borrows an amount p and financial intermediation is competitive, the default premium should exactly cover the monitoring costs leading to the following zero-profit condition

$$pr_t^b = pr_t + z \quad (7)$$

and the financial intermediary chooses the level of monitoring to be high enough to make default disadvantageous for the borrower,

$$p(1 + r_t^b) \leq \pi z. \quad (8)$$

Combining this incentive compatibility constraint, (8), with the zero-profit condition, (7), we determine the borrowing interest rate as

$$r_t^b = \frac{1}{\pi - 1} + \frac{\pi}{\pi - 1} r_t \quad (9)$$

that including the repayment of principal becomes,

$$R_t^b = 1 + r_t^b = \frac{\pi}{\pi - 1} R_t. \quad (10)$$

A first measure of the laxity of credit is given by the difference between the borrowing and lending interest rates, the interest rate spread, as a fraction of the (gross) lending rate, $\frac{r_t^b - r_t^l}{R_t^l} = \frac{1}{\pi - 1}$.

Second, besides the interest rate spread, financial markets present an additional friction, a credit constraint. By assumption, this friction only affects type- L individuals. This constraint limits the amount of middle-age wages that type- L individuals can use to finance first-period consumption,

$$b_{t,t}^L \leq \xi \frac{w_{t,t+1}^L}{R_{t+1}^b}. \quad (11)$$

Following Aghion, Bacchetta and Banerjee (2004), the fraction $0 \leq \xi \leq 1$ of the present value of future labor income that sets the borrowing limit is our second measure of the laxity of credit.

Individual preferences are given by the following life-cycle utility function

$$U_t^i = \ln(c_{t,t}^i - \gamma_0 \tilde{c}_{t,t}^i) + \beta \ln(c_{t,t+1}^i - \gamma_1 \tilde{c}_{t,t+1}^i) + \beta^2 \ln(c_{t,t+2}^i - \gamma_2 \tilde{c}_{t,t+2}^i) \quad (12)$$

where $\beta < 1$ is the subjective discount factor.

In line with the evidence on interpersonal comparisons discussed in the introduction, our key behavioral assumption is that the satisfaction derived from consumption does not depend on the absolute level of consumption itself but rather on how it compares to the level of consumption of some reference group. Furthermore, we assume that the importance of positional concerns, captured by $0 \leq \gamma_2 < \gamma_1 < \gamma_0 < 1$, decreases with age. Several pieces of evidence align with this assumption. First, the work of development psychologists and sociologists (Coleman, 1961, Simmons and Blyth, 1987, Corsaro and Eder, 1990) suggests that interpersonal comparisons and peer effects are more pronounced early in life. Second, during their youth and middle-age, people work, find partners, raise children, and they are exposed to, and therefore influenced by, a wide variety of social networks. Third, Heffetz (2011) conducts a survey on the degree of positionality of 31 categories of goods and services. He finds that expenditures that are concentrated in late periods of life, for instance medical care or bequests (life insurance), rank in the bottom third of the visibility index. To the extent that the degree of visibility is an important determinant of interpersonal comparisons, this evidence suggests that positional concerns decline with age. Fourth, more direct evidence comes from Charles, et al. (2009) and Alvarez-Cuadrado and El-Attar (2012). Charles, et al. (2009), use CEX data to document important differences in the consumption patterns for visible goods across races that they attribute to differences in the income characteristics of the reference group. These differences disappear when they restrict their sample to older households indicating that the importance of positional (visible) consumption decreases with age. Using PSID data Alvarez-Cuadrado and El-Attar (2012) evaluate the impact of reference income, measured as average local income, on individual saving decisions. They find that the negative (positive) impact of reference income on saving (consumption) decreases with age.

Following Ljungqvist and Uhlig (2000) we adopt an additive specification for relative consumption, where $\tilde{c}_{t,t+1}^i$ is the reference level of consumption of a middle-age type- i individual born at t .⁸ As Frank (1985, p. 111) points out "the sociological literature on reference group

⁸According to the terminology of Clark and Oswald (1998), our preference specification is "comparison-

theory stresses that an individual's personal reference group tends to consist of others who are similar in terms of age". Consequently, our specification restricts interpersonal comparisons to individuals within the same generation, as opposed to Abel (2005) and Alonso-Carrera, et al. (2008). Furthermore, Veblen (1899), Duesenberry (1949), and Frank (2007) eloquently argue that the behavior of successful individuals or groups sets the standard for the rest of the community. Ferrer-i-Carbonell (2005) provides convincing microeconomic evidence on the importance of upward-looking comparisons as a determinant of subjective well-being. Dynan and Ravina (2007) explore the effects on self-reported well-being of income at the ninetieth percentile of an individual's education-occupation-state group. Their results suggest that happiness of individuals above this percentile is little affected by a further increase in their income relative to this benchmark, but on the contrary individuals below this point do care to improve their position relative to the ninetieth percentile. Finally, Drechsel-Grau and Schmid (2013, 2014) estimate the effects on individual consumption of reference consumption, defined as the consumption level of all households who are perceived to be richer than the individual in question. Their estimates suggest that a 1% increase reference consumption is associated with an increase in own consumption of 0.3%. In view of this evidence, we assume the reference group of rich households is made up only of rich households while the reference group of type- L households is composed of a weighted average of both types, with $(1 - \rho)$ being the weight placed on rich households. As a result, reference consumption levels for the two groups are given by

$$\tilde{c}_{t,t}^H = c_{t,t}^H \quad \text{and} \quad \tilde{c}_{t,t}^L = \rho c_{t,t}^L + (1 - \rho) c_{t,t}^H. \quad (13)$$

Finally, we place restrictions on the distribution of productive endowments to guarantee that everyone's relative consumption is positive.

3.3 Model Solution

As a result of the interest rate spread we need to consider two separate regimes that depend on whether it is optimal for young households to borrow or lend. We refer to these two regimes as borrowing and lending.⁹ Combining (4)-(6) we reach the following lifetime budget constraint

$$c_{t,t}^i + \frac{c_{t,t+1}^i}{R_{t+1}^x} + \frac{c_{t,t+2}^i}{R_{t+1}^x R_{t+2}} = w_{t,t}^i + \frac{w_{t,t+1}^i}{R_{t+1}^x} \equiv y_t^{i,x} \quad (14)$$

concave" and therefore individuals tend to emulate their neighbors.

⁹Of course, it may also be optimal to neither borrow nor lend. In order to keep notation simple, we will limit the use of the borrowing and lending superscripts, $x = \{b, l\}$, to the interest rate and life-time income.

where $y_t^{i,x}$ is the present value of life-time income of a type- i individual born in period t operating in regime x .

This lifetime budget constraint simply states that the present value of consumption expenditures should be equal to the present value of lifetime income. Capital markets allow agents to time their consumption independently of the timing of their income.

Let's begin with the borrowing regime where we impose the following constraint

$$c_{t,t}^i \geq w_{t,t}^i \quad (15)$$

that requires non-negative borrowing for young households.

Each household takes factor prices and the choices of the other households as given and chooses consumption to maximize (12) subject to (11), (14), and (15). The solution to this problem is characterized by the following optimality conditions, where $\mu^i \geq 0$ and $\phi^i \geq 0$ are the Lagrange multipliers associated with the credit constraint and non-negative borrowing respectively,

$$\frac{1}{(c_{t,t}^i - \gamma_0 \tilde{c}_{t,t}^i)} = \frac{\beta R_{t+1}^b}{(c_{t,t+1}^i - \gamma_1 \tilde{c}_{t,t+1}^i)} + \mu^i - \phi^i \quad (16)$$

$$\frac{1}{(c_{t,t+1}^i - \gamma_1 \tilde{c}_{t,t+1}^i)} = \frac{\beta R_{t+2}}{(c_{t,t+2}^i - \gamma_2 \tilde{c}_{t,t+2}^i)} \quad (17)$$

together with (14) and the complementarity conditions associated with (11) and (15).

We proceed with the solution of the model in two stages. First, given the optimal choice of first-period consumption, $c_{t,t}^i$, we determine the remaining choices. Second, we characterize the optimal level of first-period consumption.

Let's begin by characterizing the behavior of rich households. Given first period consumption, $c_{t,t}^H$, we can solve (13), (14) and (17) to reach

$$c_{t,t+1}^H = \frac{(1 - \gamma_2)}{\beta(1 - \gamma_1)} \frac{c_{t,t+2}^H}{R_{t+2}} = -\frac{(1 - \gamma_2)}{\beta(1 - \gamma_1)} b_{t,t+1}^H = \frac{(1 - \gamma_2)}{(1 - \gamma_2) + \beta(1 - \gamma_1)} R_{t+1}^b \left(y_t^{H,b} - c_{t,t}^H \right) \quad (18)$$

$$b_{t,t}^H = c_{t,t}^H - w_{t,t}^H \geq 0. \quad (19)$$

Since, by assumption, financial intermediaries do not impose borrowing limits on rich households, $\mu^H = 0$, using (13) we can express (16) as

$$\frac{1}{c_{t,t}^H(1 - \gamma_0)} = \frac{\beta R_{t+1}^b}{c_{t,t+1}^H(1 - \gamma_1)} - \phi^H. \quad (20)$$

Within the borrowing regime we need to explore two candidate solutions, a corner solution and an interior solution. In the corner solution, $\phi^H > 0$, and therefore (15) implies that

$$c_{t,t}^H = w_{t,t}^H. \quad (21)$$

Combining (18), (20) and (21) one can see that the corner solution is optimal when the interest rate charged to borrowers exceeds the marginal rate of substitution between young- and middle-age consumption evaluated at (21), the endowment point,

$$R_{t+1}^b > \frac{(1 - \gamma_1)(1 - \gamma_2)w_{t,t+1}^H}{\beta(1 - \gamma_0)[(1 - \gamma_2) + \beta(1 - \gamma_1)]w_{t,t}^H} \equiv \frac{\partial U_t^H / \partial c_{t,t}^H}{\partial U_t^H / \partial c_{t,t+1}^H}. \quad (22)$$

In the interior solution, $\phi^H = 0$, we combine (18) and (20) to reach

$$c_{t,t}^H = \psi^H y_t^{H,b} \quad (23)$$

where $0 < \psi^H \equiv \frac{1}{1 + \beta \frac{(1 - \gamma_0)}{(1 - \gamma_1)} + \beta^2 \frac{(1 - \gamma_0)}{(1 - \gamma_2)}} < 1$.

As a result, conditional on being in the borrowing regime, first-period consumption for a rich household is given by

$$c_{t,t}^{H,b} = \max \left\{ w_{t,t}^H, \psi^H y_t^{H,b} \right\}. \quad (24)$$

A similar reasoning implies the following level of first-period consumption in the lending regime

$$c_{t,t}^{H,l} = \min \left\{ w_{t,t}^H, \psi^H y_t^{H,l} \right\}. \quad (25)$$

Notice that since preferences are quasi-concave and the constraint set is convex the necessary conditions are also sufficient. So if there is an interior solution in the borrowing (lending) regime, then we can conclude that there is no interior solution in the lending (borrowing) regime, and hence the interior solution is optimal.¹⁰ Furthermore, Figure 2 suggests that the empirically relevant case is given by the interior solution of the borrowing regime and therefore, in the remaining of the paper, we will concentrate in this case. As a result, we further restrict our use of the superscript b to the borrowing interest rate.

To sum up, in the interior solution of the borrowing regime, optimal choices for rich households are given by

$$c_{t,t}^H = \frac{c_{t,t+1}^H}{\beta R_{t+1}^b} \frac{(1 - \gamma_1)}{(1 - \gamma_0)} = \psi^H y_t^H \quad (26)$$

¹⁰Notice that we can consolidate (24) and (25) as $c_{t,t}^H = \max \left\{ \min \left\{ w_{t,t}^H, \psi^H y_t^{H,l} \right\}, \psi^H y_t^{H,b} \right\}$. If a household is in the interior solution of the borrowing regime, i.e. $\psi^H y_t^{H,b} > w_{t,t}^H$, since $y_t^{H,l} > y_t^{H,b}$ it is clear that $\min \left\{ w_{t,t}^H, \psi^H y_t^{H,l} \right\} = w_{t,t}^H$ and therefore the household is in the corner solution of the lending regime.

$$b_{t,t}^H = (\psi^H - 1) w_{t,t}^H + \psi^H \frac{w_{t,t+1}^H}{R_{t+1}^b} = \psi^H y_t^H - w_{t,t}^H > 0 \quad (27)$$

$$c_{t,t+2}^H = -R_{t+2} b_{t,t+1}^H = \beta^2 R_{t+1}^b R_{t+2} \frac{(1 - \gamma_0)}{(1 - \gamma_2)} \psi^H y_t^H \quad (28)$$

where ψ^H is a measure of the marginal (average) propensity to consume when young. In the interior solution of the borrowing regime, rich households always borrow when young and save for retirement in their middle-age.

Next, let's characterize the optimal choices of type- L households. We restrict our analysis to the interior solution of the borrowing regime, $\phi^L = 0$. As before we divide the solution in two stages. First, we determine middle- and old-age choices given first-period consumption. Second, we solve for consumption when young. Combining (13), (14), (17), (26) and (28) we reach

$$\begin{aligned} c_{t,t+1}^L &= \frac{[(1 - \gamma_2 \rho) R_{t+1}^b (y_t^L - c_{t,t}^L) + \beta^2 R_{t+1}^b (1 - \rho) \gamma_3 \psi^H y_t^H]}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \\ c_{t,t+2}^L &= \frac{\beta R_{t+2} [(1 - \gamma_1 \rho) R_{t+1}^b (y_t^L - c_{t,t}^L) - \beta R_{t+1}^b (1 - \rho) \gamma_3 \psi^H y_t^H]}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \\ b_{t,t}^L &= c_{t,t}^L - w_{t,t}^L > 0 \quad b_{t,t+1}^L = -\frac{c_{t,t+2}^L}{R_{t+2}} \end{aligned} \quad (29)$$

where $\gamma_3 \equiv \frac{(\gamma_1 - \gamma_2)(1 - \gamma_0)}{(1 - \gamma_2)(1 - \gamma_1)} > 0$.

Next we turn to the determination of first-period consumption. Since type- L households are potentially credit constrained when young, we need to consider two cases depending on whether the credit constraint binds, $\mu^L > 0$, or not, $\mu^L = 0$. We will use the superscript $Z = \{C, U\}$ to denote the "constrained" and "unconstrained" cases respectively. When the credit constraint binds, the borrowing limit determines consumption when young that combined with (29) yields the following choices

$$\begin{aligned} c_{t,t}^{L,C} &= w_{t,t}^L + \xi \frac{w_{t,t+1}^L}{R_{t+1}^b} \\ c_{t,t+1}^{L,C} &= \frac{[(1 - \gamma_2 \rho) (1 - \xi) w_{t,t+1}^L + \beta^2 R_{t+1}^b (1 - \rho) \gamma_3 \psi^H y_t^H]}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \\ c_{t,t+2}^{L,C} &= \frac{\beta R_{t+2} [(1 - \gamma_1 \rho) (1 - \xi) w_{t,t+1}^L - \beta R_{t+1}^b (1 - \rho) \gamma_3 \psi^H y_t^H]}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \\ b_{t,t}^{L,C} &= \xi \frac{w_{t,t+1}^L}{R_{t+1}^b} \quad b_{t,t+1}^{L,C} = -\frac{c_{t,t+2}^{L,C}}{R_{t+2}}. \end{aligned} \quad (30)$$

Similarly when the credit constraint is not binding, we combine (13), (16), (26), and (29) to determine the optimal choices of type- L individuals given by

$$\begin{aligned}
c_{t,t}^{L,U} &= \psi^L [(1 - \gamma_1 \rho) (1 - \gamma_2 \rho) y_t^L + \phi_0 \psi^H y_t^H] \\
c_{t,t+1}^{L,U} &= \beta R_{t+1}^b \psi^L [(1 - \gamma_0 \rho) (1 - \gamma_2 \rho) y_t^L + \phi_1 \psi^H y_t^H] \\
c_{t,t+2}^{L,U} &= \beta^2 R_{t+2} R_{t+1}^b \psi^L [(1 - \gamma_0 \rho) (1 - \gamma_1 \rho) y_t^L - \phi_2 \psi^H y_t^H] \\
b_{t,t}^{L,U} &= \psi^L \left((1 - \gamma_1 \rho) (1 - \gamma_2 \rho) y_t^{L,b} + \phi_0 \psi^H y_t^{H,b} \right) - w_{t,t}^L > 0 \quad b_{t,t+1}^{L,U} = -\frac{c_{t,t+2}^{L,U}}{R_{t+2}}
\end{aligned} \tag{31}$$

where $\psi^L \equiv \frac{1}{(1 - \gamma_1 \rho) (1 - \gamma_2 \rho) + \beta (1 - \gamma_0 \rho) ((1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho))} > 0$,

$$\begin{aligned}
\phi_0 &\equiv (1 - \rho) \beta \left\{ ((1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)) \frac{(\gamma_0 - \gamma_1)}{(1 - \gamma_1)} + \beta (1 - \gamma_1 \rho) \gamma_3 \right\} > 0, \\
\phi_1 &\equiv (1 - \rho) \left[\beta^2 (1 - \gamma_0 \rho) \gamma_3 - (1 - \gamma_2 \rho) \frac{(\gamma_0 - \gamma_1)}{(1 - \gamma_1)} \right], \\
\text{and } \phi_2 &= (1 - \rho) \left\{ (1 - \gamma_1 \rho) \frac{(\gamma_0 - \gamma_2)}{(1 - \gamma_2)} + \beta (1 - \gamma_0 \rho) \gamma_3 \right\} > 0.
\end{aligned}$$

In the presence of interpersonal comparisons, consumption of type- L households depends, not only on their lifetime income, y_t^L , but also on the lifetime income of rich households, y_t^H . The impact of reference income on consumption and borrowing choices is determined by the varying importance of interpersonal comparisons through the life-cycle. Since, by assumption, these comparisons decrease with age, positional concerns increase first-period consumption and borrowing at the expense of retirement consumption and saving.

Finally, comparing (30) and (31) we reach the following condition that determines whether the credit constraint binds,

$$\xi \leq \left[\psi^L ((1 - \gamma_1 \rho) (1 - \gamma_2 \rho) y_t^L + \phi_0 \psi^H y_t^H) - w_{t,t}^L \right] \frac{R_{t+1}^b}{w_{t,t+1}^L} \tag{32}$$

Since the amount of "desired" borrowing, the term in square brackets, depends on the timing of income, for a given value of ξ the likelihood that the constraint binds increases with the weight of the middle-age wage in lifetime income.

3.4 Dynamics of the Aggregate Capital Stock

Combining the levels of borrowing of young households with the savings of middle-age workers, the evolution of the stock of capital in period $t + 1$ is given by

$$K_{t+1} = -\mu b_{t,t}^H - (1 - \mu) b_{t,t}^L - \mu b_{t-1,t}^H - (1 - \mu) b_{t-1,t}^L. \tag{33}$$

Although this evolution depends on whether type- L households are credit constrained or not, the resulting dynamic systems have similar properties and therefore we proceed with a general analysis that drops the superscript $Z = \{C, U\}$.¹¹ At this stage it is convenient to define $x_{t+1} \equiv \frac{hw_{t+1}}{w_t R_{t+1}^b}$, the growth factor of discounted labor income over the life cycle. Under the assumption that capital fully depreciates, we replace (2) and (3) in the expression for x_{t+1} and divide (33) by w_t to express it as

$$x_{t+1} = a + \frac{b}{x_t}, \quad a, b > 0. \quad (34)$$

Denoting capital per unit of effective labor as $k_{t+1} \equiv \frac{K_{t+1}}{A_{t+1}L}$, its law of motion is given by

$$k_{t+1} = x_{t+1} \frac{\alpha}{h} \frac{1}{(1+g)} \frac{\pi}{\pi-1} (k_t)^\alpha. \quad (35)$$

The system (34)-(35) has a unique non-trivial steady state (x^*, k^*) that is globally stable. Since the slope of the transition function is negative, the path of x_t is oscillatory.

4 Some Simple Results

In this section we simplify the previous framework along several dimensions. Our goal is to provide simple analytical characterizations of the interactions between income inequality, financial liberalization, indebtedness, and welfare. All the channels explored through these simple exercises will be still at work in the general model to which we will return to for our numerical analysis.

4.1 Trickle-down Consumption, Inequality, and Indebtedness

For the sake of illustration we focus on a single generation and restrict interpersonal comparisons to the first two periods of life, i.e. $\gamma_0 = \gamma_1 = \gamma$ and $\gamma_2 = 0$.¹² Furthermore, let's abstract from financial market imperfections, so there is no credit constraint, $\xi = 1$, and the borrowing and lending interest rates coincide and are given by (3). Finally, let's assume that the timing of income is such that both types of households find optimal to

¹¹We refer the interested reader to the Appendix where we provide detailed derivations of the dynamic equations and the stability of the steady state in each of the two cases.

¹²Since we focus on a single generation we drop the generational subscript, furthermore to simplify notation we denote the first, second, and third periods of life by 0, 1, and 2.

borrow. Under these assumptions, choices for rich households are given by (23)-(28) with $\psi^H \equiv \frac{1}{1 + \beta + \beta^2(1 - \gamma)}$ and choices for type- L households simplify to

$$c_0^L = \frac{c_1^L}{\beta R_1} = \psi^L [y^L + \beta^2 \gamma (1 - \rho) \psi^H y^H] \quad (36)$$

$$b_0^L = \psi^L [y^L + \beta^2 \gamma (1 - \rho) \psi^H y^H] - w_0^L > 0 \quad (37)$$

$$c_2^L = -R_2 b_1^L = \beta^2 R_1 R_2 \psi^L [(1 - \gamma \rho) y^L - (1 + \beta) \gamma (1 - \rho) \psi^H y^H] \quad (38)$$

where $0 < \psi^L \equiv \frac{1}{1 + \beta + \beta^2(1 - \gamma \rho)} < \psi^H$.

The following propositions summarize some of the implications of upward-looking interpersonal comparisons.

Proposition 1: The cross-section of debt-to-income ratios. *Under our assumptions, individual debt-to-income ratios, $b_{rate}^i \equiv \frac{b_0^i}{w_0^i}$, decrease through the income distribution.*

Proof. Combining the definition of debt-to-income ratio with (27) and (37) it follows that¹³

$$b_{rate}^L - b_{rate}^H = \psi^H \psi^L \beta^2 \gamma (1 - \rho) \frac{y^H (w_0^H - w_0^L)}{w_0^L w_0^H} > 0.$$

In the absence of interpersonal comparisons, $\gamma = 0$, or when they are not upward-looking, $\rho = 1$, borrowing is proportional to income and therefore the debt-to-income ratio is constant in the cross-section. The introduction of upward-looking interpersonal comparisons diverts resources from less positional uses, retirement consumption, to more positional ones, first-period consumption, and this diversion falls with income. As a result, type- L households borrow a larger fraction of their income than their richer neighbors.

Proposition 2: Trickle-down consumption. *Under our assumptions, increases in first- and second-period consumption (income) of rich households lead to increases in first- and second-period consumption of type- L households:*

$$\frac{\partial c_0^L}{\partial y^H} = \psi^H \frac{\partial c_0^L}{\partial c_1^H} = \frac{1}{\beta R_1} \frac{\partial c_1^L}{\partial y^H} = \psi^H \frac{\partial c_1^L}{\partial c_1^H} = \psi^L \beta^2 \gamma (1 - \rho) \psi^H > 0.$$

As a result of upward-looking interpersonal comparisons, increases in the level of consumption of the rich shift the frame of reference that defines consumption standards for the

¹³Since lifetime income is proportional to first-period wages similar results are obtained when the debt-to-income ratio is defined using lifetime income.

rest. As a result, consumption expenditures trickle-down the income distribution and type- L households increase first- and second-period consumption expenditures at the expense of retirement consumption. This mechanism is a tractable two-type version of the expenditure cascades described by Frank, et al. (2014) by which increased consumption by households at the top leads others just below them in the income scale to spend more. Finally, notice that in the absence of interpersonal comparisons, $\gamma = 0$, or when this comparisons are not upward-looking, $\rho = 1$, the level of consumption of type- L households is independent of that of rich households and trickle-down consumption disappears.

The crucial determinant of individual borrowing, (27) and (37), is the timing of income. For a given level of lifetime income, an increase in the first-period (second-period) wage is associated with a decrease (increase) in borrowing. As a result and in order to isolate the effects of inequality on borrowing it is sensible to restrict the analysis to instances in which the timing of income is the same for both types and does not change as inequality changes. In the analysis that follows we explore the effects of this particular type of inequality.

Proposition 3. Inequality and indebtedness. *An increase in lifetime income inequality that leaves $\frac{w_0^H}{y^H} = \frac{w_0^L}{y^L}$ unchanged, and therefore does not affect the timing of income, leads to an increase in the aggregate level (rate) of borrowing.*

Proof. Defining the share of total income received by rich households by $y_s^H \equiv \frac{y^H}{y^H + y^L}$, we combine (27) and (37) to derive the aggregate (average) debt to (permanent) income ratio, b_{rate}^{agg} , as

$$b_{rate}^{agg} = y_s^H b_{rate}^H + (1 - y_s^H) b_{rate}^L = \left(\psi^L - \frac{w_0^L}{y^L} \right) + 2\beta^2\gamma(1 - \rho)\psi^L\psi^H y_s^H \quad (39)$$

which is increasing in the share of income received by rich households, y_s^H , and therefore in inequality.¹⁴

In this framework, where upward-looking interpersonal comparisons matter, an increase in income inequality increases the aggregate level of borrowing and therefore the economy-wide debt-to-income ratio. Although the fraction of lifetime income borrowed by rich households, b_{rate}^H , remains unchanged, it is clear from (37) that the increase in inequality is associated with an increase in the debt-to-income ratio of type- L households. Intuitively, after an increase in inequality, type- L households, in an attempt to keep up with the consumption patterns of their richer neighbors, increase the share of resources they devote to first-period (and second-period) consumption. This can only be achieved through additional borrowing. This result aligns well with the empirical evidence provided by Bertrand and Morse (2013)

¹⁴See the Appendix for a detailed derivation.

who report that up to one quarter of the decline in the US personal savings rate over the last three decades could be attributed to the effect of income inequality through trickle-down consumption.

4.2 Financial Liberalization and Welfare: Analytical Results

In this subsection we consider the effects of relaxing, one at a time, each of the financial market imperfections. We still focus on a single generation and we further simplify the problem by assuming this generation is composed of identical type- L households. In this case we can aggregate individual choices and solve the representative agent problem. Additionally, we eliminate the retirement period and restrict interpersonal comparisons to the first-period of life, so $\gamma_0 = \gamma > \gamma_1 = 0$. In order to explore the welfare effects of financial development we assume the timing of income is such that the representative agent wants to borrow. Finally, we assume prices are constant and therefore we abstract from general equilibrium effects mediated through changes in the real wage and the return to capital.¹⁵ All these auxiliary assumptions will be relaxed in the numerical section that follows.

4.2.1 Credit constraint

Since changes in the credit constraint only affect welfare when the borrowing limit is binding we shall focus on this specific case. Combining (32) with our simplifying assumptions, the credit constraint is binding as long as ξ satisfies

$$\xi \leq \left(\frac{1}{1 + \beta(1 - \gamma)} y^L - w_0 \right) \frac{R_1}{w_1} = \frac{1 - \beta(1 - \gamma) \frac{w_0 R_1}{w_1}}{1 + \beta(1 - \gamma)} \equiv \bar{\xi} \quad (40)$$

and in this case the optimal consumption choices for the credit constrained representative household are given by,

$$c_0 = w_0 + \xi \frac{w_1}{R_1} \quad \text{and} \quad c_1 = (1 - \xi) w_1. \quad (41)$$

Combining (12) with (41) we denote the level of welfare associated with this solution as

$$U(\xi) = \ln \left((1 - \gamma) \left(w_0 + \xi \frac{w_1}{R_1} \right) \right) + \beta \ln((1 - \xi) w_1). \quad (42)$$

The following proposition summarizes the welfare consequences of a relaxation of the credit constraint.

¹⁵One can think of a small open economy where prices are determined at the world level. Our representative household borrows from the rest of the world when young and repays in the second period of its life.

Proposition 4: The expansion of credit and welfare I. *Under a binding credit constraint as the fraction of future resources ξ that could be borrowed to finance current consumption increases, welfare first increases and then declines.*

Proof: The result follows from the differentiation of (42):

$$\frac{\partial U}{\partial \xi} = \frac{1 + \beta}{\left(\frac{w_0 R_1}{w_1} + \xi\right) (1 - \xi)} \left(\frac{1 - \beta \frac{w_0 R_1}{w_1}}{1 + \beta} - \xi \right)$$

and therefore

$$\begin{aligned} \frac{\partial U}{\partial \xi} &> 0 && \text{when } \xi < \frac{1 - \beta \frac{w_0 R_1}{w_1}}{1 + \beta} \equiv \underline{\xi} \\ \frac{\partial U}{\partial \xi} &= 0 && \text{when } \xi = \underline{\xi} \\ \frac{\partial U}{\partial \xi} &< 0 && \text{when } \underline{\xi} < \xi \leq \bar{\xi}. \end{aligned}$$

The interaction of two opposing effects drives the response of welfare to changes in the borrowing limit. First, access to credit allows agents to smooth consumption across periods. Second, since interpersonal comparisons lead to inefficiently high levels of first-period consumption, access to credit allows agents to engage in wasteful increases in conspicuous consumption. The beneficial effects associated with the former dominate as long as the constraint is relatively severe, $\xi < \underline{\xi}$, with the negative effects associated with conspicuous consumption dominating thereafter. In order to gain intuition about this result it is worth to compare the competitive solution with that of a centrally-planned economy. The central planner internalizes the effects of relative consumption on individual welfare, although we assume he is still constrained by the borrowing limit. Under these assumptions, the marginal utility of first-period consumption in the centrally-planned economy becomes $\frac{1}{c_0}$, while its competitive counterpart is given by $\frac{1}{(1 - \gamma) c_0}$. Since the *private* marginal utility of first-period consumption exceeds its *social* counterpart by a factor $\frac{1}{1 - \gamma}$, the representative household overvalues first-period consumption. As a result its willingness to increase current consumption at the expense of future consumption, the *private* marginal rate of substitution, is inefficiently high. Panel A in Figure 3 provides a simple numerical illustration. For low levels of the borrowing limit, $\xi < \underline{\xi} = 0.25$, first-period consumption is so low that the *private* and *social* marginal rates of substitution exceed the intertemporal price of consumption. As a result, as the borrowing limit increases, so do first-period consumption and welfare,

both, in the competitive and in the planned solutions. Once the borrowing limit reaches $\underline{\xi}$, first-period consumption in the centrally planned economy is no longer credit constrained and therefore further increases in the borrowing limit have no effects on the intertemporal allocation of resources or on welfare. This contrasts with the laissez-faire solution where increases in the borrowing limit beyond $\underline{\xi}$ lead to additional increases in first-period consumption. Nonetheless, these additional increases, which result from the overvaluation of current relative to future consumption, decrease welfare. In this context, the introduction of a credit constraint may be welfare-improving since it acts as a quota limiting the extent to which interpersonal comparisons divert resources from useful second-period expenditures to wasteful first-period consumption.¹⁶

4.2.2 Interest rate spread

Reductions in the interest rate spread, increases in π , only affect welfare when the representative agent is in the interior solution of the borrowing regime and therefore we shall focus in this case.¹⁷ As a result optimal consumption choices are given by

$$c_0 = \frac{1}{1 + \beta(1 - \gamma)} \left(w_0 + \frac{\pi - 1}{\pi} \frac{w_1}{R_1} \right) \quad \text{and} \quad c_1 = \frac{\beta(1 - \gamma)}{1 + \beta(1 - \gamma)} \left(\frac{\pi}{\pi - 1} R_1 w_0 + w_1 \right). \quad (43)$$

Using the counterpart of (22) it is easy to see that the interior solution for the borrowing regime arises when the parameter that governs the individual cost of default, π , satisfies

$$\pi > \frac{w_1}{w_1 - \beta R_1 w_0 (1 - \gamma)} \equiv \underline{\pi} > 0 \quad (44)$$

where the last inequality combines the fact that borrowing is positive, $b_0 = c_0 - w_0 > 0$, with (43).

Combining (12) with (43) we denote the level of welfare associated with this solution as

$$U(\pi) = \ln \left(\frac{(1 - \gamma)}{1 + \beta(1 - \gamma)} \left(w_0 + \frac{\pi - 1}{\pi} \frac{w_1}{R_1} \right) \right) + \beta \ln \left(\frac{\beta(1 - \gamma)}{1 + \beta(1 - \gamma)} \left(\frac{\pi}{\pi - 1} R_1 w_0 + w_1 \right) \right). \quad (45)$$

¹⁶Several authors have explored the welfare effects of borrowing limits. For instance, Jappelli and Pagano (1994, 1999) and Obiols-Homs (2011). The former find that the decrease in aggregate saving associated with a relaxation of the credit constraint may reduce growth and welfare in the context of an endogenous growth model. The latter find that the increase in the interest rate that follows from a reduction in credit constraints reduces welfare of those debtors that are not liquidity constrained. Finally, Nakajima (2012) explores the welfare effects of a relaxation of credit constraints in a model with preferences featuring temptation and self-control. In this context credit constraints serve as a commitment device that attenuates the overborrowing associated with hyperbolic discounting.

¹⁷Although changes in the spread do affect the threshold between the corner solution and the interior solution within the borrowing regime.

The following proposition summarizes the welfare consequences of a decrease in the borrowing-lending spread.

Proposition 5: The expansion of credit and welfare II. *In the interior solution of the borrowing regime, as the interest rate spread falls (as π increases) welfare first decreases and then increases.*

Proof: The result in this proposition follows from the differentiation of (45):

$$\frac{\partial U}{\partial \pi} = \frac{\pi (w_1 - \beta R_1 w_0) - w_1}{c_0 (1 + \beta (1 - \gamma)) R_1 \pi^2 (\pi - 1)}$$

where¹⁸

$$\begin{aligned} \frac{\partial U}{\partial \pi} &< 0 && \text{when } \underline{\pi} < \pi < \frac{w_1}{w_1 - \beta R_1 w_0} \equiv \bar{\pi} \\ \frac{\partial U}{\partial \pi} &= 0 && \text{when } \pi = \bar{\pi} \\ \frac{\partial U}{\partial \pi} &> 0 && \text{when } \pi > \bar{\pi}. \end{aligned}$$

In the interior solution of the borrowing regime decreases in the interest rate have two opposing effects on welfare. First, since young households borrow, as the cost of doing so decreases the present value of their life-time income increases. This positive income effect allows for increases in current and future consumption increasing welfare. Second, the substitution effect associated with the decrease in the relative price of current consumption shifts resources from second- to first-period uses. Since agents overvalue first-period consumption, this substitution effect has perverse welfare consequences at least for low levels of financial development. Panel B in Figure 3 illustrates this process. In the presence of high financial frictions, $\pi \in (\underline{\pi}, \bar{\pi})$, the borrowing interest rate is so high that the planner finds optimal to remain in the corner solution of the borrowing regime, equating consumption to wages in each period. In these same circumstances, competitive agents, driven by invidious comparisons, borrow against their future income to finance inefficiently high levels of first-period consumption. As a result, in the early stages of financial liberalization welfare falls. After a certain threshold is reached, $\bar{\pi}$, the positive income effect associated with further decreases in the interest rate dominates and, as a result, welfare increases.

These last two propositions emphasize the ambiguous welfare implications of some of the developments behind the expansion of credit of the last 30 years. In view of this ambiguity, in the next section we calibrate our model and explore numerically the welfare implications of an outward shift in credit supply.

¹⁸Notice that the definition of $\bar{\pi}$ imposes an additional restriction on the timing of income, $w_1 - \beta R_1 w_0 > 0$.

5 Numerical Analysis

In order to explore the welfare implications of the democratization of credit we calibrate the model to reproduce some key features of the U.S. economy prior to the 1980s. Then, under the assumption that the economy begins in the steady state associated with this calibration, we introduce three shocks; an increase in the dispersion of labor endowments (wage inequality), a reduction in financial frictions, and a decrease in the borrowing limit. Our welfare analysis compares the pre-shock steady state with the transition and the post-shock steady state.

5.1 Calibration

Panel A of Table 4 summarizes the parameter values upon which our simulations are based. The model period is 20 years. Households begin their economic life at age 25, move to their middle age at age 45, retire at age 65, and die at age 85. We begin with those parameters that are common across steady states. We set $\beta = 0.45$, which implies an annualized subjective discount rate of 4% in line with the business cycle literature (see Cooley and Prescott, 1995) and assume full depreciation consistent with the choice of period length. We target the average capital income share in the U.S. economy over the second half of the last century using the elasticity of output to capital $\alpha = 0.35$. We set the rate of productivity growth, $g = 0.49$, which implies an annualized growth rate of 2%, to match the average growth rate of per capita real output in the U.S. over the same period. Card and DiNardo (2002) construct wage-experience profiles for U.S. men using the March Current Population Survey. According to their estimates hourly wages double after 20 years of experience. This estimate implies that wages grow at an exponential rate of 3.4% per year of experience. Assuming that wage-experience profiles increase at this rate for the first 30 years of the working life and then stabilize, this estimate implies a value of $h = 1.75$. This choice is not far from the ratio of the wage rate at age 55 relative to the wage rate at age 25 estimated to be 1.9 by Roys and Seshadri (2013) using the Panel Study of Income Dynamics. The evidence on the parameters governing interpersonal comparisons, the γ 's, is sparse. Ravina (2007), using measures of consumption constructed from more than 2,500 credit-card accounts finds an estimate of γ of 0.29. Alvarez-Cuadrado, et al. (2015) report an estimate of 0.31, Maurer and Meier (2008) report estimates that range from 0.11 to 0.44 and the estimates of upward-looking interpersonal comparisons provided by Drechsel-Grau and Schmid (2013, 2014) suggest a value of γ close to one third. Since the samples in all of these papers included households ages 25 to 65, we complement this evidence with the previously discussed results

from Charles, et al. (2009) and Alvarez-Cuadrado and El-Attar (2013) that suggest that the strength of interpersonal comparisons declines with age. Along the lines suggested by this evidence we set $\gamma_0 = 0.4$, $\gamma_1 = 0.2$, and $\gamma_2 = 0.1$ in our benchmark calibration. We set $\mu = 0.05$ so that type- H households represent the top 5% of the U.S. income distribution. Finally, we set the weight of consumption of the top 5% in the reference group of type- L individuals, $1 - \rho$, equal to 0.1 stressing the importance of upward-looking comparisons. In the absence of a borrowing limit, when interpersonal comparisons only take place within group, $\rho = 1$, debt is proportional to income. In this sense ρ determines the gap between the *desired* debt-to-income ratios of the two types, where by desired we mean the debt-to-income ratio chosen by a type- L individual if the credit constraint did not bind.¹⁹ Given the uncertainty surrounding the values of ρ and the γ 's, we will explore the sensitivity of our welfare calculations to changes in these preference parameters.

Next we turn to the steady-state specific parameters. The pre- and post-shock productive endowments are set to match the share of labor income of the top 5% of the U.S. income distribution in the 1960s and in the 2000s respectively. These shares are calculated using data from the updated version of Piketty and Saez (2003). At this stage we still need to pin down two additional parameters; the borrowing limit, ξ , and the cost to evade re-payment π that is inversely related to the borrowing-lending spread. Given our previous parameter choices, we set the initial and final values of ξ and π to approximate the average debt-to-income ratios of the top 5% and bottom 95% of U.S. households ages 25 to 45 from the SCF prior to the 1980s and in the 2000s.²⁰ Since the model focuses on net debt, this calibration uses a measure of non-collateralized debt that excludes mortgages.

5.2 Financial Liberalization and Welfare: Numerical Results

In order to explore the welfare implications of the process of financial liberalization that began three decades ago and its interaction with inequality we introduce simultaneously three unanticipated permanent shocks to our initial steady state. First, keeping the aggregate productive endowment constant we change its allocation between the two types of households to reflect the increase in labor income inequality. Second, we raise the credit limit for type- L households, ξ . And third, we reduce the borrowing-lending spread through an increase in the cost to evade repayment, π . Panel B of Table 4 compares debt-to-income ratios and

¹⁹This desired level of borrowing is calculated using $b_{t,t}^{L,U}$ in (31) evaluated at the prices consistent with the relevant steady state.

²⁰Notice that while ρ affects the *desired* level of borrowing of the bottom 95%, π determines their *actual* level of borrowing.

measures of inequality across steady states. By construction the initial calibration captures well the debt-to-income ratios and the shares of labor income of the top 5% in both the initial and final steady states. The cross-sectional variation in saving and borrowing that results from upward-looking interpersonal comparisons allows the model to map inequality in endowments (labor income) into inequality in total income. Since we abstract from bequests, an important source of wealth accumulation particularly at the top of the income distribution, the model misses the level of total income inequality although it captures its change through time.²¹ While the share of total income of the top 5% generated by the model falls short of its data counterpart by almost 4 percentage points, the 51% increase in this share between the initial and final steady states is very similar to the 61% increase observed in the data over the last thirty years. Finally, our calibration delivers a marginal product of capital in the range of 8.5% slightly above the long-run real return on the S&P 500 stock index.

5.2.1 Initial Steady State

In order to understand the initial steady state configuration it is useful to consider the case that abstracts from upward-looking interpersonal comparisons, $\rho = 1$, summarized in the first column of Table 5. Since in this case type- L households are not credit constrained their debt-to-income ratio coincides with that of rich households and it is roughly 0.27, i.e. they borrow roughly one fourth of their yearly wage. This is so since the determinants of this ratio (the timing of income, the age-specific degree of interpersonal comparisons, and reference income relative to own income that determines relative consumption) are the same for both types of households. From this exercise it becomes clear that, in this framework, upward-looking interpersonal comparisons are key to generate the cross-sectional variation in debt-to-income ratios. In the initial steady state the desired debt-to-income ratio of type- L individuals is 0.66 amounting to two-thirds of their yearly wage. Nonetheless, the credit constraint lowers their actual debt-to-income ratio to 0.28. Relative to a world without upward-looking comparisons, the higher debt-to-income ratio of type- L individuals increases the demand for credit bidding up the borrowing interest rate and reducing the debt-to-income ratio of rich households to 0.26.

Finally, in terms of inequality, the share of labor income of the top 5% maps into varying shares of consumption at different ages for this same group. In the initial steady state a

²¹Kotlikoff and Summers (1981) have decomposed wealth into its life-cycle and inherited components. Their decomposition suggests that the inherited component ranges from 46 to 81 percent. Davies and Shorrocks (1999) have concluded that a reasonable estimate for this inherited component lies in the range of 35–45 percent.

share of labor income of 17% leads to a share of consumption that increases from 16.99% of total first-period consumption up to 17.43% of total retirement consumption. The tilt that interpersonal comparisons induce towards consumption when young is particularly strong for type- L households that in their attempt to keep up with the level of consumption of the top 5% in the first period fall further behind their richer neighbors in the remaining two periods of their lifetime. It is worth noticing that in the absence of upward-looking comparisons labor income inequality leads to the same amount of consumption inequality, which remains constant across age groups.

5.2.2 Final Steady State

Now we turn to explore the steady state that results after the three shocks are introduced. The decrease in financial frictions lowers the interest rate spread by almost one third, from 57 to 41 basis points. As a result both types of households find optimal to increase their borrowing. Nonetheless, the mechanical increase in first-period consumption of the top 5% that results from the increase in labor income inequality shifts upwards the frame of reference of the bottom 95%. As a result the bottom 95% increase their desired borrowing rate even further to almost 1.1 years worth of wages. Together with the higher credit limit that results from the reduction in the severity of the borrowing constraint, this increase in the demand for credit of type- L young households requires a higher return on savings to induce the adequate supply of credit from middle-age savers. This places upward pressure on the interest rate. As a result, and despite the decrease in the spread, the interest rate faced by borrowers actually increases by 11 basis points and the debt-to-income ratio of the top 5% falls by roughly 50%, from 0.26 in the initial steady state to 0.13 in the final one. At the same time the debt-to-income ratio of the bottom 95% almost doubles, increasing from 0.28 to 0.51. Overall, the increase in borrowing by type- L households, through its effects on the interest rate, displaces part of the borrowing of the rich. Finally, in terms of consumption inequality, the patterns in the final steady state are similar, although much more pronounced, than those in the initial steady state. For instance, the share of consumption of the top 5% increases from 24.6% for first-period consumption up to 26.9% for retirement consumption.

5.2.3 Transitional Dynamics

Figure 4 illustrates the transitional dynamics between steady states. The three shocks are introduced at the end of period t . Most of the adjustment of the capital stock and the debt-to-income ratio of rich households and almost all of the adjustment in the debt-to-

income ratio of the bottom 95% take place in the first 20-year period. The main source of sluggishness results from the choices of the generation born at t that entered their middle-age at the time of the shocks, but despite of this, the convergence of the model economy is very fast.²²

5.2.4 Welfare

The last rows of Table 5 report welfare changes for both types of households. These gains are equivalent variation measures, calculated as the percentage change in the lifetime flow of relative consumption necessary to equate the level of welfare in the initial steady state to that of the case under consideration.²³ In contrast to representative agent models, welfare calculations in OLG economies are subject to a certain degree of arbitrariness. To cope with this we consider four different measures that use the pre-shock steady state as their benchmark. First, we calculate the welfare change for a generation born when the post-shock steady state is already in place. We label this measure as the "long-run" welfare change. Second, we consider a generation born immediately before the shocks. We label this welfare change as "short-run". Third, we consider discounted "intertemporal" welfare changes where we compare the pre-shock steady state with the transitional path and the post-shock steady state discounting each generation at the subjective discount rate, β . Finally, we consider welfare changes holding "prices constant". The rationale for this last measure will become evident shortly.

Since the qualitative conclusions that emerge from any of the measures of welfare are similar, in the discussion that follows we restrict our attention to the long-run welfare change. Then we will highlight the differences that arise when we use other measures of welfare.

The combined effect of the three shocks leads to a welfare *gain* for a rich household roughly equivalent to 44%, i.e. for a household in the top 5% to be indifferent between the initial and the final steady states its relative consumption in each period of life in the initial steady state should be increased by 44%. The welfare *loss* for a household in the bottom 95% is very large, roughly 24% of its initial steady state relative consumption.

5.2.5 Decomposition of Welfare Changes

In order to understand the contribution of each shock to these changes in welfare it is interesting to consider the impact of one shock at a time. The last three columns of Table 5 do so.

²² Although the transitional path is in fact oscillatory the cycles are not evident to the naked eye.

²³ The calculation of welfare changes follows the methodology described in Ireland (1994).

The Effects of Inequality. Not surprisingly, the increase in inequality is the main factor behind these welfare changes. Since the increase in inequality rises the productive endowment of the rich by 47%, their consumption and therefore their welfare increase by a similar amount. Although the decrease in the productive endowment of type- L households is barely 10%, they experience a welfare loss of 23%. This loss not only captures the decrease in consumption associated with their lower endowment but also the increase in reference consumption associated with the rise in consumption expenditures of the top 5%. The welfare loss associated with the latter seems to be larger than the one associated with the former. Comparing the final steady state, column 3, with the one that only considers the increase in inequality, column 4, one begins to see that the combined effects on welfare of financial liberalization turn out to be negative. Welfare in the final steady state falls by 2.3 percentage points for the top 5% and 1.2 percentage points for the bottom 95% relative to the only-inequality steady state. These welfare losses are an approximation of the joint effects of the two measures of financial liberalization. Next, we turn to evaluate each of these two developments separately.

The Effects of Credit Limits. Column 5 in Table 5 considers a scenario where only the credit limit is relaxed. Since neither the borrowing-lending spread nor inequality change, the increase in borrowing by the bottom 95% increases the interest rate crowding out part of the demand for credit of the top 5% that reduce their borrowing rate down to 20%. Nonetheless the aggregate borrowing rate increases, from 27% to 39%, reducing the rate of capital accumulation. As a result of the lower steady state levels of capital and income, welfare for both types of households declines.²⁴ The welfare losses associated with the higher borrowing limit are substantial, exceeding 1% of the initial steady state level of relative consumption for both types. These losses are roughly two times the ones found by Nakajima (2012) in the presence of hyperbolic discounting.

The Effects of the Spread. Finally, column 6 in Table 5 considers a scenario where only the borrowing-lending spread changes. As in the final steady state the reduction in spread increases the desired level of borrowing for both types. Nonetheless since the supply of credit available for the bottom 95% is limited by a relatively stringent credit constraint rich households take advantage of the decrease in spread to increase first-period consumption. As a result their borrowing rate increases by more than 60%, from 26% to 43% of their yearly

²⁴The interest rate in our economy exceeds the rate of output growth before and after the shocks. Therefore the reported welfare losses are not driven by any of our steady states being dynamically inefficient.

wage. Notice that the increase in the interest rate that keeps in check borrowing by the top 5% in the final steady state is absent in this case since type- L households remain constrained at the initial steady state level of credit. As in the case of the credit constraint, the lower spread increases the aggregate borrowing rate reducing the pace of capital accumulation. As a result steady state output declines and so does welfare for both types of households. It is worth noticing that these welfare losses take place despite the increase in the fraction of resources available for private consumption and investment that result from a decrease in wasteful monitoring expenditures by more than one half, from 0.11% to 0.5% of GDP, associated with the increase in the cost of default, π .

5.2.6 Alternative Measures of Welfare

So far we have focused on welfare comparisons across steady states, the long-run welfare change. When we turn to short-run welfare changes the qualitative features are similar although the size of gains and losses is consistently smaller, since the shocks only affect the last two-periods of the generation born right before the shocks. According to this measure, financial liberalization provided a small welfare gain for the generation that entered their middle-age right after the shocks. Not surprisingly, the intertemporal welfare changes lie somewhere in between the previous two measures.

The welfare losses associated with a higher credit limit and the reduction in the spread capture not only the negative effects of envy on borrowing but also the decrease in income that results from the decrease in steady state capital. In order to focus on the interaction between financial liberalization and interpersonal comparisons, abstracting from the general equilibrium effects associated with price changes, we introduce an additional measure of welfare that keeps the capital stock constant at the initial steady state level. This measure, reported in the last two rows of table 5, captures the change in welfare that results from changes in the timing of consumption holding the level of income unchanged. Even according to this metric, the increase in the credit limit and the reduction in the spread are associated with welfare losses for both types of households, ranging from one tenth to one fifth of a percentage point of the initial steady state level of relative consumption. Of course, holding prices constant, the decrease in the borrowing limit has no effect on the welfare of the top 5%.²⁵

²⁵ At the prices associated with initial steady state a central planner that acknowledges the effects of individual consumption on others' welfare that result from interpersonal comparisons chooses a negative level of borrowing, i.e. in the planner's solution young households are savers.

5.2.7 Sentitivity Analysis

Given the limited empirical evidence on the value of the parameters that govern the degree of interpersonal comparisons, the γ 's, and the composition of the reference group for type- L households, ρ , it is worth to explore the robustness of these welfare changes to variations in these parameter values. Table 6 summarizes the results of this sensitivity analysis where the borrowing limit and the borrowing-lending spread are adjusted to ensure that debt-to-income ratios are consistent with those in the data before and after the shocks. The results are intuitive. Increases in the share of consumption of the top 5% that enters the reference level of the bottom 95%, ρ , or on the strength of interpersonal comparisons, γ_i , lead to larger welfare losses for the bottom 95% relative to our baseline calibration. In terms of the welfare consequences of the decrease in financial frictions, these exercises suggest that the qualitative implications of our benchmark analysis are robust. In all scenarios, the decrease in the borrowing-lending spread and the increase in the borrowing limit are associated with welfare losses for both types of households. These results contrast with those obtained in the case that abstracts from interpersonal comparisons, $\gamma_0 = \gamma_1 = \gamma_2 = 0$, reported in last two rows of Table 6. In this case, the desired debt-to-income ratio is the same across types so the model cannot match the cross-sectional variation in the data. As an alternative we simply focus on the average debt-to-income ratio in the 1960s and 2000s. This requires increasing the value of the wage-experience profile to $h = 2$. This exercise suggests that in the absence of interpersonal comparisons both types would have benefited from financial liberalization with welfare gains in the order of one fifth of a percentage point of the initial steady state level of relative consumption. Nonetheless, as we have just pointed out, this calibration is not consistent with the observed variation in debt-to-income ratios at a point in time or with their evolution over the last thirty years.

Overall, this analysis suggests that the welfare consequences of the democratization of credit are far from obvious. In fact if these results are taken literally one is likely to conclude that some of the recent financial developments have decreased, rather than increased, welfare.

6 Conclusions

Income inequality in the U.S. increased substantially over the last three decades. This surge in inequality coincided with an unprecedented growth of the financial industry partially driven by a large increase in credit intermediation activities. The expansion of credit coupled with the increase in inequality resulted in a doubling of the aggregate debt-to-GDP

ratio over the same period. Furthermore, the evolution of debt-to-income ratios has varied systematically across the income distribution. While this ratio increased substantially for households in the bottom 95% it barely rose, or actually fell, for those households in the top 5% of the U.S. income distribution.

We first document, using SCF data, that the systematic variation in debt-to-income ratios across the income distribution is not driven by consumption smoothing in the face of transitory income shocks or by variation in socio-demographic characteristics correlated with income.

Second, we present a simple OLG economy with two types of households that is consistent with these developments. Our key assumption is that individuals engage in age-specific upward-looking interpersonal comparisons. In this context, an increase in the share of income (consumption) of the rich shifts up the frame of reference for the rest of the income distribution that responds increasing their consumption. Nonetheless, this process of trickle-down in consumption in the first periods of life is only possible at the expense of consumption at later periods. As a result borrowing by non-rich households increases and so does the aggregate debt-to-GDP ratio. We calibrate a version of the model to replicate the evolution of debt-to-income ratios for the top 5% and the bottom 95% of the U.S. income distribution over the last thirty years.

Third, we use this calibrated economy to explore the welfare changes associated with two measures of financial liberalization; a relaxation of borrowing constraints and a decrease in the borrowing-lending spread. Our analysis suggests that the large expansion of credit that began in the 1980s may be associated with important welfare losses. In the light of these results it is difficult not to think about Mr. Volcker's remarks: "The most important financial innovation that I have seen in the past 20 years is the automatic teller machine, that really helps people and prevents visits to the bank and it is a real convenience. How many other innovations can you tell me of that have been as important to the individual as the automatic teller machine, which is more of a mechanical innovation than a financial one?"²⁶

²⁶Paul Volcker's address in the Wall Street Journal Future of Finance Initiative in the U.K. that took place in December of 2009.

Appendix

This section provides details on the derivation of some results.

Dynamics of the Aggregate Capital Stock

Combining the levels of borrowing of young households with savings of middle-age workers, the evolution of the stock of capital in period $t + 1$ is given by

$$K_{t+1}^X = -\mu b_{t,t}^H - (1 - \mu) b_{t,t}^L - \mu b_{t-1,t}^H - (1 - \mu) b_{t-1,t}^L. \quad (46)$$

Since the dynamics of the capital stock depend on whether type- L households are credit constrained or not, we need to consider two cases, $Z = \{C, U\}$. First, we characterize the evolution of capital when type- L households are credit constrained. Combining (27), (28), and (30), with (46) we have

$$\begin{aligned} K_{t+1}^C = & -\mu [\psi^H y_t^H - w_{t,t}^H] - (1 - \mu) \xi \frac{w_{t,t+1}^L}{R_{t+1}^b} + \mu \beta^2 R_t^b \frac{(1 - \gamma_0)}{(1 - \gamma_2)} \psi^H y_{t-1}^H \\ & + \frac{(1 - \mu) \beta}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \left[\frac{(1 - \gamma_1 \rho) (1 - \xi) w_{t-1,t}^L}{-\beta R_t^b (1 - \rho) \gamma_3 \psi^H y_{t-1}^H} \right]. \end{aligned} \quad (47)$$

At this stage it is convenient to define $x_{t+1} \equiv \frac{hw_{t+1}}{w_t R_{t+1}^b}$, the growth factor of discounted labor income over the life cycle. Combining this definition with lifetime income, given by (14), and the fact that $w_{t,t}^i = l^i w_t$ and $w_{t,t+1}^i = l^i h w_{t+1}$, we can divide both sides of (54) by w_t to reach²⁷

$$\begin{aligned} \frac{K_{t+1}^C}{w_t} = & -\mu l^H [\psi^H (1 + x_{t+1}) - 1] \\ & - (1 - \mu) \xi l^L x_{t+1} + \mu \beta^2 \frac{(1 - \gamma_0)}{(1 - \gamma_2)} \psi^H l^H h \left(1 + \frac{1}{x_t}\right) \\ & + \frac{(1 - \mu) \beta}{(1 - \gamma_2 \rho) + \beta (1 - \gamma_1 \rho)} \left[\frac{(1 - \gamma_1 \rho) (1 - \xi) h l^L}{-\beta (1 - \rho) \gamma_3 \psi^H l^H h \left(1 + \frac{1}{x_t}\right)} \right]. \end{aligned} \quad (48)$$

Under the assumption that capital fully depreciates, we replace (2) and (3) in the expression for x_{t+1} to express the left-hand side of (48) as

$$\frac{K_{t+1}^C}{w_t} = \frac{K_{t+1}^C}{(1 - \alpha) (K_t^C)^\alpha L^{-\alpha} A_t^{1-\alpha}} = x_{t+1} \frac{L}{h} \frac{\alpha}{(1 - \alpha)} \frac{\pi}{\pi - 1} \quad (49)$$

where we use the fact that the labor force is constant.

²⁷Notice that $w_{t-1} + h \frac{w_t}{R_t} = w_{t-1} (1 + x_t)$ and $R_t \left[\frac{w_{t-1}}{w_t} + \frac{h}{R_t} \right] = h \left[\frac{1}{x_t} + 1 \right]$.

As a result (48) can be written as a first-order difference equation

$$B^C x_{t+1} = C^C + D^C \left(1 + \frac{1}{x_t}\right) \implies x_{t+1} = \frac{C^C + D^C}{B^C} + \frac{D^C/B^C}{x_t} \quad (50)$$

where

$$\begin{aligned} B^C &\equiv \frac{L}{h} \frac{\alpha}{(1-\alpha)} \frac{\pi}{\pi-1} + \mu l^H \psi^H + (1-\mu) \xi l^L > 0, \\ C^C &\equiv \mu l^H (1-\psi^H) + \frac{(1-\mu) \beta (1-\gamma_1 \rho) (1-\xi) h l^L}{(1-\gamma_2 \rho) + \beta (1-\gamma_1 \rho)} > 0, \\ \text{and } D^C &= \beta^2 \psi^H l^H h \left(\mu \frac{(1-\gamma_0)}{(1-\gamma_2)} - \frac{(1-\mu) (1-\rho) \gamma_3}{((1-\gamma_2 \rho) + \beta (1-\gamma_1 \rho))} \right). \end{aligned}$$

Similarly when the credit constraint does not bind for type- L young workers, the dynamics of x_{t+1} are given by

$$B^U x_{t+1} = C^U + D^U \left(1 + \frac{1}{x_t}\right) \implies x_{t+1} = \frac{C^U + D^U}{B^U} + \frac{D^U/B^U}{x_t} \quad (51)$$

where

$$\begin{aligned} B^U &= \frac{L}{h} \frac{\alpha}{(1-\alpha)} \frac{\pi}{\pi-1} + \mu l^H \psi^H + (1-\mu) \psi^L (l^L (1-\gamma_1 \rho) (1-\gamma_2 \rho) + l^H \phi_0 \psi^H) > 0, \\ C^U &= \mu l^H + (1-\mu) l^L - \mu l^H \psi^H - (1-\mu) \psi^L (l^L (1-\gamma_1 \rho) (1-\gamma_2 \rho) + l^H \phi_0 \psi^H), \\ \text{and } D^U &= \beta^2 \left[\mu l^H \frac{(1-\gamma_0)}{(1-\gamma_2)} \psi^H + (1-\mu) \psi^L (l^L (1-\gamma_0 \rho) (1-\gamma_1 \rho) - l^H \phi_2 \psi^H) \right] h > 0. \end{aligned}$$

Additionally, we impose restrictions on the parameter values such that both D^C and C^U are positive.

Since the dynamic structure is similar in both cases we drop the superscript $Z = \{C, U\}$ and we write (50) and (51) in compact form as

$$x_{t+1} = a + \frac{b}{x_t}, \quad a, b > 0. \quad (52)$$

Finally, given the dynamics of x_{t+1} , we use (49) to characterize the evolution of the aggregate capital stock as

$$K_{t+1} = x_{t+1} \frac{\alpha}{h} \frac{\pi}{\pi-1} (L A_t)^{1-\alpha} (K_t)^\alpha. \quad (53)$$

Denoting capital per unit of effective labor as $k_{t+1} \equiv \frac{K_{t+1}}{A_{t+1} L}$, its law of motion is given by

$$k_{t+1} = x_{t+1} \frac{\alpha}{h(1+g)} \frac{\pi}{\pi-1} (k_t)^\alpha. \quad (54)$$

Equation (52) determines the path of x_t that can be replaced in (54) to determine the path of capital per unit of effective labor. The system (52)-(54) has a unique non-trivial steady

state (x^*, k^*) . This steady state is given by the positive root of the equation $(x^*)^2 - ax^* - b = 0$ and $k^* = \left(\frac{\alpha x^*}{h(1+g)} \frac{\pi}{\pi-1} \right)^{\frac{1}{1-\alpha}}$. Since the slope of the transition function, (52), is always negative the path of x_t is oscillatory.

Finally, notice that

$$|x_{t+1} - x^*| = \left| \frac{b}{x_t} - \frac{b}{x^*} \right| = \left| \frac{bx_{t-1}}{ax_{t-1} + b} - \frac{bx^*}{ax^* + b} \right| = \frac{b^2 |x_{t-1} - x^*|}{(ax_{t-1} + b)(ax^* + b)} < |x_{t-1} - x^*|,$$

as a result the sequence (x_t) converges to x^* and therefore the steady state is globally stable.²⁸

Derivation of Proposition 3.

Combining (27) and (37) with lifetime income, given by (14), we obtain the borrowing rates, b_{rate}^i , for both types of households

$$b_{rate}^H = \psi^H - \frac{w_0^H}{y^H} \quad (55)$$

$$b_{rate}^L = \psi^L - \frac{w_0^L}{y^L} + \beta^2 \gamma (1 - \rho) \psi^L \psi^H \frac{y^H}{y^L}. \quad (56)$$

Using the share of income received by rich households, $y_s^H \equiv \frac{y^H}{y^H + y^L}$, we can express the aggregate borrowing rate as

$$b_{rate}^{agg} = y_s^H b_{rate}^H + (1 - y_s^H) b_{rate}^L \quad (57)$$

that combined with (55) and (56) becomes,

$$\begin{aligned} b_{rate}^{agg} &= y_s^H \left(\psi^H - \frac{w_0^H}{y^H} \right) + (1 - y_s^H) \left(\psi^L - \frac{w_0^L}{y^L} + \beta^2 \gamma (1 - \rho) \psi^L \psi^H \frac{y^H}{y^L} \right) \\ &= \psi^L - \frac{w_0^L}{y^L} + y_s^H \left(\psi^H - \frac{w_0^H}{y^H} - \psi^L + \frac{w_0^L}{y^L} \right) + (1 - y_s^H) \beta^2 \gamma (1 - \rho) \psi^L \psi^H \frac{y^H}{y^L} \\ &= \psi^L - \frac{w_0^L}{y^L} + \left(\psi^H - \frac{w_0^H}{y^H} - \psi^L + \frac{w_0^L}{y^L} + \beta^2 \gamma (1 - \rho) \psi^L \psi^H \right) y_s^H \\ &= \psi^L - \frac{w_0^L}{y^L} + (\psi^H - \psi^L + \beta^2 \gamma (1 - \rho) \psi^L \psi^H) y_s^H \\ &= \left(\psi^L - \frac{w_0^L}{y^L} \right) + 2\beta^2 \gamma (1 - \rho) \psi^L \psi^H y_s^H. \end{aligned}$$

²⁸A full characterization of the dynamics of the capital stock needs to consider cases where there are endogenous changes in regime, i.e. along the transition the credit constraint binds or not depending on factor prices. In our numerical exercises the credit constraint is always binding.

Since the timing of income affects the level (rate) of borrowing and we want to abstract from this mechanical effect, we concentrate on changes in inequality that leave the timing of income unchanged. As a result we assume that the timing of income for both types of households is the same, $\frac{w_0^H}{y^H} = \frac{w_0^L}{y^L}$, that we use in the fourth line of the previous derivation.

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Table 1. Median regressions of debt-to-income ratio on current and permanent income.

Dependent variable	Current Income		Permanent Income							
	Debt	Debt – Mort.	Debt				Debt – Mortgage			
			Norm. Inc. (as proxy)	Norm. Inc.	Lagged Income	Vehicles [†]	Norm. Inc. (as proxy)	Norm. Inc.	Lagged Income	Vehicles [†]
Instrument	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant (Bottom 95%)	1.046*** (0.008)	0.115*** (0.001)	1.073*** (0.012)	1.075*** (0.011)	0.839*** (0.036)	0.833*** (0.009)	0.111*** (0.001)	0.114*** (0.002)	0.095*** (0.005)	0.029*** (0.001)
Top 5%	-0.383*** (0.010)	-0.089*** (0.002)	-0.392*** (0.015)	-0.411*** (0.015)	-0.255*** (0.090)	-0.100*** (0.017)	-0.093*** (0.002)	-0.010*** (0.003)	-0.040*** (0.013)	-0.016*** (0.002)
Ages 30-39	-0.017* (0.009)	0.031*** (0.002)	0.021 (0.013)	0.017 (0.013)	-0.138*** (0.051)	-0.028*** (0.011)	0.038*** (0.002)	0.038*** (0.003)	-0.007 (0.007)	0.011*** (0.001)
Ages 50-59	-0.136*** (0.008)	-0.018*** (0.002)	-0.127*** (0.013)	-0.121*** (0.012)	-0.191*** (0.043)	-0.109*** (0.010)	-0.015*** (0.002)	-0.013*** (0.003)	-0.041*** (0.006)	-0.008*** (0.0012)
No high school	-0.868*** (0.013)	-0.081*** (0.002)	-0.921*** (0.02)	-0.929*** (0.019)	-0.450*** (0.060)	-0.725*** (0.016)	-0.085*** (0.003)	-0.089*** (0.004)	0.036*** (0.009)	-0.020*** (0.002)
High school diploma	-0.515*** (0.009)	-0.008*** (0.002)	-0.529*** (0.014)	-0.542*** (0.013)	-0.249*** (0.044)	-0.480*** (0.011)	-0.003 (0.002)	-0.01*** (0.003)	0.007 (0.006)	-0.006*** (0.001)
Some college	-0.236*** (0.010)	0.032*** (0.002)	-0.242*** (0.015)	-0.265*** (0.015)		-0.184*** (0.013)	0.044*** (0.002)	0.037*** (0.003)		0.017*** (0.001)
5-8 members	0.213*** (0.010)	0.011*** (0.002)	0.243*** (0.016)	0.285*** (0.015)	0.172*** (0.053)	0.223*** (0.014)	0.008*** (0.002)	0.015*** (0.003)	-0.003 (0.008)	0.005*** (0.001)
9-12 members	0.049 (0.078)	0.001 (0.015)	0.077 (0.118)	0.083 (0.114)	-0.086 (0.326)	0.120 (0.100)	0.011 (0.016)	0.026 (0.024)	0.039 (0.047)	0.039*** (0.011)
Pseudo R^2	0.036	0.015	0.036	0.036	0.036	0.035	0.016	0.016	0.015	0.003
Sample size	101,372	101,372	81,637	81,637	2,141	101,372	81,637	81,637	2,141	101,372

Notes: The numerator of the debt-to-income ratio is either total debt or total debt minus mortgage debt, the denominator is total household income less realized capital gains. For columns (1) and (2) the dummy for the Top 5 % is constructed using this income measure for each age group and for columns (3) and (7) this dummy is constructed using normal income. Normal income is what households report as expected income in a “normal year”. In the remaining columns the dummy for the Top 5 % is constructed using measures of permanent income. Permanent income is estimated using an OLS regression of current income on instruments and a set of controls. The omitted category includes households with 1-4 members, with the head having a college degree and aged 40-49. Bootstrapped standard errors are reported in parentheses. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Sources: Data comes from wave reports (1989-2010) and a panel (1983-1989) of the SCF.

[†] When vehicles owned are used as an instrument the measure of debt excludes the value of outstanding loans used to finance vehicles.

Table 2. Median regressions of debt-to-income ratio on current and permanent income and time.

Dependent variable	Current Income		Permanent Income					
	Debt	Debt – Mort.	Debt			Debt – Mortgage		
			Norm. Inc. (as proxy)	Norm. Inc.	Vehicles [†]	Norm. Inc. (as proxy)	Norm. Inc.	Vehicles [†]
Instrument	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant (Bottom 95%)	0.877*** (0.010)	0.102*** (0.001)	0.922*** (0.018)	0.915*** (0.022)	0.719*** (0.014)	0.086*** (0.003)	0.088*** (0.004)	0.029*** (0.001)
Top 5%	-0.287*** (0.019)	-0.065*** (0.002)	-0.329*** (0.038)	-0.314*** (0.048)	-0.127*** (0.036)	-0.067*** (0.007)	-0.073*** (0.010)	-0.002 (0.004)
Time	0.0115*** (0.000)	0.001*** (0.000)	0.009*** (0.001)	0.009*** (0.001)	0.009*** (0.001)	0.001*** (0.000)	0.001*** (0.001)	0.000 (0.000)
Time x Top 5%	-0.006*** (0.001)	-0.002*** (0.000)	-0.004* (0.002)	-0.006** (0.003)	0.002 (0.002)	-0.002*** (0.000)	-0.002*** (0.000)	-0.001*** (0.000)
Ages 30-39	-0.00791 (0.007)	0.031*** (0.001)	0.022** (0.011)	0.012 (0.013)	-0.023** (0.011)	0.040*** (0.002)	0.040*** (0.003)	0.011*** (0.001)
Ages 50-59	-0.132*** (0.007)	-0.017*** (0.001)	-0.126*** (0.010)	-0.122*** (0.013)	-0.113*** (0.011)	-0.014*** (0.002)	-0.012*** (0.003)	-0.008*** (0.001)
No high school	-0.814*** (0.011)	-0.081*** (0.001)	-0.895*** (0.016)	-0.901*** (0.019)	-0.707*** (0.017)	-0.084*** (0.003)	-0.090*** (0.004)	-0.021*** (0.002)
High school diploma	-0.504*** (0.007)	-0.011*** (0.001)	-0.515*** (0.011)	-0.530*** (0.013)	-0.476*** (0.012)	-0.004** (0.002)	-0.011*** (0.003)	-0.006*** (0.001)
Some college	-0.228*** (0.009)	0.030*** (0.001)	-0.238*** (0.012)	-0.248*** (0.015)	-0.199*** (0.013)	0.042*** (0.002)	0.034*** (0.003)	0.017*** (0.001)
5-8 members	0.216*** (0.009)	0.010*** (0.001)	0.234*** (0.013)	0.267*** (0.016)	0.210*** (0.014)	0.007*** (0.002)	0.016*** (0.003)	0.005*** (0.001)
9-12 members	-0.0113 (0.067)	-0.001 (0.007)	0.013 (0.094)	0.026 (0.118)	0.154 (0.101)	0.011 (0.017)	0.027 (0.024)	0.033*** (0.011)
Pseudo R^2	0.039	0.015	0.037	0.036	0.037	0.016	0.017	0.003
Sample size	101,372	101,372	81,637	81,637	101,372	81,637	81,637	101,372

Notes: The numerator of the debt-to-income ratio is either total debt or total debt minus mortgage debt, the denominator is total household income less realized capital gains. For columns (1) and (2) the dummy for the Top 5 % is constructed using this income measure and for columns (3) and (7) this dummy is constructed using normal income. Normal income is what households report as expected income in a “normal year”. In the remaining columns the dummy for the Top 5 % is constructed using measures of permanent income. Permanent income is estimated using an OLS regression of current income on instruments and a set of controls. The omitted category includes households with 1-4 members, with the head having a college degree and aged 40-49. Bootstrapped standard errors are reported in parentheses. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Sources: Data comes from wave reports (1989-2010) and a panel (1983-1989) of the SCF.

[†] When vehicles are used as an instrument the measure of debt excludes the value of outstanding loans used to finance vehicles.

Table 3. Some robustness checks.

Dependent variable	Labor income		Consumer debt		Home ownership		Continuous measure of income	
	Debt/income		Consumer debt/income		Debt/income		Debt/income	
Income measure	Current labor income	Permanent labor income	Current income	Permanent income	Current income	Permanent income	Current income	Permanent income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant (Bottom 95%) ^{††}	0.980*** (0.010)	1.010*** (0.011)	0.060*** (0.001)	0.064*** (0.001)	0.228*** (0.010)	0.221*** (0.012)	3.024*** (0.047)	3.764*** (0.100)
Top 5%	-0.383*** (0.014)	-0.475*** (0.019)	-0.039*** (0.002)	-0.039*** (0.002)	-0.083** (0.039)	-0.117** (0.052)		
Own house					1.117*** (0.008)	1.165*** (0.010)		
Own house x Top 5%					-0.729*** (0.040)	-0.601*** (0.053)		
Bottom quintile							-3.086*** (0.135)	-3.713*** (0.147)
Ln(income)							-0.176*** (0.004)	-0.229*** (0.008)
Ln(income) x Bottom quintile							0.230*** (0.013)	0.278*** (0.013)
Pseudo R^2	0.017	0.027	0.008	0.005	0.161	0.163	0.058	0.036
Observations	91,512	73,074	49,786	39,756	104,497	81,637	101,372	78,166

Notes: The measure of permanent income is constructed normal income as an IV and a set of controls. All regressions include controls (non-reported) for age categories, household size and educational categories for the head of the household. The omitted category includes households with 1-4 members, with the head having a college degree and aged 40-49. For columns (1) and (2) the dummy for the Top 5 % is constructed using labor income. Columns (3) and (4) consider a narrower measure of debt that excludes mortgages, consumer debt. Columns (5) and (6) include a dummy for home ownership. Columns (7) and (8) include a continuous measure of income, a dummy for the bottom quintile and year dummies (non-reported). Bootstrapped standard errors are reported in parentheses. *** significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Sources: Data comes from wave reports (1989-2010) and a panel (1983-1989) of the SCF.

^{††}In columns (7) and (8) the intercept cannot be interpreted as the borrowing rate of the bottom 95%.

Table 4: Calibration: Parameter values, targets and model outcomes.

Panel A: Parameters							
Steady-state specific:	Initial	Final	General:				
l^H	3.4	5	β	0.45	μ	0.05	
l^L	0.87	0.79	δ	1	ρ	0.90	
ξ	0.0283	0.053	α	0.35	γ_0	0.40	
π	10.05	14	h	1.75	γ_1	0.20	
			g	0.49	γ_2	0.10	

Panel B: Model and data targets				
	Model		Data	
	Initial	Final	1960s*	2000s
Debt-to-income top 5%	0.26	0.13	0.26	0.14
Debt-to-income bottom 95%	0.28	0.51	0.27	0.50
Share of labor income top 5%	17%	25%	17%	25%
Share of total income top 5%	17.1%	25.9%	21%	34%

Sources: Data on share of labor income of the top 5% is from the updated version of Piketty and Saez (2003). Data on debt-to-income ratios is from the Survey of Consumer Finances. Households with heads with ages 25-45 and excluding mortgage debt.

* Our initial steady state uses data from the 1962-3 wave of the SCF since the next wave with full available data is from 1989.

Table 5: Numerical results.

	Within group comparisons	Initial steady state	Final steady state	One shock at a time		
				Inequality	Credit limit	Spread
Difference with baseline calibration	$\rho = 1$			$\pi_1 = \pi_0$ $\xi_1 = \xi_0$	$l_1^i = l_0^i$ $\pi_1 = \pi_0$	$l_1^i = l_0^i$ $\xi_1 = \xi_0$
Debt-to-income ratios						
Top 5%	0.27	0.26	0.13	0.18	0.20	0.43
Bottom 95%	0.27	0.28	0.51	0.27	0.50	0.28
Bottom 95% (desired)	0.27	0.66	1.08	1.00	0.66	0.74
Aggregate	0.27	0.27	0.41	0.25	0.39	0.31
Interest rates						
Lending rate	8.05%	8.15%	8.42%	8.22%	8.34%	8.19%
Borrowing rate	8.62%	8.72%	8.83%	8.79%	8.91%	8.59%
Spread	0.57%	0.57%	0.41%	0.57%	0.57%	0.40%
Monitoring expenditures (% of GDP)	0.12%	0.11%	0.7%	0.11%	0.16%	0.05%
Inequality (share of the top 5%)						
Labor income	17.00%	17.00%	25.00%	25.00%	17.00%	17.00%
Capital income	17.00%	17.45%	27.51%	26.38%	18.79%	17.03%
Total income	17.00%	17.14%	25.85%	25.44%	17.63%	16.98%
First-period consumption	17.00%	16.99%	24.65%	24.91%	16.67%	17.10%
Second-period consumption	17.00%	16.86%	25.35%	24.79%	17.56%	16.63%
Third-period consumption	17.00%	17.43%	26.86%	26.22%	18.19%	17.18%
Welfare change (gain if positive)						
Long-run: welfare change for a generation born in the final steady state						
Top 5%			44.12%	46.43%	-1.22%	-0.40%
Bottom 95%			-24.39%	-23.21%	-1.55%	-0.20%
Short-run: welfare change for the generation born right before the shock						
Top 5%			17.02%	16.82%	0.21%	-0.04%
Bottom 95%			-5.99%	-6.15%	0.19%	-0.04%
Intertemporal: discounted sum at a rate β for all generations after the shock						
Top 5%			29.29%	29.44%	-0.01%	-0.08%
Bottom 95%			-14.15%	-14.06%	-0.12%	-0.05%
Constant prices: initial steady state prices*						
Top 5%			46.78%	47.06%	-	-0.19%
Bottom 95%			-23.03%	-22.89%	-0.15%	-0.09%

Notes: The subscripts 0 and 1 stand for the initial and final steady state respectively.

* With constant prices, a change in the credit limit of the bottom 95% has no impact on the choices of the top 5%

Table 6. Welfare Changes: Sensitivity analysis.

Sensitivity		Final steady state	One shock at a time			Final steady state	One shock at a time		
			Ineq.	Credit limit	Spread		Ineq.	Credit limit	Spread
		Long-run welfare change				Constant-price welfare change**			
Baseline	Top 5%	44.1%	46.4%	-1.2%	-0.4%	46.8%	47.1%	-	-0.2%
	Bottom 95%	-24.4%	-23.2%	-1.5%	-0.3%	-23.0%	-22.9%	-0.1%	-0.1%
$\rho = .95$	Top 5%	44.5%	46.7%	-1.0%	-0.3%	46.8%	47.0%	-	-0.2%
	Bottom 95%	-17.2%	-15.8%	-0.7%	-0.2%	-15.7%	-15.6%	-0.2%	-0.1%
$\rho = .85$	Top 5%	43.7%	46.1%	-1.3%	-0.5%	46.7%	47.0%	-	-0.2%
	Bottom 95%	-33.2%	-32.6%	-1.4%	-0.4%	-32.5%	-32.3%	-0.0%	-0.2%
$\gamma_0 = .45 \ \gamma_1 = .25$ $\gamma_2 = .15$	Top 5%	44.1%	46.3%	-1.2%	-0.4%	46.8%	47.0%	-	-0.2%
	Bottom 95%	-28.6%	-27.5%	-1.5%	-0.3%	-27.3%	-27.2%	-0.1%	-0.1%
$\gamma_0 = .35 \ \gamma_1 = .15$ $\gamma_2 = .05$	Top 5%	45.1%	46.5%	-0.6%	-0.6%	46.8%	47.1%	-	-0.2%
	Bottom 95%	-20.6%	-19.9%	-0.7%	-0.7%	-19.7%	-19.6%	-0.1%	-0.1%
No envy*	Top 5%	45.1%	47.0%	-	-1.0%	47.2%	47.0%	-	0.2%
	Bottom 95%	-10.8%	-9.6%	-	-1.0%	-9.5%	-9.6%	-	0.2%

Notes: The financial friction parameters, π and ξ , are chosen to set debt-to-income ratios consistent with the baseline calibration (and therefore with the data). Aside from the parameter under consideration, the remaining ones are set according to Table 4.

* Since preferences are homothetic the borrowing rate of both types of household coincide. As a result, we set these rates for both groups equal to the average borrowing rate in the data. Notice that the borrowing limit for poor households is not binding.

** With constant prices, a change in the credit limit of the bottom 95% has no impact on the choices of the top 5%

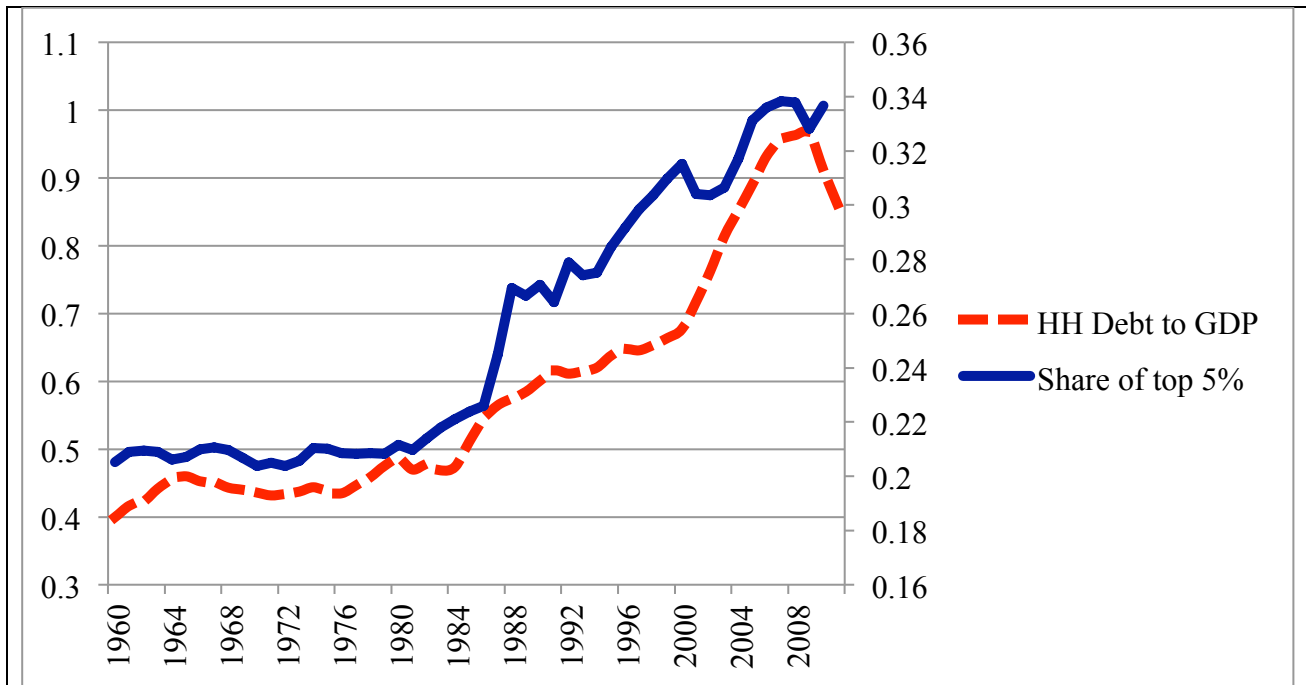


Figure 1. Aggregate debt to income ratio and share of the top 5% of the income distribution (right scale).

Sources: Share of income from Piketty and Saez (2011) and debt from the Federal Reserve Economic Data, Federal Bank of St. Louis.

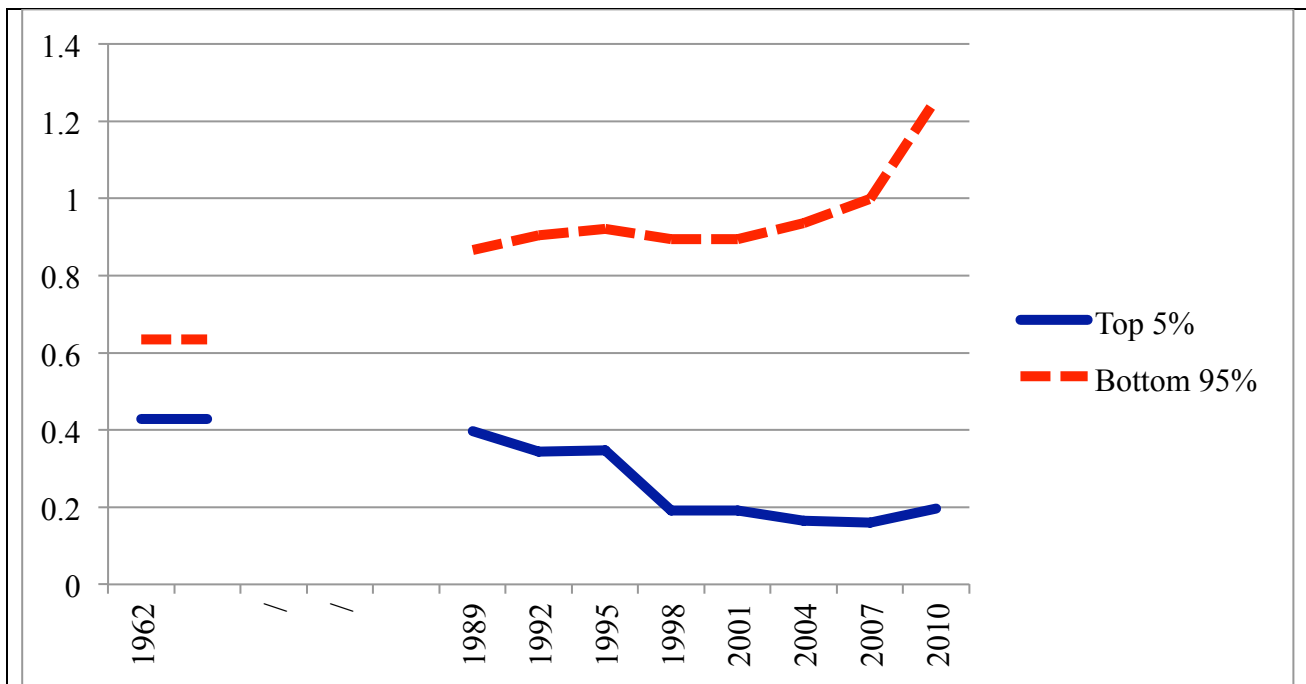
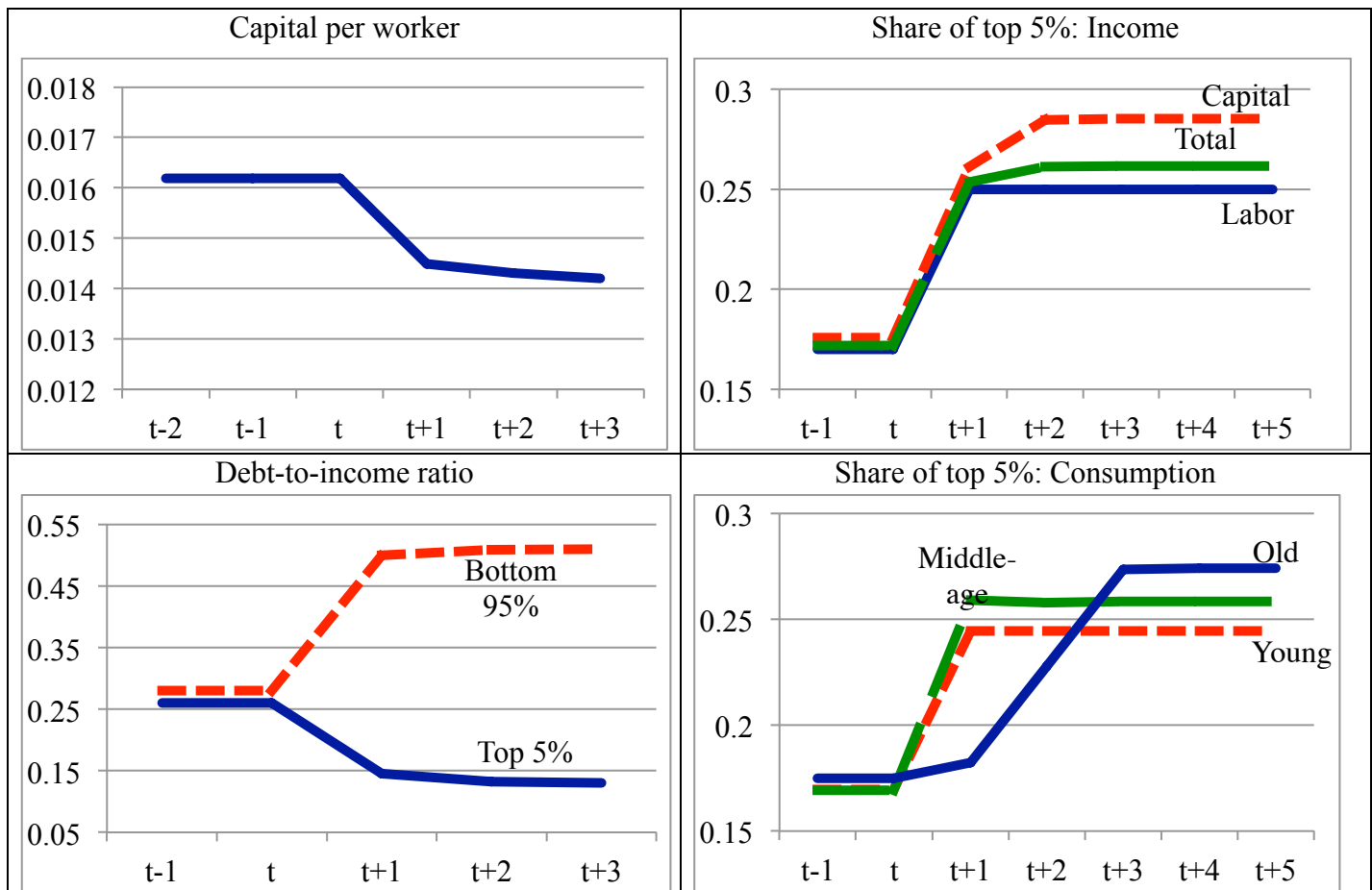
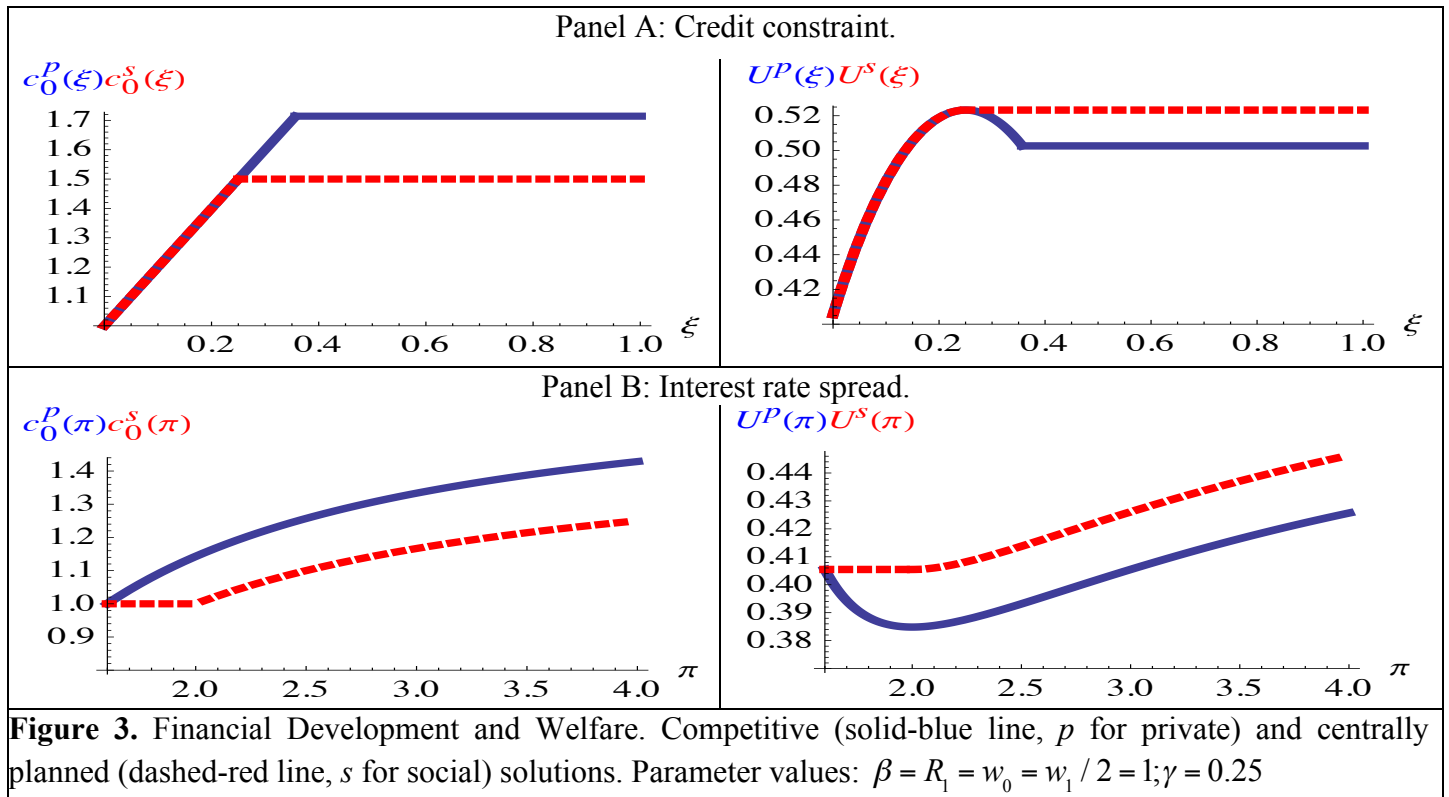


Figure 2. Debt-to-income ratios for the top 5% and the bottom 95% of the US income distribution. Income is calculated at total income minus capital gains and the measure of debt includes mortgages.

Source: Survey of Consumer Finances of the Board of Governors of the Federal Reserve System.



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