Limited Asset Market Participation and State-Dependent Effects of Monetary Policy and Government Spending Shocks

Hikaru Saijo*
University of California, Santa Cruz

July 15, 2014

Abstract

Using micro data from the Consumer Expenditure Survey, I document that households' consumption and labor supply responses to monetary policy and government spending shocks are considerably different depending on whether they hold assets or not. Motivated by this evidence, I construct a New Keynesian model with limited asset market participation and heterogeneous preferences. In the model, the sensitivity of economic activities to real interest rate movements is procyclical. As a result, the aggregate effects of policy shocks are state-dependent: the effects of monetary policy shocks are stronger during booms than during recessions and the effects of government spending shocks are stronger during recessions than during booms.

*Acknowledgement to be added. *E-mail*: hsaijo@ucsc.edu.

1 Introduction

How much do shocks to monetary policy or government spending stimulate output and other real economic activities? It is well known that the sensitivity of economic activities to changes in real interest rates are critical to the analysis of the effects of policy shocks (see, for example, Hall 1977). The more sensitive the economic activity, the stronger are the effects of monetary policy shocks and the weaker are the effects of government policy shocks. I argue that, since the economy's sensitivity to interest rate movements is procyclical, the effects of monetary policy shocks are stronger during booms than during recessions and the effects of government spending shocks are stronger during recessions than during booms. I reach this conclusion by constructing a dynamic stochastic general equilibrium (DSGE) model that can replicate micro evidence.

Using detailed household-level data from the Consumer Expenditure Survey (CEX), I document that impulse responses to monetary policy and government spending shocks are considerably different depending on their asset holding status. I focus on the distinction between households who hold stock or bonds (asset holders) and households who do not (non-asset holders) because theory suggests that it is potentially important. In standard models, monetary policy affects aggregate demand through household's Euler equations, which apply only for those who hold assets. The consumption effect of government spending depends crucially on whether agents hold assets or not (Galí et al. 2007).

In the CEX data, asset holders increase their consumption and hours in response to an expansionary monetary policy shock but non-asset holders do not. In response to an increase in government spending, non-asset holders reduce their consumption less than asset holders. Also, non-asset holders increase their hours more than asset holders.

To understand the aggregate implications of these household-level heterogeneities, I construct a New Keynesian DSGE Model with two additional features. First, only a subset of households participate in the asset market (limited asset market participation). Second, households who participate in the asset market have higher intertemporal elasticity of substitution (IES) than households who do not (heterogeneous preferences).

In the model, asset holders respond more strongly to real interest rate movements than non-asset holders. As a result, the model can generate impulse responses to policy shocks that are in line with the CEX data. The model also predicts that, at the aggregate level, the effects of monetary policy shocks are stronger during booms than during recessions and the effects of government spending shocks are stronger during recessions. During booms, asset holders' consumption and hours increase more than those of non-asset holders. Hence, their share in aggregate consumption and hours become larger and thus the economy becomes more sensitive to real interest rate movements. This compositional effect non-negligible and is magnified through general equilibrium effects, leading to sizable state-dependent impulse responses.

1.1 Related Literature

This paper is related to a burgeoning literature on state-dependent macroeconomic policy effects. Empirically, using a smooth-transition vector-autoregression model on aggregate data, Auerbach and Gorodnichenko (2012) find that government spending shocks have stronger output effects during recessions than during booms.[1] Furthermore, Tenreyro and Thwaites (2013) find that the effect of monetary policy shocks is weaker during recessions. These empirical findings are consistent with my model's predictions. Several authors, however, question Auerbach and Gorodnichenko (2012)'s findings.[2] This paper contributes to the debate by providing evidence based on micro-level data and a structural model. Theoretically, Berger and Vavra (2012), Michaillat (2014), Sims and Wolff (2013), and Vavra (forthcoming) propose models that generates state-dependent policy effects. My contribution is to account for the state-dependent effects on both monetary policy and government spending shocks through a novel channel (procyclical sensitivity to real interest movements due to limited asset market participation).

Anderson et al. (2013) and Giorgi and Gambetti (2012) use CEX data to study the consumption response to government spending shocks across households and find that they are in line with the predictions of a New Keynesian model with limited asset market participation. I extend their empirical analysis in two respects. First, I investigate the responses not only to government spending shocks but also to monetary policy shocks. Second, in addition to consumption, I examine the labor supply responses. The second point is especially important because labor supply is crucial to understanding business cycles.

Several papers incorporate the idea of limited asset market participation into macroeconomic models. Galí et al. (2007) embed the feature into a New Keynesian model to account for the consumption response to a government spending shock. Guvenen (2009) shows that a model with limited stock market participation and preference heterogeneity can solve various asset pricing puzzles. To my knowledge, however, no paper has explored the implications for state-dependent policy effects.

2 Heterogeneous Responses to Monetary Policy and Government Spending Shocks

The section provides empirical evidence that household responses to policy shocks are considerably different depending on their asset holding status. After describing the Consumer Expenditure Survey, I estimate household-level consumption and hours responses to monetary policy and government spending shocks.

[1]See Bachmann and Sims (2012) for a related finding.

[2]See, for example, Owyang et al. (2013) and Ramey and Zubairy (2014).

2.1 The Consumer Expenditure Survey

The Consumer Expenditure Survey (CEX) consists of two surveys, the Quarterly Interview Survey and the Diary Survey. The survey is collected by the Bureau of Labor Statistics (BLS) and provide information on household expenditures, income, and characteristics. Because the CEX data is available at quarterly frequency, it is ideal for studying household responses to policy shocks. The survey also covers broad categories of consumption expenditures.

I use the Interview portion of the survey available for download at the website of Inter-university Consortium for Political and Social Research, University of Michigan. In the survey, each household is interviewed 5 times over the 15-months period. The initial interview collects demographic and family information. The second through fifth interviews collect expenditure information over the past 3 months. Financial information is asked only in the fifth interview.

I construct psuedo-panel by averaging household variables identified by their asset holding status. Households are asked about their amounts in "Checking accounts, brokerage accounts and other similar accounts", "Savings accounts at banks, savings and loans, credit unions, etc", "Stocks, bonds, mutual funds and other such securities", and "U.S. savings bonds". As is evident from the categories above, it is not possible to separately identify stock holders and bond holders. In the baseline analysis, I classify households with positive responses to "Stocks, bonds, mutual funds and other such securities" and "U.S. savings bonds" as asset holders and others as non-asset holders. Later I will investigate the robustness by checking different categorizations.

I define consumption as expenditures on non-durables and services.[3] I then divide it by CPI and family size to convert it into the real per-capita value. CEX collects information on hours worked per week by head and by spouse. It also collects number of weeks worked full or part time in the last 12 months by head and by spouse. I extract the estimates of number of weeks worked per quarter using a Kalman filter. Total hours worked per quarter is obtained by summing the products of hours worked per week and the estimates of number of weeks worked per quarter both by head and by spouse.

The sample period of the consumption data spans from 1984Q1–2008Q4 and the hours data spans from 1980Q1–2008Q4. The starting date is determined by the availability of the CEX data and the end date is determined by the monetary policy shock and government spending shock data. Although it is possible to find the consumption data back to 1980Q1, concerns regarding data quality and consistency forced me to use data starting at 1984Q1 (see Anderson et al. 2013).

Table 1 gives the mean number of observations per quarter for several household groups, along with the standard deviations of their log quarterly consumption and hours growth. First, the percentage of asset holders in the CEX is 25%. As discussed in Vissing-Jørgensen (2002a), the percentage of asset holders are smaller than in other sources. This may be because households

[3]My consumption measure include expenditures on food, alcoholic beverages, utilities, fuels, public services, household operations, apparel, gasoline and motor oil, public transportation, entertainment, personal care, reading, and tobacco.

who hold stock or bonds through their pension plan do not report them. While this would lead them to be mis-categorized as non-asset holders, the mis-categorization should bias against finding differences between asset holders and non-asset holders. Second, standard deviations of both log consumption and hours growth are higher for asset holders than for non-asset holders.[4]

2.2 Measuring Responses to Monetary Policy Shocks

I use the monetary policy shocks series constructed in Coibion et al. (2012), where they extend the original series due to Romer and Romer (2004) (RR henceforth).[5] RR extracted changes in federal funds rate that are not due to the federal reserve's endogenous response to economic conditions.

To measure consumption and hours response to the RR monetary policy shock, I follow Cochrane and Piazzesi (2002) and estimate

$$\Delta x_t = a + \sum_{j=1}^{J} c_j S_{t-j} + e_t$$

where x is the variable of interest and S is the monetary policy shock. I set $J = 20$. Impulse responses (in levels) can be simply obtained by cumulating coefficients on the technology growth (the c_j's).

Figure 1 reports the consumption response to a one-standard-deviation expansionary monetary policy shock. After the shock, asset holders increase their consumption. Non-asset holders' consumption response is not statistically different from zero in the short run. Figure 2 shows the hours response. The shock increases asset holders' hours but it reduces non-asset holders' hours.

2.3 Measuring Responses to Government Spending Shocks

Following Ramey (2011), I identify government spending shocks based on the Survey of Professional Forecasters (SPF) data. The SPF government spending shock is an innovation to the forecasts of real federal spending growth. As described in Ramey (2011), the advantage of this measure is that it takes into account the fact that many changes in government spending is anticipated in advance.

To measure the response to the SPF shock, I estimate the following structural VAR:

$$Y_t = A(L)Y_{t-1} + U_t$$

where Y_t is a vector containing SPF spending growth (from period t to $t+4$), log real per capita government spending, and the variable of interest (in that order). L is the lag operator and U_t is

[4] Mankiw and Zeldes (1991) first pointed out the observation that consumption growth volatility is higher for asset holders.

[5] I am grateful to Yuriy Gorodnichenko for sharing the data.

a vector of recursively identified shocks. I set the lag length to 4 and introduce linear-quadratic time trend.

Figure 3 shows that, in response to a positive SPF government spending shock, asset holders sharply reduce their consumption. Non-asset holders also slightly reduce their consumption but the response is not statistically significant at most horizons. In Figure 4, asset holders' hours are slightly lower than non-asset holders. However, since the difference is not statistically significant, it is not possible to make a definitive claim.

3 The Model

To explore the aggregate implications of the micro-level heterogeneity found in the previous section, I construct a New Keynesian DSGE Model with two additional features. First, only a subset of households participate in the asset market (limited asset market participation). Second, households who participate in the asset market have higher IES than households who do not (heterogeneous preferences).

In the model, I assume that the participation in the asset market is exogenous and constant. For my purpose, this is a reasonable assumption. First, exogenous participation can be thought of a simplification of a model where households pay one-time or per-period participation costs (Vissing-Jørgensen 2002b). Second, throughout the postwar period until the 1990s, the asset market participation rate has been relatively stable (Poterba and Samwick 1995).[6]

The economy consists of two types of households, a final-goods sector, an intermediate-goods sector, and the government. I start by describing the household side.

3.1 Asset Holders

There is a continuum of households, indexed by $i \in [0,1]$. A fraction $(1-\chi)$ of households have access to stock and bond markets. I refer to them as asset holders (and hence the subscript a). In each period, asset holders chooses consumption C_t^a, hours worked H_t^a, share holdings S_t^a, and bond holdings B_t^a to maximize utility:

$$V_t^a = \max_{\{C_t^a, H_t^a, S_t^a, B_t^a\}} \left[\frac{(C_t^a)^{1-\psi^a}}{1-\psi^a} - \nu^a \frac{(H_t^a)^{1+\eta^a}}{1+\eta^a} + \beta \left\{ E_t \left[(V_{t+1}^a)^{1-\gamma^a} \right] \right\}^{\frac{1}{1-\gamma^a}} \right],$$

where β is the discount factor. I adopt the Epstein and Zin (1989) preference extended by Rudebusch and Swanson (2012). The advantage of Rudebusch and Swanson (2012)'s specification is that it more easily accommodates utility kernels with general functional forms that include labor. $1/\psi^a$ is the IES for consumption, ν^a is the scaling parameter that controls the level of labor supply,

[6]In contrast, according to Investment Company Institute (2008), the participation rate rose during the 1990s but has tapered off since 2001.

and $1/\eta^a$ is the Frisch elasticity of labor supply. γ^a controls the degree of relative risk aversion. Note that the preference reduces to the standard expected utility specification when $\gamma^a = 0$.

The asset holder's budget constraint is

$$P_t C_t^a + P_t^E S_t^a + B_t^a \leq W_t H_t^a + (D_t + P_t^E) S_{t-1}^a + R_{t-1} B_{t-1}^a + T_t^a,$$

where P_t is the price of consumption goods, P_t^E is the price of one-unit of share, D_t is the dividends payed per share, W_t is the nominal wage, R_{t-1} is the gross nominal interest rate on risk-free bond from period $t-1$ to t, and T_t^a is a transfer.

3.2 Non-Asset Holders

A fraction χ of households do not have access to stock and bond markets and I refer to them as non-asset holders (and hence the subscript n). In each period, non-asset holders chooses consumption C_t^n and hours worked H_t^n to maximize utility:

$$V_t^n = \max_{\{C_t^n, H_t^n\}} \left[\frac{(C_t^n)^{1-\psi^n}}{1-\psi^n} - \nu^n \frac{(H_t^n)^{1+\eta^n}}{1+\eta^n} + \beta \left\{ E_t \left[(V_{t+1}^n)^{1-\gamma^n} \right] \right\}^{\frac{1}{1-\gamma^n}} \right],$$

where β is the discount factor, $1/\psi^n$ is the IES for consumption, ν^n is the scaling parameter that controls the level of labor supply, $1/\eta^n$ is the Frisch elasticity of labor supply, and γ^n controls the degree of relative risk aversion.

Their budget constraint is

$$P_t C_t^n \leq W_t H_t^n + T_t^n,$$

where T_t^n is a transfer.

3.3 The Final-Goods Sector

In each period t, the final goods, Y_t, are produced by a perfectly competitive representative firm that combines a continuum of intermediate goods, indexed by $j \in [0, 1]$, with technology

$$Y_t = \left[\int_0^1 Y_{j,t}^{\frac{\theta-1}{\theta}} dj \right]^{\frac{\theta}{\theta-1}}.$$

$Y_{j,t}$ denotes the time t input of intermediate good j and θ controls the price elasticity of demand for each intermediate good. The demand function for good j is

$$Y_{j,t} = \left(\frac{P_{j,t}}{P_t} \right)^{-\theta} Y_t,$$

where P_t and $P_{j,t}$ denote the price of the final good and intermediate good j, respectively. Finally, P_t is related to $P_{j,t}$ via the relationship

$$P_t = \left[\int_0^1 P_{j,t}^{1-\theta} dj \right]^{\frac{1}{1-\theta}}.$$

3.4 The Intermediate-Goods Sector

In each period t, each intermediate-goods firm j chooses price $P_{j,t}$, labor input $H_{j,t}$, capital holdings $K_{j,t}$, investment $I_{j,t}$, and output $Y_{j,t}$ to maximize the discounted sum of dividends using the asset holders' stochastic discount factor λ^a:

$$\max E_t \sum_{s=0}^{\infty} \lambda_{t+s}^a \left[\frac{D_{j,t+s}}{P_{t+s}} \right],$$

subject to the production function

$$z_t K_{j,t-1}^{\alpha} H_{j,t}^{1-\alpha} \geq Y_{j,t},$$

and the capital accumulation equation

$$K_{j,t} = (1-\delta_t) K_{j,t-1} + I_{j,t} - \frac{\phi_K}{2} \left(\frac{I_{j,t}}{K_{j,t-1}} - \delta \right)^2 K_{j,t-1}.$$

where z_t is a technology shock that follows

$$\ln z_t = (1-\rho_z) \ln \bar{z} + \rho_z \ln z_{t-1} + \epsilon_{z,t},$$

where $\epsilon_{z,t}$ is i.i.d. distributed from a normal distribution with mean zero and variance σ_z^2 and δ_t is a depreciation shock that follows

$$\ln \delta_t = (1-\rho_\delta) \ln \bar{\delta} + \rho_\delta \ln \delta_{t-1} + \epsilon_{\delta,t},$$

where $\epsilon_{\delta,t}$ is i.i.d. distributed from a normal distribution with mean zero and variance σ_δ^2. ϕ_K controls the size of the investment adjustment cost.

Dividends in period t is given by

$$\frac{D_{j,t}}{P_t} = \frac{P_{j,t} Y_{j,t}}{P_t} - \frac{W_t}{P_t} H_{j,t} - I_{j,t} - \frac{\phi_P}{2} \left(\frac{P_{j,t}}{\pi P_{j,t-1}} - 1 \right)^2 Y_t,$$

where ϕ_P controls the size of the price adjustment cost and π is the steady-state inflation rate. I focus on a symmetric equilibrium where all intermediate-goods firms choose the same price, inputs, and production: $P_{j,t} = P_t, H_{j,t} = H_t, K_{j,t} = K_{j,t}, I_{j,t} = I_t$, and $Y_{j,t} = Y_t$.

3.5 Monetary Policy and the Resource Constraint

The central bank follows a Taylor-type interest rate rule:

$$\frac{R_t}{R} = \left(\frac{R_{t-1}}{R}\right)^{\rho_R} \left\{ \left(\frac{\pi_t}{\pi}\right)^{\phi_\pi} \left(\frac{Y_t}{Y_{t-1}}\right)^{\phi_Y} \right\}^{1-\rho_R} \exp(\epsilon_{R,t}),$$

where R is the steady-state level of the nominal interest rate, ρ_R is the persistence of the rule, and ϕ_π and ϕ_Y are the size of the policy response to the deviation of inflation and output growth from their steady states, respectively. $\epsilon_{R,t}$ is a monetary policy shock and is i.i.d. distributed from a normal distribution with mean zero and variance σ_R^2.

The resource constraint is given by

$$C_t + I_t + G_t + \frac{\phi_P}{2}\left(\frac{\pi_t}{\pi} - 1\right)^2 Y_t = Y_t,$$

where $C_t = (1-\chi)C_t^a + \chi C_t^n$ and G_t is the amount of government spending. The share of government spending to output, $g_t = G_t/Y_t$, follows

$$\ln g_t = (1-\rho_g)\ln \bar{g} + \rho_g \ln g_{t-1} + \epsilon_{g,t},$$

where $\epsilon_{g,t}$ is i.i.d. distributed from a normal distribution with mean zero and variance σ_g^2. The government spending is satisfied period-by-period so that $T_t^a = T_t^n = -G_t$.

4 Results (Preliminary)

In this section, I present the simulation results from the model. I do so in two steps. First, I show that the model can replicate some salient features of the business cycle as well as micro evidence presented in the previous section. Second, I show that the model implies state-dependent effects of monetary policy and government spending shocks.

I solve the model using a third-order perturbation method around its deterministic steady state.[7] I use perturbation because the model has many state variables and it is the only method that delivers an accurate solution in a reasonable amount of time (Aruoba et al. 2006). Higher-order solution is necessary because in addition to computing a model with recursive preferences (Caldara et al. 2012), my goal is to examine the non-linear effects of policy shocks. Linear approximation, by construction, eliminates any kind of state dependence in impulse responses.

[7] The computation is carried out with Dynare (http://www.dynare.org/).

Table 2 presents the baseline parameterization. At this stage, the calibration is still preliminary so the results should be understood as a rough illustration of the quantitative properties of the model. I set the IES for the asset holders and non-asset holders to 0.9 and 0.1, respectively. The values are in line with the estimates by Vissing-Jørgensen (2002a). The asset market participation rate is set to 0.5, which roughly corresponds to the participation rate during the 1990s found in Investment Company Institute (2008).

Figure 5 reports the impulse responses to a one-standard-deviation expansionary monetary policy shock. A surprise reduction in the nominal interest rate stimulates aggregate demand and raises output, consumption, hours, and investment. An increase in real wages reduces non-asset holders' hours because the income effect dominates the intratemporal substitution effect. In contrast, asset hours increase their hours due to the intertemporal substitution effect. The hours responses are in line with the CEX data. The non-asset holders increase consumption more than asset holders, which is at odds with the CEX data. This is due to the lack of consumption smoothing device by non-asset holders. A preliminary investigation suggests that incorporating home production into the model can fix this problem. Finally, because the model lacks key rigidities such as sticky wages, the real effect of a monetary policy shock is short-lived (Christiano et al. 2005).

Figure 6 gives the impulse responses to a one-standard-deviation positive government spending shock. An increase in government spending triggers a negative income effect which increases the labor supply. The net effect is weaker for asset holders because the intertemporal substitution effect counteracts the income effect. Thus, non-asset holders increase their hours more than the asset holders. An increase in government spending also raises inflation. Since the central bank is following a standard Taylor rule, the nominal interest rate increases more than inflation, leading to an increase in the real interest rate. Because the increase in the real interest rate directly induces asset holders to postpone their consumption, their consumption falls more than non-asset holders' consumption. These consumption and hours responses are consistent with the CEX data.

I now show that the model generates important non-linearities regarding the effects of monetary policy and government spending shocks. Table 3 gives the output effects of policy shocks during recessions compared to those during booms. In practice, the magnitude of the effects also depend on which shocks are driving recessions (Sims and Wolff 2013). Thus, I report the results by simulating recessions and booms driven by technology shocks (the first column) and depreciation shocks (the second column). I set the size of the shocks so that output declines and increases about six percentage points from the ergodic steady state during recessions and booms. To compare output effects over the business cycle, I divide the maximum impact on output during recessions by that during booms.[8] Regardless of which shocks are driving fluctuations, the output effects of monetary policy shocks are stronger during booms and the output effects of government spending

[8]Since the model is relatively simple, the output responses to policy shocks are monotonic. Hence, the period of maximum impact turns out to be the period when the policy shock hits.

shocks are stronger during recessions.

I argue that the state-dependence results from a variation over the business cycle in asset holders' share in aggregate consumption and hours. To see this, see Figure 7, where I report the asset holders' consumption and hours share in response to a large negative technology shock. The size of the shock is equal to the one used to construct Table 3. In response to a negative technology shock, asset holders' consumption declines more than non-asset holders' because asset holders have higher IES. Asset holders sharply reduce their hours while non-asset holders increase them since the intertemporal substitution effect only affects asset holders' labor supply.[9] As a result, asset holders' consumption and hours share declines and non-asset holders become more important in determining the aggregate responses to policy shocks. It is important to note that since the asset market participation rate is held constant over the simulation, the variation in share is purely driven by heterogeneous responses to the shock. Finally, the share of asset holders' consumption and hours also decline in response to a contractionary depreciation shock (not reported).

As another way to assess the contribution of limited asset market participation and heterogeneous preferences, I report the output effects of policy shocks in a counterfactual model where all households participate in the asset market ($1 - \chi = 1$) in Table 4. Now the output effects of monetary policy and government spending shocks are stronger during technology-shock-driven recessions but weaker during depreciation-shock-driven recessions.

(More results to be added.)

[9]Saijo (2014) shows that this prediction regarding the labor supply response to a technology shock is supported by the CEX data.

References

Anderson, Emily, Atsushi Inoue, and Barbara Rossi, "Heterogenous Consumers and Fiscal Policy Shocks," 2013. Manuscript, Duke University.

Aruoba, S. Borağan, Jesús Fernández-Villaverde, and Juan Rubio-Ramírez, "Comparing Solution Methods for Dynamic Equilibrium Economies," *Journal of Economic Dynamics and Control*, 2006, *30*, 2477–2508.

Auerbach, Alan J. and Yuriy Gorodnichenko, "Measuring the Output Responses to Fiscal Policy," *American Economic Journal: Economic Policy*, 2012, *4*, 1–27.

Bachmann, Rüdiger and Eric R. Sims, "Confidence and the Transmission of Government Spending Shocks," *Journal of Monetary Economics*, 2012, *59*, 235–249.

Berger, David and Joseph Vavra, "Consumption Dynamics During Recessions," 2012. Manuscript, Northwestern University.

Caldara, Dario, Jesús Fernández-Villaverde, Juan Rubio-Ramírez, and Wen Yao, "Computing DSGE Models With Recursive Preferences and Stochastic Volatility," *Review of Economic Dynamics*, 2012, *15*, 188–206.

Christiano, Lawrence J., Martin Eichenbaum, and Charles L. Evans, "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy," *Journal of Political Economy*, 2005, *113*, 1–45.

Cochrane, John and Monika Piazzesi, "The Fed and Interest Rates: A High-Frequency Identification," *American Economic Review*, 2002, *92*, 90–95.

Coibion, Olivier, Yuriy Gorodnichenko, Lorenz Kueng, and John Silvia, "Innocent Bystanders? Monetary Policy and Inequality in the U.S.," 2012. Manuscript, University of California, Berkeley.

Epstein, Larry G. and Stanley E. Zin, "Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: A Theoretical Framework," *Econometrica*, 1989, *57*, 937–969.

Fernández-Villaverde, Jesús, Pablo Guerrón-Quintana, Juan Rubio-Ramírez, and Martin Uribe, "Risk Matters: The Real Effects of Volatility Shocks," *American Economic Review*, 2011, *101*, 2530–2561.

Galí, Jordi, J. David López-Salido, and Javier Vallés, "Understanding the Effects of Government Spending on Consumption," *Journal of the European Economic Association*, 2007, *5*, 227–270.

Giorgi, Giacomo De and Luca Gambetti, "The Effects of Government Spending on the Distribution of Consumption," 2012. Manuscript, Barcelona GSE.

Guvenen, Fatih, "A Parsimonious Macroeconomic Model for Asset Pricing," *Econometrica*, 2009, *77*, 1711–1740.

Hall, Robert E., "Investment, Interest Rates, and the Effects of Stabilization Policies," *Brookings Papers on Economic Activity*, 1977, *8*, 61–121.

Investment Company Institute, "Equity and Bond Ownership in America, 2008," 2008. Available at http://www.ici.org/research/investors.

Mankiw, N. Gregory and Stephen P. Zeldes, "The Consumption of Stockholders and Nonstockholders," *Journal of Financial Economics*, 1991, *29*, 97–112.

Michaillat, Pascal, "A Theory of Countercyclical Government Multiplier," *American Economic Journal: Macroeconomics*, 2014, *6*, 190–217.

Owyang, Michael T., Valerie A. Ramey, and Sarah Zubairy, "Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data," *American Economic Review: Papers and Proceedings*, 2013, *103*, 129–134.

Poterba, James M. and Andrew A. Samwick, "Stock Ownership Patterns, Stock Market Fluctuations, and Consumption," *Brookings Papers on Economic Activity*, 1995, *1995*, 295–372.

Ramey, Valerie A., "Identifying Government Spending Shocks: It's all in the Timing," *Quarterly Journal of Economics*, 2011, *126*, 1–50.

_ **and Sarah Zubairy**, "Government Spending Multipliers in Good Times and in Bad: Evidence from U.S. Historical Data," 2014. Manuscript, UC San Diego.

Romer, Christina D. and David H. Romer, "A New Measure of Monetary Shocks: Derivation and Implications," *American Economic Review*, 2004, *94*, 1055–1084.

Rudebusch, Glenn D. and Eric T. Swanson, "The Bond Premium in a DSGE Model with Long-Run Real and Nominal Risks," *American Economic Journal: Macroeconomics*, 2012, *4*, 105–143.

Saijo, Hikaru, "Technology Shocks and Hours Revisited: A Supply Side Interpretation," 2014. In preparation.

Sims, Eric and Jonathan Wolff, "The Output and Welfare Effects of Fiscal Shocks over the Business Cycle," 2013. Manuscript, University of Notre Dame.

Tenreyro, Silvana and Gregory Thwaites, "Pushing On a String: US Monetary Policy is Less Powerful in Recessions," 2013. Manuscript, London School of Economics.

Vavra, Joseph, "Inflation Dynamics and Time-Varying Volatility: New Evidence and an Ss Interpretation," *Quarterly Journal of Economics*, forthcoming.

Vissing-Jørgensen, Annette, "Limited Asset Market Participation and the Elasticity of Intertemporal Substitution," *Journal of Political Economy*, 2002, *110*, 825–853.

_ , "Towards an Explanation of Household Portfolio Choice Heterogeneity: Nonfinancial Income and Participation Cost Structures," 2002. NBER Working Paper.

Table 1: Summary statistics

Group	Mean Number of Observations	St. Dev. of Cons. Growth	St. Dev. of Hours Growth
All	4247	0.017	0.032
Asset Holders	1064	0.031	0.056
Non-Asset Holders	3183	0.018	0.038

Table 2: Parameters

	Description	Value
Technology and preference		
β	Discount factor	0.99
θ	Goods demand elasticity	10
α	Capital share	0.35
δ	Depreciation rate	0.02
$1-\chi$	Participation rate	0.5
$(\psi^a)^{-1}$	IES asset holders	0.9
$(\psi^n)^{-1}$	IES non-asset holders	0.1
γ^a	Risk aversion adjustment asset holders	0
γ^n	Risk aversion adjustment non-asset holders	0
$(\eta^a)^{-1}$	Frisch elasticity of labor supply asset holders	1.1
$(\eta^n)^{-1}$	Frisch elasticity of labor supply non-asset holders	1.1
ϕ_K	Investment adjustment cost	5
ϕ_P	Price adjustment cost	50.4
Monetary policy		
π	SS inflation rate	1.01
ρ_R	Taylor rule smoothing	0.5
ϕ_π	Taylor rule inflation	1.5
ϕ_Y	Taylor rule output growth	0.1
Shock process		
ρ_z	Technology	0.95
ρ_δ	Depreciation	0.95
ρ_g	Government spending	0.9
$100\sigma_z$	Technology	0.7
$100\sigma_\delta$	Depreciation	4
$100\sigma_g$	Government spending	0.4
$100\sigma_R$	Monetary policy	0.2

Table 3: The output effects of policy shocks during recessions compared to those during booms

	Recession/Boom (Technology shock)	Recession/Boom (Depreciation shock)
Output increase MP shock	0.884	0.007
Output increase G shock	1.100	1.159

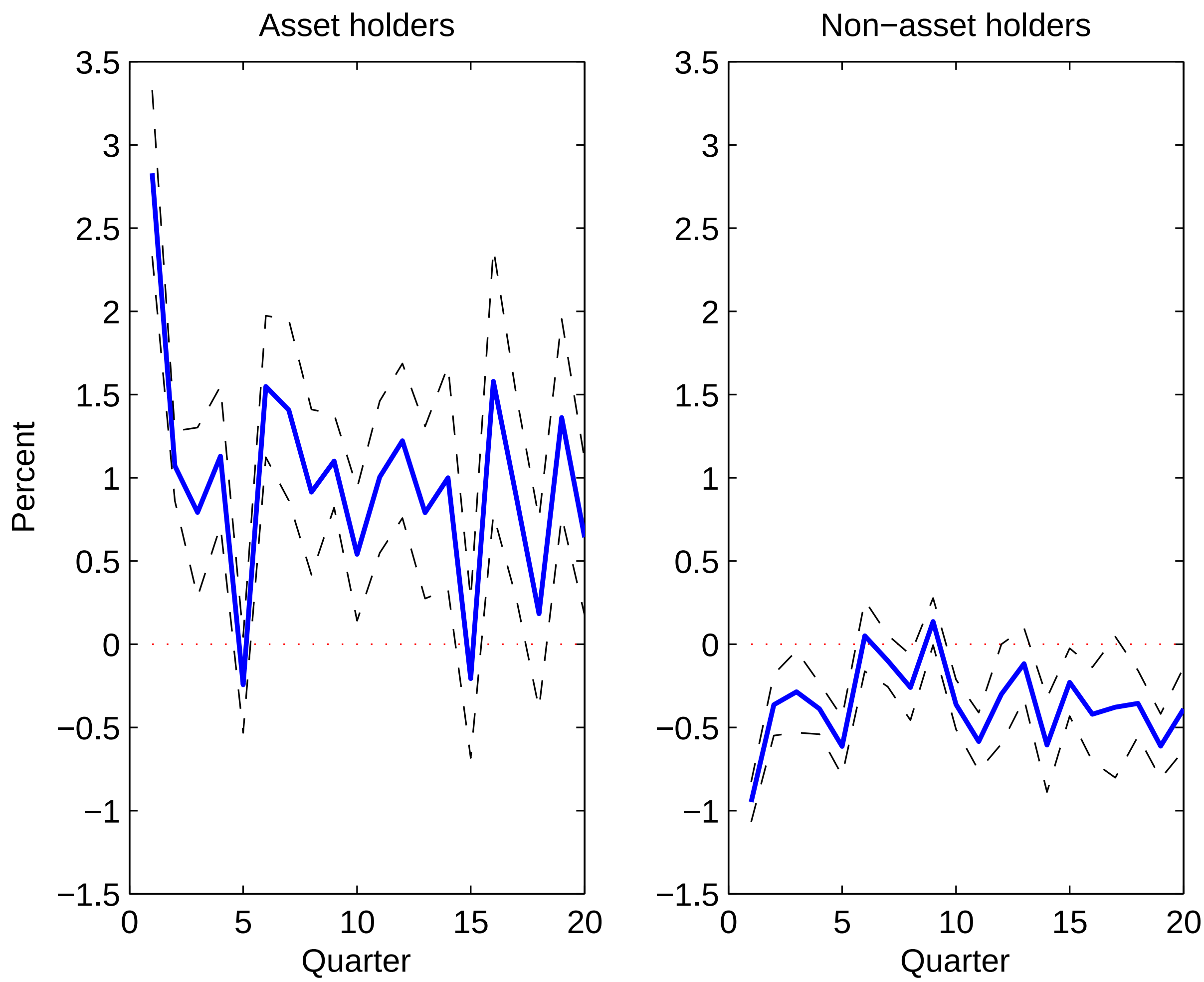
Table 4: The output effects of policy shocks during recessions compared to those during booms: Counterfactual model with $\chi = 0$

	Recession/Boom (Technology shock)	Recession/Boom (Depreciation shock)
Output increase MP shock	1.178	0.280
Output increase G shock	1.112	0.672

Figure 1: Consumption response to a one-standard-deviation expansionary monetary policy shock

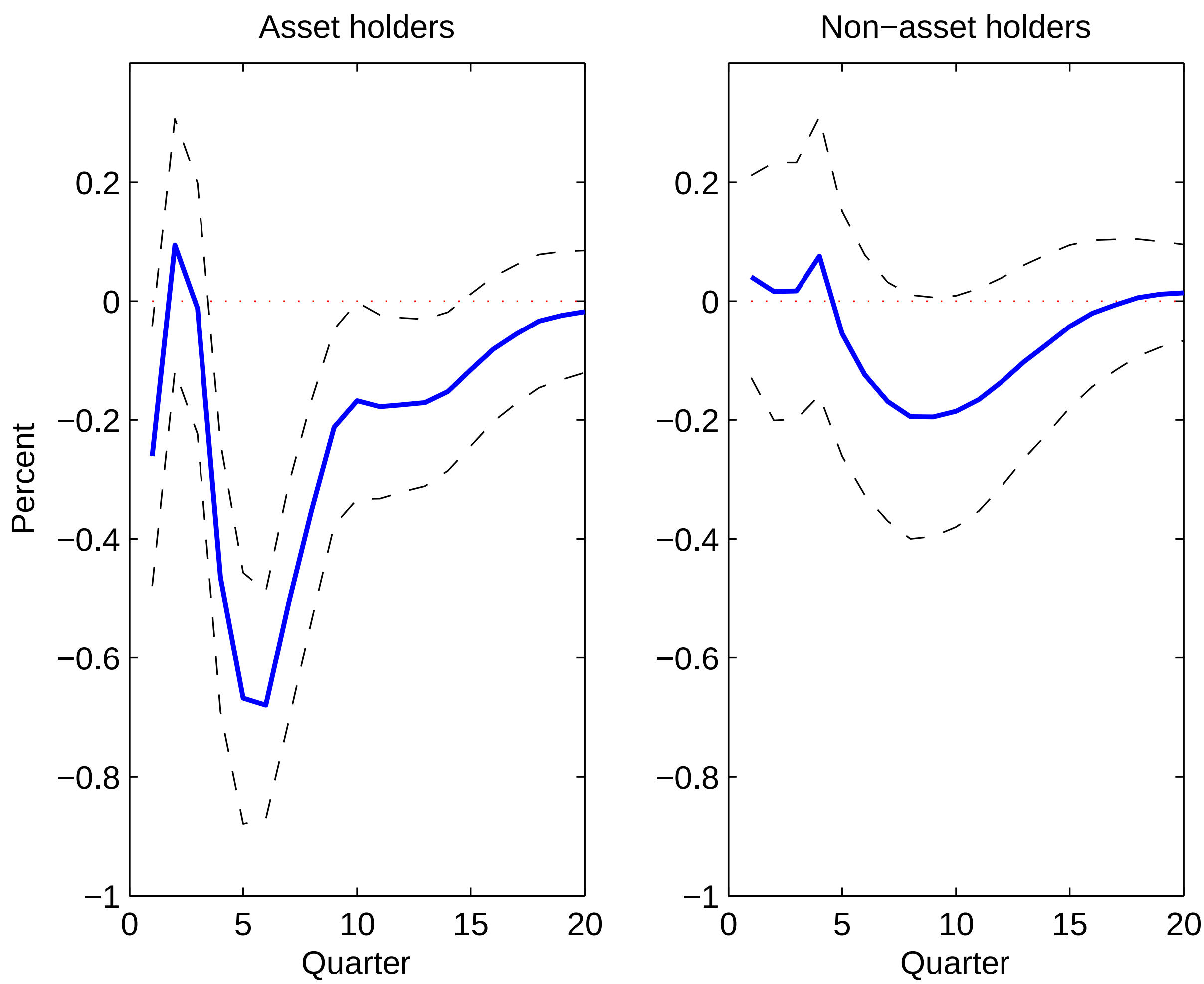
Notes: Impulse responses of the levels of consumption to a one-standard-deviation expansionary monetary policy shock. The dashed lines are one-standard-deviation confidence intervals. The sample period is 1984Q1–2008Q4.

Figure 2: Hours response to a one-standard-deviation expansionary monetary policy shock



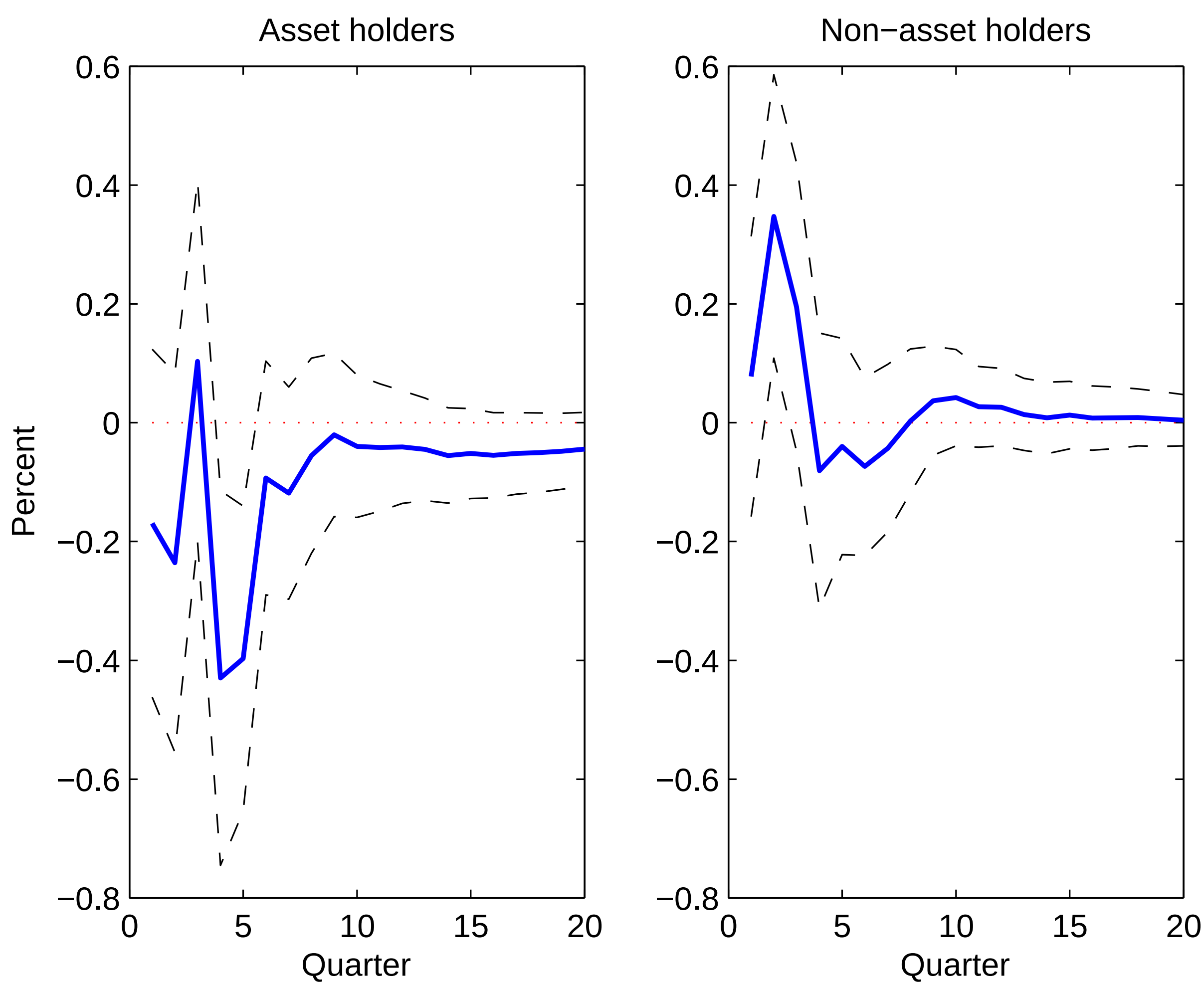
Notes: Impulse responses of the levels of hours to a one-standard-deviation expansionary monetary policy shock. The dashed lines are one-standard-deviation confidence intervals. The sample period is 1980Q1–2008Q4.

Figure 3: Consumption response to a one-standard-deviation increase in SPF government spending shock



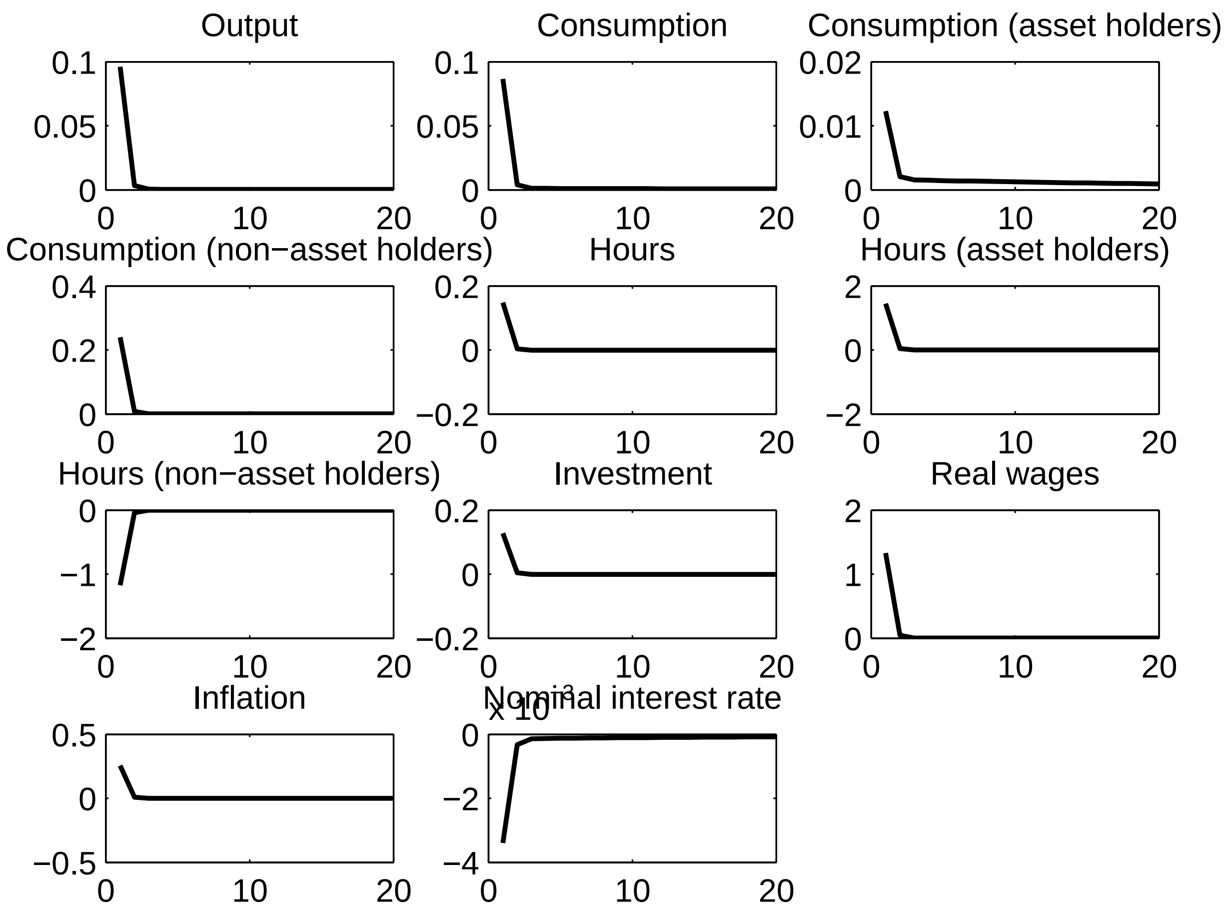
Notes: Impulse responses of the levels of consumption to a one-standard-deviation increase in SPF government spending shock. The dashed lines are one-standard-deviation confidence intervals. The sample period is 1984Q1–2008Q4.

Figure 4: Hours response to a one-standard-deviation increase in SPF government spending shock



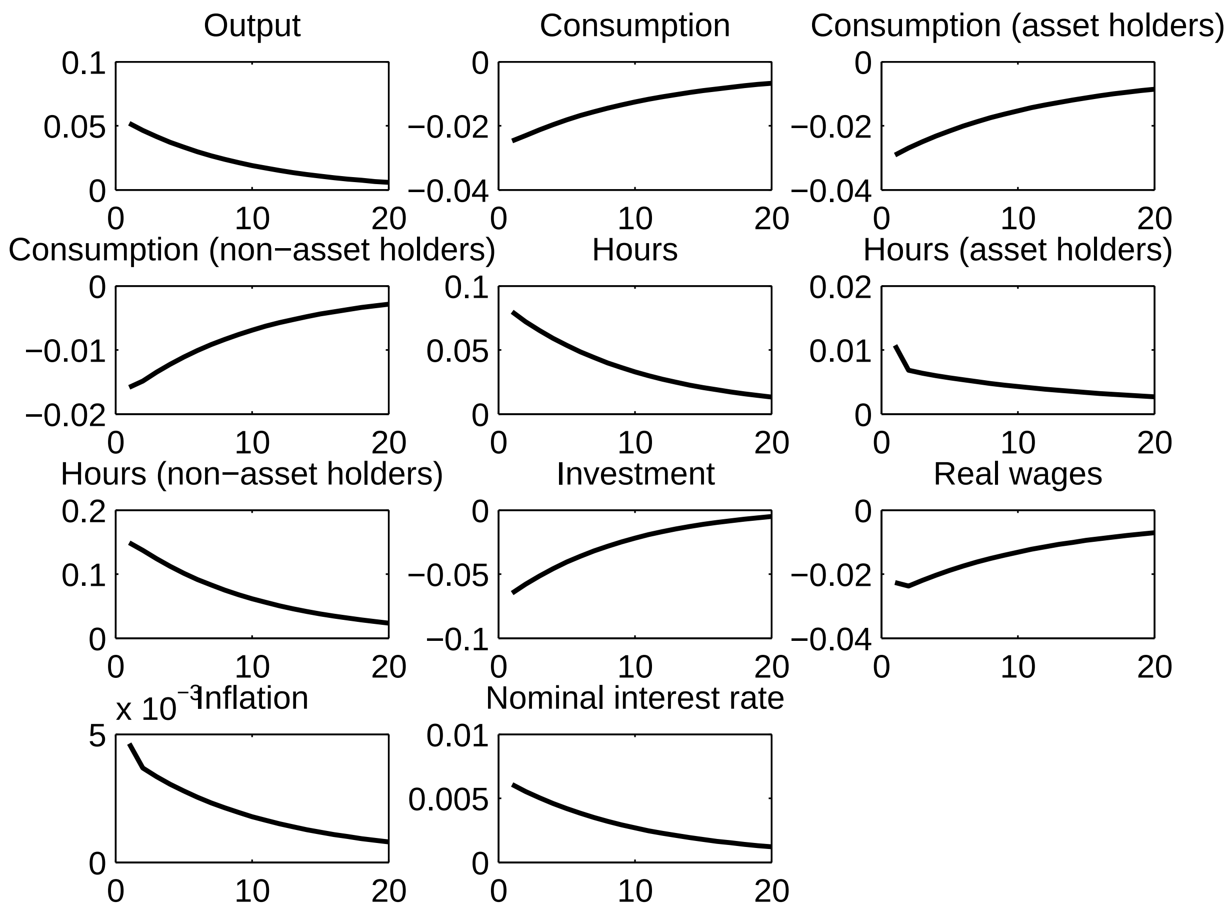
Notes: Impulse responses of the levels of hours to a one-standard-deviation increase in SPF government spending shock. The dashed lines are one-standard-deviation confidence intervals. The sample period is 1980Q1–2008Q4.

Figure 5: Impulse responses to an expansionary monetary policy shock



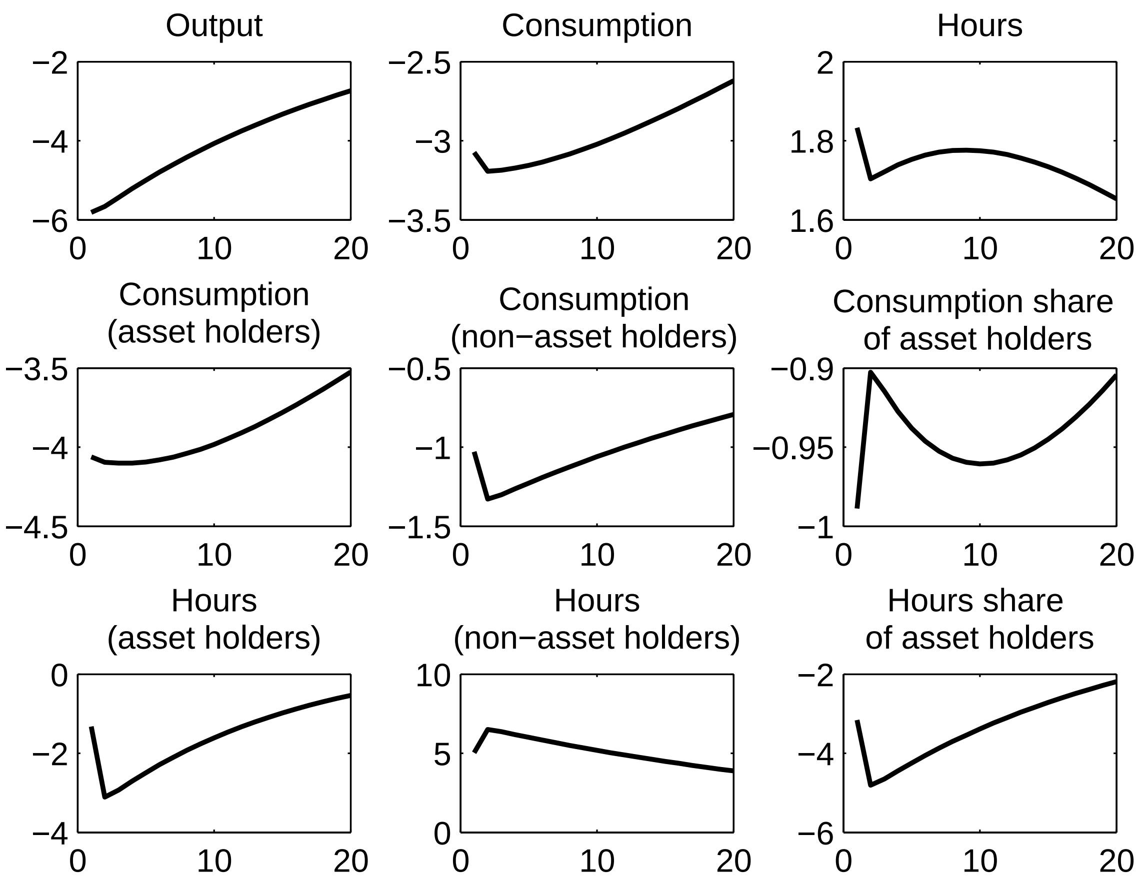
Notes: Since third-order approximations move the ergodic distribution of endogenous variables away from the steady state (Fernández-Villaverde et al. 2011), I report the impulse responses in terms of percent deviation from the ergodic mean.

Figure 6: Impulse responses to a positive government spending shock



Notes: See the notes for Figure 5.

Figure 7: Impulse responses to a large negative technology shock



Notes: See the notes for Figure 5.