

Welfare Implications of the Transition to High Household Debt*

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Abstract

Aggressive deregulation of the mortgage market in the early 1980s triggered innovations that greatly reduced the required home equity of U.S. households. This allowed households to cash-out a large part of accumulated equity, which equaled 71 percent of GDP in 1982. A borrowing surge followed: Household debt increased from 43 to 62 percent of GDP in the 1982-2000 period. This paper uses a calibrated general equilibrium model of lending from the wealthy to the middle class to evaluate the welfare effects of this reform quantitatively. We find that the “indirect” effects of endogenous interest rate and other relative price changes dominate the “direct” effect of relaxing the constraint. In our baseline experiment, the borrowing household’s welfare falls even though the reform directly relaxes a constraint on its trade. The saving household’s welfare rises substantially.

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1 Introduction

This paper examines the welfare consequences of the growth in collateralized household debt since the early 1980's. Homes and vehicles collateralize the vast majority of household debt in the United States, and these loans typically require the borrower to hold an equity stake in the collateral. The Monetary Control and the Garn-St. Germain Acts of 1980 and 1982 allowed market innovations that dramatically reduced equity requirements on collateralized loans: Greater access to alternative borrowing instruments reduced effective down payments, and cash-out mortgage refinancing allowed households to delay repayment of principle and spend previously accumulated home equity. In 1982, home equity equalled 71 percent of GDP, so a surge of household borrowing unsurprisingly followed these reforms.

Our analysis employs a calibrated general equilibrium framework for household borrowing which combines trade between a patient *saver* and an impatient *borrower* with an equity requirement on housing and consumer durable goods typical of collateralized loan contracts. When households' rates of patience differ and they face no borrowing limits, equilibrium requires the consumption of all households but the most patient to asymptote to zero. The equity requirement prevents this in our model, so it has a unique steady state with positive consumption by both households. Its structure is simple, but it captures the main features of the distribution of debt and financial assets across households in the US economy. Households in the first-to-ninth deciles of the wealth distribution owed 73.0 percent of total household debt in 1962, and 73.4 percent in 2001. Households in the tenth decile held 54.2 percent of total financial assets in 1962 and 72.8 percent in 2001. The model's equilibrium resembles this in an extreme way. The borrower owes all the debt to the saver, and the saver owns all of the economy's wealth except the borrower's equity in durable goods and housing.

We calibrate the model's parameters with observations prior to 1982, and we calculate its transition path following a financial reform which mimics the actual reduction of equity requirements on borrowers. Our calculations use a modified version of the Fair-Taylor (1983) algorithm which determines when along the transition path the equity requirement limits the borrower's debt. Because the reform allows the borrower to cash out a large amount of equity accumulated to meet the previously higher requirement, the transition path begins with a substantial interest rate increase. For about ten years after the reform, the equity requirement does not limit the borrower's debt. Both households satisfy their Euler equations, so the borrower's consumption falls while the saver's increases. Eventually, the borrower's debt stabilizes at a higher level and the interest rate gradually returns to the saver's rate of time preference. This qualitatively resembles the positive comovement of household debt

and interest rates during the middle 1980s even though we abstract from government deficits – the standard explanation for that period’s high real interest rates.

The interest rate increase dominates the welfare calculations. With fixed prices, the financial reform directly benefits the borrower and leaves the saver’s welfare unchanged. The general equilibrium results differ markedly from this because the rise in the interest rate deteriorates the borrower’s terms of intertemporal trade and shifts most of the gains to the saver. In our baseline economy, the saver’s utility gain equals that from an 11.3 percent permanent increase in consumption; and the borrower incurs a utility *loss* equal to a 1.3 percent consumption fall. The capital accumulation technology – an aspect of the economy seemingly unrelated to household credit markets – plays a key role generating the order-of-magnitude difference in these changes. The reform expands loan demand and thereby increases the return on all assets. Endogenously, the saver owns all productive capital. Without adjustment costs technology pins down the price of capital relative to consumption, so these high returns come as high dividends. At the other extreme when the capital stock is fixed, the high returns from its ownership come from the gradual reversal of an initial capital loss. Accordingly, the saver’s gain from the credit reform in an economy with fixed capital are much lower, a permanent 1.4 percent consumption increase. Fixing the capital stock prevents the wage from falling after the reform and so turns the reform into a small benefit for the borrower equal to a 0.4 percent permanent consumption increase. We also examine an alternative specification in which investment irreversibility limits the saver’s supply of funds. With this additional wrinkle, the interest rate responds more vigorously to the reform. However, investment irreversibility changes the welfare calculations little.

Household debt plays a prominent role in existing theories of risk sharing, such as [Alvarez and Jermann \(2000\)](#); so it is natural that existing examinations of household debt growth stress the use of unsecured debt to share risk. For example, [Krueger and Perri \(2006\)](#) argue that the deepening of credit markets in the 1980’s kept consumption inequality from growing as fast as income inequality. The theory of debt based on risk sharing and the subsequent quantitative empirical work has abstracted from collateralized debt. Nevertheless, it accounted for the vast majority of all household debt both before and after 1980. Our analysis complements the earlier examinations of unsecured debt by focusing on the effects of reform on the much, much larger market for collateralized household borrowing.

The paper proceeds as follows. The next section provides institutional background for our analysis and Section 3 presents the model. We qualitatively examine the steady-state to steady-state comparison following the reform in Section 4. In Section 5 we report first the calibration of the model and then the computed transition process. It concludes with

the evaluation of the reform’s welfare effects. Section 6 presents the extension of the model with a realistic cost of downward adjustment, an irreversibility constraint on investment. We discuss our results in light of the actual evolution of household debt and interest rates in the United States in Section 7, and we conclude in Section 8. In a companion paper to this (Campbell and Hercowitz, 2006), we use a very similar model to explore the implications of the credit market reform for business-cycle fluctuations.

2 Institutional Background

Our analysis takes the institutions structuring the household debt market as determined by regulation, so we begin with a review of how these have changed since 1982. It is helpful to emphasize first one feature of this market that remains the same: Homes and vehicles collateralize most household debt. According to the 1962 Survey of Financial Characteristics of Consumers, homes and vehicles collateralized 85 percent of total U.S. household debt. The analogous percentage from the 2001 Survey of Consumer Finances was 90 percent.¹

From the middle 1930s until the early 1980s, 15 and 30 year amortized mortgages accounted for most of collateralized household debt. These required the home owner to take an initial equity share at the time of purchase and to accumulate further equity as the debt amortizes. The implied forced savings reflected the desire of the Roosevelt administration to reduce the likelihood of a mass default of highly-leveraged mortgagees, as occurred at the beginning of the Great Depression. A host of financial regulations supported this policy. The most prominent gave tax incentives for Savings and Loan associations to finance home mortgage lending with demand deposits and protected this trade from other financial intermediaries. The volatile financial markets of the 1970’s made these and other New Deal financial regulations untenable. Congress and Presidents Carter and Reagan responded with the Monetary Control Act of 1980 and the Garn-St. Germain Act of 1982. These led to an aggressive reorganization of the housing finance system.²

Instruments for avoiding forced saving existed before financial deregulation. One could cash-out previously accumulated home equity either by taking a second mortgage or home-equity loan or by refinancing the debt with a loan exceeding the current mortgage balance, but lack of competition in lending made these rare. Deregulation lowered the cost of these instruments for all financial intermediaries and households. Accordingly, household debt

¹Details of these observations are provided in Campbell and Hercowitz (2006), Appendix A.

²Green and Wachter (2005) provide a history of New Deal mortgage institutions and of the process of dismantling them in the early 1980’s. See also Florida (1986) and the articles contained therein.

Year	Percent of Mortgagees	Average Equity/Value
	Refinanced	at Purchase
1983	9.9	22.6
1989	21.2	23.4
1992	33.0	20.9
1995	40.9	16.9
1998	42.3	16.4
2001	44.4	16.4

Table 1: Mortgage Terms and Instruments from the Survey of Consumer Finances

began to grow. The ratio of mortgage debt to the value of owner-occupied homes was 0.31 in 1982, 0.37 in 1990, and 0.42 in 1995. Since then, it has fluctuated around this higher level.

A more detailed appreciation of how deregulation affected home equity accumulation can be gained by examining how households structured their mortgage debts. Time-series observations on typical terms of first mortgages are available from the Federal Home Finance Board’s *Monthly Interest Rate Survey*, but these provide an incomplete picture because they ignore subordinated debt used to lower effective down payments. Hence, we proceed by examining households’ debts in the Survey of Consumer Finances. Understanding that deregulation had the potential to vastly change households’ financial decisions, the Federal Reserve Board resurrected its Survey of Consumer Finances program in the early 1980s, which collected the first “modern” SCF data set in 1983.³ The Federal Reserve carried out subsequent SCFs every three years. These surveys gathered detailed information on households’ balance sheets and use of different financial instruments and institutions, so they provide the data required for tracking the effects of deregulation on households’ mortgage borrowing decisions.

For six SCFs, Table 1 reports two key summary statistics characterizing households’ mortgage borrowing, the percentage of mortgagees who have refinanced the mortgage on

³The code book to the 1983 SCF (written initially in 1985) begins “There have been many changes in financial markets during the last decade. Inflation and interest rates increased sharply in the late 1970s and then fell after recessions in 1980 and 1981-82. Major financial innovations occurred, such as the introduction of money market funds, and the regulation of financial markets altered dramatically after enactment of the Depository Institutions Deregulation and Monetary Control Act of 1980. To assess the effects of these changes on the financial position of households, the Board of Governors of the Federal Reserve System (and other agencies) joined together to sponsor the 1983 Survey of Consumer Finances (SCF).”

their current residence, and the average home equity to value ratio for new home purchases. The first survey considered is that of 1983, which was collected only shortly after the Garn-St. Germain Act became law in October 1982. We consider these observations as indicative of mortgage borrowing just before deregulation's completion. We do not report results from the 1986 SCF, because of its problematic sampling procedure.⁴ The other surveys we do use are from 1989, 1992, 1995, 1998, and 2001.

In 1983, approximately 10 percent of mortgagees had refinanced their current home.⁵ By 1989, this had more than doubled, and it increased again to 33 percent in 1992. In 1995, it reached almost 41 percent, and it was slightly higher than that in 1998 and 2001. Mortgage refinancing went from atypical to commonplace in about 12 years.

The final column reports the ratio of home equity to home value for newly purchased homes.⁶ These homes' owners have had very little time to accumulate equity through debt amortization, so these ratios are very close to the homeowners' effective down payments. We expect deregulation to lower down payments, because it allowed lenders to more easily issue second or third mortgages when closing the home purchase. Because of these widespread options, down payments on individual mortgages after deregulation do not provide information about the effective initial equity shares. In 1983, this ratio equalled 22.6 percent. Although it changed little through 1992, it dropped four percentage points between 1992 and 1995 (to 16.9 percent). In the 1998 and 2001 surveys it equaled 16.4 percent.

These figures reflect the substantial changes in homeowners' financing options after deregulation. Refinancing became cheaper and thus also more widespread, and typical down payments on new homes fell considerably although with a delay of about ten years. We have also examined mortgagees use of home-equity lines of credit, but total debt incurred with this instrument never exceeded 1.5 percent of mortgagees' home value. Explaining the timing and relative magnitudes of these institutional changes lies beyond the scope of this paper. Our analysis takes the reduced equity requirements for household debt as given and uses a quantitative general-equilibrium model to determine their implications for macroeconomic

⁴To create a panel data set, the 1986 survey sampled households living in the same housing units as the respondents to the 1983 survey. This non-standard sampling makes the resulting observations not representative of the U.S. population in that year.

⁵We identify these households by comparing the year of home purchase with the year their oldest mortgage debt was issued.

⁶For the 1983 SCF, we defined a newly-purchased home as any home purchased in 1982 or 1983. For the other surveys, all such homes were purchased by their current occupant in the survey year. The values reported equal the averages of this ratio across all such homes with mortgage debt exceeding 50 percent of the home's value.

dynamics and market participants' resultant welfare.

3 The Model

The model combines financial trade between a patient *saver* and an impatient *borrower* with an equity requirement typical of collateralized loan contracts in the United States. The different rates of time preference generate intertemporal trade in the form of household debt owed by the borrower to the saver. [Becker \(1980\)](#) showed that there exists no steady-state with positive consumption by all households in a similar economy without constraints on debt. In our model, the equity requirement limits the borrower's debt, so both households have positive consumption in the steady state. In it, the interest rate equals the saver's rate of time preference, and the equity requirement prevents the borrower from expanding debt without further purchases of durable goods.

We study the transition path from one steady state to another with a lower equity requirement. The borrower begins this transition with a large amount of equity no longer required for borrowing, so the equity requirement might not always bind.

This section presents preferences, production technology, and the constraints on trade between the two households. It concludes with a discussion of both households' utility maximization problems and the definition of a competitive equilibrium.

3.1 Preferences

The borrower and saver have time-separable preferences with identical felicity functions and different discount rates. This generates a concentration of assets in a relatively small number of households, and it follows [Krusell and Smith's \(1998\)](#) use of heterogeneity in thrift to generate an empirically realistic wealth distribution. The borrower's and the saver's utility functions are:

$$\sum_{t=0}^{\infty} \hat{\beta}^t \left[\theta \ln \hat{S}_t + (1 - \theta) \ln \hat{C}_t \right], \quad 0 < \theta < 1, \quad \omega > 0, \quad (1)$$

$$\sum_{t=0}^{\infty} \tilde{\beta}^t \left(\theta \ln \tilde{S}_t + (1 - \theta) \ln \tilde{C}_t \right), \quad (2)$$

where $\hat{\beta} < \tilde{\beta}$. In (1), \hat{S}_t and \hat{C}_t are the borrower's stock of durable goods (assumed to be proportional to the service flow) and his consumption of non-durable goods and labor supply. In (2), \tilde{S}_t , and \tilde{C}_t are the saver's consumption of the two goods. We use \hat{A} and \tilde{A} to represent borrower and saver specific versions of A for the remainder of the paper.

3.2 Technology

The aggregate production function is $Y_t = K_t^\alpha N_t^{1-\alpha}$, where $0 < \alpha < 1$, Y_t is output, K_t is the capital stock, and N_t is labor input. The borrower inelastically supplies N units of labor each period. We simplify the model along an unimportant dimension by assuming that the saver supplies no labor.⁷ Output can be used for investment in productive capital or for either household's nondurable consumption or durable goods purchases. That is

$$Y_t = I_t + \hat{C}_t + \tilde{C}_t + \hat{X}_t + \tilde{X}_t$$

The right-hand side's final two terms are the investments in the two households' durable good stocks. Both of these depreciate at the rate δ , so their evolution follows

$$\hat{S}_{t+1} = (1 - \delta)\hat{S}_t + \hat{X}_t, \tag{3}$$

$$\tilde{S}_{t+1} = (1 - \delta)\tilde{S}_t + \tilde{X}_t. \tag{4}$$

Similarly, productive capital depreciates at rate λ and evolves according to

$$K_{t+1} = (1 - \lambda)K_t + I_t. \tag{5}$$

3.3 Trade

All trade takes place in competitive markets. The households sell capital services at the rental rate H_t and labor at the wage W_t to the representative firm. They also trade in collateralized debt, which is the only available security. The households' outstanding debts at the end of period t are \hat{B}_{t+1} and \tilde{B}_{t+1} . We denote the corresponding gross interest rate with R_t , which adjusts every period.

An exogenous equity requirement on collateral constrains debt. It mimics a typical feature of loan contracts in the United States: An equity share that starts from a positive level

⁷When we endow both households with logarithmic preferences in leisure and calculate their steady-state labor supplies, we find that the wealth effect induces the saver to consume her entire time endowment in leisure.

(the down payment) and increases over time (if debt amortizes more rapidly than the good depreciates). In the model, the parameters capturing this feature are $0 \leq \pi < 1$, the initial equity share, and ϕ , which governs the speed of subsequent equity accumulation. When a loan is collateralized by a durable good j periods old, the required equity share at the beginning of the following period is

$$e_j = 1 - \left(\frac{1 - \phi}{1 - \delta} \right)^j (1 - \pi). \quad (6)$$

For newly purchased goods ($j = 0$), the equity share is π . When $\phi = \delta$ the equity share remains at its initial level thereafter. If instead $\phi > \delta$, then the equity share converges to one as j increases. We call this accelerated amortization. The institutional background presented above suggests modelling deregulation by lowering the initial equity share with a drop in π and lowering the rate of equity accumulation by bringing ϕ closer to δ .

For a household with positive debt, the total amount of equity at the beginning of period $t + 1$ is $(1 - \delta)S_{t+1} - R_t B_{t+1}$, where the durable stock is adjusted for depreciation and the debt for accumulated interest. This household's required equity in durable goods sums the equity requirements on the (depreciated) goods of all ages from equation (6):

$$(1 - \delta)S_{t+1} - R_t B_{t+1} \geq (1 - \delta) \sum_{j=0}^{\infty} (1 - \delta)^j X_{t-j} e_j. \quad (7)$$

Using the definition of e_j , (7) can be expressed as a repayment constraint.

$$R_t B_{t+1} \leq (1 - \delta)(1 - \pi) \sum_{j=0}^{\infty} (1 - \phi)^j X_{t-j} \quad (8)$$

Here, a debtor's total liability cannot exceed a linear function of the value of the goods that collateralize it with coefficients which decrease with π and ϕ . If $\phi = \delta$, the right-hand side of (8) reduces to $(1 - \delta)(1 - \pi)S_{t+1}$. In this case, the constraint is formally identical to that which [Kiyotaki \(1998\)](#) derives from an environment with costly repossession. We do not stress this interpretation of the constraint, because we assume that public policy decisions force π and ϕ to exceed their levels dictated by considerations of private contracting alone.

3.4 Utility Maximization

We now examine both households' utility maximization problems. For this, we conjecture that in equilibrium the saver owns all physical capital and the borrower's debt. With the proposed equilibrium in hand, verifying this is straightforward.

3.4.1 The Borrower's Problem

To formulate the borrower's utility maximization problem, it is helpful to first represent the debt limit recursively. Define

$$\hat{V}_{t+1} = (1 - \delta)(1 - \pi) \sum_{j=0}^{\infty} (1 - \phi)^j \hat{X}_{t-j} / R_t. \quad (9)$$

This is the maximum debt principle this household can carry out of period t . Multiplying \hat{V}_t by $(1 - \phi)R_{t-1}/R_t$ and subtracting the result from \hat{V}_{t+1} yields

$$\hat{V}_{t+1} = (1 - \phi) \frac{R_{t-1}}{R_t} \hat{V}_t + \frac{(1 - \delta)(1 - \pi)}{R_t} \hat{X}_t. \quad (10)$$

With this definition of V_t , the equity requirement becomes

$$\hat{B}_{t+1} \leq \hat{V}_{t+1}. \quad (11)$$

Together, (10) and (11) represent the borrower's required equity in its durable goods stock.

Given \hat{V}_0 , $R_{-1}\hat{B}_0$ and \hat{S}_0 , the borrower chooses sequences of \hat{C}_t , \hat{X}_t , \hat{B}_{t+1} , and \hat{V}_t to maximize the utility function in (1), subject to the sequence of budget constraints

$$\hat{C}_t + \hat{X}_t + R_{t-1}\hat{B}_t = W_t N + \hat{B}_{t+1} \quad (12)$$

and the sequences of constraints in (10) and (11). Denote the current-value Lagrange multiplier on (12) with Ψ_t . Expressing the Lagrange multipliers on (10) and (11) with $\Psi_t \Xi_t$ and $\Psi_t \Gamma_t$, then Ξ_t and Γ_t measure the value in units of either consumption good or marginally relaxing their associated constraints.

In addition to the three constraints and the transversality conditions,

$$\lim_{t \rightarrow \infty} \hat{\beta}^t \Psi_t = \lim_{t \rightarrow \infty} \hat{\beta}^t \Psi_t \Gamma_t = \lim_{t \rightarrow \infty} \hat{\beta}^t \Psi_t \Xi_t = 0, \quad (13)$$

the optimality conditions for this maximization problem are

$$\Psi_t = \frac{1 - \theta}{\hat{C}_t}, \quad (14)$$

$$\Xi_t = \Gamma_t + \hat{\beta} \frac{\Psi_{t+1}}{\Psi_t} \Xi_{t+1} (1 - \phi) \frac{R_{t-1}}{R_t}, \quad (15)$$

$$\Gamma_t = 1 - \hat{\beta} \frac{\Psi_{t+1}}{\Psi_t} R_t, \quad (16)$$

$$1 - \Xi_t \frac{(1 - \pi)(1 - \delta)}{R_t} = \hat{\beta} \frac{\Psi_{t+1}}{\Psi_t} \left[\frac{\theta}{1 - \theta} \frac{\hat{C}_{t+1}}{\hat{S}_{t+1}} + (1 - \delta) \left(1 - \frac{\Xi_{t+1}(1 - \pi)(1 - \delta)}{R_{t+1}} \right) \right], \quad (17)$$

The equity requirement alters the interpretation of the multiplier on the budget constraint. For an unconstrained household such as the saver, it equals the marginal value of permanent income. In contrast, Ψ_t represents the marginal value of additional *current* resources, because the borrower cannot freely substitute intertemporally.

In (16), Γ_t equals the deviation from the standard Euler equation, the shadow value of borrowing at time t . It is positive if the equity constraint currently binds and zero otherwise. Iterating (15) forward yields Ξ_t as the present value expression of the current and future values of Γ_t . That is, Ξ_t equals the price of an asset that allows its holder to borrow today and in the future. This is positive if the equity constraint ever binds in the future.

Equation (17) characterizes optimal durable good purchases. If the borrower's equity requirement *never* binds, then $\Xi_t = \Xi_{t+1} = 0$ and (17) equates the purchase price of the durable good to its immediate payoff (the marginal rate of substitution between durable and non-durable goods) plus its discounted expected resale value. In the more relevant case where Ξ_t and Ξ_{t+1} are both positive, it has the same interpretation where the borrower's "purchase price" is $1 - \Xi_t(1 - \pi)(1 - \delta)/R_t$. Because the durable good provides the household with $(1 - \pi)(1 - \delta)/R_t$ units of V_t —the allowed loan-to-value ratio of the "asset" mentioned above—the borrower's effective price lies below the real resource cost of 1.

3.4.2 The Saver's Problem

The saver's utility maximization problem presents no novelties, but we present it here for the sake of completeness. Given the initial capital stock, \tilde{K}_0 , the initial durable goods \tilde{S}_0 , and the financial assets $-R_{-1}\tilde{B}_0$; the saver chooses sequences of \tilde{C}_t , \tilde{X}_t , I_t , and \tilde{B}_{t+1} to maximize utility subject to

$$\tilde{C}_t + \tilde{X}_t + I_t - \tilde{B}_{t+1} = H_t\tilde{K}_t - R_t\tilde{B}_t. \quad (18)$$

The right-hand side of (18) sums the sources of funds: Capital rental revenue and the market value of household debt. The left-hand side includes the four uses of these funds: Non-durable consumption, purchases of durable goods, purchases of productive capital, and the extension of household credit.

Denoting the current-value Lagrange multiplier on (18) with Υ_t , the problem's first-order conditions are

$$\Upsilon_t = \frac{1 - \theta}{\tilde{C}_t}, \quad (19)$$

$$1 = \tilde{\beta} \left[\frac{\Upsilon_{t+1}}{\Upsilon_t} \left(\frac{\theta}{1 - \theta} \frac{\tilde{C}_{t+1}}{\tilde{S}_{t+1}} + (1 - \delta) \right) \right], \quad (20)$$

$$1 = \tilde{\beta} \frac{\Upsilon_{t+1}}{\Upsilon_t} R_t, \quad (21)$$

$$1 = \tilde{\beta} \frac{\Upsilon_{t+1}}{\Upsilon_t} (H_{t+1} + (1 - \lambda)). \quad (22)$$

Equation (20) is a typical condition for optimal durable goods purchases, and (21) is the standard Euler equation. Together with (22), it requires the returns to purchasing productive capital and household debt to equal each other.

3.5 Production and Equilibrium

The standard conditions for profit maximization of the representative firm are

$$W_t = (1 - \alpha) \left(\frac{K_t}{N} \right)^\alpha, \quad (23)$$

$$H_t = \alpha \left(\frac{K_t}{N} \right)^{\alpha-1}. \quad (24)$$

Given the initial capital stock K_0 , the two households' initial stocks of durable goods, \hat{S}_0 and \tilde{S}_0 , the stock of outstanding debt issued by the borrower and held by the saver, $B_0 = \hat{B}_0 = -\tilde{B}_0$, the borrower's initial debt capacity \hat{V}_0 , and the predetermined interest rate on outstanding debt R_{-1} , a competitive equilibrium is a set of sequences for all prices and the borrower's, saver's, and representative firm's choices such that both households maximize utility subject to the constraints, the representative firm maximizes its profit, the stocks of durable goods and productive capital obey the accumulation equations in (4) and (5), and the input, product and debt markets clear.

Before proceeding to apply the model, we wish to comment on the model's demographics. The model is written with *one* saver and *one* borrower, but we intend the saver to stand-in for the wealthiest ten percent of households while the borrower represents all others. Because both households' preferences are homothetic and the saver earns no labor income, we can show that increasing the number of borrowers while holding the aggregate time endowment constant has no impact on any equilibrium object except consumption per borrower. With

this in mind, we maintain the simplifying convention of referring to “the” borrower and “the” saver.

4 Steady State Analysis

Comparison of the model’s steady state with different values of π and ϕ provides an insight into the long-run implications of changing the equity requirement and also guides the quantitative examination of the complete equilibrium path. The steady-state interest rate equals $R = \tilde{\beta}^{-1}$ from the saver’s Euler equation. Hence it immediately follows that changing π or ϕ has no long-run impact on the interest rate.

From the borrower’s Euler equation (16), we get that $\Gamma = 1 - \hat{\beta}/\tilde{\beta}$. Plugging this into the steady-state version of (15) then yields

$$\Xi = \frac{\Gamma}{1 - \hat{\beta}(1 - \phi)} > 0.$$

That is, the saver’s rate of time preference determines the interest rate at a level below the borrower’s discount rate; and the equity requirement limits the borrower’s steady-state debt.

The interest rate, Ξ , and (17) together determine the steady-state value of \hat{S}/\hat{C} .

$$\frac{\hat{S}}{\hat{C}} = \frac{\theta}{1 - \theta} \frac{\hat{\beta}}{(1 - \Xi(1 - \pi)(1 - \delta)/R)(1 - \hat{\beta}(1 - \delta))}$$

Lowering π and ϕ impacts \hat{S}/\hat{C} through Ξ , which represents the shadow value of durable goods for borrowing purposes. Consider first lowering ϕ . This increases Ξ and so shifts the borrower’s consumption towards durable goods. Lowering π leaves Ξ unchanged but also has a positive impact on \hat{S}/\hat{C} .⁸

Because the equity requirement limits the borrower’s debt, we can determine \hat{B}/\hat{S} by solving for \hat{V}/\hat{S} using (10) and equating \hat{B} with \hat{V} . The resulting debt to value ratio is

$$\frac{\hat{B}}{\hat{S}} = \frac{(1 - \pi)(1 - \delta)\delta}{R\phi},$$

⁸One question of possible interest that is tangential to this comparative steady-state analysis is “Which household spends a greater fraction of income on durable goods?” They differ in two respects: The borrower discounts the future with a lower discount factor, and the borrower faces a lower “shadow price” of durable goods. The first difference lowers \hat{S}/\hat{C} relative to \tilde{S}/\tilde{C} , while the second difference works oppositely. It is not hard to show that the first difference dominates the second, so that $\hat{S}/\hat{C} < \tilde{S}/\tilde{C}$. That is, although the ability to buy durable goods with credit induces the borrower to raise \hat{S}/\hat{C} , the borrower spends a greater fraction of income on *nondurable* consumption because she is impatient to receive the future utility from durable goods.

which clearly decreases with both π and ϕ .

With these ratios in hand, we can determine the share of labor income spent on the borrower's consumption.

$$\frac{\hat{C}}{W\hat{N}} = \frac{1}{1 + (R - 1)\frac{\hat{B}}{\hat{S}}\frac{\hat{S}}{\hat{C}} + \delta\frac{\hat{S}}{\hat{C}}}. \quad (25)$$

The results above imply that this increases with π and ϕ , so lowering equity requirements shifts the borrower's steady-state allocation of income away from nondurable consumption. The Federal Reserve's Board of Governors regularly tabulates the *debt service ratio* for U.S. households as "an estimate of the ratio of debt payments to disposable personal income."⁹ In the model's steady state, the borrower's required debt payments equal net interest plus required equity accumulation $(R - 1 + \phi)\hat{B}$. It is not difficult to show that this rises as either π or ϕ falls if the parameters are such that $\hat{B} > \hat{C}$. For this reason, we expect credit market reform to increase the long-run debt service ratio.

We now proceed to consider the saver's steady-state consumption and wealth. Equating the return to productive capital with R immediately yields H . Combining this with N then gives W and K . Thus, the size of the productive sector is invariant to π and ϕ .¹⁰ The saver's steady-state income equals $R\hat{B} + HK$, which obviously increases as π and ϕ fall. Therefore, lowering the equity requirement increases steady-state inequality. This redistribution has direct implications for welfare: The saver is better off and the borrower is worse off in the new steady state. Of course, a steady-state welfare comparison abstracts from the principle reason borrowers find it attractive to expand debt after deregulation: They can increase current consumption and pay later. The next section lays the foundation for a complete welfare analysis by calculating the equilibrium transition path following a reduction of π and ϕ in a calibrated version of the model.

5 Quantitative Investigation

Moving beyond the qualitative results from comparing steady states requires us to assign values to the model's parameters and calculate its equilibrium path following an unexpected simultaneous reduction in π and ϕ . This reform's welfare consequences can then be tabulated from the equilibrium consumption choices.

⁹For this definition, see <http://www.federalreserve.gov/releases/housedebt/default.htm>

¹⁰This is *not* so if the borrower's labor supply is endogenous. In that case, the negative wealth effect of extra debt expands labor supply and thereby induces a proportional increase in K .

5.1 Calibration

The calibration of the model is similar that in this paper’s companion (Campbell and Hercowitz, 2006). The production function elasticity α equals 0.3, and the capital depreciation rate λ is 0.025. The depreciation rate for durable goods (δ) is 0.01, which is the appropriately weighted average of 0.003 for owner-occupied residences and 0.031 for automobiles.¹¹ For the saver we chose $\tilde{\beta} = 1/1.01$, so that the quarterly interest rate is 1.0 percent; for the borrower, we assign a relative impatience of 0.5 percent per quarter, i.e., $\hat{\beta} = 1/1.015$. This degree of impatience is similar in magnitude to that used by Krusell and Smith (1998). They use three levels of time preference, with 0.72 percent between the two extremes.

The main aspect of the calibration is setting the values of π and ϕ for the high- and low-requirement regimes. This calibration is based on the following correspondence between the model and the data. The model’s loan-to-value ratio at the steady-state $(1 - \delta)(1 - \pi)/R$ is matched to an average actual ratio; given the values of R and δ , this equality can be used to solve for π . The steady-state amortization rate ϕ is matched to an average repayment rate. Given the interpretation of the model’s durable goods stock S_t as homes and vehicles, the values of these parameters are computed as weighted averages of estimates for mortgages and car loans.

The calibration of π and ϕ involves the basic issues of choosing the sample period for each of the model’s regimes and the type of data required. The discussion of the institutional background in Section 2 provides guidance for these choices. For the high-requirement regime we use observations through 1982, given that the timing of the Garn-St.Germain Act in October of that year. We presume that immediately following deregulation the equity constraint is not binding because of the large size of home equity that is cashable at that time. Because it is much easier to read equity constraint parameters from data generated under a binding constraint, we do not use observations immediately following 1982 to calibrate the post-reform regime. According to Table 1, the effective down payment on mortgages and the percentage of mortgages refinanced stabilize around 1995. This and the stabilization of the debt/asset ratio around the same time—See Figure 3 below—both suggest that by then the equity constraint binds again. Hence, we use observations from 1995 onwards to calibrate the low-requirement regime.

¹¹The source is “Fixed Assets and Consumer Durable Goods in the United States, 1925-1997.” The service life of 1-4 units residences is 80 years. Automobiles’ service life of 8 years is inferred from the reported non-linear depreciation profile. We used the weights 0.75 and 0.25, which are the shares of the owner occupied residential stock and consumer durable goods stock in the 1954-2004 sample.

As discussed in Section 2, data on individual mortgages have little relevance after deregulation: Loan-to-value ratios may not reflect initial equity shares because of the possibility of more than one mortgage, and maturities are likely to be extended later by refinancing. Hence, we proceed as follows. For car loans, we use observations on down payments and loan maturities in car loan contracts, which we assume reflect actual equity requirements in the two sample periods. For mortgages, we use data from the Survey of Consumer Finances, as reported in Section 2. The initial equity share for homes is computed as the average equity share of households that purchased their homes within 12 months of the interview date. Because maturities reported at the interviews do not take into account the likelihood of future refinancing, calibrating ϕ for the low-requirement regime necessitates an alternative procedure. We set ϕ for this regime so that the model’s increase in the debt-to-asset ratio across regimes equals the actual change from the pre-1983 sample to the post-1995 sample, 10.5 percentage points.

Additional details about calibration of π and ϕ are presented in Appendix A. The resulting values are 0.16 and 0.0315 for the high-requirement regime, and 0.11 and 0.0161 for the low-requirement regime.

The final remaining parameter is θ . We chose this to match the average share of durable goods expenditure in total households’ expenditures in the 1954:I-1982:IV sample, 0.21.¹² Given the other parameters, including the π and ϕ values for the pre-reform regime, the unique value of θ that matches this ratio 0.37. Table 2 summarizes the calibrated parameter values.

In addition to lowering down payments on new loans and extending repayment of old loans, the reduction of equity requirements enables immediate additional borrowing based on accumulated equity. This is the “borrowing shock”, which is the difference between the old and the new equity share on the stock \hat{S} , held by the borrower in the initial steady state. This difference equals

$$\frac{\delta \hat{S}(1 - \delta)}{R} \left(\frac{1 - \pi'}{\phi'} - \frac{1 - \pi}{\phi} \right),$$

where π , ϕ and π' , ϕ' are the pre- and post-reform pairs of values. Given the model’s calibration, this amounts to 70 percent of initial output. For our baseline calculation, we

¹²To calculate this ratio, we adjusted the NIPA’s nondurable personal consumption expenditures by subtracting the imputed service flow of housing. We then added residential investment to personal consumption expenditures on durable goods.

Equity Requirement	π	ϕ	α	λ	δ	$\tilde{\beta}$	$\hat{\beta}$	θ
High	0.16	0.0315	0.3	0.025	0.01	$\frac{1}{1.01}$	$\frac{1}{1.015}$	0.37
Low	0.11	0.0186						

Table 2: Calibrated Parameter Values

assume that only half of this amount can be borrowed.¹³

5.2 Transition Dynamics

Given the calibrated parameter values, the reduction of π and ϕ substantially impacts the economy's steady state. The change directly raises \hat{B}/\hat{S} from 0.26 to 0.48. The greater debt burden lowers \hat{C} by 5.5 percent. The greater borrowing capacity of durable goods fails to offset the income effect from the additional debt, so \hat{S} falls 3.9 percent. On the other hand, the saver's additional wealth leads to a 25 percent expansion of both \tilde{C} and \tilde{S} . In the initial steady state, the saver accounts for 15 percent of nondurable consumption expenditures and 17 percent of durable expenditures. The reform raises these ratios in the long run to 19 and 20 percent.

To calculate the equilibrium path between the initial and the new steady state, we use a modified version of Fair and Taylor's (1983) procedure. We conjecture that the equity constraint does not bind for the borrower until some date $t^* \geq 0$ and then binds forever; and we calculate the path of prices, quantities, and Lagrange multipliers that satisfies all of the optimality and market clearing conditions. If the resulting multipliers on the constraints are all nonnegative and the households' choices violate none of the constraints, then the resulting path is the desired equilibrium. Otherwise, we search other values of t^* until such an equilibrium path is found.

We find that $t^* = 39$ given the parameters' calibrated values. Figure 1 presents plots of the equilibrium path for the model's key quantities and the interest rate. The reform begins at date 1 with a one-time unexpected reduction in π and ϕ and increase in \hat{V}_0 —the borrowing capacity of the durable goods' stock given the equity requirements. The sudden excess of equity over the required amount acts like a shock to the demand for loanable funds. Both the debt and the interest rate immediately jump. Later, as debt growth slows down, the interest

¹³Note that this assumption does not alter the new steady state, which is based only on π' and ϕ' —along with the constant parameters of the model.

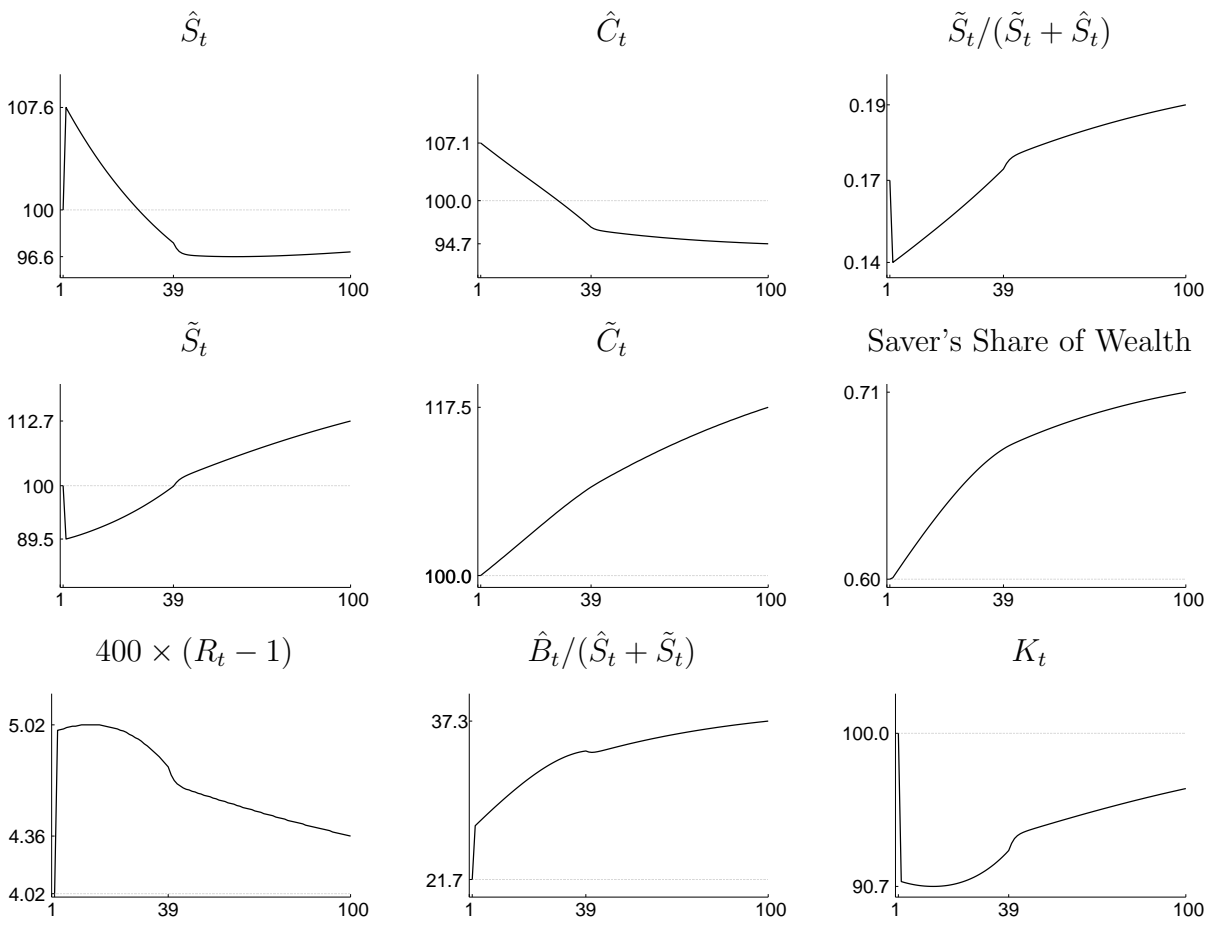


Figure 1: The Model's Equilibrium Path

All variables, except the interest rate and the shares, are expressed in percentage points relative to their initial steady-state values.

rate gradually declines towards its steady-state value.

The interest rate jumps 100 basis points to a level between the two rates of time preference.¹⁴ The temporarily high rate of interest induces the saver to disinvest productive capital and to dramatically reduce durable goods consumption. The interest rate rise has a weaker substitution effect on the saver's nondurable consumption. In contrast to the saver, the borrower *increases* consumption of both goods and expands debt as would an unconstrained household facing a temporarily *low* rate of interest. From the period of the reform until the borrower's constraint again binds, the interest rate rises slightly beyond the initial jump and then gradually falls. During this time, the borrower's consumption of both goods falls while the saver's consumption rises. The binding borrowing constraint directly slows the fall of \hat{C}_t after t^* . At the same time, \hat{S}_t begins to slope *up*. The intuition for this upward trend can be seen using the multiplier of the equity constraint in (11),

$$\Gamma_t = 1 - \hat{\beta} \frac{\hat{C}_t}{\hat{C}_{t+1}} R_t,$$

which reflects the value of additional funds for the borrower. After t^* , the gradual decline of R_t increases Γ_t . Because durable goods provide borrowing possibilities, their value for the borrower correspondingly increases over time.

The evolution of inequality in wealth and durable goods over time follows directly from the mechanism just described. Over the 25 year period shown in Figure 1, \hat{B}_t rises by 71 percent. This implies a redistribution of wealth from the borrower to the saver. This is the main force raising the saver's share of total wealth from 60 percent in the initial steady state to 71 percent after 25 years.

5.3 Welfare Analysis

With the equilibrium transition path in hand, we can calculate both households' welfare levels and compare them to their values in the initial steady state. Converting these utility differences into permanent percentage changes in both goods required to achieve the new utility level allows an interpersonal comparison of these gains. We call these the welfare changes' consumption equivalents, and Table 3 reports these for both households. Its first row gives the results of the baseline experiment.

¹⁴It is easy to show that in an endowment economy without borrowing constraints and only nondurable consumption, the households' rates of time preference bound the interest rate. Before t^* , the present economy differs from such economy in having also a fixed endowment of labor and durable consumption. However, the interest rate from this economy stays within the bounds from the simpler endowment economy.

	Borrower	Saver
Baseline Experiment	-1.3	11.2
Fixed R	1.4	0.0
Fixed K	0.4	1.4
No Cash Out ⁽ⁱ⁾	-1.0	9.6
Full Cash Out ⁽ⁱⁱ⁾	-1.5	12.2

Table 3: Consumption Equivalents of Welfare Changes

Notes: (i) This experiment leaves V_0 equal to its value in the initial steady state. That is, V_0 does not jump following the reform. (ii) In this experiment, V_0 jumps to the value from applying (9) using the post-reform values of π and ϕ and the steady state value of \hat{X} calculated with pre-reform parameters.

Examining a borrower’s problem in isolation leads to the intuition that lowering equity requirements benefits borrowers, but in fact the reform makes the borrower worse off. The intuition from this is familiar from the analysis of quotas in international trade. Removing one can move the terms of trade adversely and so make the “importing” country worse off. The borrower of our analysis sells labor and issues debt, and the reform lowers the wage and increases the interest rate. To gauge the quantitative impact of these price movements on the borrower’s welfare, the second row of Table 3 reports the consumption equivalent welfare changes from the reform allowing both the borrower and saver to access an international capital market at the fixed interest rate of R . Since the borrower’s labor supply is constant, the capital stock and wage remain unchanged in this experiment. No price relevant for the saver changes, so neither does her welfare. The reform increases the borrower’s welfare by 1.4 percent. That is, the negative terms-of-trade effects on the borrower’s welfare have twice the magnitude of the positive direct effect from lowering equity requirements.

We wish now to decompose the terms-of-trade effects on welfare into those due solely to the interest-rate increase and those arising from the concomitant changes in the wage and capital rental rate. For this, we calculate the post-reform equilibrium path in an economy with a fixed capital stock endowment that cannot be augmented through saving. Since both factor inputs are fixed, so are their competitive prices. The interest rate response in this economy is nearly identical to that in the baseline experiment. The only major difference between the two paths is that the equity requirements limit the borrower’s debt after 30 quarters; and this ends the interest rate’s initial “hump”. In spite of this similarity in the interest rate paths, the welfare results are very, very different. The third line of Table 3

reports the consumption equivalents, 0.4 percent for the borrower and 1.4 percent for the saver. Apparently, the endogenous responses of the wage and capital rental rate dominate the welfare calculations.

We can understand the strong effect of input price movements on welfare from examining the saver’s portfolio. Whether or not the capital stock is fixed, equilibrium requires the rate of return on owning productive capital to equal the interest rate on household debt. The conventional capital accumulation technology without adjustment costs pins down the price of capital, so the interest rate and capital rental rate move together. The additional return on the saver’s prior investments clearly benefits her. If instead the capital stock is fixed, it is the rental rate that cannot change. The required return from owning productive capital comes from the gradual reversal of an initial capital loss. This brings no benefits to the saver.

The remaining lines of Table 3 report welfare results from experiments designed to assess the robustness of our findings to changes in the amount of equity accumulated before the reform that the borrower can cash-out thereafter. The previous experiments lead us to expect that reducing the equity which can be cashed-out will reduce the interest rate increase and thereby transfer welfare from the saver to the borrower. This is indeed the case, but the effects are relatively small. When the borrower cannot cash-out any equity, his consumption equivalent welfare loss from the reform equals -1.0 percent. With a full cash out this equals -1.5 percent.

6 An Extension with Irreversible Investment

Asserting that the large overnight disinvestment of capital and transfer of durable goods from the saver to the borrower are feasible strains the bounds of credibility. To ensure that our results do not depend crucially on them, we here recalculate the welfare effects of credit market reform with nonnegativity constraints on investment.

$$I_t \geq 0, \quad \hat{X}_t \geq 0, \quad \tilde{X}_t \geq 0. \tag{26}$$

The first constraint in (26) is the standard requirement that the capital stock fall no faster than it depreciates. The second two impose the same requirement on the individual households’ durable goods stocks. Clearly, households trade durable goods. We intend the constraints in (26) to reflect the difficulty of converting durable goods demanded by wealthy households (mansions) into durables more useful for the middle class (2-bedroom houses). We next spell out how these constraints change the model, and we then describe the modified economy’s transition and welfare results.

6.1 Utility Maximization

We solve the model using the following conjectures about the equity and irreversibility constraints. We verify that these hold good for the calculated equilibrium path.

- As in the basic model, the equity constraint binds for the borrower on and after some date $t^* \geq 0$.
- The irreversibility constraint on productive capital binds until some date $t_K^{**} > 0$. We conjecture so because high interest rates generated by the additional borrowing demand requires the capital stock to fall. Once this fall is complete, the constraint should become slack.
- The irreversibility constraint on the saver's durable good's stock binds until some date $t_S^{**} > 0$. Just as with productive capital, an initially high interest rate should induce the saver to substitute towards nondurable consumption. With the required disinvestment complete, this constraint should also become slack.
- The irreversibility constraint never binds for the borrower. Immediately following the reform, the borrower wishes to *increase* its durable stock, and we expect any later decline in the desired stock to occur gradually.

Given these conjectures, only the saver's problem changes. Denote the Lagrange multiplier on the investment irreversibility constraint with $\Lambda_t \Upsilon_t$ and that on the durable goods irreversibility constraint with $\Omega_t \Upsilon_t$ (where Υ_t is, as previously, the multiplier of the saver's resource constraint). With this, the first-order conditions for the Saver's optimal choices of K_{t+1} and \tilde{S}_{t+1} are now

$$1 - \Lambda_t = \tilde{\beta} \left[\frac{\Upsilon_{t+1}}{\Upsilon_t} (H_{t+1} + (1 - \lambda)(1 - \Lambda_{t+1})) \right],$$

$$1 - \Omega_t = \tilde{\beta} \left[\frac{\Upsilon_{t+1}}{\Upsilon_t} \left(\frac{\theta}{1 - \theta} \frac{\tilde{C}_{t+1}}{\tilde{S}_{t+1}} + (1 - \delta)(1 - \Omega_{t+1}) \right) \right].$$

When either irreversibility constraint binds, the saver's shadow price of the corresponding good declines and thereby slows down disinvestment.

6.2 Transition Dynamics with Irreversible Investment

Figure 2 presents plots of the equilibrium path analogous to those in Figure 1 in Section 5. Overall, the same mechanism also operates here: The borrower issues debt to the saver to

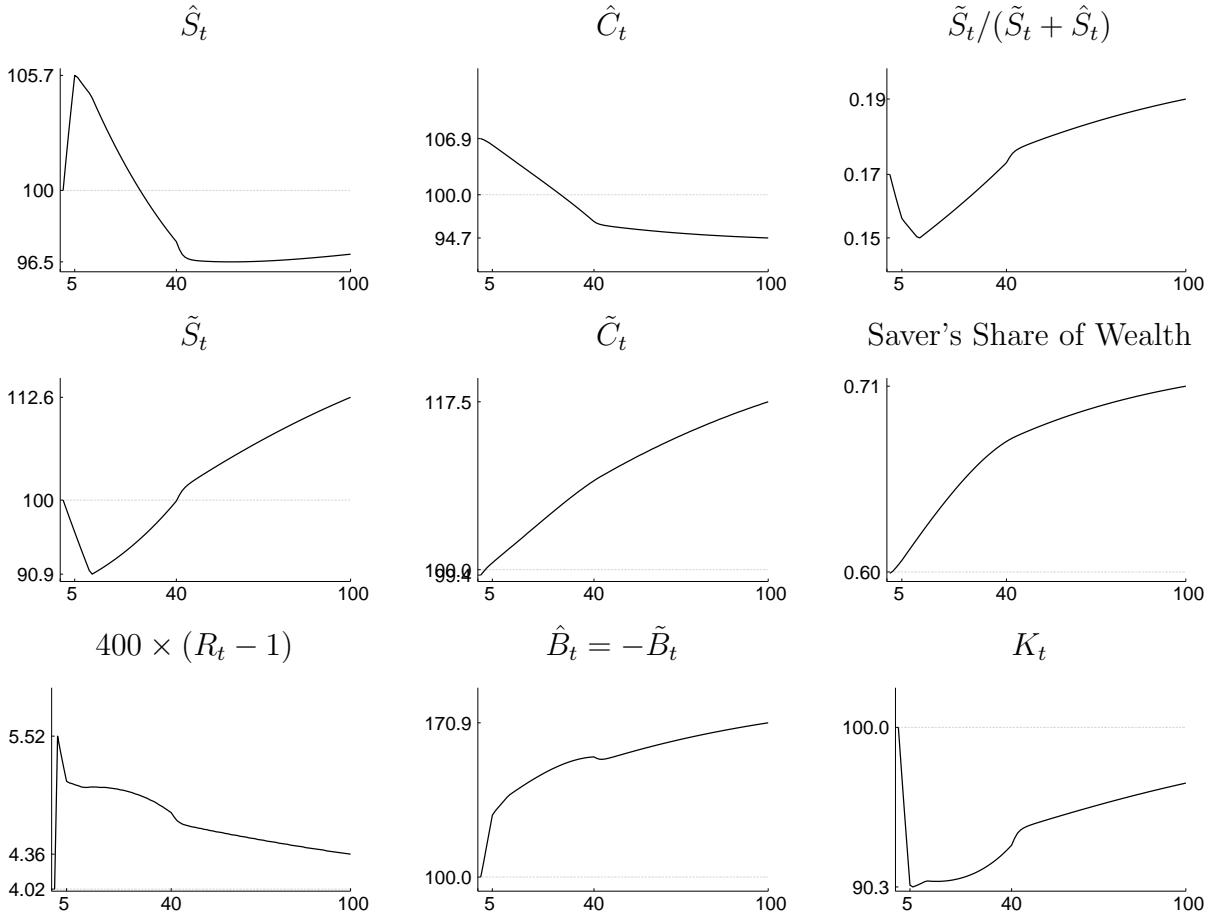


Figure 2: The Equilibrium Path with Irreversible Investment⁽ⁱ⁾

(i) All consumption variables expressed in percentage points relative to their initial steady-state values. Dashed lines give the initial steady-state values.

expand consumption and this raises the interest rate. Adding the irreversibility constraint changes two specific aspects of the story. The first follows directly from the frictions introduced: The reduction of K_t and \tilde{S}_t and increase of \hat{S}_t after the reform occur gradually. The calculated values of t_K^{**} and $t_{\tilde{S}}^{**}$ are 5 and 10. The limit to the saver's disinvestment also slows down the borrower's reduction of equity. Accordingly, the equity requirement does not limit the borrower's debt until $t^* = 40$ quarters after the reform.

The second change to the story arises from the typical amplification of price movements when quantities are slow to adjust. The limit on the saver's ability to generate loanable funds by selling household capital amplifies and sharpens the interest rate increase: Immediately after the reform the interest rate jumps directly to its peak, 5.5 percent—rather than peaking

later and at a lower rate, 5.0 percent, as in Figure 1. The sluggish quantity behavior shows also in the debt’s initial surge, which lasts t_K^{**} periods now, rather than one in the basic model. Overall, the welfare implications of credit market reform in the economy with nonnegativity constraints are nearly identical to those in the baseline economy. The permanent consumption equivalents for the borrower and saver are -1.3 and 11.3 percent.

7 Interpretation of Macroeconomic Evidence

This paper departs from the observation that household debt rose substantially following the deregulation of the early 1980s. Figure 3 quantifies this expansion, which starts in 1983:I. Using data from the Flow of Funds Accounts, it plots the ratio of nominal household debt to the value of household capital (primarily homes and vehicles).¹⁵ The ratio grows from 0.32 in 1983:I to 0.42 in 1995:I. The Figure’s dashed line gives the ratio of mortgage debt to owner-occupied real estate, which displays virtually the same behavior. Both ratios level off during the second half of the 1990s.

In the model, a large increase in the interest rate directly follows from the borrower’s additional demand for funds, and it is well-known that interest rates rose dramatically in 1983. Figure 4 quantifies this with a plot of the real three-year treasury rate. For this, we used realized inflation over the leading twelve months as expected inflation. Using the last 12 months inflation produces a very similar picture. The average real rate for the “pre-Volcker” period in this sample, 1961:I-1979:III, was 1.6 percent. During the Volcker monetary policy experiment, taken here to be from 1979:IV to 1982:IV, the real rate jumped to an average of 6 percent. After the peak of 10.3 percent in March 1981, the easing of monetary policy was followed by a sharp decline in the real interest rate. From November 1982 through April 1983, it hovered between five and six percent. Between April and May it jumped 0.9 percentage points, and it repeated this increase from May to June. Thereafter it continued rising at a more modest rate until it reached a peak of 9.6 percent in July 1984. From 1983 through 1995, the real rate is 4.40. This greatly exceeds the average rate from either the pre-Volcker era or the post-1995 period.

The model’s comovement of the debt/asset ratio and the interest rate in Figure 1 provides

¹⁵In 1961, this ratio equalled 0.32 and it grew to 0.40 by 1966. This is the end of a long expansion of household debt following the Korean War. The imposition of Regulation Q ceilings on Saving and Loans institutions in 1966 combined with increasing nominal interest rates resulted in financial disintermediation which shows in Figure 3 as the decline in the ratio of debt to assets until 1982. See [Campbell and Hercowitz \(2006\)](#) for more discussion of this history.

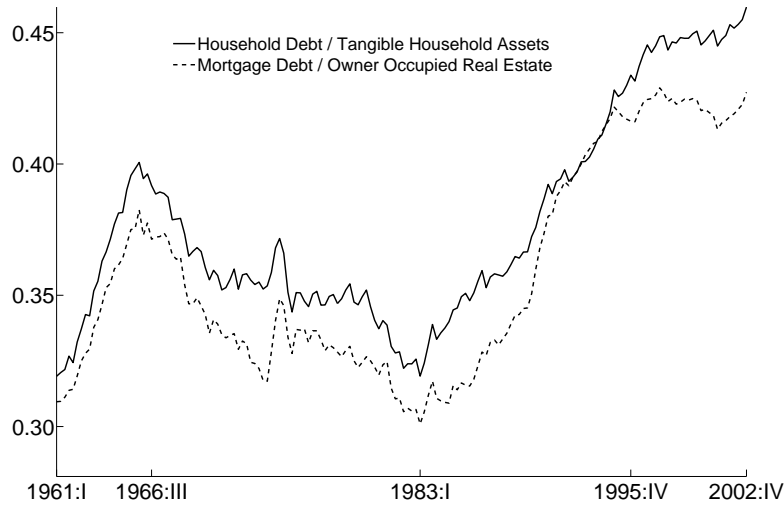


Figure 3: Ratios of Household Debt to Tangible Household Assets

a straightforward interpretation for the observations in Figures 3 and 4. The expansion of household credit demand triggered by lowering equity requirements induces an increase in interest rates in order for savers to be willing to supply those funds.

Contemporaneous macroeconomic observers attributed the high real interest rates from 1983 through 1986 to expansionary fiscal policy. The fourth of Friedman's (1992) lessons from the Reagan deficits is

Greater deficits did result in, or at least coincide with, higher real interest rates.
(pp. 301)

Similarly, Blanchard (1987) wrote

By the end of 1982, budget deficits had become the dominant macroeconomic force. Large deficits were strongly increasing aggregate demand and putting pressure on interest rates. (pp. 27)

The growth of household debt after 1982 and our theoretical analysis suggest that increased demand for *private* credit substantially contributed to this period's high interest rates. If the only cause of the high interest rates was the government deficit, then higher interest rates should have crowded out crowding out household debt.

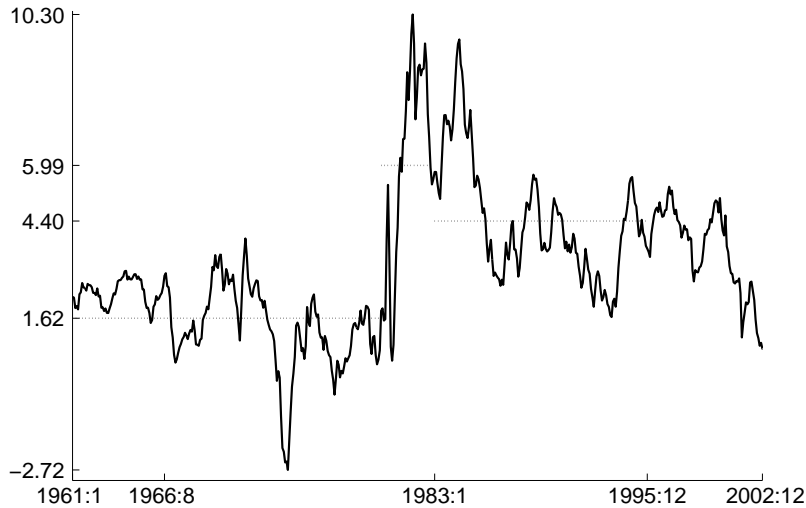


Figure 4: Three-Year Real Treasury Constant Maturity Rate

The Three-Year Treasury Constant Maturity Rate from Federal Reserve Release H.15 minus realized annual inflation using the chain-type deflator for Personal Consumption Expenditures other than Food and Energy.

On the calculated transition path, the interest rate immediately rises about 100 basis points. It is of course hard to say how much the additional borrowing demand in 1983 increased the interest rate, but the actual rise certainly exceeds the calibrated model's prediction. From the discussion in Section 5, the equilibrium interest rate movements were confined between the two households' rates of time preference. With this in mind, we experimented with the borrower's rate of time preference. Raising it from the 6 percent annual rate in the calibrated model to 12 percent raises the initial interest rate from 5.0 to 6.4 percent. Increasing the borrower's rate of time preference further to 18 percent increases the initial interest rate to 7.1 percent. These results indicate that the interest rate change in the model can be quite large if the two households' rates of time preference differ enough.

8 Concluding Remarks

We have examined the dramatic growth of collateralized household debt in the 1980s through the lens of a simple economy. Although the credit market reform which drives the debt growth directly relaxes a constraint on the borrowing household, shifts in the terms of trade can move some or all of the gains from the reform to saving households. The magnitude of

the shift depends crucially on an aspect of technology that seemingly has little to do with household credit markets, the ability to adjust capital. This surprising result reinforces our prior belief that assessing the welfare consequences of credit market reforms requires a general equilibrium approach.

One aspect of credit market reform that our analysis leaves unexplored is the effect of credit market regulation on housing prices. In our model, the price of durable goods relative to nondurable consumption is constant and equal to one. Endogenizing this price by introducing curvature to the production possibilities frontier or by introducing a complementary input in fixed supply (land) would make it possible to explore real estate price responses to financial liberalization and their macroeconomic impact. We believe that this is an important extension of the present paper.

Appendix

A Calibration of the Equity-Requirement Parameters

The calibration of the pre-reform values of π and ϕ proceeds as follows. For automobile loans, we use the Federal Reserve Statistical release G.19, which reports average loan-to-value ratios and repayment periods for automobile loans from 1971 onwards. Over the 1971-1982 sample, the average loan-to-value ratio is 0.87 and the average term is 13.4 quarters. For mortgage loans, the calibration is based on the Survey of Consumer Finances. The SCF includes the year of home purchase, the equity stake in the home and the original maturity of the first two mortgages. Our basic measure of the initial equity share for homes is the average equity share of households that purchased their homes within 12 months of the interview date, and borrowed at least half of the home's value. In the 1983 SCF, there are 104 such homeowners. Their average equity share is 0.2275 with a standard error of 0.0137. For the same sample, average mortgage maturity and its standard error are 85.5 and 3.8 quarters.

Because the 1983 SCF immediately followed the Garn-St. Germain Act, we think of these terms as representative of mortgage terms at the time of the reform. To check whether they are typical for the period prior to the reform as well, we examined trends in average mortgage terms before 1983, as reported in the Federal Home Loan Bank Board's Monthly Interest Rate Survey. This survey covers single-family homes only; hence, it is more restrictive than the SCF. This survey reports stable loan-to-value ratios from 1963, the first available observation, until 1982. Thus, the average initial equity share from the 1983 SCF of 0.2275 appears to be a good estimate for the pre-reform period. In contrast to the stability of the loan-to-value ratio, the average repayment period increased from 85.2 quarters in 1963 to 102.4 in 1982. This increase indicates that average mortgage duration in 1983 was higher than the typical duration for the period of interest. Hence, we adjust the 85.5 quarters measure from the 1983 SCF downwards by subtracting half of that increase. The resulting loan period is 76.9 quarters.

We measure mortgage and automobile debt repayment rates with the inverse of their period-average terms to maturity, and then calculate ϕ as the weighted average of these rates. The weights are the average shares of mortgage debt and consumer credit in total household debt over the 1954-1982 period, that is 0.7 and 0.3. The resulting value of ϕ is 0.0315.

Similarly, π is a weighted average of the initial equity shares from automobile and mortgage debt. Ideally, the weights should reflect the flow of loans used to purchase new automobiles and homes. As such observations are not available, we construct the weights indirectly. In a steady-state version of the model with two durable goods, loans extended in each category should equal the principle repayment rate multiplied by the category's steady-state debt. Given the repayment rates and debt shares used to calibrate ϕ for the period before 1983:I, the implied shares of home and automobile loans in total loans extended are 0.29 and 0.71.¹⁶ The resulting value of π for the high-equity requirement regime is 0.16 (the weighted average of 0.2275 for homes and 0.13 for automobiles).

For the post-reform values of π and ϕ use observations from 1995 onwards, when debt/assets ratios stabilize.

The value of π is calculated similarly as for the pre-reform period. The average loan-to-value ratio for automobiles in the 1995:I–2004:II sample is 0.92. The average equity share of new home owners in the 1995 SCF and the 2001 SCF are 0.1756 and 0.1749—with the standard errors 0.0090 and 0.0094. There are 334 and 251 new homeowners in these two surveys. We use the average of the two years' observations as our measure of the mortgage down-payment rate. The average initial equity shares for both automobiles and homes decline by 0.05 from the pre- to the post-reform period. Hence, we set the value of π for the latter period equal to 0.11.

The post-reform value of ϕ is much more problematic to estimate. Because the financial reform substantially widened the options for refinancing and home equity loans, the terms of the initial mortgages ceased to represent the actual equity requirements. One possibility for evaluating ϕ is to assume that the terms of automobiles loans still represent actual equity constraints, and for homes, refinancing and equity loans make it possible to extend the loans' terms to the entire life of the home. The latter assumption implies that the mortgage repayment rate equals the home's depreciation rate. Computing ϕ in this way causes the debt/assets ratio to increase too much relative to the data. Hence, we set ϕ based on the actual change in the debt/asset ratio from the 1954–1982 sample average of 0.34 to the 1995–2005 sample average of 0.45. Given the other parameter values, for the model to reproduce this 11 percentage point increase in the debt/asset ratio across steady states, the value of ϕ has to decline from 0.0315 indicated above for the pre-reform period to 0.0186.

¹⁶The weight for home loans is computed as $(0.70/76.9) / ((0.70/76.9) + (0.30/13.4)) = 0.29$, where $0.7/76.9$ is the mortgage/total debt ratio times the repayment rate of mortgages and, similarly, $0.30/13.4$ is the car loans/total debt ratio times the repayment rate of cars loans.

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