“Consumption Dynamics during Recessions”

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Introduction

The paper argues that microeconomic durable frictions lead to sluggish macro responses during recessions.

- Durable adjustment is infrequent. Households are unlikely to adjust their durable holdings during recessions.

Introduction

Durable adjustment is defined by the authors as a self-reported house or vehicle sale together with a 20 percent change in the reported value for the durable stock. The authors justify this definition by saying that

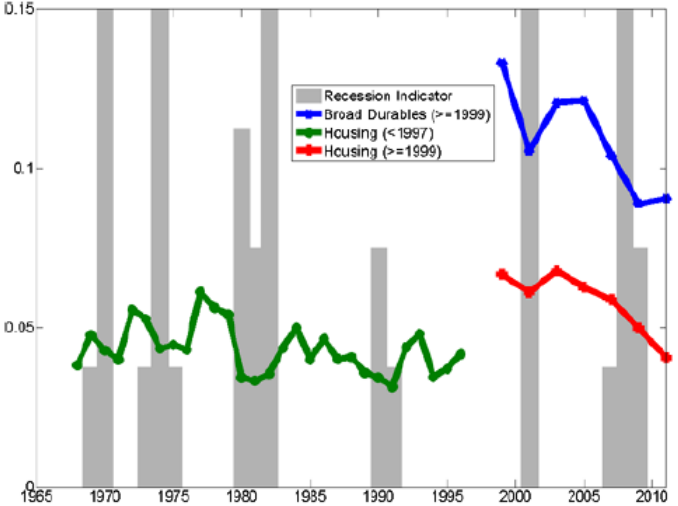
- Combining these is likely to reduce spurious adjustments due to measurement error.
- Some house sales are likely to be the results of idiosyncratic moves across location which may not lead to any substantial adjustment in the size of the stock.
- Self-reported adjustment indicators are taken every 3 years while the sample is taken every 2 years meaning some adjustment may be counted twice.
- The 20 percent threshold is chosen because the median change in reported durable stock conditional on self-reported adjustment is 40 percent while the median is 4 percent conditional on no adjustment.

Introduction

Figure 1 shows the frequency of durable adjustment.

- Data is from PSID.
- Frequencies are annual.
- The figure uses a broad measure of durables beyond 1999. This broad measure includes housing and vehicles.
- Shaded areas indicate periods of recessions.

Introduction



We spilt the sample at 1999 as the PSID survey questions and sampling frequency changed. Broad measures of durable consumption are only available in the latter half of the sample. See Appendix A for details and variable definitions. Recession Indicator is proportional to fraction of year in recession.

FIGURE 1.—Frequency of durable adjustment.

Introduction

Table 4 reports the results for a panel logit regression of the probability of durable adjustment on recession indicators.

Introduction

TABLE IV

EFFECT OF RECESSIONS ON THE PROBABILITY OF DURABLE ADJUSTMENT

Outcome	Sample Period	Odds Ratio	Std. Err.	#Obs	#Households	Age Controls
Sold (Broad d)	1999–2011	0.78***	0.074	5316	1460	NO
	1999–2011	0.84**	0.078	5316	1460	YES
Sold (House)	1969–1999	0.88***	0.035	76,851	8954	NO
	1969–1999	0.85***	0.033	76,851	8954	YES

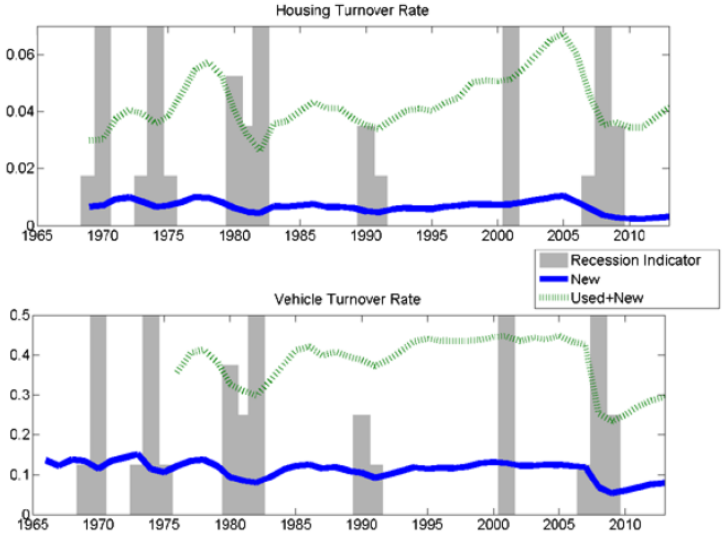
Introduction

- Recessions lead to a decline in the probability of broad durable adjustment and a decline in the probability of of buying/selling a house.
- The authors also find that an increase in state unemployment lowers the probability of broad durable adjustment. (Output not reported.)

Introduction

Figure 2 shows measures of durable sales (housing and vehicles turnover rate) in a year divided by initial stocks.

Introduction



"New" turnover each year is #New Homes (Light Vehicles) Purchased /# Homes (Light Vehicles) at start of year. "New+Existing" turnover adds used sales to the numerator. Sources for Housing Data: HUD and Census. Sources for Auto Data: CNW. Recession Indicator is the fraction of year spent in recession.

Introduction

- Both new and used durable purchases are procyclical.
- Lumpy durable adjustment at the household level causes aggregate durable expenditures to become less responsive to shocks or unanticipated policy changes during recessions.
- Why?

The Model

Baseline model for estimation. Households maximize:

$$\max_{c_t^i, d_t^i, a_t^i} E \sum \beta^t \left(\frac{[(c_t^i)^{\upsilon}(d_t^i)^{1-\upsilon}]^{1-\gamma} - 1}{1-\gamma} \right)$$

subject to the following constraints:

$$\begin{aligned} c_t^i =& wh\eta_t^i(1-\tau) + (1+r)a_{t-1}^i + d_{t-1}^i(1-\delta_d) \\ & - d_t^i - a_t^i - A(d_t^i, d_{t-1}^i) \\ a_t^i \geq & -(1-\theta)d_t^i; d_t^i \geq 0 \\ log\eta_t^i =& \rho_\eta log\eta_{t-1}^i + \varepsilon_t^i \text{ with } \varepsilon_t^i \sim N(0, \sigma_\eta) \end{aligned}$$

The Model

Where

- c is household i's consumption.
- d is durable stock.
- a is liquid assets.
- β is the quarterly discount factor.
- υ is the relative weight on non-durable consumption .
- w is wage.
- r is the interest rate.
- h is a household's fixed hours of work.
- η is a shock to idiosyncratic labor earnings.
- τ is a proportional payroll tax.
- δ_d is the depreciation rate of durables.

The Model

$A(d, d_{-1})$ is the fixed adjustment cost that households face when adjusting their durable stock. It is assumed to take the form

$$A(d, d_{-1}) = \begin{cases} 0 & \text{if } d = [1 - \delta_d(1-\chi)]d_{-1}, \\ F^d(1-\delta_d)d_{-1} + F^t wh\eta_t^i & \text{else.} \end{cases}$$

where χ is a "required maintenance" parameter between 0 and 1.

- χ represents the fact that some maintenance is required to continue enjoying the flows from durable consumption. For example, think of changing the oil of your car every few months.
- If households have to pay a fixed cost of adjustment, then they lose a fixed fraction of the value of their durable stock ($F^d(1-\delta_d)d_{-1}$) and face a time cost for adjusting ($F^t wh\eta_t^i$).

Aside on Dynamic Programming

Suppose you want to solve the following:

$$\max_{\{u_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t r(x_t, u_t)$$

subject to the following constraint:

$$x_{t+1} = g(x_t, u_t)$$

where an initial value x_0 is given, $r(x_t, u_t)$ is concave and the set $\{(x_{t+1}, x_t) | x_{t+1} \leq g(x_t, u_t) \in \mathbb{R}^k\}$ is convex and compact.

Aside on Dynamic Programming

- x_t is a state variable. It describes the state of the system at any point in time.
- u_t is a control variable. It is chosen by the decision maker.
- $x_{t+1} = g(x_t, u_t)$ is the transition equation. It is an inter-temporal constraint that links the state variable with control variables.

Aside on Dynamic Programming

- The goal is to find the optimal policy function $h(x_t)$ that maps the state x_t into the control u_t so that the sequence of controls, $\{u_t\}_{t=0}^{\infty}$, generated by iterating

$$u_t = h(x_t)$$

and

$$x_{t+1} = g(x_t, u_t)$$

starting from the initial condition solves the original problem.

- $h(x_t)$ must be time consistent. As time goes on, there should be no incentive to deviate from the original plan.

Aside on Dynamic Programming

To solve for $h(x_t)$, we need to know the function $V(x)$ that expresses the optimal value of the original problem, starting from any point in time. This function is the value function, given by:

$$V(x_0) = \max_{\{u_t\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t r(x_t, u_t)$$

subject to the following constraint:

$$x_{t+1} = g(x_t, u_t)$$

Aside on Dynamic Programming

- We will not know what this is until we actually solve the model.
- If we knew $V(x_0)$, then $h(x)$ can be computed for each x by solving

$$\max_u \{ r(x,u) + \beta V(\tilde{x}) \}$$

subject to the following constraint:

$$\tilde{x} = g(x,u)$$

and x given.

Aside on Dynamic Programming

So now we must solve for the optimal policy function and the optimal value function. This can be done by solving the following Bellman equation that links the two:

$$V(x) = \max_u \{r(x, u) + \beta V[g(x, u)]\}$$

where the maximizer of this equation solves

$$V(x) = \max_u \{r[x, h(x)] + \beta V[g(x, h(x))]\}$$

Aside on Dynamic Programming

Methods of solving the Bellman equation:

1. Undetermined Coefficients (Guess and Verify): Guess the functional form of the solution and solve for the missing coefficients.
2. Value function iteration: Iterate V starting from $V_0 = 0$ until the sequence of value functions converges.
3. Howard's improvement algorithm: Iterate the policy function.
4. Write a code in MATLAB or some other program. (The paper does this.)

The Model

The infinite horizon problem from the paper can then be recast recursively as

$$V(a_{-1}, d_{-1}, \eta) = max[V^{adjust}(a_{-1}, d_{-1}, \eta), V^{nonadjust}(a_{-1}, d_{-1}, \eta)]$$

where

$$V^{adjust}(a_{-1}, d_{-1}, \eta) = \max_{c,d,a} \frac{(c^{\upsilon} d^{1-\upsilon})^{1-\gamma}}{1-\gamma} + \beta E_{\varepsilon} V(a, d, \eta')$$

s.t.

$$\begin{aligned} c =& wh\eta(1-\tau) + (1+r)a_{-1} + d_{-1}(1-\delta_d) \\ & - d - a - F^d(1-\delta_d)d_{-1} - F^i wh\eta \\ a >& -(1-\theta)d \\ log\eta' =& \rho_\eta log\eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\eta) \end{aligned}$$

The Model

$$V^{nonadjust}(a_{-1}, d_{-1}, \eta) = \max_{c,d,a} \frac{(c^{\upsilon} d^{1-\upsilon})^{1-\gamma}}{1-\gamma} + \beta E_{\varepsilon} V(a, d_{-1}(1-\delta_d(1-\chi)), \eta')$$

s.t.

$$\begin{aligned} c =& wh\eta(1-\tau) + (1+r)a_{-1} - \delta_d \chi d_{-1} - a \\ a >& -(1-\theta)d \\ log\eta' =& \rho_\eta log\eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\eta) \end{aligned}$$

Calibration of Parameters

A subset of parameters in the model are calibrated based to fit the data and are based on "reliable external evidence".

$$
\begin{aligned}
r &= 0.0125 & \beta &= 0.98 \\
\gamma &= 2 & w &= 1 \\
h &= \frac{1}{3} & \tau &= 0.05 \\
\rho_\eta &= 0.975 & \sigma_\eta &= 0.1
\end{aligned}
$$

Calibration of Parameters

The depreciation rate is calibrated to mach data from BEA, weighted by the relative size of the housing and consumer demand shocks.

$$\delta_d = \delta_H^{BEA} \frac{H^{BEA}}{H^{BEA} + CD^{BEA}} + \delta_{CD}^{BEA} \frac{CD^{BEA}}{H^{BEA} + CD^{BEA}} = 0.018$$

Calibration of Parameters

Durables provide direct utility to households and serve as collateral against which households can borrow. Set

$$\theta = 1$$

to prevent households from using durables as collateral.

Calibration of Parameters

Why set $\theta = 1$?

- When $\theta < 1$, and there are no adjustment costs on a, households can costlessly adjust their durable equity.
- If collateral constraint become looser during expansions, this might amplify the results since when down-payments are low, households can quickly adjust their durable holdings in response to shocks.
- Conversely, if down-payments are high, households must save more liquid assets before increasing their durable holdings.

Estimation of Remaining Parameters

The remaining parameters,

- F^d - the proportional fixed cost of adjustment
- F^i - the time cost of adjustment
- υ - the durable weight in utility
- χ - the required maintenance parameter
- σ_ε - the measurement error parameter that allows all variables in the model and data to be reported with some error.

are estimated using indirect inference.

Estimation of Remaining Parameters

- Assume that the reported value of a variable $\hat{Z}$ is the true value Z plus some percentage measurement error: $\hat{Z} = Z(1 + \hat{\epsilon})$ with $\hat{\epsilon} \sim iidN(0, \sigma_\epsilon)$.
- Define the gap

$$x = logd^* - log(d_{-1})$$

where d^* is the choice of d that solves the maximization problem in V^{adjust}.

Estimation of Remaining Parameters

- x measures the difference between the stock of durables that a household inherits at the start of a period and the stock of durables that a household would choose if it adjusted today.
- The stock of durables today may or may not be equal to d^* because households face adjustment costs.
- If $V^{adjust} > V^{noadjust}$, then $d = d^*$. Otherwise, $d = d_{-1}(1 - \delta_d(1 - \chi))$.

Estimation of Remaining Parameters

- x is not observed directly in the data. Need to impute x using the restrictions in the model.
- Construct a model-generated function G^m that maps variables z which are observable in both the data and the model to x which is only observable in the model: $x^m = G^m(z^m)$.
- Using the same function on the data gives $x^d = G^m(z^d)$.

Estimation of Remaining Parameters

Outline of whole estimation procedure

1. For a given set of parameters p, solve the model and compute $x^m = G^m(z^m)$.
2. Introduce measurement error and aggregate the model to the same frequency as the PSID to compute model gaps with sampling error: $\widehat{x^m} = G^m(\widehat{z^m})$.
3. Compute the imputed gaps in the PSID: $\widehat{x^d} = G^m(\widehat{z^d})$.
4. Compute the difference between model simulated hazards and densities and those in the data:

$$L_p = \int [(f_p^m(\widehat{x^m}) - f^d(\widehat{x^d}))^2 + (h_p^m(\widehat{x^m}) - h^d(\widehat{x^d}))^2]dx$$

5. Repeat the first four steps with a different set of parameters and minimize L.
6. Bootstrap the standard errors.

Estimation Results

Table 1 reports the point estimates of the parameters with Bootstrapped 95% confidence intervals.

Estimation Results

TABLE I

MODEL PARAMETER ESTIMATES

Parameter	Point Estimate	95% Confidence Interval
F^d (Fixed cost stock)	0.0525	(0.043, 0.068)
F^t (Fixed cost time)	0.001	(0.000, 0.004)
ν (Utility flow non-dur.)	0.88	(0.875, 0.885)
m (Measurement error)	0.08	(0.06, 0.10)
χ (Maintenance)	0.80	(0.75, 0.95)

[29]The age fixed effects remove pure demographic effects, which we do not model. Household fixed effects remove any unmodeled permanent differences across households (which are ex ante identical in the model).

[30]Diaz and Luengo-Prado (2010) calibrated a value of 0.05 and Bajari et al. (2013) estimated a value of 0.06 in models of housing adjustment. Eberly (1994) used a transaction cost of 0.05 in her analysis of automobiles.

Estimation Results

Figure 3 shows the distribution of gaps in the model, imputed gaps in the data and bootstrapped 95% confidence intervals.

Estimation Results

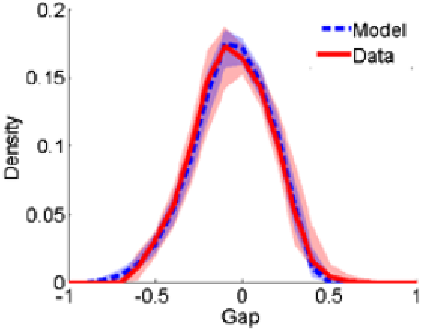


FIGURE 3.—Distribution of gaps in model and PSID.

Estimation Results

Figure 4 shows the adjustment hazard in the model and in the data.

Estimation Results

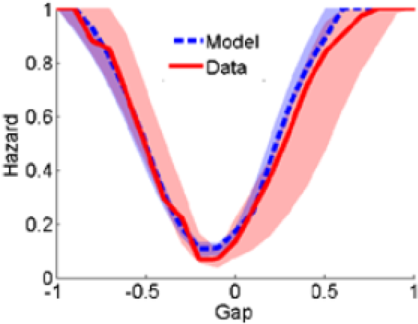


FIGURE 4.—Adjustment probabilities in model and PSID.

Estimation Results

Figure 5 shows different slices of durable distribution in the joint density of the model variables.

Estimation Results

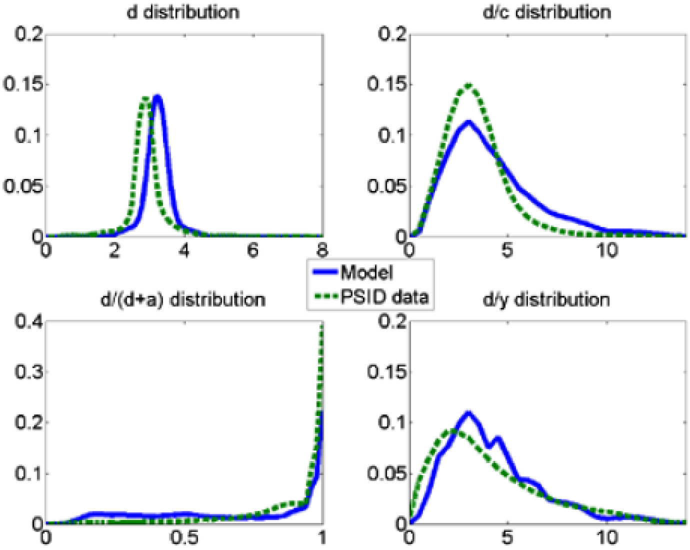


FIGURE 5.—Durable holdings in model and data.

Aggregate Income Shocks

- Introduce aggregate income shocks by assuming that

$$logy_{tot} = log\eta + logy$$

  where η follows the same AR(1) process as before to match the behavior of the HP filtered GDP from 1960 to 2013.
- The model is matched to US data by picking a sequence of aggregate income shocks.
- Given these shocks, the impulse response of durable expenditures to an additional impulse to aggregate income at each date is computed.

Aggregate Income Shocks

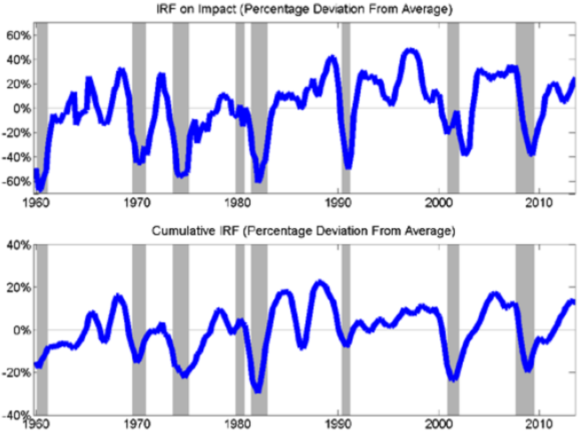


FIGURE 6.—How responsive are durable expenditures to income shocks?

Aggregate Income Shocks

TABLE II

CYCLICALITY OF THE IMPULSE RESPONSE TO SHOCKS[a]

Aggregate Shock	$\frac{IRF^{95}_{impact}}{IRF^{5}_{impact}}$	$\frac{IRF^{95}_{cum}}{IRF^{5}_{cum}}$
Income	2.74	1.46
Wealth	6.17	4.72
Interest rate	2.29	2.17
Tax	1.60	1.52
Durable purchase subsidy	1.85	1.91

[a]95 is the 95th percentile across time. 5 is 5th percentile across time. Impact computes the first element of the IRF and cum is the total area under the IRF.

Aggregate Income Shocks

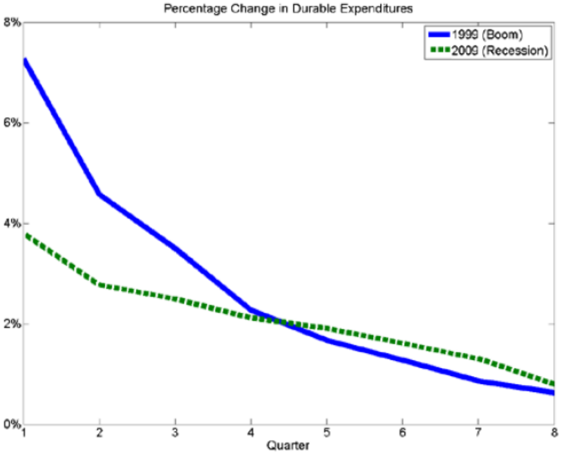


FIGURE 7.—Durable expenditure impulse responses to 1% aggregate income shock.

Aggregate Income Shocks

- On average, the impulse response functions on impact in recessions is only 54 percent of that in expansions.
- Significant amount of state-dependence.
- Impulse response functions of durable spending is procyclical to aggregate income shocks.

Aggregate Wealth Shocks

- Introduce aggregate wealth shocks by assuming that

$$a'_{actual} = a'_{choice} * \omega'$$
$$log\omega' = \varepsilon_\omega + \rho_w log\omega$$

- The shocks are calibrated to match the persistence and standard deviation of HP filitered quarterly US capital stock.
- $\rho = 0.95$ and standard deviation is 0.003.

Aggregate Wealth Shocks

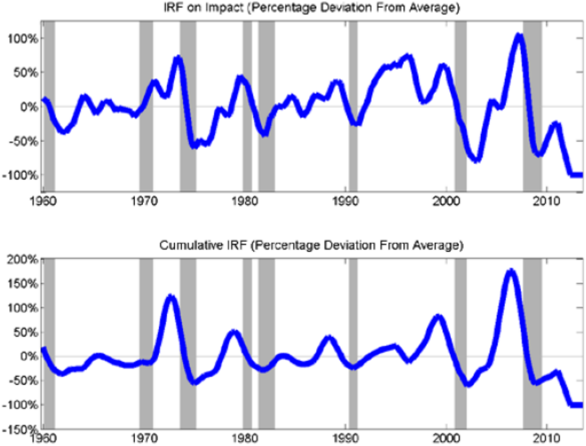


FIGURE 8.—How responsive are durables to wealth shocks?

Aggregate Wealth Shocks

- Durable response is even more procyclical to aggregate wealth shocks than to aggregate income shocks.
- The authors also find that if wealth shocks mainly affect the rich, then the IRF becomes even more procyclical.

Policy Shocks

- Assume the set-up of the model when there are aggregate income shocks.
- Compute the optimal response of households to a one time unanticipated policy experiment at different points in the business cycle.
- Policy shocks used are: a permanent decline in the interest rate, a permanent decline in the payroll tax and a subsidy to durable adjustment.

Policy Shocks

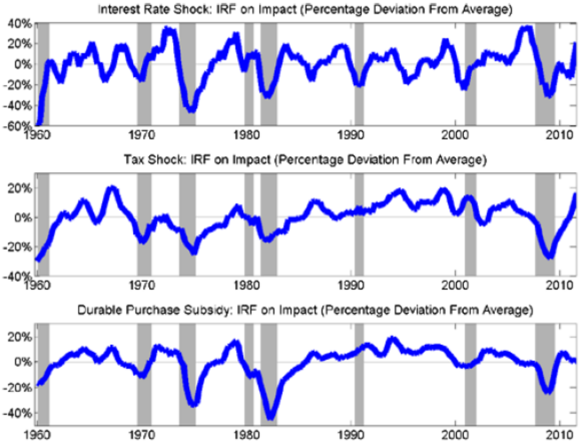


FIGURE 9.—Impulse response to policy shocks.

Importance of Fixed Costs

IRF of durable expenditures to aggregate shocks are procyclical.

- These are because of household-level nonlinearities induced by fixed costs of durable adjustments.

Suppose there are no fixed costs to adjustments.

Importance of Fixed Costs

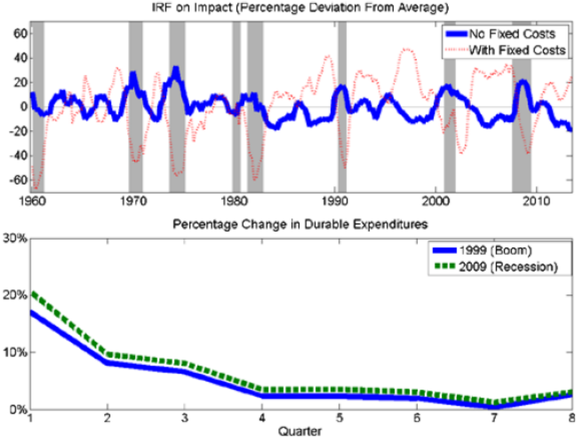


FIGURE 10.—Impulse response to 1% income shocks (frictionless durable adjustment).

Importance of Fixed Costs

The IRF with no fixed costs are countercyclical.

- This is because households that are more constrained have a larger marginal propensity to consume out of income shocks.
- Inconsistent with the data.

The Role of the Cross Section

Why do fixed costs of adjustment induce a procyclical IRF?

- The more households choose to adjust their durable holdings, the more responsive aggregate durable investment.

$$IRF_t^{impact} = \lim_{\Delta d^* \to 0} \frac{\Delta ID}{\Delta d^*} = \int h_t(x) f_t(x) dx + \int x h_t^i(x) f_t(x) dx$$

The Role of the Cross Section

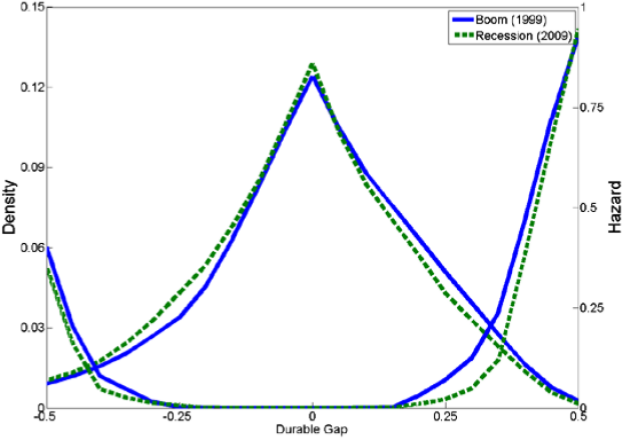


FIGURE 11.—Model gap distribution and hazard: boom versus bust.

The Role of the Cross Section

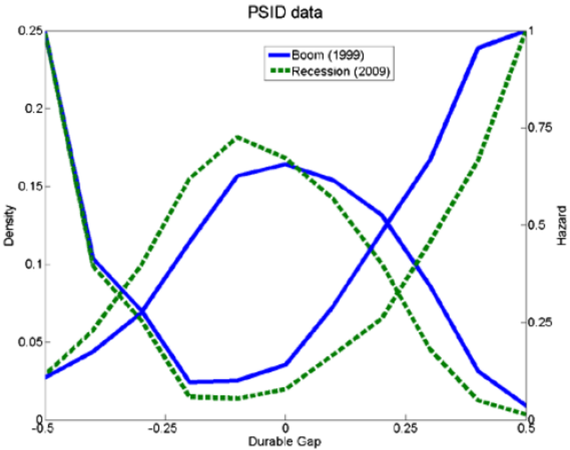


FIGURE 12.—Estimated gap distribution and hazard in PSID: boom versus recession.

The Role of the Cross Section

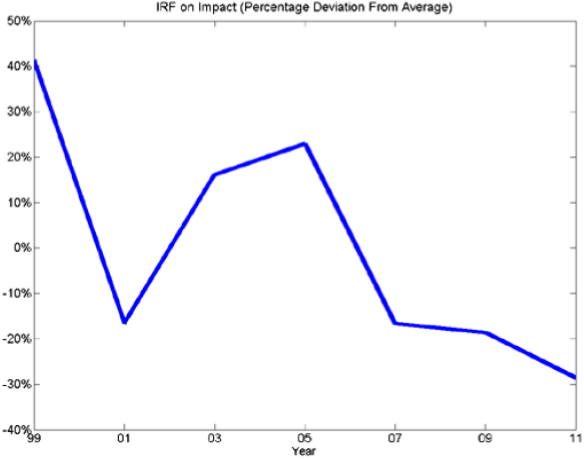


FIGURE 13.—Impulse response implied by PSID gap distribution and hazard.

General Equilibrium

- The literature suggests that general equilibrium can undo the results found in partial equilibrium.
- For this paper, the set up is similar to the partial equilibrium model but with endogenous wages and interest rates.

General Equilibrium

A representative firm rents capital and labor and its FOCs give

$$w_t = (1-\alpha) Z_t K_t^{\alpha} H^{1-\alpha}$$
$$r_t = \alpha Z_t K_t^{\alpha-1} H^{1-\alpha} - \delta_k$$

General Equilibrium

Since the interest rate is now endogenous, β is chosen so that $r = 0.0125$. Other parameters have also been changed or added to match HP filtered US TFP data.

$$\delta_k = 0.022 \qquad \alpha = 0.3$$
$$\rho_Z = 0.85 \qquad \sigma_Z = 0.008$$

where in equilibrium

$$K_t = \int a^i_{t-1} \qquad D_t = \int d^i_t$$
$$C_t = \int c^i_t \qquad A_t = \int A(d^i, d^i_{-1})$$
$$H = \int h\eta^i_t$$

General Equilibrium

The budget constraint is

$$C_t + D_t + K_{t+1} + A_t = Z_t K_t^{\alpha} H^{1-\alpha} + (1-\delta_k)K_t + (1-\delta_d)D_{t-1}$$

Aggregate productivity evolves as an AR process

$$log(Z_t) = \rho_Z log(Z_{t-1}) + \xi_t$$

Aggregate capital is a linear function of current aggregate capital

$$K_{t+1} = \gamma_0(Z) + \gamma_1(Z)K_t$$

General Equilibrium

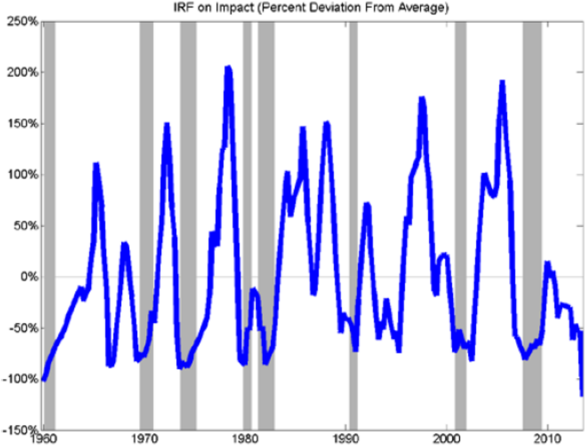


FIGURE 14.—How responsive are durable expenditures to TFP shocks in general equilibrium?

General Equilibrium

- As with partial equilibrium, IRF is procyclical to TFP shocks that correspond to US Solow Residuals.
- TFP shocks that raise household wealth and income raise durable responsiveness.

General Equilibrium

Why are the effects in partial equilibrium not undone by general equilibrium like the literature says?

- Households have two sources of savings in this model: liquid and illiquid assets.
- With multiple sources of savings, large changes in the behavior of the component of savings do not necessarily imply that households must violate consumption smoothing.

Geographical Evidence

- The structural model shows that durable spending responds less economics shocks during recessions than booms.
- Use cross sectional geographic variation (MSA-level) to verify.
- Identify local demand shocks similar to Mian and Sufi.
- Use Saiz' housing supply elasticity to instrument.
- Cluster the standard errors by state.

Geographical Evidence

Base model has the following Least Squares specification:

First stage

$$\begin{aligned}\Delta logHP_{i,t} =& \omega + \eta_1 Elasticity_i \times \Delta U_{i,t} + \eta_2 Elasticity_i + \\ & \eta_3 \Delta U_{i,t} + \Psi X_i + \epsilon_{i,t} \\ \Delta logHP_{i,t} \times \Delta U_{i,t} =& \psi + \lambda_1 Elasticity_i \times \Delta U_{i,t} + \lambda_2 Elasticity_i + \\ & \lambda_3 \Delta U_{i,t} + \Pi X_i + \xi_{i,t}\end{aligned}$$

Second stage

$$\begin{aligned}\Delta logAutosales_{i,t} =& \alpha^{IV} + \beta_1^{IV} \Delta log\widehat{HP_{i,t} \times} \Delta U_{i,t} + \\ & \beta_2^{IV} \Delta log\hat{H}P_{i,t} + \beta_3^{IV} \Delta U_{i,t} + \Lambda X_i + \varepsilon_{i,t}\end{aligned}$$

Geographical Evidence

TABLE III

RESPONSE OF AUTOMOBILE SPENDING TO WEALTH SHOCKS[a]

	(1) OLS	(2) Saiz IV	(3) Saiz IV + Year FE	(4) Bubble IV	(5) Saiz IV + Bartik IV	(6) Saiz IV
ΔHouse Price × ΔU	−0.114*	−1.314***	−1.174***	−1.286***	−1.429***	
	(0.063)	(0.373)	(0.353)	(0.382)	(0.414)	
ΔHouse Price	1.522***	3.206***	3.634***	3.184***	2.339	9.391***
	(0.119)	(0.769)	(0.906)	(0.617)	(2.367)	(2.209)
ΔU	−0.020	−0.056***	0.024	−0.054***	−0.085*	
	(0.012)	(0.012)	(0.023)	(0.018)	(0.051)	
ΔHouse Price × U						−1.034***
						(0.360)
Unemployment Rate						−0.038*
						(0.020)
Construction Share 2002	−0.140	−0.835	−0.776	−0.820*	−0.883	−0.786*
	(0.782)	(0.544)	(0.545)	(0.440)	(0.602)	(0.474)
Non Tradeable Share 2002	0.380**	0.644***	0.683***	0.639***	0.602***	0.494**
	(0.187)	(0.177)	(0.179)	(0.207)	(0.209)	(0.214)
ln(AGI/Capita) 2002	0.036**	0.003	0.004	0.004	0.001	0.039**
	(0.017)	(0.022)	(0.022)	(0.016)	(0.022)	(0.016)
N	2237	2237	2237	2237	2237	2237

[a]Standard errors in parentheses, clustered at state-level. Results weighted by population. Sample period 2002–2012. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Geographical Evidence

The coefficient on $\Delta logHP_{i,t} \times \Delta U_{i,t}$ is negative and significant.

- Auto spending responds less to wealth shocks in recessions than in booms.
- Supports previous results.
- Robust to other specifications.

Rental Markets

Now allow households to rent durables. The value function is then

$$V(a_{-1}, d_{-1}, \eta) = max[V^{adjust}(a_{-1}, d_{-1}, \eta), V^{nonadjust}(a_{-1}, d_{-1}, \eta), \\ V^{rent}(a_{-1}, d_{-1}, \eta)]$$

where

$$V^{rent}(a_{-1}, d_{-1}, \eta) = \max_{c,d,a} \frac{(c^{\upsilon} d^{1-\upsilon})^{1-\gamma}}{1-\gamma} + \beta E_{\varepsilon} V(a, d, \eta')$$

s.t.

$$\begin{aligned} c =& wh\eta(1-\tau) + (1+r)a_{-1} + d_{-1}(1-\delta_d) \\ & - d - a - f^d(1-\delta_d)d_{-1} - f^t wh\eta \\ a >& -(1-\theta)d \\ log\eta' =& \rho_\eta log\eta + \varepsilon \text{ with } \varepsilon \sim N(0, \sigma_\eta) \end{aligned}$$

Rental Markets

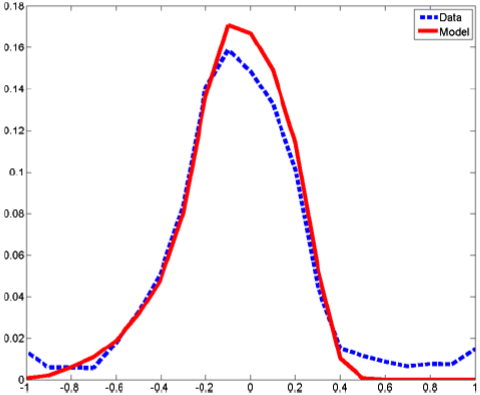


FIGURE S.1.—Gap distribution in model with rental markets.

Rental Markets

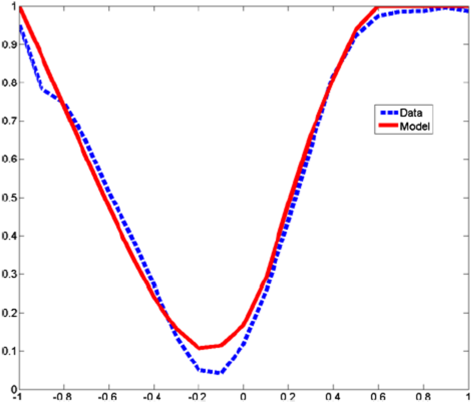


FIGURE S.2.—Predicted and actual hazard: model with rental markets.

Collateralized Borrowing

Now allow households to borrow against their durables.

- In the original model, $\theta = 1$. Households could not use durables as collateral.
- Now let $\theta < 1$. Households can put up durables as collateral. Specifically, set $\theta = 0.2$.

Collateralized Borrowing

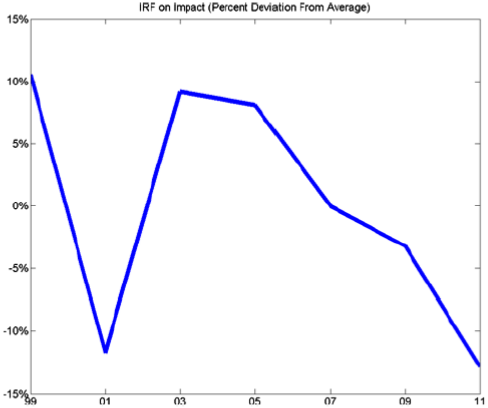


FIGURE S.3.—IRF on impact: model with rental markets.

Collateralized Borrowing

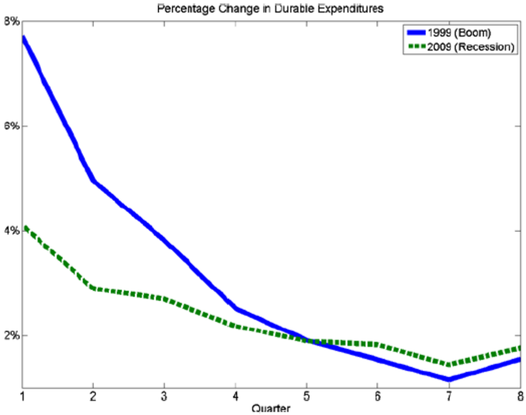


FIGURE S.4.—IRF in boom and bust: model with rental markets.

Conclusions

- Household level durable adjustment frictions matter for aggregate dynamics.
- The elasticity of aggregate durable expenditures to shocks that affect aggregate durable demand falls during recessions.

Ideas for Research

- Study the consumption dynamics of other countries during recessions. How would the results change for a less developed country?
- Study employment dynamics and/or firm investment during recessions and the implications on policy.