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U.S. Consumption after the 2008 Crisis

Jaewoo Lee, Pau Rabanal, and Damiano Sandri

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Prepared by Jaewoo Lee, Pau Rabanal, and Damiano Sandri

Authorized for distribution by Olivier Blanchard

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Authors' E-mail Addresses: jlee3@imf.org; prabanal@imf.org; dsandri@imf.org

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EXECUTIVE SUMMARY

U.S. household consumption declined sharply in late 2008, marking a departure from the trend of a steady increase in U.S. consumption as a share of income since the 1980s. Combining econometric and simulation analysis, we estimate that this departure will be sustained beyond the crisis: the U.S. household consumption rate will likely decline somewhat further from its current level, as the saving rate rises to around 6 percent of disposable personal income (from nearly 5 percent in 2009). Compared to the pre-crisis years (2003–07), this saving rate implies a decline in U.S. private-sector demand on the order of 3 percentage points of GDP.

I. INTRODUCTION

1. U.S. household consumption declined sharply in late 2008, against the backdrop of a deepening financial crisis. Personal consumption expenditure, which had peaked above 95 percent of disposable personal income in 2005, fell below 92 percent by the second quarter of 2009. This decline, if sustained, would break the trend of steady increase in the U.S. consumption rate since the 1980s. In this note, we explore the likely direction of U.S. consumption after the crisis.
2. The future of U.S. consumption has tangible macroeconomic implications both for the recovery of the U.S. economy and for the prospects of global growth and current account imbalances (Blanchard 2009 and WEO 2009). If U.S. private-sector demand remains at a subdued level, global economic growth will be less vigorous than otherwise, and the distribution of current account balances will need a realignment—a smaller deficit in the U.S. will have to be matched by smaller surpluses or larger deficits in other countries.
3. Our analysis suggests that U.S. household consumption and saving rates will settle at 89½–91½ and 5–7 percent, respectively, over the next several years.² Similar levels of consumption and saving rates were last seen in the early 1990s. Though not too far from the 2009 saving rate of nearly 5 percent, the forecast implies a significantly lower share of private sector demand in GDP by about 3 percentage points compared to the pre-crisis (2003–07) average. However, the forecast uncertainty is large: a 95-percent confidence interval has width of about 7 percentage points (3¾ percentage points on each side).
4. These forecasts for savings have been obtained by taking into account several interrelated shocks that weighed down on consumption in this crisis. In late 2008, household

² Note that the saving rate and consumption rate add up to less than 100 percent. The remainder, averaging 3½ percent of disposable personal income since the 1980s, comprises personal interest payments (nonmortgage interest payment) and personal current transfer payments. Over a five-year period before the crisis (2003–07), the average consumption and saving rates were 94 and 2½ percent of disposable personal income, respectively.

wealth fell sharply, and macroeconomic and financial uncertainty (also called risk in this note) surged to a level rarely experienced in several decades. Concurrently, the long-term growth outlook of the U.S. economy turned markedly weaker, and the credit available for households contracted.

5. To incorporate the effect of these shocks on consumption, we combine econometric and simulation approaches. We first adopt a time series approach to aggregate data to explore the role of wealth and uncertainty in explaining consumption, and forecast the consumption rate after the crisis. The focus on wealth and uncertainty is driven by their conspicuous role during this crisis, while we also examine additional effects of the potential growth and credit availability. We then turn to a simulation of consumer choice in the face of shocks to wealth and risk as well as growth and credit availability. The simulations provide a structural interpretation and quantitative robustness check, complementing the results of the time-series approach.³

6. The rest of this note is organized as follows. Section 2 presents background facts that motivate our analysis. Section 3 presents econometric evidence and forecasts on U.S. consumption for the next several years. Section 4 simulates a life-cycle model that captures main features of U.S. consumer behavior, and develops a simulation-based forecast of U.S. consumption after the crisis. Section 5 concludes.

II. BACKGROUND FACTS

During the crisis, consumption and wealth declined sharply, reflecting the surge in uncertainty, weakening of economic prospects, and tightening of credit availability.

7. The decline in U.S. household consumption since 2008 is unmistakable (Figure 1). The consumption rate (in percent of disposable personal income) fell to 92 percent in 2009 from the pre-crisis high that exceeded 95 percent. With it, the saving rate rose to about 5 percent. The consumption and saving rates thus moved back toward the historical average, undoing much of the increase in consumption rate (and decline in saving) over the last two decades.

8. The decline in consumption has coincided with a sharp decline in wealth and several closely related macroeconomic shocks in the background:

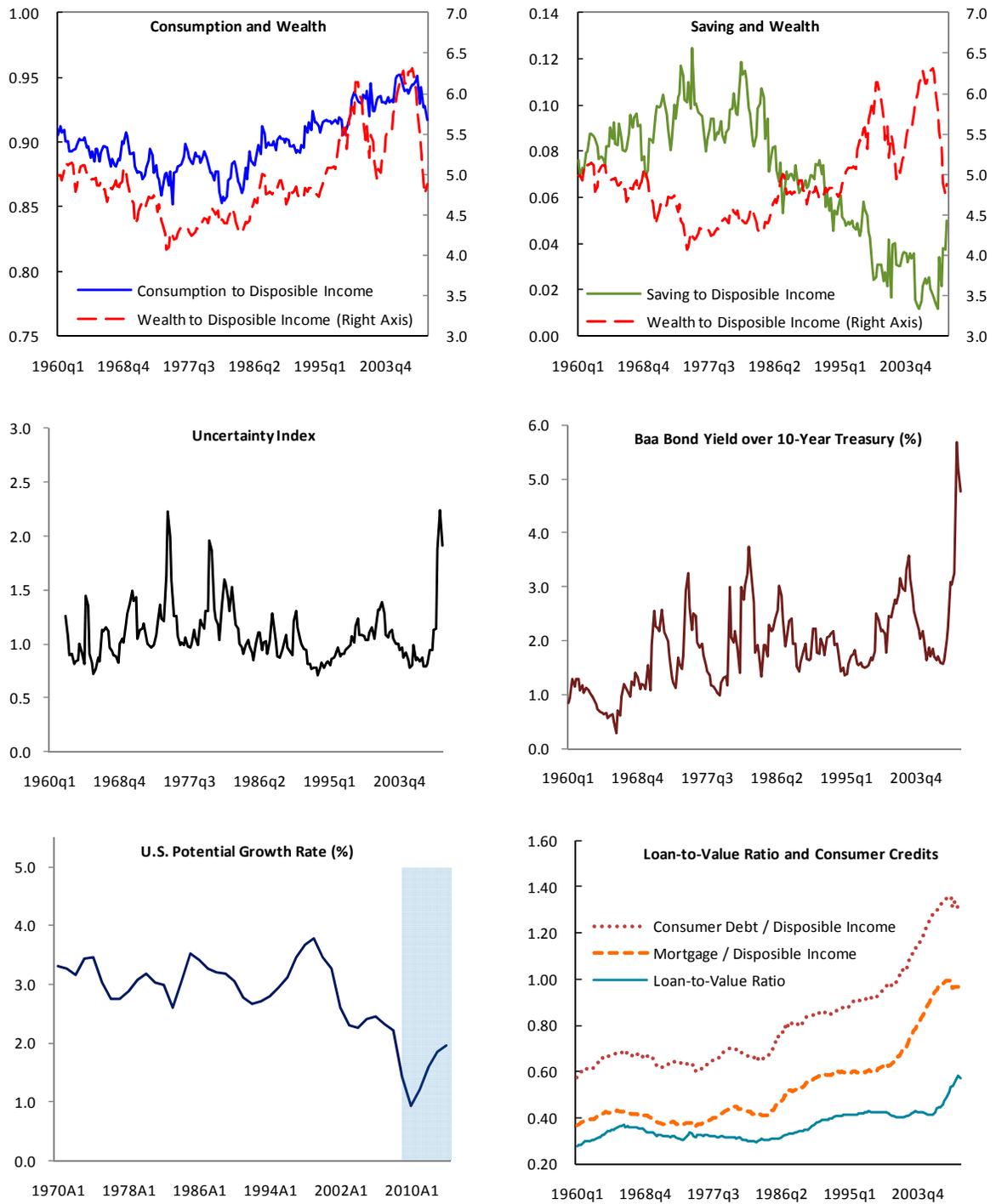
³ The simulations also help overcome a limitation that applies to any regression-based approach—since large tail events have been rare for the U.S. economy, the full impact of unusually large shocks in the current crisis is difficult to measure with confidence from historical data alone.

- Household wealth fell sharply, reaching 480 percent of disposable personal income in 2009.⁴ This decline exceeded somewhat the decline in wealth during 2001–02 after the bursting of the internet bubble. In contrast to earlier episodes of wealth decline, housing wealth also declined since peaking in 2007, as the U.S. housing market experienced a nation-wide fall in prices for the first time since the mid-1970s (Case 2008).
- Macroeconomic and financial uncertainty surged in late 2008, as an extreme fright took over the financial market in such intensity and scope that have rarely been experienced since the Great Depression. The spread between Baa corporate bonds and government securities of 10-year maturity rose to a level that topped all earlier highs of the post-war period by a wide margin. And a comprehensive measure of aggregate uncertainty—constructed by Bloom (2009), combining information about the stock market, the labor market, and firm-level and industry-level dispersion rates—also peaked in late 2008, driven by the sharp rise in financial uncertainty.
- Long-term growth prospects of the U.S. economy were appreciably revised down with the crisis. The U.S. potential growth rate was estimated to have been above 3 percent in the late 1990s, but is now estimated to reach about 2 percent over the medium term, that is after the U.S. economy recovers from this crisis (Barrera and others, 2009).
- Credit availability tightened relative to pre-crisis years. The debt-to-income ratio of the U.S. household stopped growing in 2008, following a rapid rise before the crisis. The pre-crisis expansion in credit was driven by mortgages, which accounted for nearly 90 percent of the rise in household debt over the 2000–07 period.

9. These negative shocks are expected to have lasting effects on U.S. consumption beyond the crisis. Asset prices and household wealth are not likely to return to their pre-crisis highs in the near future, not least reflecting the weakened outlook for the long-term growth. Credit conditions are likely to remain tighter than in the past decade, reflecting a renewed appreciation of risks and the decline in wealth—including housing wealth which tends to recover very slowly (Greenlaw and others, 2008). One exception could be the extreme uncertainty of late 2008 which began to subside, accompanied by some recovery in asset prices. However, perceived uncertainty facing households could remain high longer than observed indexes, given the anemic pace of recovery, slow job creation and lingering concerns of a double dip recession; and our analysis shows that a temporary surge in uncertainty had a lasting effect on consumption and wealth in the past.

⁴ Household wealth is measured as tangible and financial assets net of liabilities, thus without including the value of government-provided pension or human wealth.

Figure 1 : Household Consumption and Selected Indicators



Source : NIPA, Flow of Funds, Haver Analytics, Bloom(2009), and Staff Estimates

10. We organize our analysis of the post-crisis consumption around wealth and uncertainty, while examining the direct effects of lower future growth and tighter credit in a supplementary manner. This focus enables us to capture most of the combined effect of major shocks on the post-crisis consumption, because wealth and uncertainty are strongly correlated with other shocks, as well as having themselves been particularly important shocks of this crisis. Wealth is the conduit through which other shocks affect consumption. A rise in perceived uncertainty and a weakening in long-term growth prospects would both lead to a decline in wealth (as the present value of future outputs), one by increasing the risk-adjusted discount rate and the other by decreasing future outputs (to be discounted). Credit tightening is closely associated with both rising uncertainty and declining wealth, causality aside. And a large uncertainty appreciably reduces consumption not only indirectly via a lower wealth and tighter credit, but also directly via higher precautionary savings and postponed consumption.

III. VAR APPROACH TO AGGREGATE CONSUMPTION

A parsimonious VAR captures well the role of wealth and risk in consumption dynamics, and provides a forecast for consumption following this crisis, implying a saving rate of about 5-7 percent of disposable income.

11. We adopt a parsimonious Vector Autoregressive (VAR) model that helps us understand the interaction of aggregate consumption with shocks to wealth and uncertainty:

$$\begin{bmatrix} \sigma_t \\ C_t/Y_t \\ W_t/Y_t \end{bmatrix} = A(L) \begin{bmatrix} \sigma_{t-1} \\ C_{t-1}/Y_{t-1} \\ W_{t-1}/Y_{t-1} \end{bmatrix} + \varepsilon_t,$$

where σ is the uncertainty index, C/Y is the consumption rate (the ratio of personal consumption expenditure to disposable personal income), and W/Y is the ratio of household wealth to disposable personal income. We estimate the VAR with two lags on quarterly data over 1960Q1-2009Q2.

12. The effect of uncertainty on consumption is uncovered from two impulse responses, obtained by the Cholesky decomposition. Figure 2 comes from the baseline specification using the aggregate consumption expenditure, and Figure 3 comes from a specification that separates consumption expenditures on durables and on nondurables and services.

- In Figure 2, uncertainty has the expected and statistically significant effects on other variables: it leads to a decline in the consumption rate and wealth-to-income ratio. These results suggest that asset prices decline when uncertainty increases, generating a higher risk premium as demanded under a higher uncertainty. The decline in wealth

and consumption builds up for about two years, generating hump-shaped responses, while the uncertainty shock declines to half its original size in about five quarters.

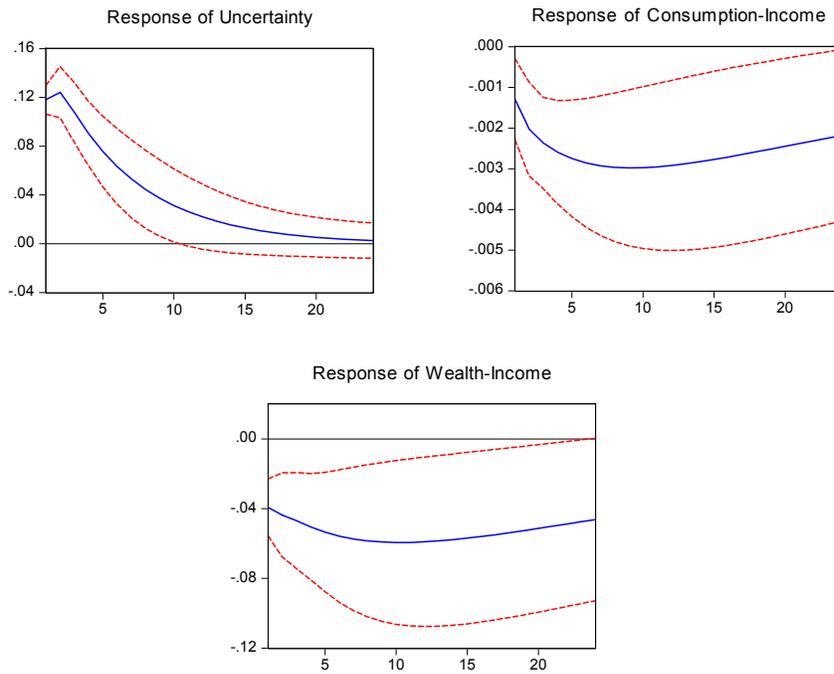
- In Figure 3, durables consumption rate declines immediately after an increase in uncertainty, but recovers over time. This result coincides with other findings that firms and individuals postpone purchases of durable goods when uncertainty increases (Bloom and others 2009, and Romer 1990). In contrast, the effect on nondurables consumption rate builds up over time. The combination of these two responses—given that the durables consumption expenditure is about 10 percent of the personal consumption expenditure—would generate the response of the consumption rate reported in Figure 2.

13. The wealth effect is estimated as a long-term reduced-form relationship between aggregate consumption and wealth: one-dollar increase in wealth is associated with an increase in consumption expenditure by 2-5 cents, broadly consistent with the literature.⁵

- We infer the wealth effect from cointegration estimates rather than from impulse responses, because of the difficulty of identifying shocks to aggregate wealth that is a highly endogenous variable, unlike the uncertainty index. Our estimates have been obtained from cointegrating vectors in two error-correction specifications: one with a cointegrating restriction imposed between the consumption-to-income ratio and wealth-to-income ratio; and the other with a cointegrating restriction imposed among the logs of real consumption, income, and wealth. Neither cointegrating restriction includes the uncertainty index which is clearly a stationary variable.
- This wealth effect is also consistent with the 3–5 cents per dollar estimated by Maki and Palumbo (2001) from the U.S. disaggregate data of the 1990s. This study is noteworthy in having provided convincing evidence that the wealth effect was a primary factor behind the rapid decline in the U.S. saving rate (rise in the consumption rate) in the late 1990s. They find that the high-wealth groups which benefited most from rising wealth decreased substantially their saving rates, while low-wealth groups changed little or even increased their saving rates.

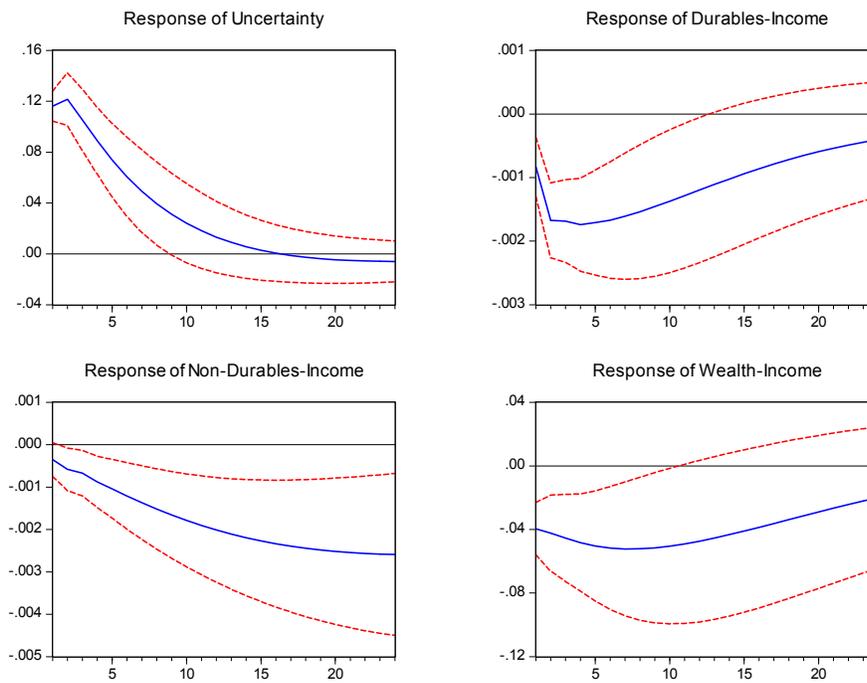
⁵ See Lettau and Ludvigson (2004) and Carroll, Otsuka, and Slacalek (2006) for recent additions to the well-established literature on wealth effects that started with the seminal work of Ando and Modigliani (1963).

Figure 2. Impulse Response to an Uncertainty Shock—Total Consumption Expenditure



Note: Dashed lines represent 95 percent confidence intervals.

Figure 3. Impulse Response to an Uncertainty Shock—Durables and Nondurables/Services

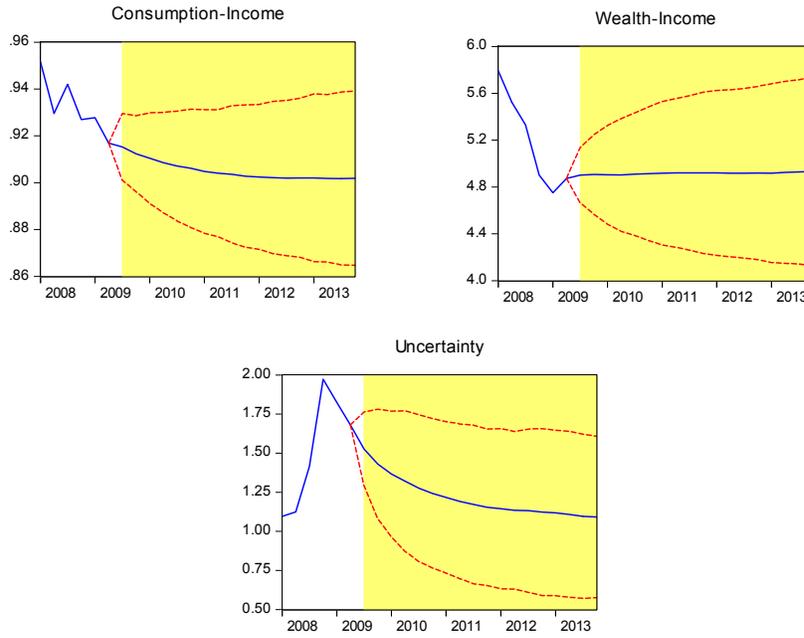


Note: Dashed lines represent 95 percent confidence intervals.

14. Having confirmed that our VAR captures well the role of two important shocks in this crisis, we generate forecasts for consumption over the next several years. These forecasts imply the consumption rate of $89\frac{1}{2}$ – $91\frac{1}{2}$ percent and saving rate of 5–7 percent for the next several years. Here and throughout the paper, we map consumption rates to saving rates by using the fact that interest payments and current transfers have been fairly stable around $3\frac{1}{2}$ percent of disposable personal income since the 1980s.

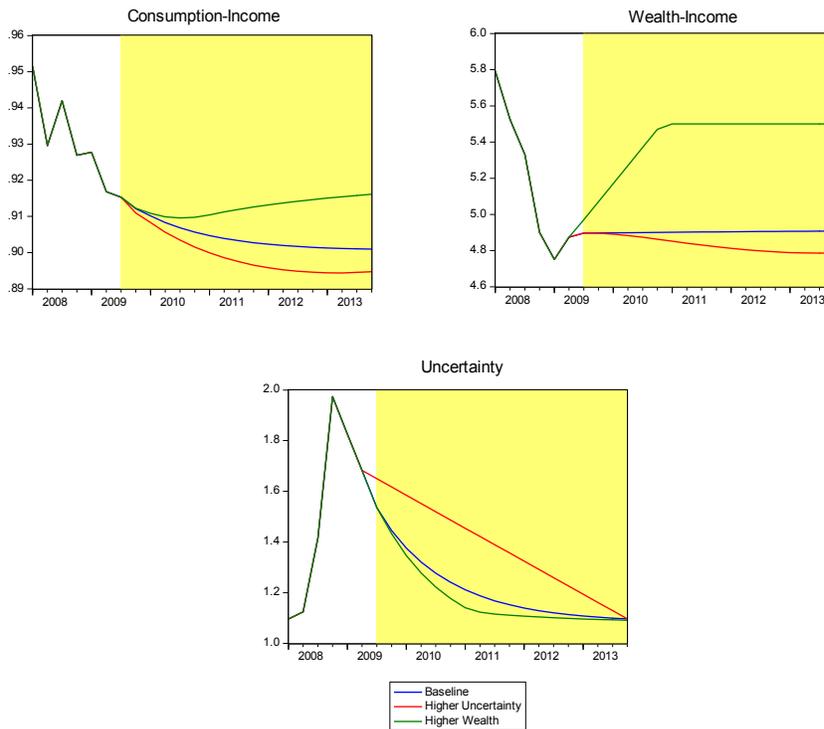
- The baseline forecast (Figure 4) is that the consumption rate will settle to a long-run value of 90 percent, and we convert this to the long-run saving rate of $6\frac{1}{2}$ percent (close to the historical average, and higher than its 2009 value of $4\frac{1}{2}$ percent). However, forecast uncertainty is large: by late-2013 the saving rate could lie between $2\frac{3}{4}$ and $10\frac{1}{4}$ percent with 95 percent probability.
- Two conditional forecast scenarios imply a saving rate of 5 or 7 percent (Figure 5). A downside scenario (higher uncertainty) assumes that uncertainty stays higher than the unconditional VAR forecasts through early 2013, lowering consumption (and raising saving) as implied by impulse responses in Figure 2. An upside scenario (higher asset prices) assumes that the wealth-to-income ratio rises above 540 percent of disposable personal income (its average in the 1990–2008 period, higher than the unconditional VAR forecasts), lowering the saving rate via wealth effect.
- Alternative VAR specifications forecast the saving rate to be 5–6 percent by late-2013 (Box 1). These are obtained from error-correction models that complement the baseline forecast, and from including additional variables that could affect consumer behavior. We also explore the effects of two changes in the historical relationship embedded in the estimated VAR models. We first assume that the consumption shocks (VAR residuals) over 2008Q1–2009Q2 have a permanent effect on the consumption rate. Second, we assume that future income growth is 1 percentage point lower than that implied by VAR estimates.

Figure 4. Forecasts from the Baseline VAR



Note: Dashed lines denote 95 percent confidence intervals. Forecast starts in 2009:Q3.

Figure 5. Conditional Forecasts—Imposed Paths for Uncertainty and Wealth-to-Income Ratio.



Note: Forecast starts in 2009:Q3.

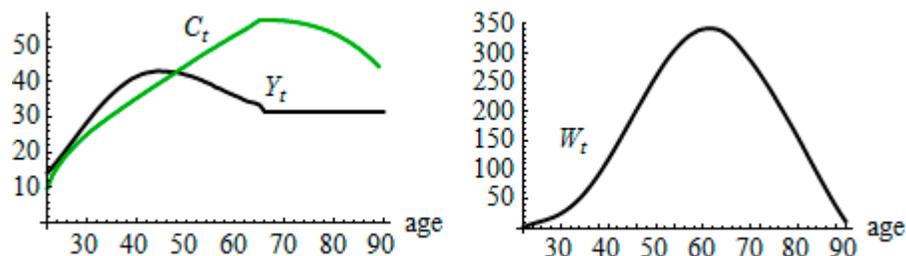
IV. LIFE-CYCLE CONSUMER UNDER RISK

Structural simulations imply that consumption and saving rates will settle at levels similar to VAR forecasts, while providing a structural interpretation of the VAR evidence on the effect of uncertainty.

15. We conduct simulations of a life-cycle consumption model that reflects U.S. consumer behavior (Gourinchas and Parker, 2002; and Cocco and others, 2005). Being based on parameter values that enabled the model to replicate many features of U.S. consumer behavior at disaggregate levels, the simulations provide a structural interpretation of and quantitative comparator to VAR results.

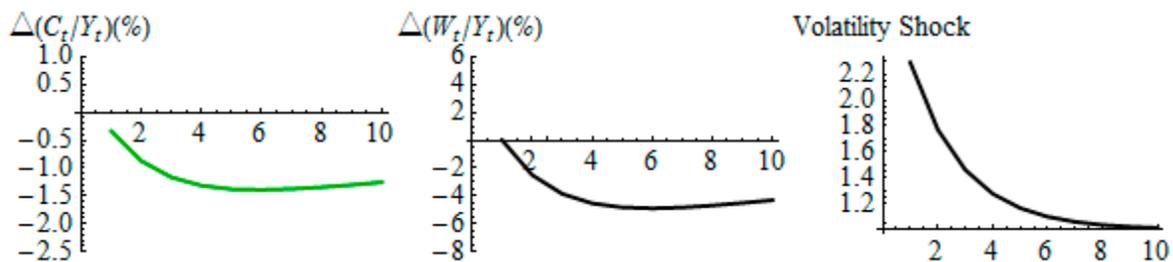
- In our simulations, agents work from age 22 to age 65, and can live up to age 90 facing a death risk that increases with age. They earn labor income, which has a deterministic component varying over the life cycle, subject to both permanent and transitory idiosyncratic shocks. In most simulations, we allow for the possibility of a zero income shock, thereby generating a realistic motive for precautionary savings (Carroll, 1997). Agents invest their savings in riskless bonds and risky stocks that have a higher expected return than bonds. (See Annex and Sandri (2009) for further details.)
- Figure 6 shows the average life-cycle dynamics obtained from simulating 10,000 agents who start working at age 22 with zero wealth. Even though labor income (Y_t) is expected to grow strongly in the early stage of working life, agents are reluctant to borrow against it owing to income risk. They save in order to accumulate a buffer stock of wealth to smooth income fluctuations. Late in working life and at retirement, labor income declines from the peak level in their 40s, while the level of consumption (C_t) is sustained by running down wealth.

Figure 6. Life Cycle Dynamics
(In thousands of 1992 dollars)



16. We use these simulations to infer the effect of crisis-like shocks on aggregate consumption. We first solve for the responses of agents in different age cohorts, and aggregate them using the actual age composition of the U.S. population in 2007 to get the responses of aggregate consumption. Figure 7 shows one such case, the effects of shocks to the volatility of stock returns. The volatility of stock returns doubles (2.3 times, comparable to this crisis) and then declines gradually consistent with the past experience documented in Section II, with the gradual decline in volatility being expected by agents.⁶ Faced with the higher investment risk, agents increase the share of wealth invested in bonds, thereby lowering the rate of return on overall wealth. Consumption and wealth decline gradually, until the volatility shock dissipates substantially. This gradual decline in consumption would generate the hump-shaped responses of consumption and wealth to the uncertainty shock (reported in Figure 2 from VAR analysis). One notable difference in Figure 2 is the immediate drop in wealth, which reflects the immediate decline in asset prices that would be induced by a higher uncertainty and consequent increase in risk premium.⁷

Figure 7. Responses to an Increase in the Volatility of Stock Returns
(Years since the shock on the horizontal axis)



17. Simulations combining multiple crisis-like shocks indicate that the saving rate will increase by 3–4¼ percentage points to settle at 5½–6¾ percent after the crisis (compared to 2½ percent before the crisis). This is derived by adjusting the simulation results according to a plausible assumption that about one third of U.S. consumers do not behave as rationally or optimally as the agents in the simulation.

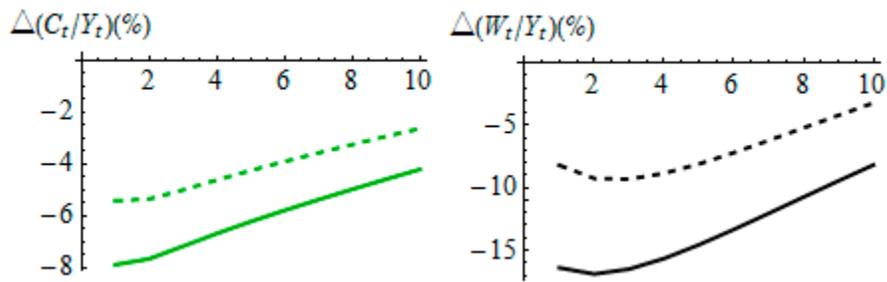
- We first simulate the effects of four combined shocks that are set to a size comparable to the current crisis (Figure 8). We use the average over the 2003–07 period as the benchmark for calibrating the shocks and inferring their effects on consumption. The volatilities of stock return and labor income are assumed to double (2.3 times as in

⁶ As discussed in Bloom and others (2009), the simulation results are an aggregated outcome of many sub-simulations in which agents expect the uncertainty shock to vanish each year with a probability consistent with historical data (i.e., one minus the historical annual persistence of the volatility shock).

⁷ Impulse responses of Figure 2 would thus be a combined outcome of wealth decline and volatility rise in our simulations, thus Panels I and II of Box 2 that discusses the effects of each individual shock.

late 2008) and decline gradually. Agents anticipate these temporary volatility shocks to decline with a probability consistent with past experiences, unlike the other permanent shocks which are (correctly) perceived as such. The income growth rate is assumed to decline permanently, in proportion to the downward revision of the medium-term potential growth rate by 0.4 percentage points from the 2003–07 average of 2.4 percent (using the series of Figure 1). The permanent decline in household wealth, however, is set at two different values: 16 percent as implied by the late-2008 data (solid line), and the half of it (dotted line) to allow for the possibility that households foresee a recovery in certain asset prices and their wealth over the medium term.

Figure 8. Responses to Crisis-Like Shocks
(Dashed line with wealth shock half as large)



- To derive the simulation-implied saving rates after crisis, we focus on the responses of consumption 3–7 years after the crisis-like shocks. Simulations alone suggest that the saving rate will increase from 2½ percent (before the crisis) to 7–8¾ percent.⁸
- However, these simulation results tend to over-estimate the effect of crisis on consumption: all agents are assumed to be fully forward-looking optimizers, while a significant fraction of the population behaves in a non-optimal manner (Mankiw 2000). Assuming that a third of U.S. consumers are “rule-of-thumb” types whose consumption rate does not change with the aggregate wealth, we estimate that the aggregate consumption and saving rate will change two-thirds as much as the simulation-only results, leading to the saving rate of 5½–6¾ percent.

⁸ Simulations suggest that the consumption rate will decline by 5½–8 percent from its pre-crisis level, including the ½ percent decline that is implied by credit tightening (discussed in Box 2 but not included in the simulation of Figure 8). Applying this to the pre-crisis consumption rate of 94 percent, we estimate that the consumption and saving rate will change by 4½–6¼ percentage points.

V. CONCLUSION

18. We expect the U.S. consumption to remain at a relatively subdued level over the next several years, with the household saving rate settling at 5–7 percent of disposable personal income, somewhat above the 2009 saving rate of nearly 5 percent. Though the estimate is subject to a sizable statistical uncertainty, it is supported by several alternative estimates and simulation analysis. Compared to the pre-crisis years (2003–07), the estimated changes in saving and consumption imply a decrease in the U.S. private-sector demand of 2–3¼ percentage points of GDP—close to a half of the U.S. current account deficit at its peak. This will have substantial effects on global economic development after the current crisis.

REFERENCES

- Ando, Albert, and Franco Modigliani, 1963, "The 'Life-Cycle' Hypothesis of Saving: Aggregate Implications and Tests," *American Economic Review*, Vol. 53, No. 1, pp. 55–84.
- Barrera, Natalia, Marcello Esteveao, and Geoffrey Keim, 2009, "U.S. Potential Growth in the Aftermath of the Crisis," United States: Selected Issues (Washington: International Monetary Fund).
- Blanchard, Olivier, 2009, "Sustaining a Global Recovery," *Finance and Development*, September, pp. 8–12.
- Bloom, Nicholas, 2009, "The Impact of Uncertainty Shocks," *Econometrica*, Vol. 77, No. 3, pp. 623085.
- , Max Floetotto, and Nir Jaimovich, 2009, "Really Uncertain Business Cycles" (unpublished; Palo Alto: Stanford University).
- Cagetti, Marco, 2003, "Wealth Accumulation over the Life Cycle and Precautionary Savings," *Journal of Business and Economic Statistics*, Vol. 21 (July), pp. 339–53.
- Carroll, Chris D., 1997, "Buffer-Stock Saving and the Life Cycle/Permanent Income Hypothesis," *Quarterly Journal of Economics*, Vol. 112, No. 1, pp. 1–55.
- Carroll, Otsuka, and Jiri Slacalek, 2006, "How Large Is the Housing Wealth Effect? A New Approach," NBER Working Paper No. 12746 (Cambridge, Massachusetts: National Bureau of Economic Research).
- Case, Karl E., 2008, "The Central Role of House Prices in the Current Financial Crisis: How Will the Market Clear?" *Brookings Papers on Economic Activity*, Fall 2008, pp. 161–94 (Washington: Brookings Institute).
- Cocco, Joao F., Francisco J. Gomes, and Pascal J. Maenhout, 2005, "Consumption and Portfolio Choice over the Life Cycle," *The Review of Financial Studies*, Vol. 18, No. 2, pp. 491–533.
- Gourinchas, Pierre-Olivier, and Jonathan Parker, 2002, "Consumption over the Life-Cycle," *Econometrica*, Vol. 70, No. 1, pp. 47–89.
- Greenlaw, David, Jan Hatzius, Anil K. Kashyap, and Hyun Song Shin, 2008, "Leveraged Losses: Lessons from the Mortgage Market Meltdown," U.S. Monetary Policy Forum

Report No. 2, Rosenberg Institute, Brandeis International Business School and Initiative on Global Markets, University of Chicago Graduate School of Business.

International Monetary Fund, 2009, *World Economic Outlook*, September.

Lettau, Martin, and Sydney C. Ludvigson, “Understanding Trend and Cycle in Asset Values: Reevaluating the Wealth Effect on Consumption,” *American Economic Review*, Vol. 94 (March), 276–99.

Maki, Dean M., and Michael G. Palumbo, 2001, “Disentangling the Wealth Effects: A Cohort Analysis of Household Saving in the 1990s,” Finance and Economics Discussion Series 2001–21 (Washington: Board of Governors of the Federal Reserve System).

Mankiw, N. Gregory, 2000, “The Savers-Spenders Theory of Fiscal Policy,” *American Economic Review*, Vol. 90, No. 2, pp. 120–25.

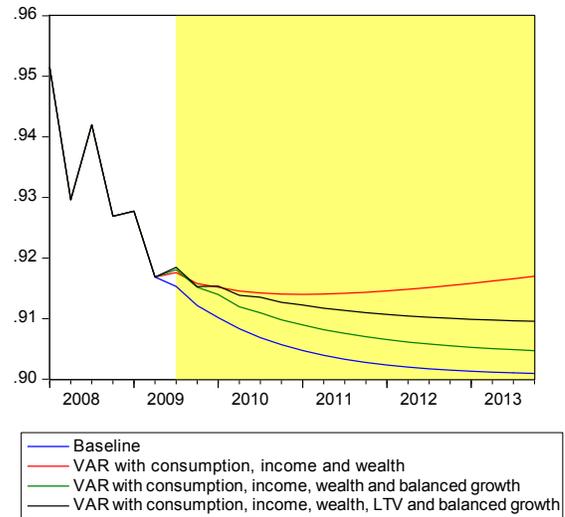
Romer, Christina D., 1990, “The Great Crash and the Onset of the Great Depression,” *Quarterly Journal of Economics*, Vol. 105 (August), pp. 597–624.

Sandri, Damiano, 2009, “The Impact of Uncertainty Shocks on Consumption: The 2008 U.S. Crisis.” (unpublished; Baltimore: Johns Hopkins University, Department of Economics, Ph.D. Dissertation, Chapter 3).

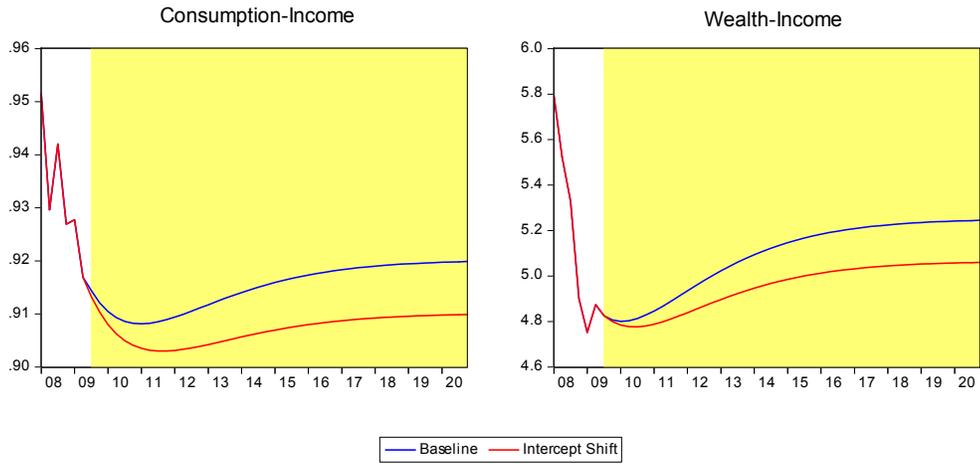
Box 1. Forecasts from Alternative VAR Specifications

Several alternative specifications of VAR models have been tried, to check the robustness of forecasts based on the baseline VAR model.

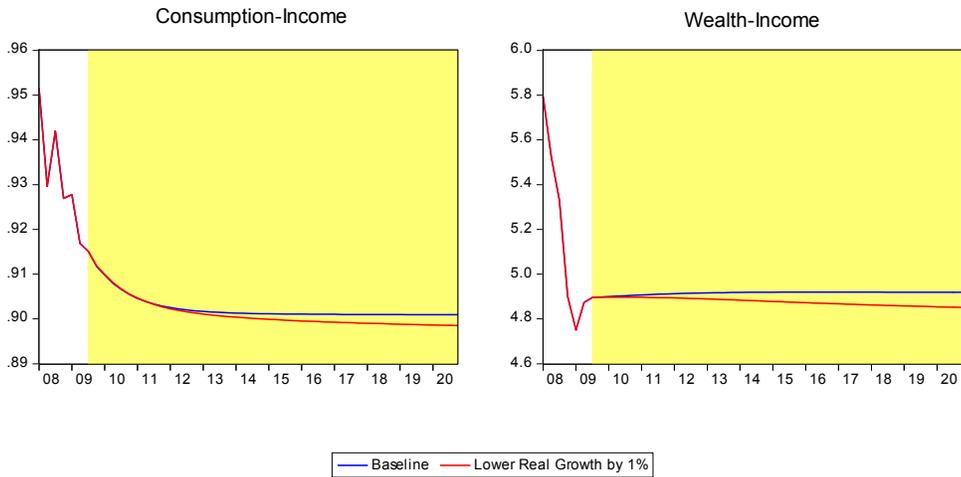
Vector error-correction models have been estimated for the uncertainty index and the logs of real consumption, income, and wealth. One specification includes the loan-to-value ratio, as a proxy for credit conditions. They predict somewhat higher consumption rates than the baseline forecast, thus implying somewhat lower saving rates than the baseline, in the range of 5–6 percent. Similar results are obtained from using other credit proxies, including debt-to-income ratio, real credit outstanding, and bond spreads. It should be noted that these forecasts are derived from the estimation that imposes a balanced-growth condition. When the balanced-growth condition is not imposed, these models predict a steadily rising consumption rate, suggesting that past consumption developments harbored a non-convergent trend.



We also explore the outcome of shifting the estimated models by shocking the consumption equation or the predicted growth rate of income. These offer an informal investigation of permanent changes that will generate shifts in the estimated VAR models. We first shift the estimated consumption function so that the long-run consumption rate declines by 1 percentage point, which is the amount of consumption rate residuals over 2008Q1–2009Q2. This exercise is based on the VAR estimated for a subsample of 1989–2009, which forecasts a consumption rate higher than the VAR estimated for the full sample (1960–2009). As the consumption rate declines by 1 percentage point to 90½ percent (saving rate of 6 percent), and the wealth-to-income ratio declines by about 12 percentage points and the income growth slows until it adjusts eventually to the lower consumption rate.



We then augment the VAR with real disposable personal income, and investigate the effect of a growth slowdown. When we reduce the growth rate of the disposable personal income by 1 percentage point, the saving rate increases by 0.3 percentage point in the long run, while the wealth-to-income ratio decreases by 8 percentage points.



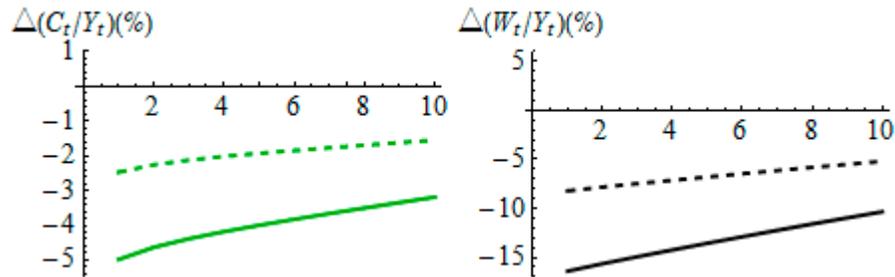
Box 2. Effects of Individual Shocks

We discuss the responses of aggregate consumption to individual shocks: fall in wealth, rise in the volatility of labor income, rise in the volatility of stock returns, fall in expected income growth, and fall in credit availability. The size of shocks is the same as used in Figure 8, except for the fall in credit availability which has been simulated in a slightly modified model, as described below.

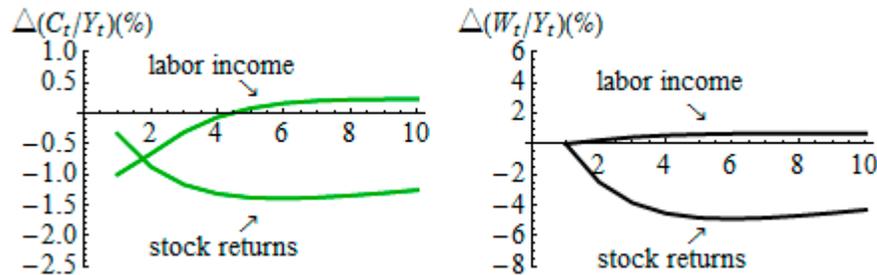
- Panel I shows the responses of consumption to a permanent decline in net wealth, which in turn would include the effect of other shocks on wealth itself. Consumption declines sharply at impact, and then rises gradually as higher saving rebuilds wealth. Consumption and wealth accumulation have both been adjusted down in response to the negative wealth shock, and it takes a long time to rebuild the lost wealth—less than one third of the lost wealth is regained 10 years after the shock.
- Panel II shows the effects of higher volatility of stock returns and of the transitory component of labor income. These volatility shocks decline gradually, as described in Figure 7 that discusses the effects of higher volatility of stock returns. Higher investment risk lowers consumption largely as the portfolio reallocation lowers the rate of return on overall wealth. Higher labor income risk strengthens the motive for precautionary saving, leading agents to reduce consumption sharply at impact. Wealth increases gradually as the buffer-stock wealth gets accumulated, eventually reducing the need for precautionary saving and increasing consumption.
- Panel III shows the effects of a lower labor income growth. Faced with a reduction in the expected present discounted value of labor income, agents reduce consumption immediately. The consequent gradual accumulation of wealth, however, leads to a fairly rapid recovery in the consumption rate.
- Panel IV shows the effects of a tightening in credit constraint. These simulations are based on a slightly modified model in which bonds are the only means of investment and borrowing, the minimum labor income is not zero but 55 percent of expected regular income, and agents are able to borrow up to the value of the minimum income. A tighter credit constraint is simulated by assuming that agents cannot borrow at all. (We use a modified model for this simulation to avoid a levered investment in stocks, which seems of limited relevance, while also reducing dramatically the effect of credit tightening on consumption.) The effects of a tighter credit constraint fall primarily on the young, who reduce consumption and increase saving to accumulate buffer-stock wealth. In the aggregate, the consumption rate declines by 2½ percent on impact. However, the effect on consumption rate quickly diminishes to a negative half percent, as household wealth increases owing to the forced deleveraging and precautionary saving. (In the background, the debt-to-income ratio declines by 2¼

percentage points, comparable to the 3 percentage point increase in the ratio of the consumer credit to disposable personal income from the 1995–99 to 2003–07 period.)

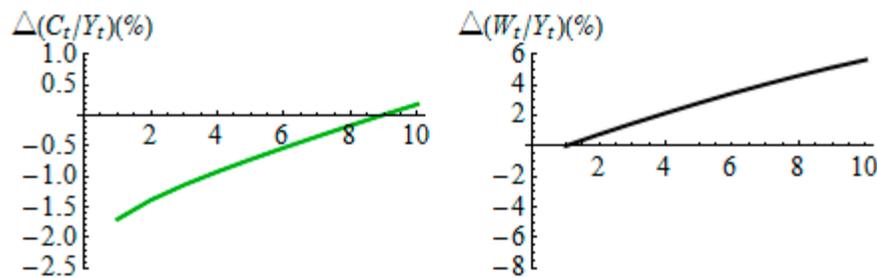
Panel I. Wealth shock (dashed line with a half shock)



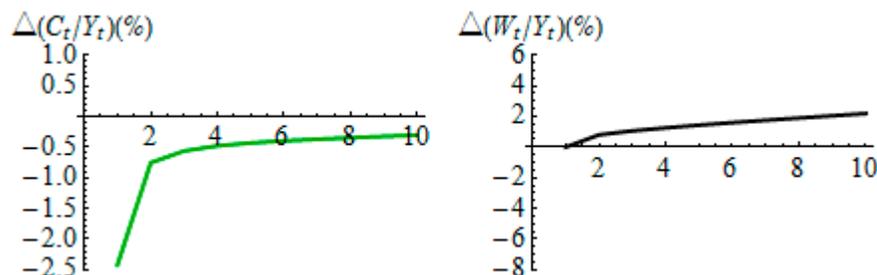
Panel II. Increase in volatility in labor income and stock returns



Panel III. Lower expected growth in labor income



Panel IV. Tighter credit



ANNEX: Household Optimization Problem

The optimization problem for a household at age t , where $t = 1$ corresponds to age 22 which is the first year of labor income, can be written as follows:

$$V_t(X_t, P_t) = \max_{\{C_t, B_{t+1}, S_{t+1}\}} \left\{ \frac{C_t^{1-\rho}}{1-\rho} + \beta E_t [Y_{t+1} V_{t+1}(X_{t+1}, P_{t+1})] \right\}$$

subject to:

$$\begin{aligned} X_t &= C_t + B_{t+1} + S_{t+1} \\ W_{t+1} &= RB_{t+1} + (R + \mu + \eta_{t+1})S_{t+1} \\ X_{t+1} &= W_{t+1} + Y_{t+1} \\ Y_{t+1} &= P_{t+1} \Theta_{t+1} \\ P_{t+1} &= G_{t+1} P_t \Psi_{t+1} \\ S_{t+1} &\geq 0 \end{aligned}$$

If $W_t - C_t \leq 0$ then $S_{t+1} = 0$, otherwise $S_{t+1} \leq W_t - C_t$

Variable definitions are as follows:

X_t is current cash on hand, including financial wealth W_t and labor income Y_t ;
 B_{t+1} and S_{t+1} are respectively bond and stock holdings at time $t+1$ (chosen at time t);
 R is the riskless interest rate, μ is the average equity premium, and η_{t+1} is a $N(0, \sigma_\eta^2)$ random variable; P_{t+1} is permanent labor income which grows deterministically at rate G_{t+1} and is subject to permanent shocks Ψ_{t+1} (lognormally distributed with mean 1 and variance σ_Ψ^2);
 Θ_{t+1} are mean 1 transitory shocks to labor income, including also a zero-income unemployment risk; and Y_{t+1} is the survival probability.

We normalize the problem by labor income and solve it by iterating backward on the first order conditions. The parameter values are based primarily on Cagetti (2003) and Cocco and others (2005). The temporary shocks to volatility were simulated by the method of Bloom and others (2009).