



Payment Due:
**The Effects of Higher Interest Rates on
Consumers and the Economy**

Christian E. Weller and Radha Chaurushiya

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Center for American Progress
1333 H Street, 10th Floor, NW
Washington, D.C. 20005
www.americanprogress.org

EXECUTIVE SUMMARY

- The current economic recovery has relied heavily on households to borrow ever more money to sustain their consumption. Households have taken on ever higher amounts of debt, particularly in the form of mortgage debt and home equity lines. These additional funds have fuelled a surge in residential construction and household consumption, which has propped up economic growth.
- Economic fundamentals suggest that long-term interest rates, such as mortgage rates, are more likely to rise in the coming year than to stay the same or even fall. Upward pressures on interest rates arise from large budget and trade deficits, higher oil prices, and the Federal Reserve's short-term interest rate increases.
- Households will likely end up paying more in interest payments, even if they do not borrow more. A growing share of household debt is variable interest rate debt: home equity lines, adjustable rate mortgages, and credit card debt.
- Under realistic assumptions, the average household will pay \$194-\$229 more annually if interest rates rise by 0.5 percentage points and \$387-\$449 if interest rates rise by 1 percentage point, depending on how much more they will borrow at the same time. This additional burden could be two to three times as large as the additional burden from greater medical out-of-pocket expenditures.
- A higher debt service burden can translate into more financially distressed households. For instance, the estimated share of households filing for bankruptcy has risen for three years in a row.
- The access that households have had to cash through refinancing will have dried up as interest rates rise. If consumer spending on consumption items and on their homes slows down enough, the recovery may lose steam. We estimate that a 1 percentage point increase in interest rates can substantially reduce consumption growth, so that other sectors would have to grow 6-10 percent in inflation adjusted terms just to maintain a basic overall growth rate of 3 percent.
- Public policy should focus on weaning the economy off a debt driven consumption boom and replacing it with income support consumption growth. A number of policy options exist to boost income growth, such as higher minimum wages, improved labor laws to support the efforts of workers to join unions, and improved unemployment insurance.

INTRODUCTION

In recent months, households had sticker shock every time they went to the gas station. The next sticker shock is not far behind. As the Fed is poised to raise interest rates, households' wallets may be quickly deflated again. Households today find themselves more indebted than ever before. Worse, households could end up paying more money to service their debts even if they do not borrow more. A growing portion of household debt is owed at variable interest rates: home equity lines, adjustable rate mortgages, and credit card debt. Hence, higher interest rates will quickly translate into larger payments, even if the total amount of debt stays the same.

We estimate that an increase in interest rates will have a substantial effect on household interest payments. Under realistic assumptions, the average household will pay \$194-\$229 more annually if interest rates rise by 0.5 percentage points and \$387-\$449 if interest rates rise by 1 percentage point, depending on how much more they will borrow at the same time. Thus, the additional burden from higher interest rates could be two to three times as large as the additional burden from greater medical out-of-pocket expenditures.

Sharp increases in interest payments can translate into more financially distressed households. Already, record debt levels have taken a toll on household incomes in the weak labor market of the past few years. Over the last two years, the debt service burden, the amount of income a household pays in debt payments relative to its income, reached record heights, as did personal bankruptcies.

The potential additional financial distress for households is enough cause for concern. But rising debt burdens will leave less money for consumption, which could slow economic growth. In addition, the access that households have had to cash through refinancing will have dried up as interest rates rise. If consumers' spending on consumption items and on their homes slows down enough, the recovery may lose a lot of steam. We estimate that a 1 percentage point increase in interest rates can substantially reduce consumption growth, so that other sectors would have to grow 6-10 percent in inflation adjusted terms just to maintain a basic overall growth rate of 3 percent.

IMPACT OF RISING INTEREST RATES ON HOUSEHOLD DEBT

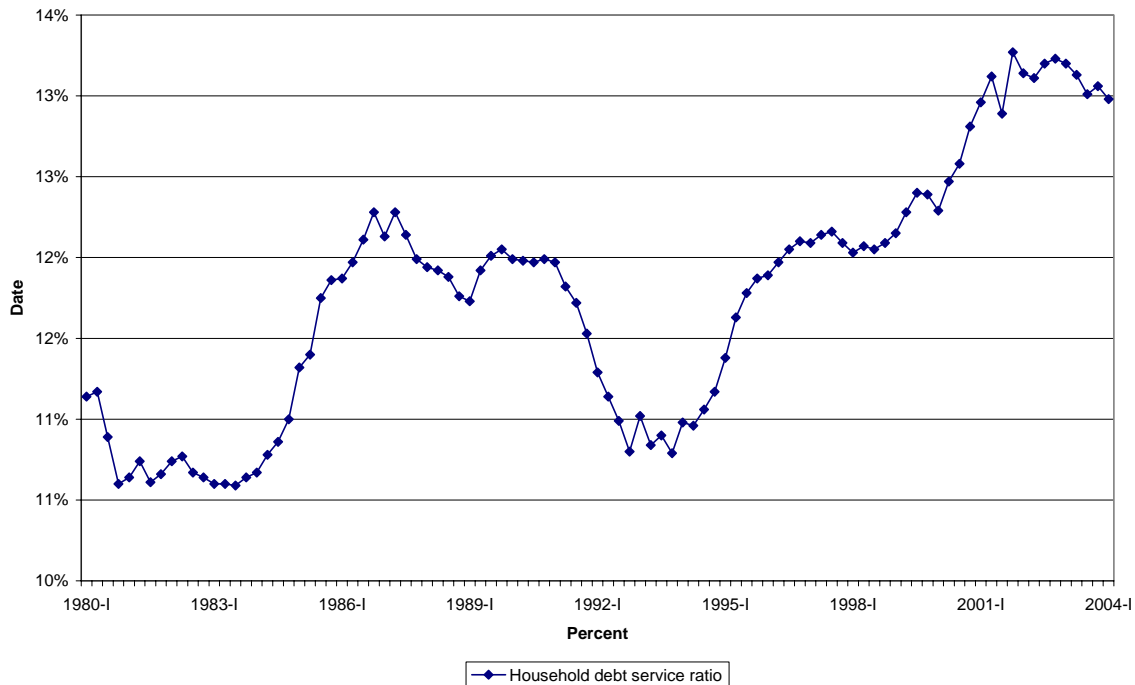
The economic recovery began in November 2001. Since then, the labor market has remained comparatively weak. Employment even fell for most of the first two years, while incomes stayed flat. Consumers borrowed heavily to maintain their consumption, to buy new homes or renovate existing ones, or to finance their education. For instance, the total amount of student loans rose by 74 percent from 1997 to 2003 (Hagenbaugh, 2003).

Borrowing became more appealing than in the past since interest rates reached their lowest levels in decades and home prices shot up, providing households with equity to

borrow against. By March 2004, households had amassed \$9.8 trillion in debt, \$6.9 trillion of which consisted of mortgages and another \$2 trillion of which came in the form of credit card debt and consumer loans, such as car loans. Relative to households' disposable income, total consumer credit reached a record high of 115 percent (BOG, 2004a).

Households' vulnerability to higher interest rates, though, also stems from the composition of their debt, as a large share of debt is held in the form of variable interest rate debt. About 10 percent of mortgage debt was in the form of home equity lines at the end of last year. Also, adjustable rate mortgages (ARMs) have become more popular: 18 percent of new mortgages were ARMs in 2003, up from 12 percent in 2001 (FHFB, 2004). According to data from the Federal Reserve, 15 percent of all prime mortgages – 90 percent of all mortgages – as well as 60 percent of all sub-prime mortgages were adjustable rate mortgages (ARMs) by March 2004.¹ Since mortgages amounted to about 70 percent of consumer credit by March 2004, variable rate mortgages – home equity lines and ARMs – constituted close to 21 percent of total consumer debt.² Further, 20 percent of total debt came from consumer credit – much of which is credit card debt with variable interest rates. Also, other forms of consumer credit, such as margin debt, which amount to 9 percent of total consumer debt, tend to be variable interest rate loans. Added together, consumers may experience quick increases in interest rates on more than 45 percent of their debt if interest rates rise.

Figure 1: Household Debt Service Ratio (DSR)



Source: BOG, 2004b.

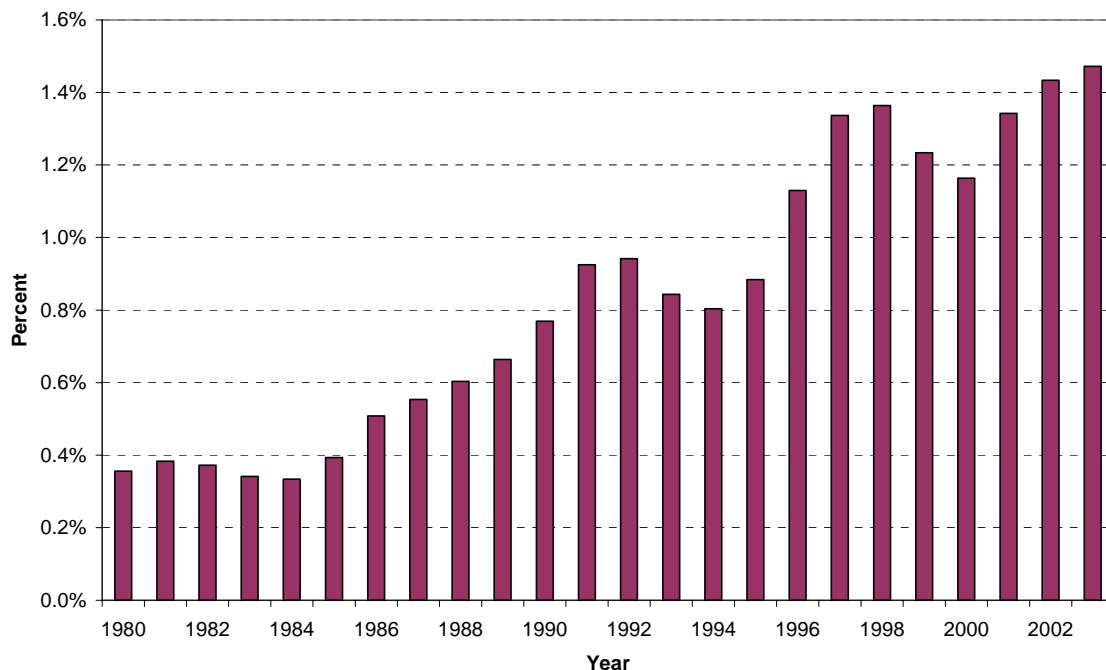
¹ The share of adjustable rate mortgages out of total mortgages was provided by the Federal Reserve.

² The figure is generated by $(0.7 \cdot 0.15 \cdot 0.9 + 0.7 \cdot 0.1 \cdot 0.6 + 0.7 \cdot 0.1)$.

Already, households have felt the pinch of the costs from record debt amid a poor labor market. For the last three years, households have had to dedicate at least 13 percent of their income to service their debts - the highest proportion since the Federal Reserve began keeping track in 1980 (figure 1). Charge-off rates – a measure of credit defaults - have remained high throughout the recession and the recovery, with, for instance, credit card charge-off rates above 5 percent of all loans since 2001 (BOG, 2004c). Also, personal bankruptcies have continued to rise at the same time. By 2003, the share of households that declared bankruptcy continued to climb for the third year in a row, reaching an estimated 1.5 percent in 2003 (figure 2). That is, even with low interest rates, households are becoming increasingly financially distressed.

Households may be in for a rude awakening. Record debt levels, a growing share of variable interest rates and a trend towards rising interest rates could potentially make for a dangerous mixture. This could quickly lead to higher costs for households, precipitating a rise in defaults and bankruptcies.

Figure 2: Personal Bankruptcy Filings as Share of Households



Notes: Sources are ABI, 2004, Census, 2004, and authors' calculations. Figures for 2003 are based on estimates for total number of households. Total number of households is assumed to be equal to 1/1.1 times the number of housing units.

RISING INTEREST RATES

Long-term interest rates rose dramatically earlier this year with 30-year mortgage rates leaping a full percentage point in a period of two months, from mid-March to mid-May. Most of this increase was driven by strong employment numbers during those months,

which appeared to be the missing piece to the economic recovery. Financial markets attached particular importance to the employment data because the Federal Reserve had up to that point expressed concern about the lagging job market. Markets thus anticipated the Fed would move to increase interest rates as soon as the non-farm payroll numbers began to strengthen in March. In June and August, the Fed fulfilled these expectations and raised interest rates by 0.25 percentage points at each of its two meetings.

Recent employment numbers and GDP growth for the second quarter of 2004 were weaker than expected, and wage and salary growth have remained stagnant. Interest rates fell accordingly, as market participants expected the Fed to take a more gradual path in raising interest rates given the relatively weak economic data in June. As a result, the rise in the long-term interest rates stalled. The 30-year fixed rate mortgage rate is now hovering around 6 percent, 0.65 percentage points higher than at its last low point in the middle of 2003 (BOG, 2004d).

However, there are reasons to believe that interest rates are more likely than not to rise in the medium term. For one, the Fed looks poised to keep raising the federal funds rate by 25 basis points at each meeting this year, helping to propel long-term interest rates upward. Statements by Fed officials indicate these intentions and market expectations are currently for the federal funds rate to hit 2 percent by the end of the year. The growing trade and budget deficits can also push interest rates higher. Mounting deficits should exert upward pressure on long-term interest rates because as the government borrows more, the costs of borrowing should rise. Further, the U.S. trade deficit continues to widen to record levels, raising questions about its sustainability (Weller, 2004). As investors may become more reluctant to finance the U.S. trade deficit, interest rates may experience upward pressures. Specifically, China and Japan have had a large appetite for U.S. Treasury securities over the last year. They have been purchasing these securities to manipulate the value of their currencies relative to the U.S. dollar. The demand they have provided for these securities have arguably kept U.S. Treasury securities' prices higher than they would have been, and thus interest rates lower. However, there has been a fall off in purchases of U.S. Treasury securities by these governments in recent months, another factor that could influence a rise in interest rates (Roach, 2004; Wolf, 2004).

THE COSTS TO HOUSEHOLDS

What does this mean for households? To answer this question, we need to make a few reasonable assumptions. Specifically, we assume that interest rates will rise immediately by either 0.5 percentage points or by 1 percentage point and remain at that level for the coming year, which approximates market expectations. Further, we assume that nominal disposable income will grow at the rate of nominal personal income growth over the past year, 5.0 percent, or of the entire recovery, 3.5 percent.³ We also assume that the number of households will grow at its historic rate of 1.4 percent per year. Additionally, we assume that consumer debt will grow 2 percentage points faster than income – 7 percent

³ This assumption avoids complications in using personal disposable income that arise from the tax cuts.

and 5.5 percent, respectively – which is equal to the historical differential between the two variables. However, this does imply a slowdown of debt growth from its level during the recovery, 9.2 percent.

Also, we keep the share of variable interest rate debt constant. Seventy percent of consumer debt is assumed to be in the form of mortgages, 20 percent in the form of consumer credit and 10 percent in other forms of variable interest rate debt. Further, 21 percent of mortgages are assumed to be variable interest rate mortgages. This likely understates the interest rate increase that households will experience on their fixed rate mortgages since it ignores the share of fixed rate mortgages that households will pay off. However, this is offset by the fact that our assumption on adjustable rate mortgages implies that interest rate increases will almost immediately show up as higher interest rates for ARMs, even though some of them are fixed for a number of years.

Given all of these assumptions, we are now able to calculate four potential increases in interest payments that arise from the combination of two different interest rate increase assumptions and two debt increase assumptions. These scenarios should be compared to the relevant baseline, which assumes that households will not borrow more (table 1). Interest rate changes clearly matter more than the debt increases for changes in interest payments. Even without any increases in debt levels, households will face, on average, higher interest payments equal to \$194 over the year following an interest rate increase of 0.5 percentage points, or \$387 if interest rates rise by 1 percentage point. Obviously, if interest rates rise more slowly, these effects will be smaller. However, even a gradual increase of 1 percentage point over the course of one year will have an effect similar to an immediate increase of 0.5 percentage points. Over the course of one year, an interest rate increase can add costs of about 0.3 to 0.5 percent of income in additional interest payments to households' already high debt service burden.

Table 1: Changes in Household Interest Payments after Interest Rate Changes

	Interest rate increase	Debt increase	Net payment increase	Net payment increase relative to income
Baseline 1	0.5%	0.0%	\$194	0.2%
Baseline 2	1.0%	0.0%	\$387	0.4%
Scenario 1	0.5%	7.0%	\$229	0.3%
Scenario 2	0.5%	5.5%	\$221	0.3%
Scenario 3	1.0%	7.0%	\$459	0.5%
Scenario 4	1.0%	5.5%	\$442	0.5%

Note: The baseline assumes an income increase equal to the income increase of the past year, 5 percent.

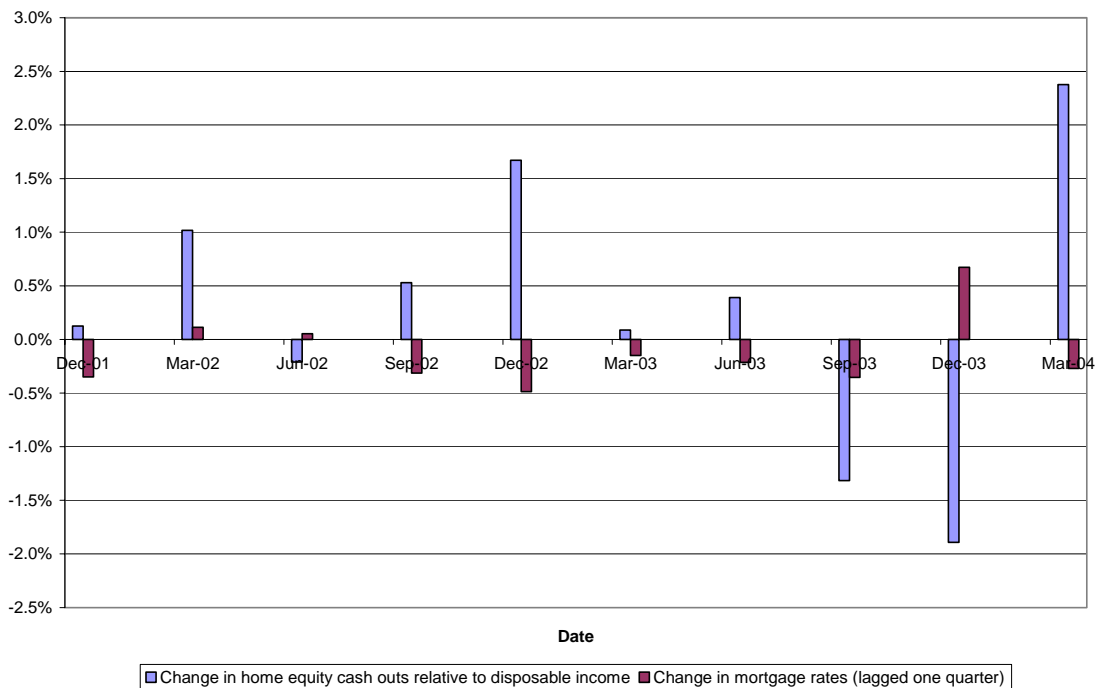
To put this in perspective, higher costs from interest rate increases far surpass the expected cost increases from higher medical expenditures. The Centers for Medicare and Medicaid Services (2004) project that per-capita out-of-pocket expenditures will rise by \$53 from 2004 to 2005. With about 2.6 people in the average household, interest rate

increases could cost households roughly two to three times as much as higher medical expenditures.

ECONOMIC IMPACT OF RISING DEBT SERVICE BURDENS

In addition, higher interest rates can slow economic growth. Because the cost of debt increases, households may reduce their borrowing.⁴ Changes in interest rates can quickly affect the rate at which households cash-out the equity built up in their homes. When interest rates rise, households slow down taking money out of their homes in the following quarter since it takes a while to process mortgage applications. Since the recovery started at the end of 2001, changes in home equity cash-outs have gone in the opposite direction of changes in mortgage rates in the previous quarter in eight out of ten quarters (figure 3). Small interest rate changes can have comparatively large effects on home equity cash outs.

Figure 3: Change in Mortgage Rates and Home Equity Cash-outs



Notes: All figures are in percentage points. Changes in mortgage rates are lagged by one quarter to account for the effect of mortgage processing. Sources are BOG, 2004a, 2004d, and BEA, 2004.

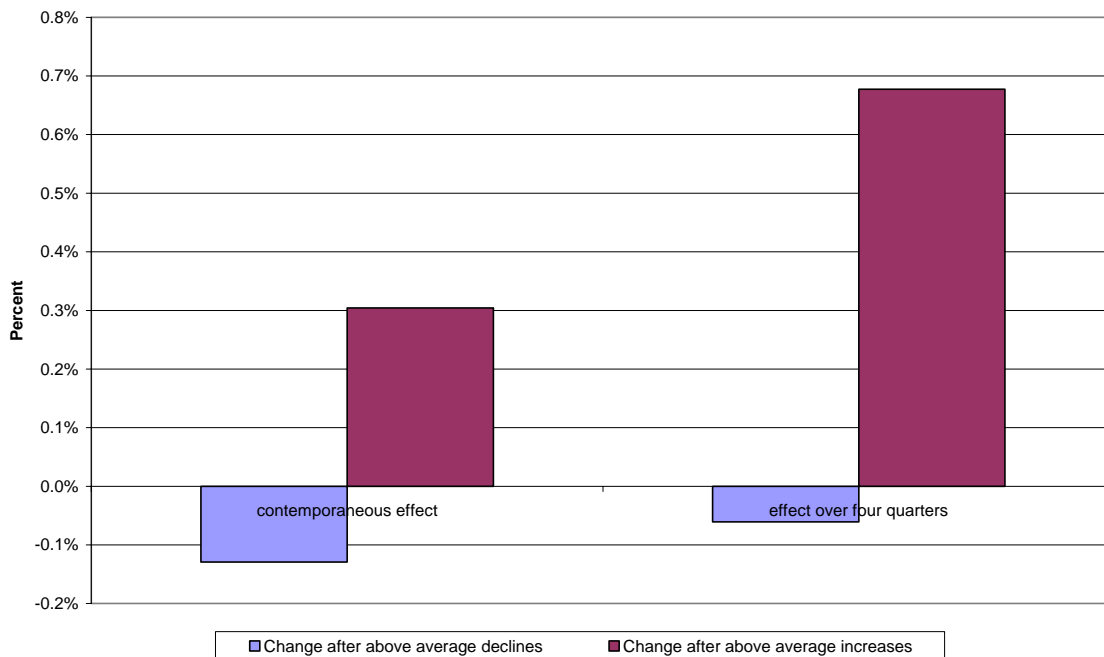
On the face of it, it seems clear that higher interest rates will slow down the home equity cash-out rate of consumers. In fact, formal statistical tests confirm that changes in interest rates are a significant indicator of changes in home equity cash outs, as are changes in

⁴ It is unclear whether the additional interest rate costs alone will slow down consumption since households may decide to borrow more to maintain their level of consumption. We thus focus on the link between consumer borrowing and consumption amid higher interest rates in this section.

house prices.⁵ Also, the effect of changes in mortgage interest rates on home equity cash outs is rather quick. Statistical tests confirm our description in figure 3 that higher interest rates take their largest toll on home equity cash outs in the quarter after their change. To be more specific, our results show that a 1 percentage point increase in the real mortgage rate results in a decline of home equity cash outs relative to disposable income by 0.6 percentage points. Assuming that inflation stays stable and that interest rates climb by 1 percent, home equity cash outs, which are currently at about 2-3 percent of disposable income, could fall by approximately one fourth to one third of their current levels relative to household disposable income.

However, is this enough to have a measurable economic effect? A look at the numbers indicates that it does (figure 4). Following well above average increases in home equity cash outs, consumption relative to disposable income also rises in the ensuing four quarters. Also, after a well above average decline in home equity cash outs,⁶ consumption declines, too, but not as much as it increased after above average increases.

Figure 4: Changes in Consumption Relative to Disposable Income following Above Average Declines or Increases in Home Equity Cash-outs



Notes: All figures are percentages. Above average declines and increases are defined as declines/increases that are one standard deviation below/above the average change in home equity cash outs relative to disposable income.

This is good news and bad news for the recovery. The good news is that the effect of a decline in home equity cash outs may not necessarily reduce the *level* of consumption

⁵ See the technical appendix for a detailed discussion of the techniques used here.

⁶ Note that this means that households increase their borrowing at a smaller rate, but it does not necessarily mean that households stop borrowing.

relative to disposable income by much. The bad news is that economic growth in the recovery has depended heavily on *increases* in consumption. Home equity cash outs relative to disposable income grew in seven out of ten quarters during the recovery, and in three quarters the increase was well above average, i.e. more than one standard deviation above the mean. In other words, the economic recovery has depended heavily on the boosts from ever higher home equity cash outs, which will vanish and possibly be replaced with lower home equity cash outs. Thus, consumption will likely slow down in response to higher interest rates and fewer home equity cash outs.

The numbers in figure 4 also show that much of the effect of a decline or increase in home equity cash outs on consumption occurs in the same quarter. The additional effects in subsequent quarters as households have less or more money to spend are cumulatively much smaller. That is, there is a strong contemporaneous relationship between home equity cash outs and consumption. This is confirmed by using formal statistical analysis techniques.⁷ Specifically, a 1 percentage point decline in home equity cash outs will reduce consumption relative to disposable income by 0.31 percentage points over the course of two quarters, all else equal.

This can put a serious damper on economic growth. Our results show that a 1 percentage point increase in long-term interest rates will reduce home equity cash outs relative to disposable income by 0.6 percentage points in the subsequent quarter. Further, our results also show that this will reduce consumption relative to disposable income by 0.18 (0.6×0.31) percentage points over the course of two quarters. This can be translated into a growth effect with a number of steps (table 2). First, consumption currently amounts to about 95 percent of disposable income and it would decline to 93.2 percent – a difference of 0.18 percentage points – after a 1 percent increase in the interest rate. If nominal disposable income grew by 5 percent, nominal consumption would have to grow by 3 percent, and if nominal disposable income grew by 3.5 percent, nominal consumption would have to grow by 0.15 percent to get the ratio of consumption to disposable income down to 93.2 percent.

However, part of this increase in nominal consumption is due to inflation, which has no effect on growth. So, assuming that inflation will average about 3 percent at the time that these changes occur, inflation-adjusted consumption will either stay flat or decline by 1.5 percent. If inflation is only 2 percent, inflation-adjusted consumption will grow by 1 percent or decline by 0.5 percent.

What does this mean for growth? Consumption has played a very important role in the recovery. On average, about 93 percent of economic growth resulted from consumption growth in the recovery. Since the start of the recession, about 64 percent of growth came from consumption. However, over a longer period, data from 1947 collected by the BEA (2004) show that consumption on average contributes 54 percent to growth. Hence, assuming that consumption will contribute 60 percent to growth, the real economic growth rate will see either no effect – good or bad – from consumption or it will be

⁷ See the technical appendix for a detailed discussion of the results.

between 0.3 and 0.9 percentage points lower due to the changes in consumption. Put differently, to generate a real economic growth rate of 3 percent, other sectors – investment, exports and the government – will have to grow by 7.5 to 9.8 percent at the same time. That is, to generate an economic growth rate that many economists consider the bare minimum to get the labor market to expand, 3 percent, investments, (net) exports and the government would have to grow a lot faster than they have so far.

Table 2: Simulated Consumption and Growth Effects from a 1 Percentage Point Increase in Mortgage Rates

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Change consumption relative to disposable income	95 to 93.2	95 to 93.2	95 to 93.2	95 to 93.2
Nominal income growth (percent)	5	3.5	5	3.5
Nominal consumption growth (percent)	3	1.5	3	1.5
Inflation	3	3	2	2
Real consumption growth (nominal consumption growth minus inflation)	0	-1.5	1	-0.5
Growth effect	0	-0.9	0.6	-0.3
Growth outside of consumption needed to achieve 3 percent real growth	7.5	9.8	6.0	8.3

Notes: Nominal income growth is arrived at by $(PDI_{t+1} * 0.932) / 0.95 - 1$. It is assumed that on average 60% of economic growth results from real consumption growth.

CONCLUSION

The current recovery has relied heavily on households borrowing ever more money to sustain their consumption. However, economic fundamentals suggest that long-term interest rates, such as mortgage rates, are more likely to rise in the coming year than to stay the same or even fall. The effects will be two-fold.

First, households will quickly face higher interest rate costs. A comparatively large amount of household debt, about 45 percent, is held in the form of variable interest rate debt. A simple simulation suggests that an interest rate increase of 1 percentage point will roughly translate into additional costs of approximately \$400 in interest payments for the coming year for the average family.

This cost increase would come at a time when households are already financially strapped. Income increases have been small due to the weak labor market. Yet cost increases, particularly for health care, education and housing, have been sharp. In fact, our projected increase in interest payments is two to three times larger than the projected out-of-pocket increases for medical expenditures for the average family. Thus, it is not unreasonable to expect that signs of households' financial distress, such as personal bankruptcies, will continue to climb to new record highs.

Second, because the economy has relied so heavily on consumers to borrow money, especially against the equity in their homes, a rise in interest rates could quickly affect overall consumption and potentially economic growth. Our findings suggest that higher interest rates will reduce home equity cash outs relatively quickly, typically with a lag of about one quarter. Moreover, when home equity cash outs decrease, consumption does so almost simultaneously. We estimate that a 1 percentage point increase in interest rates would substantially reduce consumption growth, so that other sectors would have to grow 6-10 percent in inflation-adjusted terms just to maintain a basic overall growth rate of 3 percent.

Many other factors will come to bear on economic growth if and when interest rates rise. However, it seems clear that higher interest rates can quickly take a toll on households and the economy. To avoid a serious economic slowdown, the focus should be on other engines for economic growth, such as investment, exports, and more focused government spending. At the same time, public policy should focus on weaning the economy off a debt driven consumption boom and replacing it with income support consumption growth. A number of policy options exist to boost income growth, such as higher minimum wages, improved labor laws to support the efforts of workers to join unions, and improved unemployment insurance. As long as the economy remains so heavily dependent on consumers borrowing more money, sticker shock from higher interest rates will mean less money in people's pockets and less growth.

A.1 TECHNICAL APPENDIX

A.1.1 VAR Regression

To test how quickly higher interest rates will affect home equity cash out, we use the Granger causality test and a vector auto regression. This technique allows us to test for the intertemporal relationship between the variables of interest without having to specify a full structural model, which encounters the obstacle that many of the behavioral factors leading to home equity cash outs are unknown. Underlying the vector auto regression estimation is the following equation:

$$\begin{bmatrix} \Delta \frac{NewMort - NewRE}{PDI}_t \\ \Delta r_t \\ \Delta hpi_t \end{bmatrix} = \alpha + \beta * \begin{bmatrix} L(\Delta \frac{NewMort - NewRE}{PDI}) \\ L(\Delta r) \\ L(\Delta hpi) \end{bmatrix} + \varepsilon \quad (1)$$

where *NewMort* is the amount of new mortgage debt, *NewRE* is the amount of new spending on residential homes, *PDI* is personal disposable income, *r* is the real mortgage rate, *hpi* is the house price index above and beyond the consumer price index, ε is a randomly distributed error term and *L* is a lag operator, representing four lags in our estimation. Thus, equation (1) estimates the effect of the real interest rate and the deviation of the housing price index from overall inflation on the rate of home equity cash outs relative to disposable income.⁸ This model allows us to gauge how quickly households will change their cash out behavior if interest rates rise.

The data are compiled from publicly available sources. Data on interest rates are from BOG (2004d); data on disposable income are taken from BEA (2004); data on new mortgages and new investments in residential real estate are from BOG (2004a); data on the housing price index are from OFHEO (2004). We consider data from 1975 through the first quarter of 2004, since complete data are only available for this period. All data are quarterly data, i.e. for mortgage rates, we take the quarterly average of monthly data.

Before estimating equation (1), we provide some results on pair-wise Granger causality tests. These tests provide a sense of which variable “leads the way” for the other over time. Our results show, for instance, that changes in interest rates lead the way, or Granger cause, changes in home equity cash-outs, but not the other way around (table A1). The results further indicate that the rise in home prices has been a contributing factor to home equity cash outs and that house price increases are somewhat of a leading indicator for interest rate increases. The latter result is likely a reflection of the fact that higher house prices lead to more loan demand and to higher interest rates, all else equal.

⁸ Equation (1) also tests for the reverse causality that home equity cash outs are leading the way for interest rates and house prices. However, since this is not the focus of our argument here, we are focusing solely on the first inter-temporal relationship. All variables are stationary.

The estimation results for equation (1) reiterate our findings from the pair-wise Granger causality tests. Again, higher interest rates translate into lower home equity cash outs (table A2). Also, higher house prices above inflation result in higher interest rates and in higher home equity cash outs (table A2).

Furthermore, the regression results show that the effects of higher interest rates on home equity cash outs are fairly quick. The largest effect occurs in the first quarter after a change. An increase of interest rates equal to 1 percent, from the average interest rate, translates into a decline of home equity cash outs relative to disposable income by 0.58 percentage points in the subsequent quarters. All other lagged effects of changes in the real (inflation-adjusted) mortgage interest rate are statistically insignificant.

Table A1: Granger Causality Tests for Effects of Higher Interest Rates, Housing Prices, and Home Equity Cash-outs

Null hypothesis	Reject/fail to reject
Changes in home equity cash outs do not Granger cause changes in interest rates	Fail to reject
Changes in interest rates do not Granger cause changes in home equity cash outs	Reject***
Changes in home equity cash outs do not Granger cause changes in house price index above inflation	Fail to reject
Changes in house price index above inflation do not Granger cause changes in home equity cash outs	Reject***
Changes in interest rates do not Granger cause changes in house price index above inflation	Fail to reject
Changes in house price index above inflation do not Granger cause changes in interest rates	Reject*

Notes: In each case, four lags are used. The findings are robust with respect to the number of lags used. All variables are stationary. * denotes significance at 10%-level, ** denotes significance at 5%-level, and *** denotes significance at 1%-level.

Our statistical results show two findings. First, changes in interest rates have a significant statistical and economic effect on changes in home equity cash outs and thus higher interest rates could contribute to an economic slowdown by slowing down consumption as households borrow less against the equity in their homes. Second, the effect of higher interest rates occurs comparatively quickly. Our results showed that interest rate changes had their largest effect on home equity cash outs in the first quarter after an interest rate change.

This can also be visually represented by the cumulative effect of an impulse response function (figure A1). An impulse response function measures the response of one

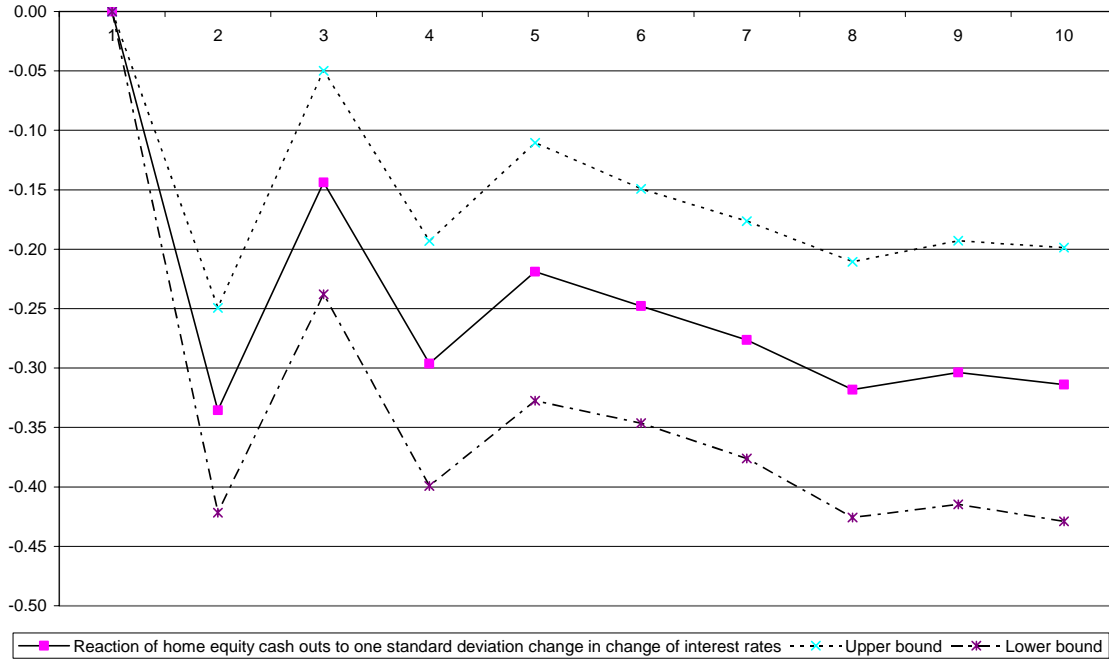
variable, in this case the change in home equity cash outs relative to disposable income, to a one-time change in another variable, in this case the real interest rate. Figure A1 depicts the cumulative effect over time on interest rate changes on home equity cash out changes. The largest change in home equity cash outs comes in the quarter following the interest rate change. After that the effect peters off, but continues to weaken home equity cash outs over time.

Table A2: Vector Auto Regression Results

	$\Delta \frac{NewMort - NewRE}{PDI}_t$	Δr_t	Δhpi_t
$\Delta \frac{NewMort - NewRE}{PDI}_{t-1}$	-0.73*** (0.10)	0.11 (0.07)	-0.24 (0.20)
$\Delta \frac{NewMort - NewRE}{PDI}_{t-2}$	-0.49*** (0.13)	0.13 (0.08)	-0.01 (0.26)
$\Delta \frac{NewMort - NewRE}{PDI}_{t-3}$	-0.26** (0.13)	0.17** (0.08)	0.12 (0.26)
$\Delta \frac{NewMort - NewRE}{PDI}_{t-4}$	-0.06 (0.10)	0.08 (0.07)	-0.02 (0.21)
Δr_{t-1}	-0.58*** (0.17)	0.38*** (0.11)	-0.49 (0.33)
Δr_{t-2}	0.09 (0.18)	0.08 (0.12)	-0.07 (0.37)
Δr_{t-3}	-0.03 (0.18)	-0.09 (0.12)	0.03 (0.36)
Δr_{t-4}	0.06 (0.16)	0.13 (0.11)	-0.05 (0.33)
Δhpi_{t-1}	0.03 (0.06)	0.07* (0.04)	0.27*** (0.11)
Δhpi_{t-2}	-0.01 (0.07)	-0.07 (0.05)	0.12 (0.14)
Δhpi_{t-3}	0.19*** (0.07)	-0.05 (0.05)	0.21 (0.14)
Δhpi_{t-4}	-0.06 (0.06)	0.06 (0.04)	0.21 (0.12)
Constant	-0.07 (0.09)	-0.04 (0.06)	0.22 (0.19)
N	111	111	111
R-squared	0.49	0.20	0.43

Notes: Figures in parentheses are standard errors. The findings are robust with respect to the number of lags used. All variables are stationary. * denotes significance at 10%-level, ** denotes significance at 5%-level, and *** denotes significance at 1%-level.

Figure A1: Cumulative Change in Home Equity Cash Outs in Response to Changes in Interest Rates



Notes: Results derived from impulse response function based on vector auto regression detailed in table A1.

A.1.2 Regression Results

To determine what kind of effect a change in home equity cash outs has on consumption, we estimate the following equation, which is an expansion of basic consumption theory. Here, consumption is the result of income, which we expand by the additional resources (costs) households can spend from (have to pay for) home equity cash outs (home renovations) and from other consumer credit:

$$\Delta\left(\frac{consumption}{PDI}\right)_t = \alpha + \beta_1 L\left(\frac{PDI}{PCE} \Big|_t - \frac{PDI}{PCE} \Big|_{t-1}\right) + \beta_2 L\left(\Delta \frac{NewMort - NewRE}{PDI} \Big|_t\right) + \beta_3 L\left(\Delta \frac{ConsumerCredit}{PDI} \Big|_t\right) + \varepsilon \quad (2)$$

where all variables are defined as before, *PCE* is the price index for personal consumption expenditures, *consumption* are total personal consumption expenditures, and ConsumerCredit contains credit market debt, such as credit cards and nonrevolving loans for consumption items. *L* is again a lag operator. Data for the consumption price index and for total consumption are from BEA (2004) and data for consumer credit are from BOG (2004a). Equation (2) says that changes in consumption, out of income, depend on unexpected shocks to real income, on shifts between consumer spending from consumption to spending on their homes (new homes and renovations), and on the ability of households to borrow money in the form of consumer loans.

Table A3: Regression Results for Determinants of Changes in Consumption Relative to Disposable Income

Explanatory variable	Change in consumption to disposable income _t
Change in home equity cash outs to disposable income _t	0.17*** (0.05)
Change in home equity cash outs to disposable income _{t-1}	0.14** (0.06)
Change in home equity cash outs to disposable income _{t-2}	0.05 (0.05)
Real disposable income growth _t	-0.65*** (0.06)
Real disposable income growth _{t-1}	0.16*** (0.06)
Real disposable income growth _{t-2}	-0.01 (0.05)
Change in consumer credit to disposable income _t	0.33*** (0.11)
Change in consumer credit to disposable income _{t-1}	0.01 (0.11)
Change in consumer credit to disposable income _{t-2}	-0.13 (0.11)
Constant	0.00*** (0.00)
Adj. R-squared	0.66
Durbin-Watson	2.04

Notes: Figures in parentheses are standard errors. The findings are robust with respect to the number of lags used. All variables are stationary. * denotes significance at 10%-level, ** denotes significance at 5%-level, and *** denotes significance at 1%-level.

The regression results confirm the descriptive findings. Since our initial descriptive calculations suggest a strong contemporaneous relationship, we included only the contemporaneous value plus two lags for each variable.⁹ A decline in home equity cash outs will also reduce consumption during the current and subsequent quarter.

⁹ The results are not sensitive to the lag specification of the model.

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ABOUT THE AUTHORS

Christian Weller is a senior economist at the Center for American Progress, where he specializes in Social Security and retirement income, macroeconomics, the Federal Reserve, and international finance. Prior to joining American Progress, he was on the research staff at the Economic Policy Institute, where he remains a research associate. Weller has also worked at the Center for European Integration Studies at the University of Bonn, Germany, in the Department of Public Policy of the AFL-CIO in Washington, D.C., and in universal banking in Germany, Belgium and Poland. His publications appear in publications ranging from the *Cambridge Journal of Economics*, the *Journal of Policy Analysis and Management*, the *International Review of Applied Economics*, the *Journal of Development Studies*, and the *Journal of International Business Studies* to the *Atlanta Journal Constitution*, *USA Today*, *Detroit News*, *Challenge*, and the *American Prospect*. Weller is often cited in the press and he has been a frequent guest on news programs on ABC, NBC, CNN, MSNBC, CNBC, Fox News and Bloomberg Television. He holds a Ph.D. in economics from the University of Massachusetts at Amherst.

Radha Chaurushiya is an economic policy analyst at the Center for American Progress. Prior to joining American Progress, she worked for the Federal Reserve Board of Governors in Washington, D.C., where she assisted staff economists with economic and financial markets research and produced briefing materials for the Board. Her research on the Federal Reserve's past experiences targeting long-term interest rates was presented to the Federal Open Market Committee in 2003. Radha graduated cum laude from Wellesley College in 2002 with a degree in economics and also studied at the London School of Economics.

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