Interest rates following financial re-regulation

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Introduction and summary

Mortgages and other forms of household borrowing typically require collateral, such as a house or car. Typical loan contracts require borrowers to take an initial equity stake in the collateral (the down payment) and to increase ownership further by repaying the loan's principal before the collateral fully depreciates (amortization). Since the New Deal, government regulation has substantially influenced these terms of private contracts. In the 1940s and early 1950s, the Federal Reserve Board imposed stringent minimum down payment rates and maximum amortization periods for home mortgages, auto loans, and loans to purchase other consumer durable goods. The suspension of these regulations in 1953 allowed consumer credit to grow steadily until the credit crunch of August 1966. The financial deregulation wave of the late 1970s and early 1980s triggered innovations in consumer lending that further decreased households' ownership stakes in their housing and other tangible property. Many observers have blamed precisely this deregulation for the most recent financial crisis, so it seems very possible that households' required ownership stakes will be rising as policymakers look at their options for improving the regulation of consumer loans and other financial contracts.

In this article, we employ a model of lending from the wealthy to the middle class to evaluate the effects of raising the equity requirements of household debt. We build on our earlier analysis of the Carter–Reagan financial deregulation in Campbell and Hercowitz (2009). In that article, we found that lowering equity requirements raises the demand for household credit and thereby increases the interest rate. This resembles the simultaneous increases in household debt and interest rates during the mid-1980s, even though we abstract from rising government deficits, which are the standard explanation for that period's high interest rates. In this article, we examine the implications of reversing this process by increasing down payment rates for new loans and by forcing all loans to amortize faster. The model's results show that this reform reduces loan demand. The interest rate falls 78 basis points over three years and then very slowly returns to its level before the reform. In an alternative version of our model in which producers cannot absorb the capital freed by tightening household lending standards, the interest rate falls 129 basis points over the three years after the reform. These results are potentially of interest to monetary policymakers because they can guide an assessment of how financial market reforms impact the "neutral" interest rate required to keep the economy's output at its potential in the absence of business cycles.

In the model, saving households are rentiers living off of their wealth, so the low interest rate unambiguously harms them. Nevertheless, the low rate has two beneficial effects for borrowers. First, the lower interest rate reduces the carrying cost of debt. Second, the lower interest rate brings down the user cost of capital and thereby encourages investment. These investments increase the demand for labor and thereby raise wages. Overall, the model's predictions show that borrowers' welfare gains are equivalent to raising their consumption permanently by 0.9 percent. If we treated the household credit market in isolation from the rest of the economy, then this second effect would be absent.

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In fact, such a market-by-market analysis would be misleading; the reform makes borrowers slightly worse off after shutting down its indirect effect on wages.

If tighter lending standards changed neither the interest rate nor wages, then they must harm borrowers by limiting their choices. Following this intuition about the "direct" effects alone leads to the conclusion that tighter lending standards primarily harm borrowers. Our results show that this intuition can easily be overturned by a complete equilibrium analysis that accounts for the "indirect" effects of changing prices. Since the reform helps some households at the expense of others, its assessment requires us to weight the households' utility changes. Even with a specific assumption about these weights, the result is only a partial assessment, since we have nothing to say about how tightening household lending standards changes systemic economic risk.

Our article proceeds as follows. In the next section, we review the history of interest rates and household debt markets in the United States, paying particular attention to households' ownership stakes in their tangible property. Then, we present the model and derive its long-run implications for debt and interest rates. We show that financial re-regulation has no long-run effect on interest rates, leaves saving households worse off, and improves borrowers' welfare. Finally, we present the complete analysis of the reform.

Household debt and interest rates in the United States

The rise of mass production techniques early in the twentieth century created a large volume of standardized capital goods, such as automobiles, which could serve as collateral for credit extended to households. By the 1920s, most durable household goods could be bought "on credit" directly from their retailers. The home mortgage market of that decade bears a remarkable resemblance to that of the 1990s and 2000s. First mortgages had low loan-to-value ratios, and households often financed the first mortgage's required down payment with second and third mortgages. All of these mortgages matured in only a few years, and they required no repayment of principal before maturing.[1]

The Great Depression, World War II, and the Korean War dramatically increased government involvement in consumer credit markets. In the early 1930s, the federal government purchased large volumes of "underwater" mortgages. These were loans with principals exceeding the value of their collateral. It then refinanced them with 15-year amortized mortgages, which built in the gradual repayment of the principal over the 15-year amortization period. This amortization directly served the policy goal of avoiding a wave of mortgage defaults arising from a sudden lack of refinancing options. The 15-year amortized mortgage and its 30-year cousin accounted for most household debt from the 1930s through the 1980s, even though they required substantial down payments from borrowers.[2] The move from interest-only short-term loans to long-term amortized debt reduced systemic risk at the cost of keeping potential homeowners with insufficient funds for a mortgage's down payment out of the market. With the onset of World War II, the Federal Reserve Board tightened loan standards further by issuing Regulations X and W. These dictated restrictive maximum loan-to-value ratios and amortization periods for home mortgages (Regulation X) and other collateralized consumer credit (Regulation W).

The Federal Reserve suspended enforcement of Regulations X and W near the end of the Korean War in 1953. Figure 1 illustrates the evolution of credit markets since 1952. The data come from the Federal Reserve Board's *Flow of Funds Accounts of the United States*. The dashed line in figure 1 shows the ratio of all mortgage debt on owner-occupied housing relative to this housing stock's value, and the solid line represents the ratio of all household debt to all tangible assets of households, which include the stock of owner-occupied real estate and the stock of automobiles owned by households. Since these are both useful measures of household leverage (the use of debt to finance investment), we refer to them henceforth as *leverage ratios*.

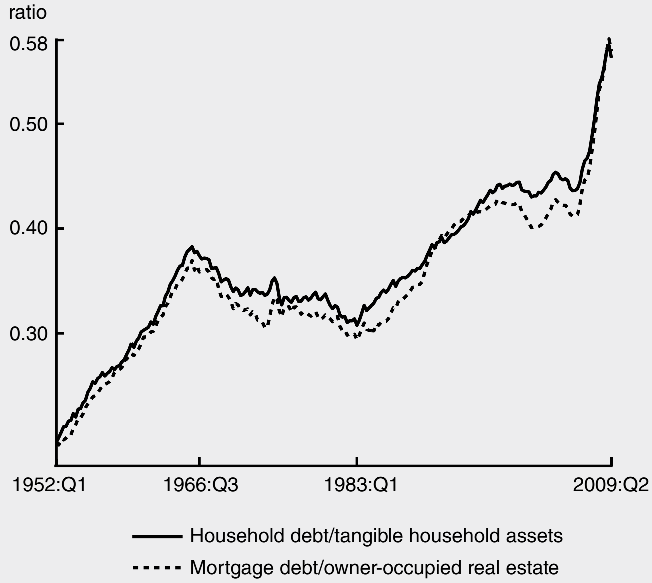
The wartime credit restrictions made these leverage ratios very low: They both equal about 0.195 in the first quarter of 1952. Throughout the 1950s, both ratios rise dramatically. The overall leverage ratio (the solid line in figure 1) peaks at 0.38 in the fourth quarter of 1965. At that time, the Federal Reserve's Regulation Q placed a cap on the permissible interest rate paid on savings accounts. During the credit crunch of August 1966, market interest rates exceeded this cap, and the resulting outflow of funds from savings and loans and other traditional sources of mortgages reduced the availability of household credit.

The mid-1960s marked a turning point for household leverage ratios. They declined (not always steadily) until the enactment of the Garn–St Germain Depository Institutions Act in the last quarter of 1982. This act and the Monetary Control Act of 1980 eliminated many restrictions on mortgage lending. Along with the concurrent growth of mortgage debt securitization, these changes fueled a second wave of post-war household leverage growth. In the first quarter of 1983, both ratios equaled about 0.30. By the first quarter of 1995, they both equaled 0.41.

Throughout the credit expansion of the late 1990s and the early 2000s, these ratios rarely exceeded 0.45. Home prices began to decline in the middle of 2006, mechanically raising the household leverage ratios. This continued until the first quarter of 2009, when both ratios equaled about 0.58. The most recently available data come from the second quarter of 2009, and they show the leverage ratios declining. Of course, the leverage ratios' common recent spike emanated from a loss in the value of previously mortgaged properties rather than from any deliberate loosening of mortgage terms. With their mortgages considered underwater, many homeowners chose to delay repayment or default outright. The financial turmoil that arose from the resulting impairment of mortgage debt has led most observers to reassess the need for tighter mortgage standards. Therefore, we expect these household leverage ratios to continue their declines as creditors write off their bad debts (thus reducing household indebtedness) and as lenders raise required down payments and principal repayment rates on newly issued loans. Furthermore, the possibility of congressionally mandated changes to financial market regulation might either directly or indirectly lead to tighter standards for household credit.

FIGURE 1

Household leverage ratios for the United States, 1952:Q1–2009:Q2



Source: Authors' calculations based on data from the Board of Governors of the Federal Reserve System, *Flow of Funds Accounts of the United States* (Federal Reserve Statistical Release Z.1).

We expect tighter loan standards to reduce demand for credit, thereby lowering interest rates. To get a sense of how much lower we could expect them to go, we plot the yield on three-year constant-maturity zero-coupon U.S. Treasury debt in figure 2. To account for the effects of anticipated inflation on these interest rates, we have subtracted from each of them the most recent four-quarter percentage change in the Personal Consumption Expenditures Price Index. The yield's average over the time period plotted (the fourth quarter of 1953 through the third quarter of 2009) is 2.6 percent.

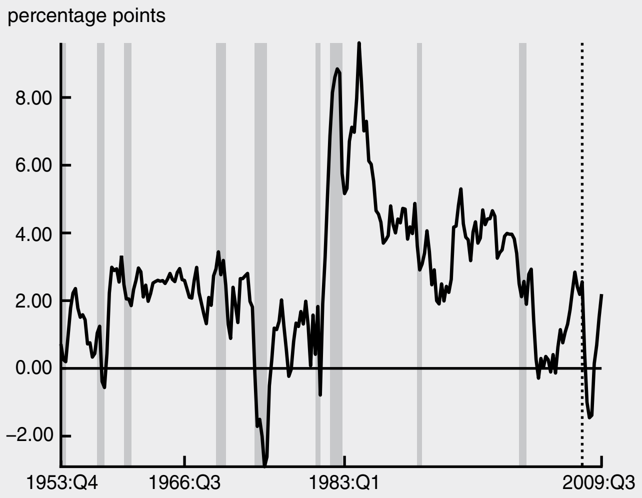
The most noticeable feature of the data is the familiar rise in real interest rates associated with the Federal Reserve's policy of targeting the growth rate of money that began in the fourth quarter of 1979 and ended in the fourth quarter of 1982. To get a better sense of the relationship between credit demand and interest rates, we remove this period and that of the recent financial crisis from the analysis. For the remainder, we have calculated average interest rates for the periods defined by turning points of the household leverage ratios in figure 1: These are 1953:Q4–1966:Q3, 1966:Q4–1979:Q3, 1983:Q1–1995:Q4, and 1996:Q1–2007:Q2. The results are 1.94 percent, 1.33 percent, 4.50 percent, and 2.45 percent. Thus, it appears that the interest rate rose at the same time household leverage ratios were growing in the 1980s and early 1990s, and a decline in interest rates accompanied the end of both growth spurts in figure 1. An explanation of interest rates that focuses only on household leverage ratios is clearly incomplete. For example, contemporaries attributed the high interest rates of the 1980s to that era's high government deficits.[3] Nevertheless, the association between interest rates and changes in household leverage seems strong enough to merit further quantitative exploration. We next present a theoretical framework for doing so.

A model of household debt and interest rates

Much of modern macroeconomic theory builds on the useful fiction that identical infinitely lived households populate the economy. This will not do for the question at hand because two identical households have no incentive to lend to each other. Accordingly, our model of household debt and interest rates has two representative households, which we call the *borrower* and the *saver*. The borrower is less patient

FIGURE 2

Inflation-adjusted three-year constant-maturity interest rates, 1953:Q4–2009:Q3



Notes: The shaded areas indicate official periods of recessions as identified by the National Bureau of Economic Research; the dashed vertical line indicates the most recent business cycle peak. See the text for further details.

Source: Authors' calculations based on data from Federal Reserve Bank of St. Louis.

than the saver. The difference in patience motivates the (heads of) households to live up to the names we have assigned them. If the borrower's debts were limited only by her ability to repay them, then she would never stop borrowing more. As time passes, she would spend more and more on interest payments and less and less on her own consumption.[4] This is grossly unrealistic for the United States as a whole. Another feature of our model—collateral requirements—inhibits the never-ending expansion of debt. In the long run, the saver's consumption–savings decisions determine the interest rate. At that rate, the borrower would like to expand her debts. However, the collateral requirement inhibits her from doing so.

As noted previously, most household debts require the borrower to hold an equity stake in the good serving as collateral. The borrower's down payment is the equity stake at purchase, and the equity stake grows as the borrower repays the loan's principal. In the model, two parameters determine the borrower's equity requirements. Because the history of household debt in the United States indicates that government regulation substantially influences equity requirements, we view the two equity requirement parameters as being set by policy.[5] In Campbell and Hercowitz (2009), we modeled the expansion of leverage following the financial market deregulation of the early 1980s as a reduction of government-set equity requirements. To consider the effects of anticipated increases in equity requirements on the interest rate, we now reverse that experiment by raising the equity requirement parameters.

Next, we present the model of household debt and interest rates. We begin by describing the two households' preferences. We then lay out the economy's technology for producing goods, and we finish with a discussion of both households' consumption and savings choices in a competitive equilibrium.

Consumer choices

Both the saver and the borrower value the consumption of two goods. The first good is nondurable and stands in for items such as food, energy, and entertainment services. The second good represents the use of durable goods such as housing, furniture, automobiles, and consumer electronics. Both individuals can adjust their consumption of these goods once every calendar quarter.

We denote the quantity of the nondurable good consumed in quarter t by the borrower with $\hat{C}_t$. The analogous quantity for the saver is $\tilde{C}_t$. Similarly, we represent the quantities of the durable good used by the borrower and saver in quarter t with $\hat{S}_t$ and $\tilde{S}_t$. Henceforth, we use $\hat{A}$ and $\tilde{A}$ to represent borrower- and saver-specific versions of A.

If these households are to make consumption and savings decisions, then they need to know how to trade off nondurable and durable consumption in the present quarter and how to balance consuming more of either good today versus saving to enable more consumption in the future. For this, we suppose that they plan how much of both goods to consume in the present quarter *and in every future quarter*. We denote a plan for the borrower's nondurable consumption from quarter t onward with $\hat{C}^t = \left(\hat{C}_t, \hat{C}_{t+1}, \hat{C}_{t+2}, \ldots\right) = \left(\hat{C}_t, \hat{C}^{t+1}\right)$. The borrower's analogous plan for durable consumption is $\hat{S}^t = \left(\hat{S}_t, \hat{S}_{t+1}, \hat{S}_{t+2}, \ldots\right) = \left(\hat{S}_t, \hat{S}^{t+1}\right)$. We suppose that for each possible plan, the borrower computes a utility value $\hat{U}\left(\hat{C}^t, \hat{S}^t\right)$, using the following formula:

$$\hat{U}\left(\hat{C}^t, \hat{S}^t\right) = \theta \ln \hat{S}_t + (1-\theta) \ln \hat{C}_t + \hat{\beta} \hat{U}\left(\hat{C}^{t+1}, \hat{S}^{t+1}\right).$$

The parameters θ and $\hat{\beta}$ both lie between zero and one. This says that the utility value of following a plan equals the *felicity* from the current quarter's consumption, $\theta \ln \hat{S}_t + (1-\theta)\ln \hat{C}_t$, plus the value of continuing to follow the plan discounted by $\hat{\beta}$.[6]

The saver's utility value of a given plan can be calculated from his analogous equation:

$$\tilde{U}\left(\tilde{C}^t, \tilde{S}^t\right) = \theta \ln \tilde{S}_t + (1-\theta)\ln \tilde{C}_t + \tilde{\beta}\tilde{U}\left(\tilde{C}^{t+1}, \tilde{S}^{t+1}\right).$$

The value of θ here equals its value in the borrower's utility rule, so both households agree on how to divide an allocation of income for the current quarter between nondurable goods and (the services from) durable goods to make felicity as large as possible. However, the saver's discount factor $\tilde{\beta}$ exceeds the borrower's discount factor $\hat{\beta}$. In this sense, the borrower is less patient than the saver. The borrower would prefer to trade the saver's best possible consumption plan for one of equal cost, but with higher consumption in the present and lower consumption in the future.

Production of income and accumulation of wealth

Each quarter, the economy inherits three stocks of capital goods from the previous quarter. The first is the stock of *market capital*. We denote the number of machines in the stock of market capital available in quarter t with K_t. Combining these machines with N_t hours of work (provided in principle by either household) yields an output of $Y_t = K_t^{\alpha} N_t^{1-\alpha}$, measured in units of the nondurable consumption good. After production, a fraction λ of the machines stop working. Investments in machines, I_t, can replace those lost to depreciation and (if sufficiently large) expand the stock of machines available for the next quarter. Thus,

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

The remaining two stocks inherited from the previous quarter are the two households' stocks of *home capital*, that is, durable goods. We assume that the flow of services from a stock of home capital is proportional to its size, so that we use $\hat{S}_t$ and $\tilde{S}_t$ to represent each of the households' durable goods stocks as well as the flows of services forthcoming from them. Just as with market capital, the home capital goods depreciate and can be replaced and expanded with investment. The two stocks' common depreciation rate equals δ, and their respective investments are $\hat{X}_t$ and $\tilde{X}_t$. Therefore,

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

and

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

All income in the economy can be directed toward one of the following uses: each household's nondurable consumption, investment in each household's stock of home capital, or investment in the stock of market capital. It is costless to convert one unit of income into one unit of any of these goods. Since the uses of income cannot exceed that available, we have

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

The households face two other substantial limits on their accumulation of capital. First, the machines in the stock of market capital may not be converted into consumption goods of either kind. This makes sense for most capital goods because blast furnaces and airliners are of little use to the typical consumer. We impose this limit by requiring that $I_t \geq 0$. Second, neither household may sell durable goods from their stocks of home capital. That is, $\hat{X}_t \geq 0$ and $\tilde{X}_t \geq 0$. Obviously, households can and do sell their durable goods all of the time. However, we find this assumption reasonable when we suppose that the model's borrower and saver represent two classes of individuals with different tastes. If the saver is rich and consumes mansions while the borrower is middle class and consumes bungalows, then the restriction means that we cannot convert mansions into bungalows and vice versa.

Trade and competition

We have now described how the two households rank consumption plans and the technology available for implementing them. We will now present how the households implement these plans by reviewing a typical quarter's trades in the sequence they occur. We then describe the collateral requirements that restrict the households' debts and finish with a presentation of the conditions required for markets to clear.

The sequence of trades in a quarter

At the beginning of quarter t, the households own their stocks of durable goods; stocks of market capital, $\hat{K}_t$ and $\tilde{K}_t$; and financial assets (bonds), $\hat{B}_t$ and $\tilde{B}_t$.

Production takes place at a representative firm. It rents capital from the households and combines it with labor to produce income. The cost of renting one machine in quarter t is H_t, and the cost of one hour of work is W_t. Capital and labor employed at each firm are chosen to maximize its profits. After production takes place, the representative firm makes its required rental payments to the owners of capital, returns the undepreciated capital goods to their owners, and pays its wage bill. We think of the saver as representing the wealthiest families in the United States, so we suppose that he spends all of his time on leisure activities and offers none to the labor market. The borrower represents the middle class, so we suppose that she offers N hours of work to the market regardless of the wage she earns for each one. Thus, the saver's wage income equals zero always, while the borrower's is $W_t N$.

The funds available to either household is the sum of that household's labor earnings, the rents it receives for the use of its market capital, and its stock of bonds. It can put these funds to one of four uses. Three of these—nondurable consumption, investment in home capital, and investment in market capital—have already been covered. The fourth use of funds is the purchase of new bonds. All bonds pay one unit of the nondurable consumption good in the next quarter, and their price in the current quarter is $1/R_t$, where R_t is the gross rate of interest. With this in place, we can write the two households' budget constraints as

$$\hat{C}_t + \hat{X}_t + \hat{I}_t + \hat{B}_{t+1} / R_t \leq W_t N + H_t \hat{K}_t + \hat{B}_t$$

and

$$\tilde{C}_t + \tilde{X}_t + \tilde{I}_t + \tilde{B}_{t+1} / R_t \leq H_t \tilde{K}_t + \tilde{B}_t.$$

Collateral requirements

A household can choose any positive value of bonds ($\hat{B}_{t+1}$ or $\tilde{B}_{t+1}$) that is consistent with its budget constraint. When either of these bond stocks is *negative*, we say that household is indebted. An indebted household must pledge some or all of its home capital stock as collateral. We denote the maximum debts that can be collateralized by the two households' home capital stocks with $\hat{V}_t$ and $\tilde{V}_t$. So, we require:

$$-\hat{B}_t \leq \hat{V}_t$$

and

$$-\tilde{B}_t \leq \tilde{V}_t.$$

We specify these maximum debts with

$$\hat{V}_{t+1} = (1-\phi)\hat{V}_t + (1-\pi)\hat{X}_t$$

and

$$\tilde{V}_{t+1} = (1-\phi)\tilde{V}_t + (1-\pi)\tilde{X}_t.$$

Here, $1 - \pi$ is the maximum loan-to-value ratio allowed for household debt, and ϕ is the rate at which the principal must be repaid. If $\phi = \delta$, then the borrower must repay the principal only to the extent that depreciation erodes the collateral's value. If instead $\phi > \delta$, then the borrower must accumulate equity in the collateral as it ages. We adopt the specification requiring the geometric repayment of principal because it greatly simplifies the ensuing analysis.

Market clearing and equilibrium

The evolution of the model economy can be completely described by a collection of plans for current *and future* nondurable consumption, durable consumption, market capital, and collateral values, as well as the sequences of the wage rate, the rental rate of capital, and the interest rate. We say that such a collection is an *equilibrium* if the households' consumption plans maximize their utility values given their incomes; the representative firm maximizes its profit given the wage and interest rate; and the demands for bonds, market capital, and labor always equal their corresponding supplies. The interested reader can find a more technical definition of equilibrium in box 1.

The model's steady state

Next, we examine how the steady-state values of the model's key outcomes change with parameters so that we can gain intuition valuable for interpreting the model's dynamics. By definition, a steady state is an equilibrium in which all of the variables are constant over time. Therefore, a household's borrowing constraint binds either always or never. It is tedious but not difficult to show that only the less patient household's borrowing constraint binds in the steady state.

For our purposes, the three key variables of interest are the interest rate and the two households' leverage ratios (their stocks of outstanding household debts divided by the values of their household capital stocks). To characterize all of these variables, we first need to consider both households' optimal consumption and savings choices. Suppose that the saver begins with a utility-maximizing steady-state consumption plan with nondurable consumption $\tilde{C}$ and changes it slightly by decreasing consumption in year t by $\Delta > 0$,

BOX 1

Equilibrium definition

Building upon the notation we used for the two households' consumption plans, we denote the path for any quantity or price A_t with $A^t = (A_t, A_{t+1}, \ldots)$. For a collection of plans to form an equilibrium, they must satisfy the following five conditions.

1) Given $\hat{K}_t, \hat{S}_t, \hat{B}_t, \hat{V}_t, R^t, H^t$, and W^t, the borrower's plans for $\hat{C}^t, \hat{S}^t, \hat{X}^t, \hat{K}^t, \hat{I}^t, \hat{B}^t$, and $\hat{V}^t$
   - are consistent with the initial given values of $\hat{K}_t, \hat{S}_t, \hat{B}_t$, and $\hat{V}_t$;
   - obey the rules for accumulating market capital, home capital, and collateral value;
   - satisfy the borrower's borrowing and budget constraints in every quarter; and
   - yield a higher utility value for the borrower than any other plans that satisfy this condition's other requirements.
2) Given $\tilde{K}_t, \tilde{S}_t, \tilde{B}_t, \tilde{V}_t, R^t, H^t$, and W^t, the saver's plans for $\tilde{C}^t, \tilde{S}^t, \tilde{X}^t, \tilde{K}^t, \tilde{I}^t, \tilde{B}^t$, and $\tilde{V}^t$
   - are consistent with the initial given values of $\tilde{K}_t, \tilde{S}_t, \tilde{B}_t$, and $\tilde{V}_t$;
   - obey the rules for accumulating market capital, home capital, and collateral value;
   - satisfy the saver's borrowing and budget constraints in every quarter; and
   - yield a higher utility value for the saver than any other plans that satisfy this condition's other requirements.
3) For all $\tau > 0$, $\hat{B}_{t+\tau} + \tilde{B}_{t+\tau} = 0$.
4) For all $\tau > 0$, $K_{t+\tau} = \hat{K}_{t+\tau} + \tilde{K}_{t+\tau}$.
5) For all $\tau > 0$, $K_{t+\tau}$ and N are the capital and labor choices that maximize the representative firm's profits given H_t and W_t.

The first two conditions just require each of the households to do the best they can (measured with their utility values) with what they have got. The third condition states that the net supply of risk-free bonds in the economy equals zero. Thus, if one household wishes to borrow, the other must lend. The fourth condition says that the economy's stock of market capital must equal the sum of the two households' market capital stocks. And the final condition requires the rental rate of capital and the wage rate to induce the profit-maximizing representative firm to rent the entire available capital stock and employ all of the available hours of work.

investing the proceeds in bonds, and consuming the principal and interest in year $t + 1$. By its construction, this experiment leaves consumption in all years after $t + 1$ unchanged. If Δ is small, then the utility loss in year t is $\Delta / \tilde{C}$ and the discounted utility gain in year $t + 1$ equals $\tilde{\beta} R \Delta / \tilde{C}$. Here, R is the steady-state interest rate. Since the original consumption plan maximized utility, this slight change cannot increase utility. The change also cannot lower utility because if it did, then the analogous experiment that increases consumption in year t by borrowing Δ and repaying it in year $t + 1$ would increase utility. Therefore, we have that:

$$\frac{\Delta}{\tilde{C}} = \tilde{\beta} R \frac{\Delta}{\tilde{C}}.$$

Eliminating common terms from both sides yields our first important result, $R = 1/\tilde{\beta}$. That is, the saver's discount rate determines the steady-state rate of interest alone. Credit market regulation that changes either π and ϕ has no long-run effect on the interest rate.

Since the borrower is less patient than the saver, the experiment of borrowing Δ in year t and paying it back at the interest rate $1/\tilde{\beta}$ in year $t + 1$ would increase her utility. However, the collateral requirements prevent her from doing this. Since the borrower exhausts her borrowing opportunities in the steady state, we can calculate her leverage ratio as:

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

Thus, increasing either π or ϕ directly reduces the borrower's leverage ratio in the long run. Since the saver *purchases* bonds, we set his leverage ratio to zero.

Quantitative analysis of increasing equity requirements

Although the steady-state analysis reveals that equity requirements have no long-run effect on interest rates, it does not rule out substantial short-run effects in the wake of a reform. Investigating this possibility requires a quantitative analysis of the model's equilibrium, which we provide here. For this, we assign values to the model's parameters that reflect the equity

TABLE 1

Calibrated parameter values

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						

Note: See the text for further details.
Source: Campbell and Hercowitz (2009).

requirements of household debt typical of the late 1990s and early 2000s. After calculating the model's steady state with these values, we raise the equity requirement parameters to values more typical of the period before the financial deregulation of the early 1980s. We then calculate the model's equilibrium paths for all quantities and prices when households start with the capital and debt stocks from the initial steady state (associated with low equity requirements) but face the new higher equity requirement parameters. In the long run, the economy's interest rate, its capital stocks, and the debt owed by the borrower to the saver converge to their values in the steady state calculated with the new parameters. We focus on the model economy's transition from the initial steady state to the other steady state following the parameter change.

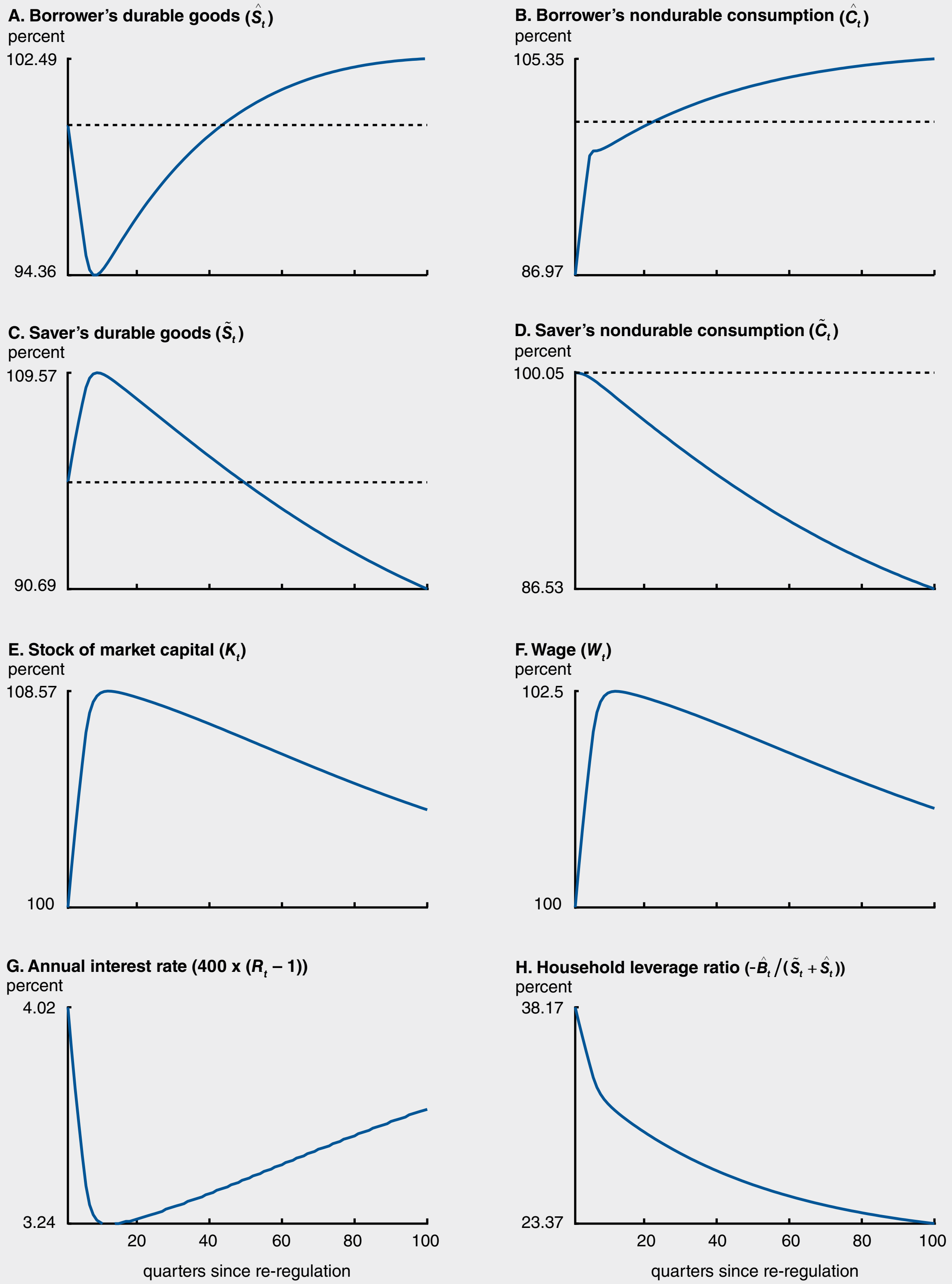
Table 1 lists the parameter values we use for this experiment. All of them are taken from our earlier analysis of credit market deregulation in Campbell and Hercowitz (2009). We consider two configurations for the equity requirement parameters: high and low. In both cases, π equals the average of typical down payments on homes and automobiles weighted by their shares of durable purchases, and ϕ equals the average repayment rates of home mortgages and automobile loans weighted by their shares of household debt. The parameters for the high regime were chosen using observations of household debt and loan terms from before the financial liberalization of 1983, while the choice of the low regime's parameters used similar observations from 1995 through 2001. The required down payment for a home capital good equals 16 percent of its value in the high regime and 11 percent in the low regime. The model's remaining parameters are held constant across the two regimes. Campbell and Hercowitz (2009) provide justification for the specific values chosen. We note here only that the choice of $\tilde{\beta}$ produces an annual steady-state interest rate of 4.02 percent.

For our experiment, we start the economy at the model's steady state calculated with the parameters from the low regime. We suppose that, without warning, the parameters switch to those of the high regime. Both of the model's households expect the change to be permanent. Given the initial values of $\hat{S}_t$, $\hat{V}_t$, $\hat{B}_t$, $\tilde{B}_t$, $\tilde{S}_t$, and $\tilde{K}_t$, from the steady state associated with low equity requirements, we calculate the model's equilibrium. Figure 3 contains plots of the resulting equilibrium paths for the model's key variables. Panels A, B, C, and D plot the values of both households' consumption choices, and panels E and F display the evolution of the productive capital stock and the wage. All of these have been scaled so that their values in the original steady state equal 100 percent. Panel G shows the interest rate in annual percentage points, and panel H shows the household leverage ratio in percentage points.

In the model, there are two reasons for the borrower to purchase durable goods: They create a flow of valuable services, and they enable the expansion of debt. The re-regulation of household debt markets reduces the size of this second incentive, and so the reform initially makes the borrower wish to reduce her stock of durable goods. Indeed, the borrower purchases *no* durable goods for six quarters following the re-regulation (figure 3, panel A). This decline in durable purchases together with the acceleration of principal repayment required by the higher value of ϕ reduces loan demand, so both the interest rate and the household leverage ratio fall as expected. The leverage ratio starts at 38.17 percent, falls rapidly while the borrower purchases no durable goods, and then declines more gradually toward its new long-run level of 23.37 percent (figure 3, panel H). The interest rate falls rapidly from its initial value of 4.02 percent to its trough three years after re-regulation, 3.24 percent—a decrease of 78 basis points (figure 3, panel G). Thereafter, the interest rate rises very slowly towards its steady-state value. Even 25 years after re-regulation, the interest rate is 36 basis points below its original value. Apparently, it takes a long time indeed to reach the long run.

FIGURE 3

The model's equilibrium following financial re-regulation



Notes: Panels A through F indicate the variable relative to its value in the initial steady state, which has been set to equal 100 percent (the dashed horizontal line). The values on the vertical axis in each panel are the variable's minimum and maximum values attained in the 100 quarters following re-regulation.

A note on welfare

TABLE 2		
Consumption-equivalent welfare changes		
	Borrower	**Saver**
Baseline experiment *(percent)*	0.9	–8.4
Fixed *K (percent)*	–0.1	–4.8

Note: See the text for further details.

In this article, we have examined interest rates in the wake of the deregulation and re-regulation of financial markets. Appropriate monetary policy requires understanding and forecasting persistent interest rate changes, so our results can contribute to that discussion. However, for those who set financial market policy, the interest rate serves only as a means to an end. Policymakers instead concern themselves with how adopting a given policy changes the welfare of borrowers and savers. In the model, we can measure welfare with the two households' utility values after the policy change. Comparing these with the analogous utility values from the pre-reform steady state provides the desired welfare assessment.

Before reporting on the actual welfare changes, it is worth returning to figure 3. It shows that after 25 years, the saver consumes much less of both goods than he did before the reform (panels C and D). At the same time, the borrower consumes more of both goods (panels A and B). Although the economy has not yet reached its new steady state in that time, these changes also characterize the long run. Therefore, the reform unambiguously increases the borrower's welfare while decreasing the saver's.

The long-run welfare changes are only tangentially interesting for policymakers; they care about the total welfare change that accounts for the short-run transition from one steady state to another. In the short run, the borrower's consumption of both goods falls (figure 3, panels A and B). The saver's nondurable consumption slowly trends down (panel D). The saver's durable purchases rise to peak at about 10 percent above their pre-reform level, and then fall to their new steady state value (panel C).

In principle, the borrower's short-run utility loss could dominate her welfare calculation. This would be intuitive because re-regulation imposes a constraint on her decisions. The actual utility changes reported in table 2 show that this is not the case. The utility values themselves have no meaningful units, so all of the table's entries give the *permanent* percentage change in the consumption of both goods (starting from the original steady state) required to make the household's utility equal to its post-reform value.

In table 2, the first row reports the results for the experiment plotted in figure 3. The borrower's welfare change equals that from permanently and instantly raising her consumption of both durable and nondurable goods by 0.9 percent. The borrower is better off, even though she faces tighter constraints on her borrowing. This would be impossible if the interest rate she pays on her debts and the wage she receives for her labor were held constant. Of course, both of these variables also change in the short run, and the changes are favorable to the borrower: The interest rate falls, and the wage rises. These two are actually tightly connected. The interest rate decline increases the capital employed by the representative firm, which in turn raises wages. Put differently, the re-regulation induces the saver to invest more in productive capital and thereby benefit the borrower indirectly with higher wages.[7]

To determine whether the "direct" effect of lower interest rates or the "indirect" effect of higher wages contributes more to the borrower's welfare gain, we have run an experiment with the model in which we hold the stock of market capital fixed at its original steady-state level. Put differently, we force the saver to replace depreciated market capital and do not allow any further investment. In this experiment, the interest rate falls 129 basis points (to 2.73 percent) over three years; the wage remains constant by construction. In table 2, the row for fixed *K* reports the consumption equivalent welfare changes analogous to those from the previous experiment. Even though the fall in interest rates is much larger than before, the borrower's welfare gain becomes a loss. The change also cuts the saver's welfare loss substantially. Apparently, the indirect effects of financial re-regulation on consumer welfare can easily dominate its more easily envisioned direct effects.[8]

Since tightening consumer lending standards helps one household at the expense of the other, it is impossible to unambiguously state that such a policy change helps or hurts "society as a whole." A policymaker who cares only for the borrower would prefer tighter lending standards, while one who represents the saver's interests would be against them. A policymaker who wishes to keep both households' considerations in mind can come to either conclusion depending on the weights she assigns to the two households' preferences. We have been silent regarding how many "real" households the borrower and saver each represent because that detail is actually irrelevant for the model's equilibrium. As long as no single household thinks that it can influence the wage or interest rate, nothing changes if we divide either household into 10, 100, or 1,000 smaller (but identical) households.

Nevertheless, the number of "actual" borrowers and savers clearly matters for a policymaker's welfare calculations. In our favored interpretation of the model, the saver represents the 5 percent or 10 percent of households with the highest wealth, and the borrower represents the remainder. If 5 percent of households are savers, then tightening lending standards increases the average utility value of all households. However, the same tightening decreases average utility if 10 percent of households are savers. Therefore, we have little concrete advice to give a policymaker who wishes to base her judgment on changes in average utility. That is, we can identify winners and losers from tightening lending standards, but assessing whether or not this improves society lies well beyond our capabilities.

Conclusion

Empirically, times of expanding home leverage have had higher-than-average interest rates. Interest rates in the United States during the post-Korean War surge in household leverage were about 60 basis points higher than their average in the period immediately after the leverage ratio had peaked. Similarly, interest rates fell about 200 basis points when the second sustained increase in household leverage ratios ended in 1995 (recall our discussion of figures 1 and 2). Of course, macroeconomic events other than changes in credit market regulation substantially influence interest rates. Nevertheless, these results give a range within which reasonable model predictions for the interest rate effects of financial re-regulation should fall. In the baseline version of our model in which the saver accumulates market capital, the interest rate falls 78 basis points over three years after financial re-regulation. Thereafter, the interest rate rises very slowly back to its original level. If we instead suppose that the stock of market capital is fixed and cannot be augmented, the analogous decline is about 130 basis points. These two specifications embody two extreme assumptions on the costs of adjusting market capital: none and infinite. Accordingly, we argue that any persistent decline in interest rates between 78 basis points and 130 basis points is a reasonable forecast in the wake of financial re-regulation.

NOTES

[1]See Semer et al. (1986) and Olney (1991) for more information about household credit markets before the Great Depression.

[2]Green and Wachter (2005) provide a history of the spread of amortized mortgages in the United States.

[3]See Friedman (1992) for a discussion of government deficits and interest rates in the 1980s. Campbell and Hercowitz (2009) argue that rising demand for credit must have contributed to that decade's high interest rates because otherwise household indebtedness would have declined as government deficits increased interest rates.

[4]Becker (1980) describes this long-run behavior of household indebtedness in detail.

[5]For an alternative view, see Kiyotaki (1998). He discusses one environment of *limited commitment* in which the creditors require down payments because collateral loses value upon repossession.

[6]To calculate $\hat{U}(\hat{C}^t, \hat{S}^t)$, choose a large integer τ and artificially set $\hat{U}(\hat{C}^{t+\tau}, \hat{S}^{t+\tau})$ to zero. Next, use the equation to calculate $\hat{U}(\hat{C}^{t+\tau-1}, \hat{S}^{t+\tau-1}), \hat{U}(\hat{C}^{t+\tau-2}, \hat{S}^{t+\tau-2}), \ldots, \hat{U}(\hat{C}^t, \hat{S}^t)$. This calculation is obviously incorrect because the assumption upon which it is predicated is false. However, the error will generally be proportional to $\hat{\beta}^\tau$, which gets very small as τ becomes larger.

[7]It is important to note here that the borrower's welfare increase does *not* reflect a paternalistic assumption built into the model that regulators can make better financial decisions than individual borrowers. Instead, it reflects the benefits accruing to all borrowers from them simultaneously reducing their loan demand. In this sense, financial re-regulation has the same effects as would the formation of a borrowers' cartel to limit the demand for loans. All of the borrowers are made better off if they stick to the cartel agreement, but each one of them would like to deviate and expand her indebtedness so long as the others conform.

[8]In this experiment, the saver's welfare improves when his choices over market capital are restricted. Just as before with the borrower's welfare following financial re-regulation, this welfare improvement can be interpreted as a cartelization of savers. If all savers commit to not increasing market capital, they can all avoid paying higher wages on the transition path. This increases their welfare, even though it further reduces the interest rate. Of course, each individual saver would like to expand his purchases of market capital if all other savers stick to the cartel agreement.

REFERENCES

Becker, R. A., 1980, "On the long-run steady state in a simple dynamic model of equilibrium with heterogeneous households," *Quarterly Journal of Economics*, Vol. 95, No. 2, September, pp. 375–382.

Campbell, J. R., and Z. Hercowitz, 2009, "Welfare implications of the transition to high household debt," *Journal of Monetary Economics*, Vol. 56, No. 1, January, pp. 1–16.

Friedman, B. M., 1992, "Learning from the Reagan deficits," *American Economic Review,* Vol. 82, No. 2, May, pp. 299–304.

Green, R. K., and S. M. Wachter, 2005, "The American mortgage in historical and international context," *Journal of Economic Perspectives,* Vol. 19, No. 4, Fall, pp. 93–114.

Kiyotaki, N., 1998, "Credit and business cycles," *Japanese Economic Review,* Vol. 49, No. 1, March, pp. 18–35.

Olney, M. L., 1991, *Buy Now, Pay Later: Advertising, Credit, and Consumer Durables in the 1920s*, Chapel Hill, NC: University of North Carolina Press.

Semer, M. P., J. H. Zimmerman, J. M. Frantz, and A. Ford, 1986, "Evolution of federal legislative policy in housing: Housing credits," in *Housing and the New Financial Markets*, R. L. Florida (ed.), New Brunswick, NJ: Center for Urban Policy Research, pp. 25–31.