Micro MPCs and Macro Counterfactuals: The Case of the 2008 Rebate

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[1] Views expressed here do not necessarily reflect those of the Federal Reserve Board or the Federal Reserve System

Introduction

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- Liquidity constraints, behavioral reasons can lead to a higher MPC than predicted by LC/PI model.
- Micro estimates suggest MPCs$\geq$ 50% out of rebates.
- Calibration of heterogeneous agent macro models $\Rightarrow$ temporary rebates can be a powerful macro stimulus.

Micro/Macro Tension Regarding 2008 Rebates

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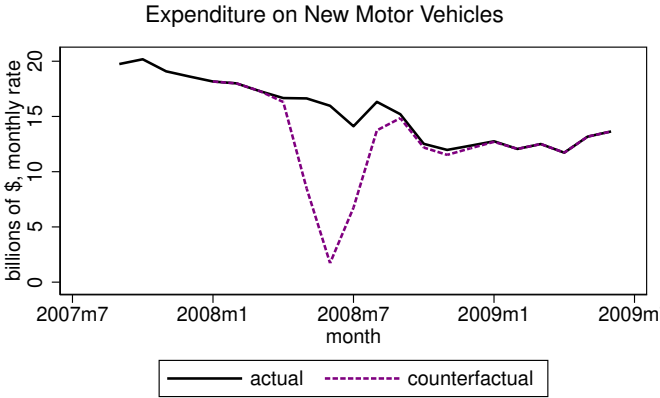
- Feldstein (2008), Taylor (2009)
  - Simple analysis of macro data
  - Big saving rate spike, no consumption spike.
  - Concluded that MPCs out of the 2008 rebate were low.

Micro/Macro Tension Regarding 2008 Rebates

- Feldstein (2008), Taylor (2009)
  - Simple analysis of macro data
  - Big saving rate spike, no consumption spike.
  - Concluded that MPCs out of the 2008 rebate were low.
- Parker and co-authors
  - Added rebate questions to CEX, Nielsen household data
  - Great natural experiment, applied micro methods.
  - Estimated very high MPCs: 0.5 - 0.9 on total consumption.

What are the Macro Implications of Parker et al.'s Estimates?



- Sahm-Shapiro-Slemrod (2012) calculation for new motor vehicles.
- Counterfactual implies 90% drop in expenditures if no rebate

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4. OLS diff-in-diff estimator overstates micro MPC?
   - Uses previously treated households as control group.
   - Borusyak-Jaravel-Spiess (2022) diff-in-diff estimator $\Rightarrow \downarrow$ MPC estimates by 40% or more.

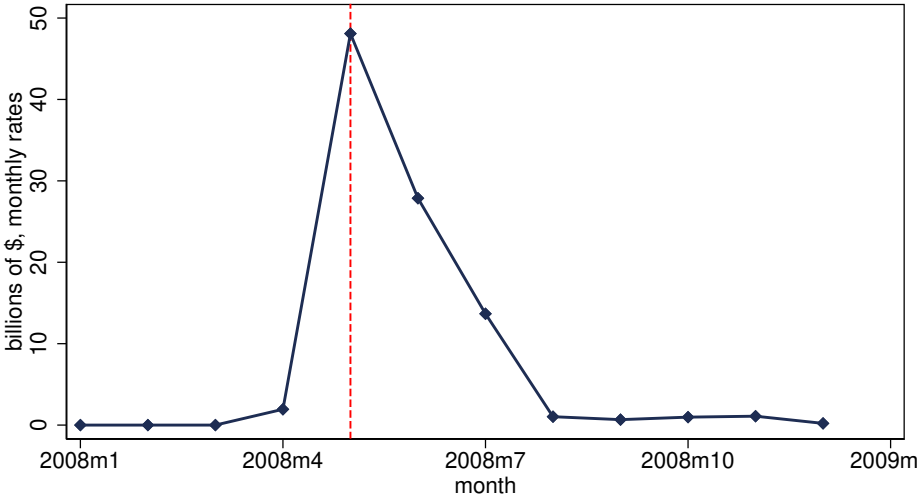
Narrative of 2008

Review of data and major economic events.

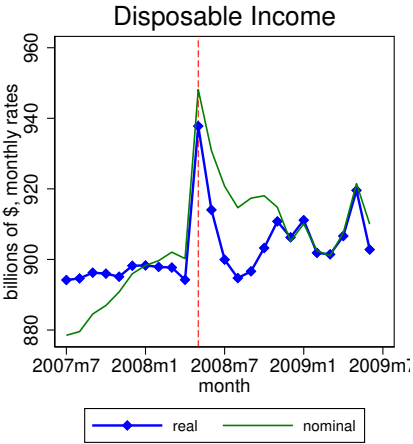
Details of the 2008 Rebate

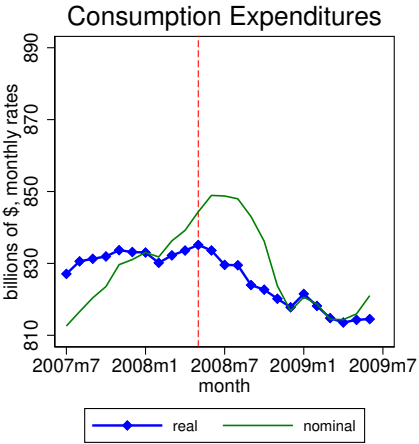
- Passed in February 2008, most funds distributed April - July.
- $100 billion, equal to 11% of January disposable income (monthly basis).
- 85% of "tax units" received a payment; phased out at higher income.
- Among households receiving a payment, the average check was $1,000.

2008 Tax Rebate



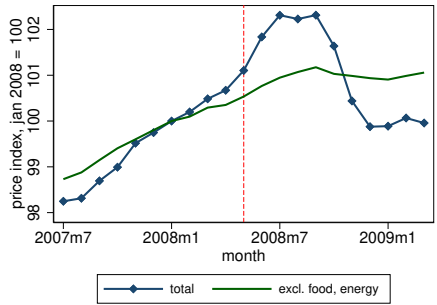
Disposable Income and Consumption

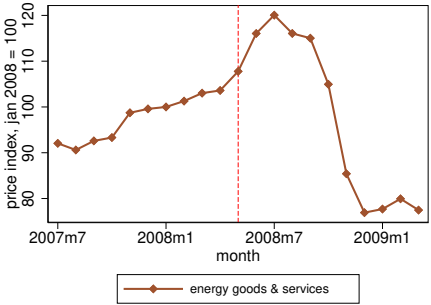




PCE by Product | Motor Vehicles

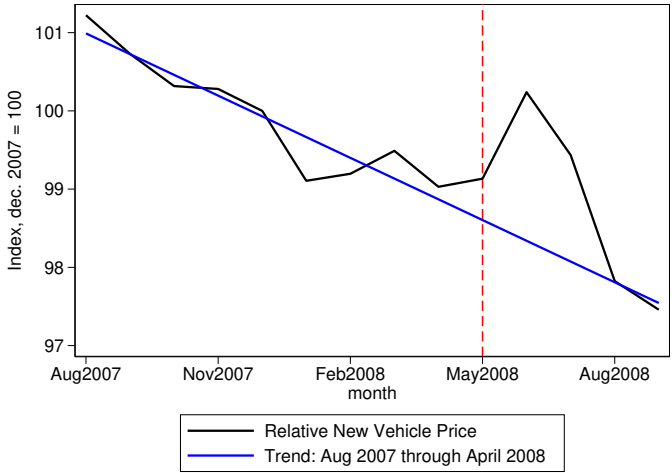
Consumption Price Indexes (PCE)



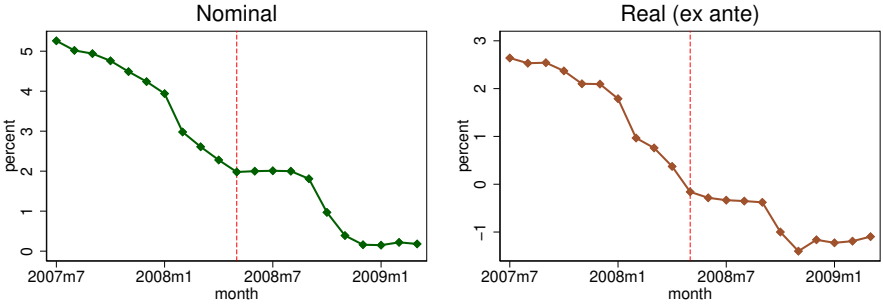


- Prices rose, peaked in July, then fell.
- Energy prices were a significant contributor.

Relative New Motor Vehicle Price



Behavior of Monetary Policy: Federal Funds Rate



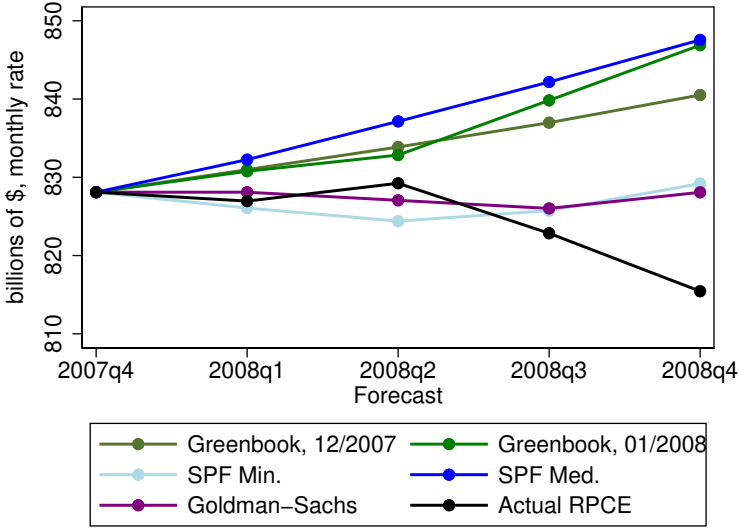
Note: Ex ante real interest rate constructed using the University of Michigan Consumer Survey median inflation expectations.

Do any forecasts suggest a V-shaped consumption path?

- Professional forecasters
  - Forecasts became more pessimistic after release of December 2007 employment report.
  - Some predicted rebate enacted in second half of the year.
  - The following graph shows forecasts made just before the rebate was enacted in February 2008.
- Our forecasts:
  - Make forecasts pessimistic by allowing perfect foresight of recession, oil prices, and Lehman Brothers.
  - Similar results.

Own Forecasts

Professional Forecasters



Methodology for creating macro counterfactuals

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- Construct a medium-scale two-good, two-agent New Keynesian model.
  - Nondurables and durables (interpreted as motor vehicles).
  - Optimizing and hand-to-mouth households.
  - Sticky prices and wages, noncompetitive labor markets, etc.
  - Combination of Ramey's (2021) extension of Gali et al. (2007) and McKay-Wieland (2021 Econometrica).

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- Calibrate fraction of hand-to-mouth households to match micro MPCs.
- Simulate response of consumption to rebates and subtract from actual consumption data to derive the counterfactual path with no rebate.

Durable Goods in the Utility Function

- Utility function of both types of consumers:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{(C_t)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \psi \frac{(D_t)^{1-\frac{1}{\sigma^d}}}{1-\frac{1}{\sigma^d}} - \nu \frac{(H_t)^{1+\phi}}{1+\phi} \right]$$

C_t = nondurable consumption, D_t = durable stock, H_t = hours worked.

Durable Goods Accumulation

$$D_t = (1 - \delta^d)(1 - f^d)D_{t-1} + \frac{X_t}{p_t^d}$$

X = durable expenditure denominated in nondurable goods

δ^d = depreciation rate of household durables.

f^d = additional mechanisms that reduce effective economic value of durable (e.g. resale discounts, stochastic depreciation)

p_t^d = relative price of durable goods.

Durable Goods Production

- Supply curve for consumer durables $p_t^d = \left(\frac{X_t}{\bar{X}}\right)^{\frac{\zeta}{1+\zeta}}$
- Supply elasticity of real durable goods is given by ζ^{-1}.
- If $\zeta^{-1} = \infty$ then nondurable and durable goods are perfect substitutes in production.

Household Behavior

- Fraction 1 - γ are optimizers, receive all profits.
- Fraction γ follow hand-to-mouth ("m") rules.
  - Standard models assume that they neither borrow nor save and simply consume all of their current income,

$$C_t^m + X_t^m = W_t H_t^m - T_t^m$$

  - We allow for lagged effects of an income shock spread over a few months, calibrated to the micro MPC evidence.

Calibration

- Assume that hand-to-mouth households spread spending equally over three months, beginning with current month.
  - Best estimates: 2/3rds in current month, 1/6th in each of next two months.
  - Our assumption of 1/3-1/3-1/3 makes our counterfactuals less V-shaped and hence less implausible.

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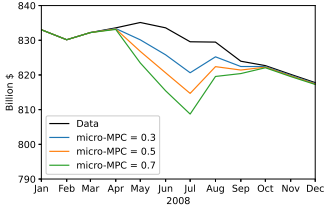
- Supply elasticity: baseline $\zeta^{-1} = \infty$, less elastic alternative $\zeta^{-1} = 5$.

Counterfactual Simulations Procedure

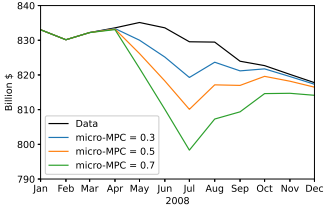
- We use our TG-TANK model to simulate the dynamic general equilibrium consumer spending response to a rebate.
  - Match anticipation lag, size, and timing of the actual rebate.
- Run experiment for micro MPCs equal to
  - 0.3 — Shapiro-Slemrod (2009) and our estimates.
  - 0.5 and 0.7 — Low and mid-point of Parker, Souleles, Johnson, McClelland (AER 2013)

Counterfactual Consumption Expenditure: Baseline Model

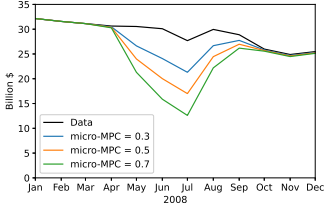
Real PCE: Micro MPCs



Real PCE: GE Baseline



Motor Vehicles: Micro MPCs



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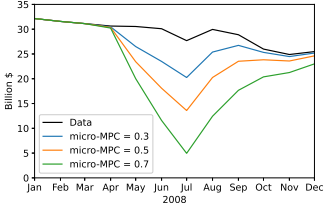

▸ Nominal ▸ w/ Forecast

Baseline Model: GE Forces Amplify Micro MPCs

Table: General Equilibrium Marginal Propensity to Consume: Baseline Model

PCE		Motor vehicles		Nondurable goods	
micro	GE	micro	GE	micro	GE
0.3	0.38	0.25	0.31	0.05	0.07
0.5	0.77	0.42	0.64	0.09	0.13
0.7	1.38	0.58	1.14	0.12	0.23

Reconciling micro MPCs with Macro Counterfactuals

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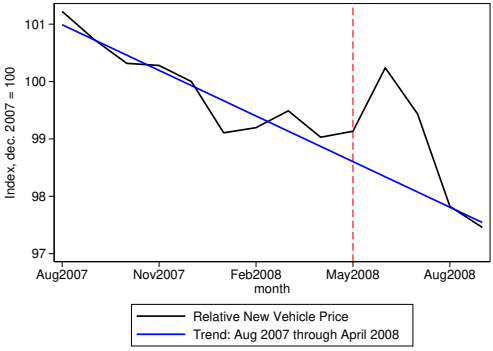

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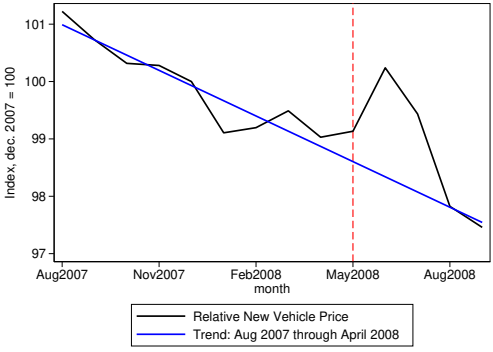

- Less elastic durable goods supply - we change elasticity from ∞ to 5.

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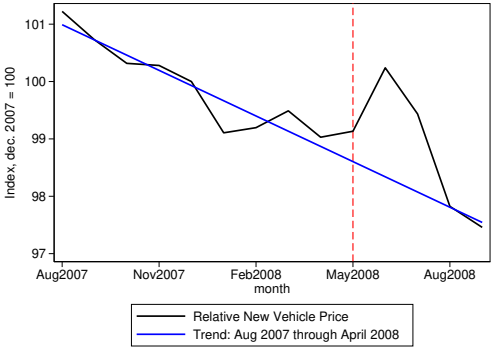

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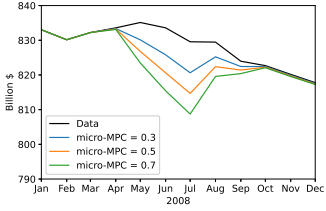
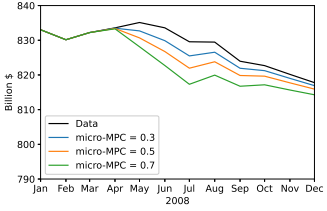
- Re-examination of the micro MPC estimates.

Counterfactual: Less Elastic Durable Supply Model

Real PCE: Micro MPCs



Real PCE: GE Less Elastic



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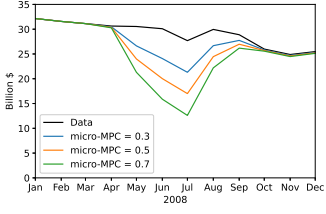

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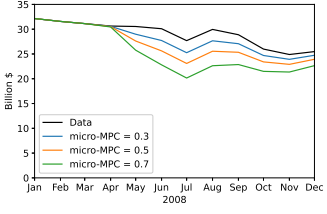

▸ Nominal ▸ w/ Forecast ▸ Model Price IRF

Less Elastic Durable Supply: GE Forces Dampen Micro MPC

Table: General Equilibrium Marginal Propensity to Consume: Model with Less Elastic Durable Supply

PCE		Motor vehicles		Nondurable goods	
micro	GE	micro	GE	micro	GE
0.3	0.20	0.25	0.17	0.05	0.04
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- Relatively elastic demand for durables important for dampening.
- With only nondurables micro MPC $= 0.3$ becomes GE MPC $= 0.4$.

Model Price IRF

Lessons for HANK Models

- The addition of durable goods is crucial for our dampening result because durables have much more elastic demand than nondurables.
  - $\uparrow$ durable price $\rightarrow$ optimizing households intertemporally substitute away from durables
- Both overall MPC and the distribution of spending across goods matter for the GE outcome.
- If we calibrate the MPC to 0.3 in a one-good nondurable model, we still get implausible counterfactuals because GE forces amplify.
- Heterogeneity of goods is as important as heterogeneity of households.

Estimation Framework

We focus on the indicator specification of Parker et al. 2013

$$C_{i,t+1} - C_{i,t} = \sum_s \beta_{0s} month_{s,i} + \beta_1' \mathbf{X}_{i,t} + \beta_2 I(\text{Rebate}_{i,t+1}) + u_{i,t+1}$$

- C is consumer expenditures.
- i indexes the household.
- t indexes the interview (performed once every three months).
- $month_{s,i}$ are fixed effects for each month.
- $X_{i,t}$ includes household controls for age and change in household size.
- I(Rebate) = 1 if the household received a rebate.

Recent Econometric Developments in Staggered Event Studies

- Standard two-way fixed effects estimators assign weights under implicit assumption of homogenous treatment effects.

  e.g. De Chaisemartin-d'Haultefoeuille (2015), Sun-Abraham (2020), Borusyak, Jaravel, and Spiess (2022).

- These weights are inappropriate when treatment effects are heterogenous and the object of interest is the average effect of treatment on the treated (ATT) in the population.

- We use the Borusyak et al. (2022) method that imputes a counterfactual spending path based on untreated and not-yet-treated households.

Steps of Borusyak, Jaravel, Spiess (BJS) Method

1. Estimate regression on never- and not-yet treated observations

$$\Delta C_{i,t+1} = \sum_s \beta_{0s} month_{s,i} + \beta_1' \mathbf{X}_{i,t} + \tilde{u}_{i,t+1}$$

2. Impute ΔC for all observations as though no rebate received.

$$\Delta C_{i,t+1}(0) = \sum_s \hat{\beta}_{0s} month_{s,i} + \hat{\beta}_1' \mathbf{X}_{i,t}$$

3. Create $\tau_{i,t+1} = \Delta C_{i,t+1} - \Delta C_{i,t+1}(0)$ for households treated in t+1.

4. Take average of τ using CEX sample weights, ω.

$$\tau = \sum_{i,t+1 \in I(ESP_{i,t+1})=1} \omega_{i,t+1} \tau_{i,t+1}$$

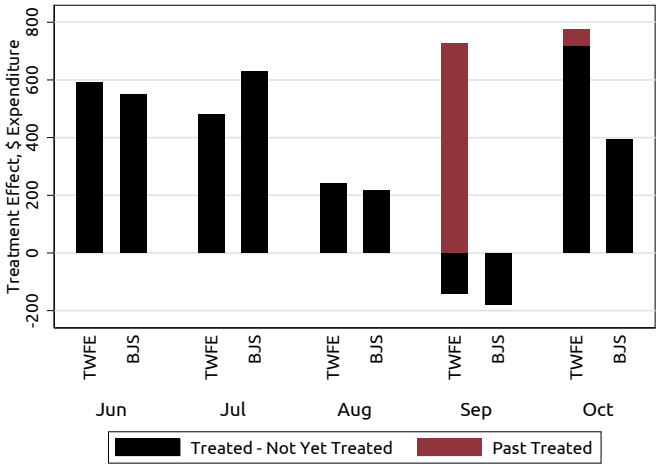
Table: Contemporaneous Household Expenditure Response to Rebate

Panel A: TWFE				
	Full Sample		Rebate Only Sample	
	(1)	(2)	(3)	(4)
Rebate Indicator	483.2**	325.7*	779.2**	593.6**
	(209.9)	(178.2)	(310.2)	(238.8)
Implied MPC	0.52	0.35	0.86	0.65
Extra Controls	No	Yes	No	Yes
Observations	17,229	17,229	10,343	10,343

Panel B: BJS				
	(1)	(2)	(3)	(4)
Rebate Indicator	287.0	116.2	984.4	−64.3
	(216.0)	(191.4)	(665.6)	(579.0)
Implied MPC	0.30	0.12	1.03	-0.07
Extra Controls	No	Yes	No	Yes
Observations	12,499	12,499	5,585	5,585

Non-durables | New Vehicles | Pre-Trends

Decomposing TWFE and BJS



Details

Summary of Estimation Results

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- For total consumption expenditures and the full sample,
  TWFE $\rightarrow$ MPC = 0.5, BJS $\rightarrow$ MPC = 0.3.
- Most of the change comes from nondurables expenditures.
- According to our TG-TANK model with less elastic durable good supply, a micro MPC of 0.3 corresponds to a GE-MPC of 0.12.
- Since there is negligible investment response to the temporary tax rebate, and our model is a closed-economy model, the GE-MPC is approximately equal to the Keynesian multiplier.

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- Two possible reconciliations: GE forces severely dampen the stimulus effects of high micro MPCs and/or there may be upward bias in the micro MPC estimates. We provide evidence for both.
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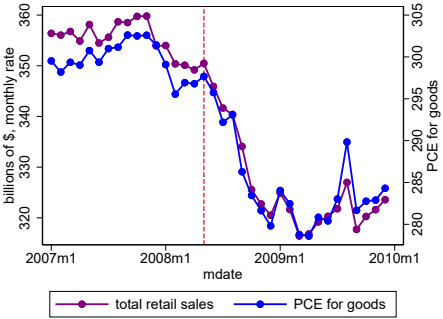
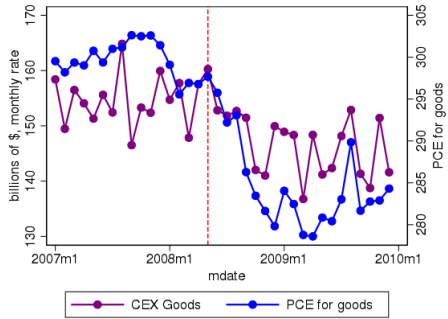
- Two possible reconciliations: GE forces severely dampen the stimulus effects of high micro MPCs and/or there may be upward bias in the micro MPC estimates. We provide evidence for both.
  - Both imply small multipliers.
- More broadly, we propose this new method for evaluating micro estimates: combine theory and historical evidence to construct and assess the implied counterfactuals.

Alternative measures of Aggregate Consumption

- NIPA monthly PCE is based on combining and smoothing various data sources.
- We use detailed data to make sure NIPA PCE captures the path of consumer purchases in summer 2008.
- Supplementary data: retail sales, Wards Automotive Reports, and our own CEX aggregates.

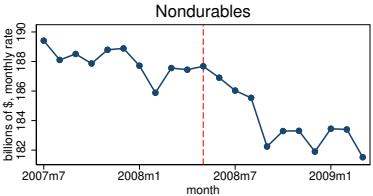
Comparison of PCE to Retail Sales and CEX

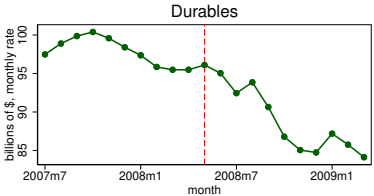


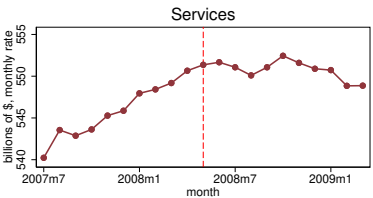


Difference in CEX and PCE Over Time

Real Consumption Expenditures by Type of Product

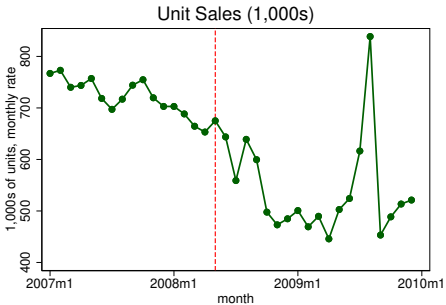


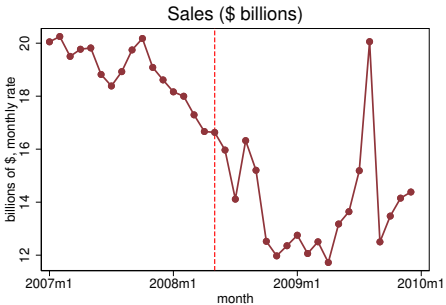




Return

New Motor Vehicle Sales to Consumers





Sales and prices by segment | Fixed Weight Price Index | Return

Table: Counterfactual Real PCE Declines between March and June 2008

MPC	Decline
0.3	1.3 %
0.5	2.5 %
0.7	4.1 %

Table: Largest Actual Three-Month Real PCE Declines

Date	Episode	Decline
Jan-Apr 2020	COVID lockdowns	20 %
Jan-Apr 1980	Credit controls, Volcker	2.9 %
Aug-Nov 1974	prior spike up	2.3 %
Apr-Jul 1960	prior spike up	1.8 %

Description of our forecasting equations

Included Variables

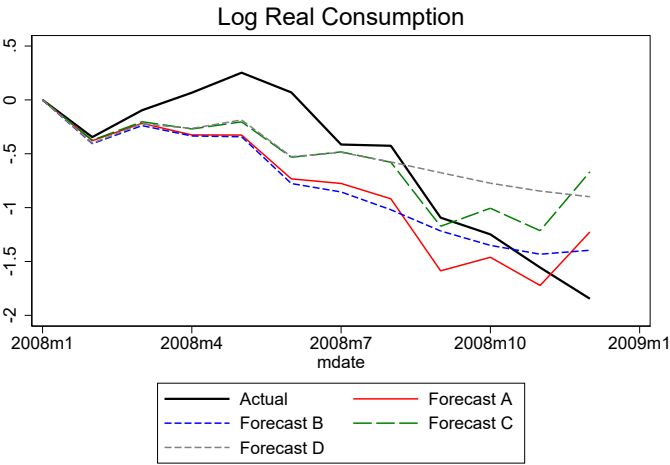
Endogenous variables	Endogenous or exogenous depending on specification
Log real consumption	Recession dummy
Log real disposable income	Log real oil prices
Log consumption deflator	Lehman bankruptcy dummy
Gilchrist-Zakrajek spread	

Notes: The sample is monthly, 1984m1 - 2019m12. 6 lags of all variables except the Lehman dummy are included. Current values of spread, recession, and oil are included. When the Lehman dummy is used, current and 2 lags are included.

Forecast Model Specifications

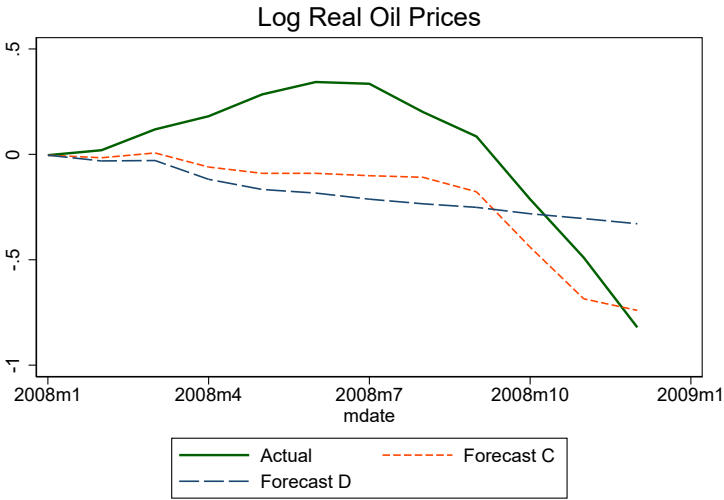
Forecast Model	Lehman dummies included?	Real Oil Prices
Model A	Yes	exogenous
Model B	No	exogenous
Model C	Yes	endogenous
Model D	No	endogenous

Forecasts from four models using information through 2008m1

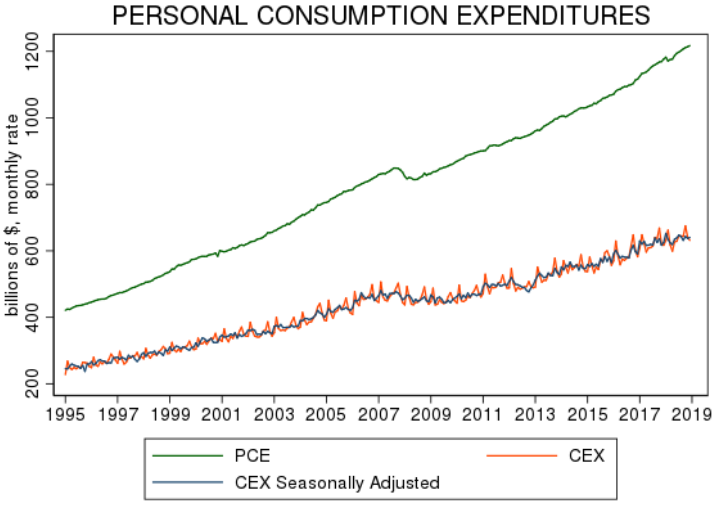


Return

Forecasts of Log Oil Prices

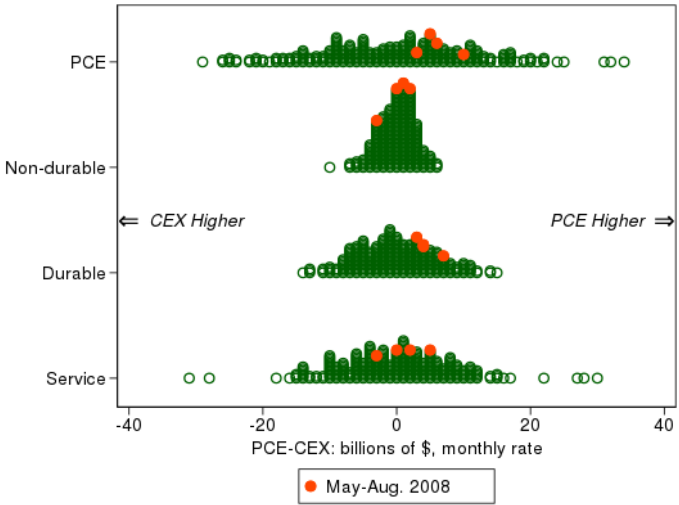


Difference CEX and PCE Over Time



Return

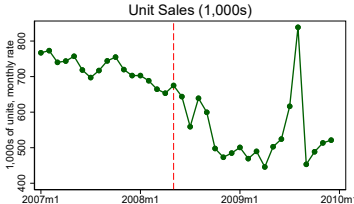
CEX v PCE Gap is Normal in Summer of 2008

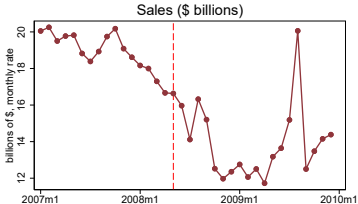


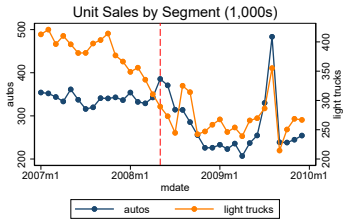
Note: Difference is demeaned and conditional on linear time-trend.

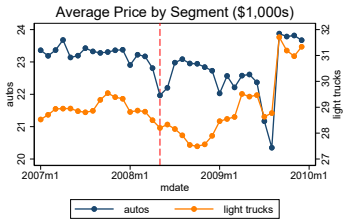
Return

Motor Vehicle Sales by Segment



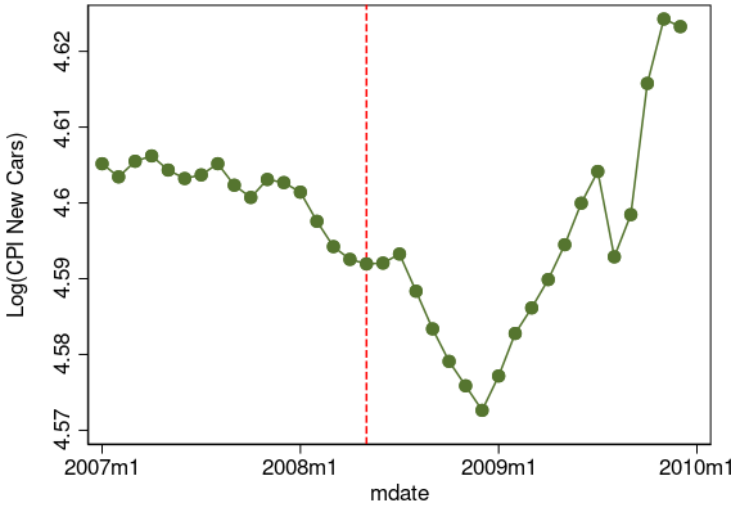






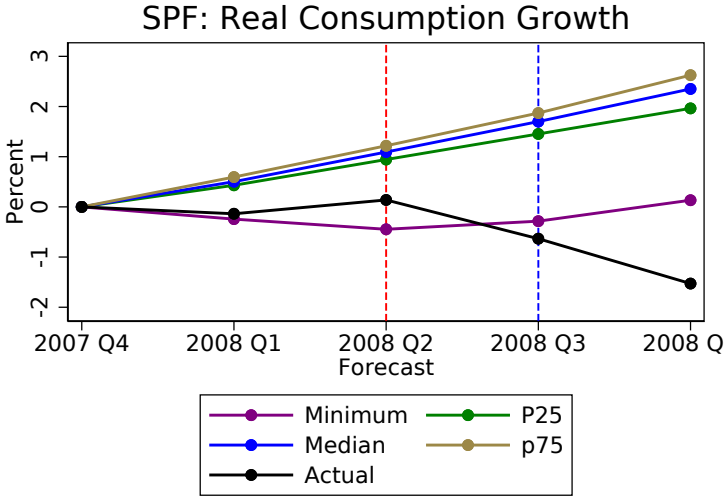
Return

CPI New Vehicles



Return

Survey of Professional Forecasters: 2007q4 Forecast and Actual



Rebate Receipt Correlated with Interview Schedule

Table: Distribution of CEX Interview Schedule

	Panel A: EFT and Check Recipients			
	Overall CEX	May Cohort	June Cohort	July Cohort
Interview Schedule				
Jan-Apr-Jul-Oct	33%	32%	35%	26%
Feb-May-Aug-Nov	33%	29%	37%	39%
Mar-Jun-Sep-Dec	33%	39%	28%	34%

	Panel B: Check Recipients Only		
	May Cohort	June Cohort	July Cohort
Interview Schedule			
Jan-Apr-Jul-Oct	30%	36%	28%

Baseline Calibration of Model

Parameter	Value	Description
σ	0.5	Utility curvature on nondurable consumption
ϕ	1	Inverse of the Frisch elasticity of labor supply
γ	varies	Fraction of Hand-to-Mouth consumers
mpx	0.83	Hand-to-Mouth MPC on durables
ψ	0.724	Weight on durable service flow
δ_d	0.015	Depreciation of durable consumption goods
θ_p	0.917	Calvo parameter on price adjustment
θ_W	0.917	Calvo parameter on wage adjustment
δ_2	0.017	Parameter on quadratic term of capital utilization cost
ϕ_b	0.1	Debt feedback coefficient in fiscal rule
ρ_r	0.947	Monetary policy interest rate smoothing
ϕ_π	1.5	Monetary policy response to inflation
ϕ_{gap}	0.083	Monetary policy response to the output gap

Return

Could the rise in oil prices have reduced consumption?

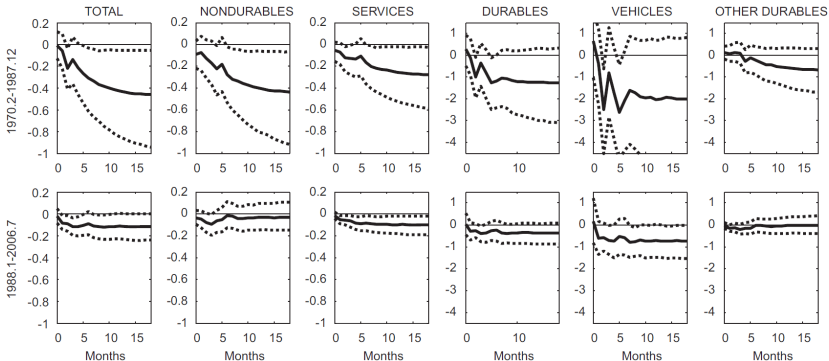


Fig. 4. Selected responses by sample period. *Notes*: Split-sample VAR estimates for U.S. data based on the purchasing power loss associated with an unanticipated change in weighted retail energy prices.

Table: Contemporaneous Household Non-Durable Expenditure Response to Rebate

Panel A: OLS				
	Full Sample		Rebate Only Sample	
	(1)	(2)	(3)	(4)
Rebate Indicator	126.4*	116.2*	262.9***	241.5***
	(67.2)	(66.8)	(94.8)	(91.2)
Implied MPC	0.14	0.13	0.29	0.27
Extra Controls	No	Yes	No	Yes
Observations	17,229	17,229	10,343	10,343

Panel B: DID Imputation				
	(1)	(2)	(3)	(4)
Rebate Indicator	57.0	44.8	175.2	42.8
	(68.9)	(70.5)	(212.5)	(203.2)
Implied MPC	0.06	0.05	0.18	0.04
Extra Controls	No	Yes	No	Yes
Observations	12,499	12,499	5,585	5,585

Return

Table: Contemporaneous Household New Vehicle Expenditure Response to Rebate

Panel A: OLS				
	Full Sample		Rebate Only Sample	
	(1)	(2)	(3)	(4)
Rebate Indicator	301.2**	231.4*	310.8	245.2
	(128.7)	(121.4)	(192.2)	(176.8)
Implied MPC	0.32	0.25	0.34	0.27
Extra Controls	No	Yes	No	Yes
Observations	17,229	17,229	10,343	10,343

Panel B: DID Imputation				
	(1)	(2)	(3)	(4)
Rebate Indicator	301.3**	235.8*	539.0*	173.7
	(126.8)	(121.2)	(309.8)	(299.2)
Implied MPC	0.32	0.25	0.56	0.18
Extra Controls	No	Yes	No	Yes
Observations	12,499	12,499	5,585	5,585

Return

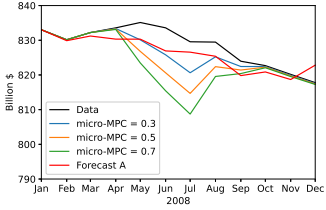
Table: Test for Pre-trends using DID Imputation

	Expenditure					
	Total		Vehicle		Non-Durable	
	(1)	(2)	(3)	(4)	(5)	(6)
Pre-trend	96.4	−38.0	25.5	−41.8	81.7	75.9
	(263.5)	(215.5)	(208.6)	(192.3)	(82.1)	(81.5)
F-Stat	0.13	0.03	0.01	0.05	0.99	0.87
P-Value	(0.71)	(0.86)	(0.90)	(0.83)	(0.32)	(0.35)
Extra Controls	No	Yes	No	Yes	No	Yes
Observations	12,499	12,499	12,499	12,499	12,499	12,499

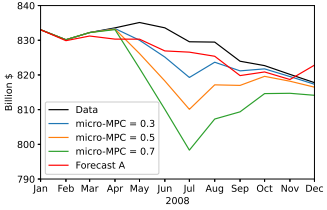
Return

Counterfactual Consumption Expenditure: Baseline Model

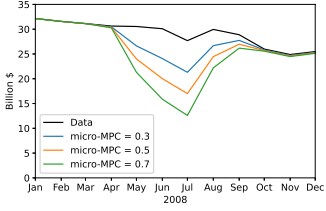
Real PCE: Micro MPCs



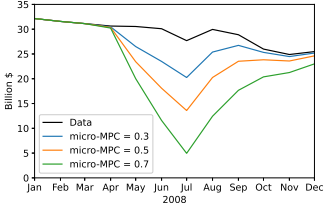
Real PCE GE: Baseline



Motor Vehicles: Micro MPCs



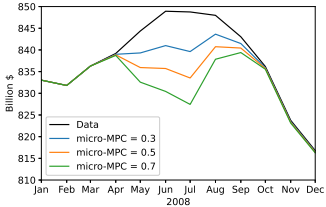
Motor Vehicles: GE Baseline



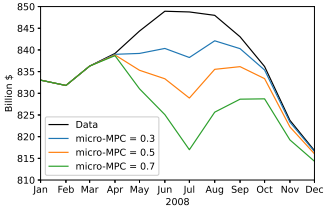
Return

Counterfactual Consumption Expenditure: Baseline Model

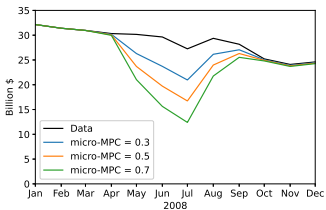
Nominal PCE: Micro MPCs



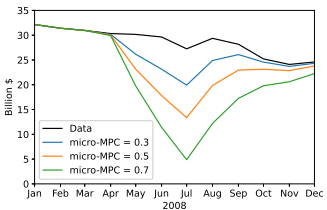
Nominal PCE GE: Baseline



Motor Vehicles: Micro MPCs



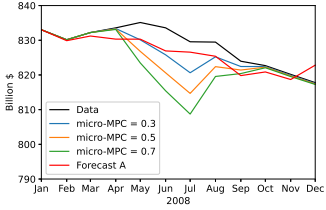
Motor Vehicles: GE Baseline



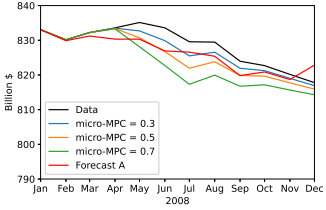
Return

Counterfactual: Less Elastic Durable Supply Model

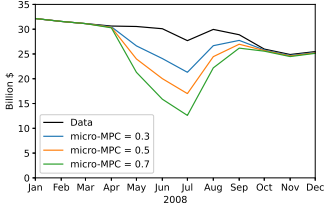
Real PCE: Micro MPCs



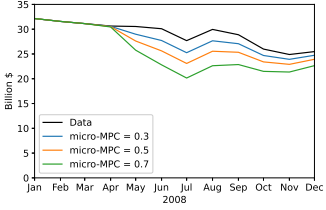
Real PCE: GE Less Elastic



Motor Vehicles: Micro MPCs



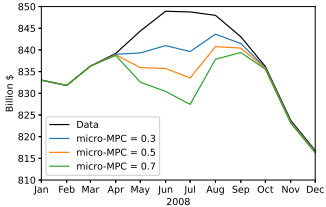
Motor Vehicles: GE Less Elastic



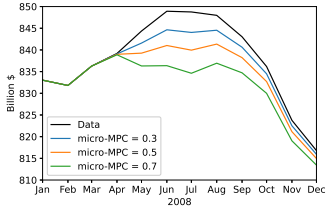
Return

Counterfactual: Less Elastic Durable Supply Model

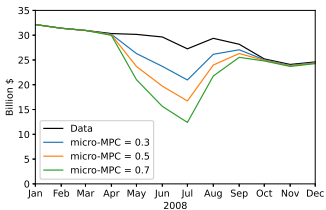
Nominal PCE: Micro MPCs



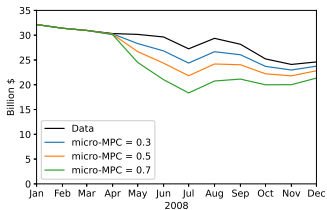
Nominal PCE: GE Less Elastic



Motor Vehicles: Micro MPCs

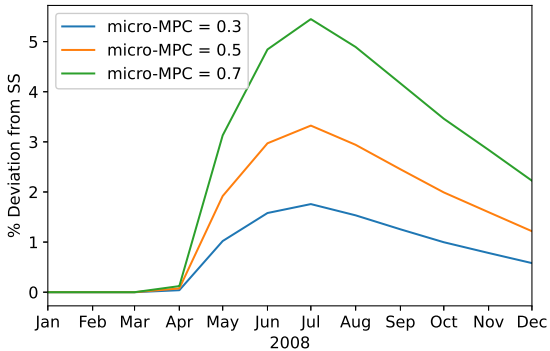


Motor Vehicles: GE Less Elastic



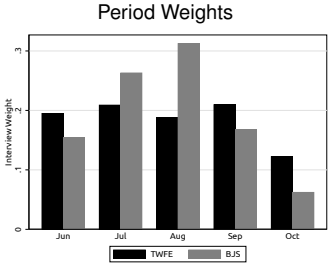
Return

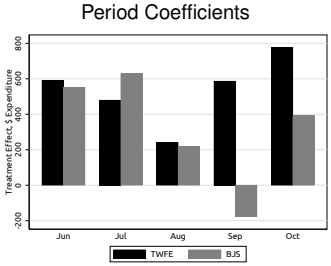
IRF of Relative Durable Price

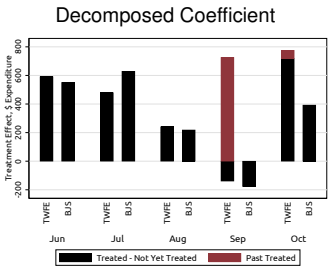


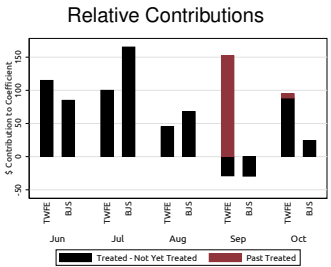
Return

Decomposing OLS v.DID Imputation









Return