Do They Add Up?
Using Macro Counterfactuals
to Assess Micro Estimates and Macro Models

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Introduction

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Angrist and Pischke "The Credibility Revolution in Empirical Economics" (JEP 2010).

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Angrist and Pischke "The Credibility Revolution in Empirical Economics" (JEP 2010).

- "Macroeconomists slow to adopt new empirical micro methods."
- At that time, the dominant macro methods were time series and quantitative DSGE
- However, a few macroeconomists were using natural experiments, etc. to estimate parameters or causal effects of interest to macro.
  - natural experiments such as wars, timing of social security checks.

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- Many new natural experiments to estimate household MPCs.
- Bartik instruments to estimate regional fiscal multipliers in panel data.
- Two caveats raised in my 2019 JEP paper.
  - These micro estimates answer macro questions only with the help of macro models.
  - The micro estimate/macro model answers are often different from the aggregate data answers.

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- We can exploit this micro/macro confluence to take the "credibility revolution" one step further.
- In particular, we should use macro counterfactuals implied by micro estimates to assess the plausibility of micro estimates and macro models.
- Why this tool is useful
  - Micro estimates and macro aggregates don't always agree.
  - Tool helps determine which estimates and/or models need more scrutiny.
  - Search for reconciliation is often illuminating.

Motivation: Micro/Macro Tension Regarding 2008 U.S. Rebates

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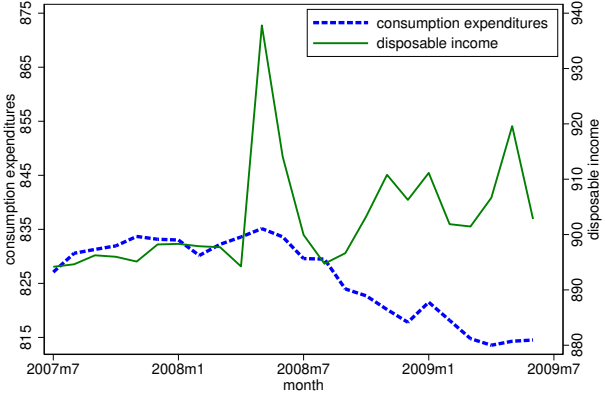

- Big disposable income spike, no consumption spike.
- Concluded that marginal propensity to consume (MPC) from 2008 rebate was low.

Micro/Macro Tension Regarding 2008 U.S. Rebates (cont.)

- Parker and co-authors micro MPC estimates
  - Added rebate questions to CEX, Nielsen household data
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  - Estimated very high MPCs: 0.5 - 0.9 on total consumption.
  - Majority of spending on motor vehicles.
- Policymakers and researchers believed the micro estimates and ignored the simple macro analysis.

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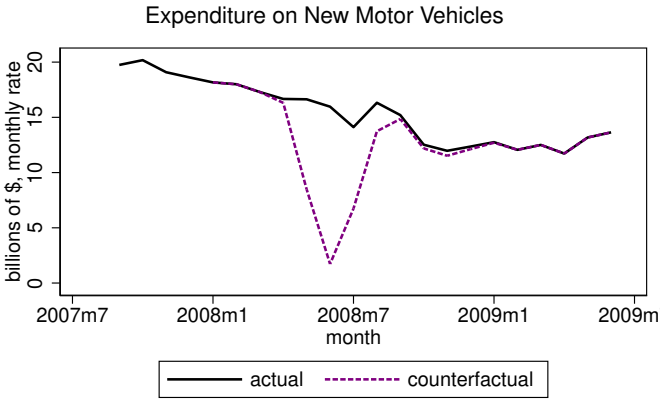

- Based on Sahm-Shapiro-Slemrod (2012) induced spending calculation for new motor vehicles - no general equilibrium effects.
- Counterfactual implies 87% drop in expenditures if there were no rebate.

Key Ingredients for a Macro Counterfactual Plausibility Analysis

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- A macro model that translates the micro or subregional estimates to dynamic general equilibrium effects.
- A narrative analysis of the time period surrounding the policy or event to assess whether the macro counterfactual is plausible.

Illustrations of the Counterfactual Method

- Macro Implications of Micro MPC Estimates.

  Based on joint work with Jacob Orchard and Johannes Wieland.

  - The 2001 U.S. Tax Rebate
  - The 2008 U.S. Tax Rebate

- Macro Implications of State-Level Multiplier Estimates.

Micro MPC Estimates Illustrations

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- Parker, Souleles, Johnson, and McClelland (PSJM) (AER 2013), Broda-Parker (JME 2014) studied the 2008 tax rebate.
- Each study relied on a natural experiment and novel data creation:
  - tax rebates distributed to households over several months, with timing randomized by the last two digits of Social Security numbers.
  - the authors added special questions to surveys (CEX for JPS, PSJM; Nielsen Survey for Broda-Parker) that measured the time, amount, and form of the rebate for each household.

JPS and PSJM Estimation Framework

$$(1) \qquad C_{i,t+1} - C_{i,t} = \sum_s \beta_{0s} month_{s,i} + \beta_1' X_{i,t} + \beta_2 \mathbf{R}_{i,t+1} + u_{i,t+1}$$

- 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.
- R is the rebate variable, which can take the form of the dollar amount, an indicator for receipt, or the dollar amount instrumented with the indicator.

Details of the 2001 Rebate

- Bush 10-year tax cuts passed in early June 2001.
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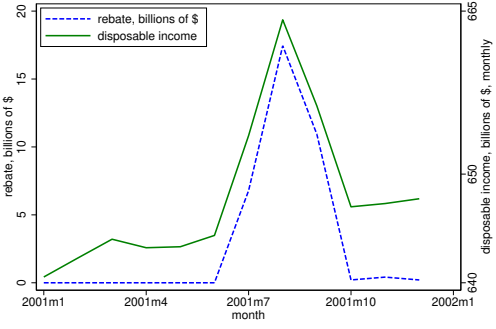

JPS MPC Estimates for 2001 Rebate

- Construct a "nondurable" spending category that is a mix of some nondurable goods and services, and even some durable goods.

- Their IV estimates produce an MPC = 0.375 (s.e. = 0.136), based on a quarter-to-quarter difference in spending.

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- Their preliminary analysis finds a statistically insignificant MPC on total consumption that is less than the MPC on their "nondurable" subcategory.
  - They attribute that anomaly to noise induced by durable expenditures.
  - Thus, they ignore durables and total consumption.

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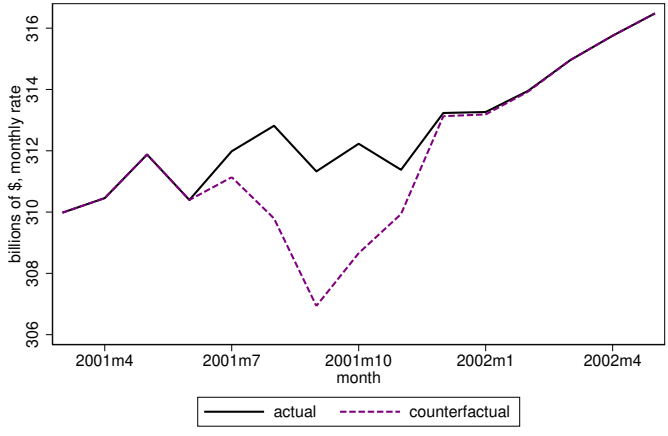
- Counterfactual "nondurable" consumption

  = actual aggregate "nondurable" consumption - induced spending.

Counterfactual 2001 Consumption - No GE Effects



- Uses JPS definition of nondurables.
- Based on micro estimates, no GE effects.

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  - Only other 3-month periods with greater % decrease in consumption were during COVID and the 1980 credit crunch/Volcker tightening.
- But this counterfactual doesn't allow for general equilibrium effects.

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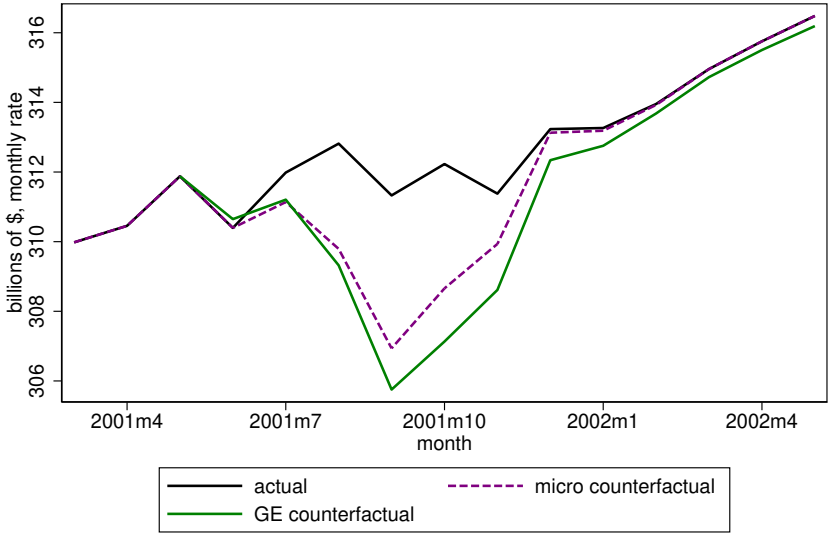
- Calibrate fraction of hand-to-mouth households to match micro MPCs.
- Simulate response of consumption to rebates.
- Subtract simulated responses from actual consumption data to derive the counterfactual path with no rebate.

Macro Counterfactual Consumption Expenditures



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MPCs	
micro	GE
0.38	0.50
0.66	1.33

- GE amplification grows with the MPC value - nonlinear.

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- Re-examine the micro MPCs based on CEX data.
- Possible modifications to the TANK Model:
  - Make monetary policy less accommodative.
  - Make supply less elastic - don't allow variable utilization of capital, less sticky prices/wages, etc.

Re-examination of CEX Estimates for 2001 Rebate

- JPS "Non-Durables" category includes many nondurables, services and some durables, but is only 61% of BEA nondurables + services.
- Let's compare MPC for JPS vs. BEA categories.

Re-examination of CEX Estimates for 2001 Rebate

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	JPS Definitions		BEA Definitions	
	Strict Non-Durables	Non-Durables	Non-Durable Goods	Services
	(1)	(2)	(3)	(4)
Rebate Amount	0.12	0.32**	0.06	0.03
	(0.13)	(0.15)	(0.06)	(0.22)
Observations	12,018	12,018	12,018	12,018

- BEA category estimates imply MPCs ≈ 0.

Comments on CEX Estimates and Interpretation

- The JPS estimates are not robust to different categorizations.
  - Many categories they omitted have negative MPCs.
  - Estimates with BEA aggregates imply MPCs near 0.

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- The JPS estimates are not robust to different categorizations.
  - Many categories they omitted have negative MPCs.
  - Estimates with BEA aggregates imply MPCs near 0.
- And, the 2001 tax rebate wasn't a temporary stimulus!
  - The rebates were an initial payment on a 10-year tax cut.
  - Permanent income households should have MPC ≈ 0.33 if not Ricardian.
  - With Ricardian equivalence, predicted MPC ≈ 0.
- Experiment and micro estimates are too imprecise to shed light on macro model.

Lessons Learned from 2001 Rebates Counterfactual Exercise

- The headline JPS estimates imply implausible macro counterfactuals.
- Factoring in GE forces amplifies the problem.
- Re-examining the micro estimates reveals nonrobustness of estimates.
  - The BEA categories give quantitative and statistical 0 MPCs.
- Re-examining the natural experiment reveals that it is not a temporary stimulus experiment.

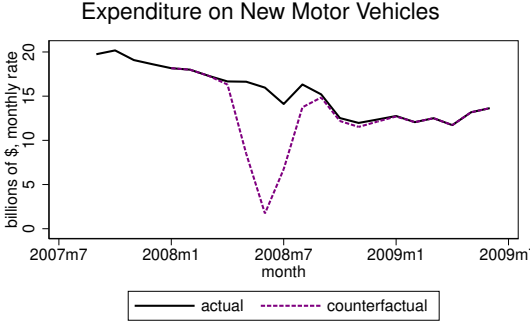
The 2008 Rebates Counterfactual

The 2008 Rebates Counterfactual

- 2008 rebates were even bigger - $100 billion, 11% of disposable income.
- Among recipients, average rebate was $1,000.
- Passed February 2008, distributed May - August 2008
- These rebates were temporary.
- The following is based on Orchard, Ramey, Wieland "Micro MPCs and Macro Counterfactuals: The Case of the 2008 Rebates" (2003)

Parker et al. (PSJM) Estimates from the 2008 Rebate

- PSJM estimated very high MPCs: 0.5 - 0.9 for total consumption.
- Majority of spending on motor vehicles.
- Motor Vehicle counterfactual (with no GE) is implausible.



Our GE Counterfactual Analysis of 2008 Rebate

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- Use a two-good, two-agent NK (TG-TANK) model to compute general equilibrium counterfactuals.
  - Nondurable and durable goods.
  - Durable good interpreted as motor vehicles.

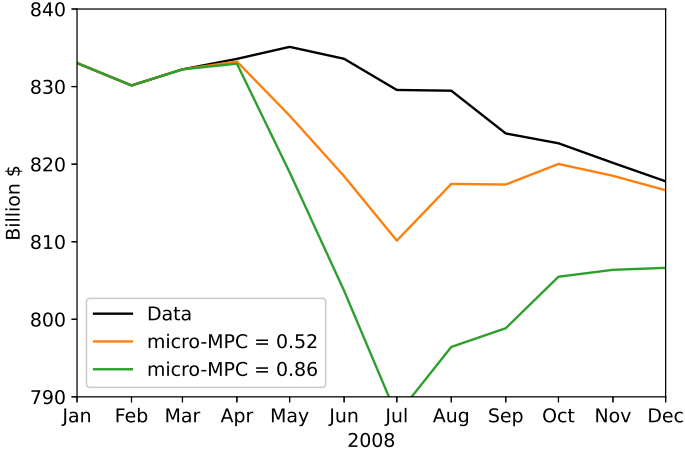
Our GE Counterfactual Analysis of 2008 Rebate

- Use a two-good, two-agent NK (TG-TANK) model to compute general equilibrium counterfactuals.
  - Nondurable and durable goods.
  - Durable good interpreted as motor vehicles.
- Argue that high micro MPCs imply implausible macro counterfactuals.
  - Offer detailed narrative of events in spring/summer 2008.
  - Compare counterfactual path to professional forecasts and our own forecasting model.

A Few Details of the Calibration of TG-TANK Model

- Match micro estimates of durable demand elasticity.
- Set fraction of hand-to-mouth households to match PSJM range for total consumption, 0.52 and 0.86; set motor vehicle MPC at 0.4.
- Baseline model - relative supply curve of durables (in terms of nondurables) is infinitely elastic.
- Match size and timing of the actual rebate.

Counterfactual Total Consumption: Baseline Model

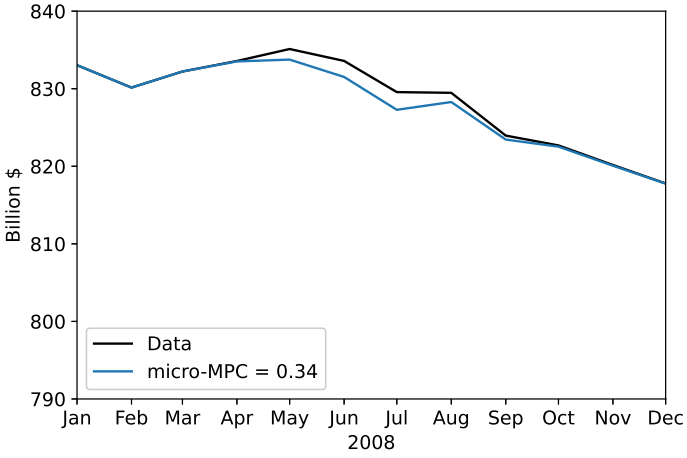


- Counterfactuals have pronounced V-shapes.

Reconciliation of Micro Estimates with Macro Counterfactuals

- We re-examine the micro MPC estimates in light of the new econometrics of diff-in-diff estimators.
  - We identify three upward bias.
  - Correcting for those biases $\Rightarrow \downarrow$ MPC estimates by 40% or more.
  - MPC on nondurables = 0.
- We modify the macro model to allow for general / partial equilibrium dampening.
  - Upward-sloping relative supply curve for motor vehicles $\Rightarrow$ crowding out.
  - Consistent with $\uparrow$ relative price of motor vehicles during the period.

Counterfactual: Less Elastic Durable Supply Model



- Micro-MPC = 0.34 on total consumption is our estimate.
- Less elastic supply $\Rightarrow$ GE-MPC < 0.1.

Lessons from the Rexamination of the 2008 Rebate

- The addition of durable goods is crucial for our dampening result because durables have much more elastic demand than nondurables.
- Both overall MPC and the distribution of spending across durables vs. nondurables matter for the GE outcome.
- If we calibrate the MPC to 0.34 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.
- The reconciliation implies that the multiplier on temporary rebates is below 0.1.

3rd Illustration: State-Level ARRA Multiplier Estimates

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- Chodorow-Reich's (2019) synthesized cross-sectional state-level estimates of jobs multipliers for the ARRA (Obama Stimulus), passed in February 2009.

- He estimated that 2.01 jobs (s.e. 0.59) were created for every $100,000 federal dollars spent in a state.

- Using theoretical insights from Farhi-Werning (2016), he argued that the state level multipliers were a lower bound on the aggregate multipliers, due to ZLB in 2009.

Creating the Macro Counterfactual

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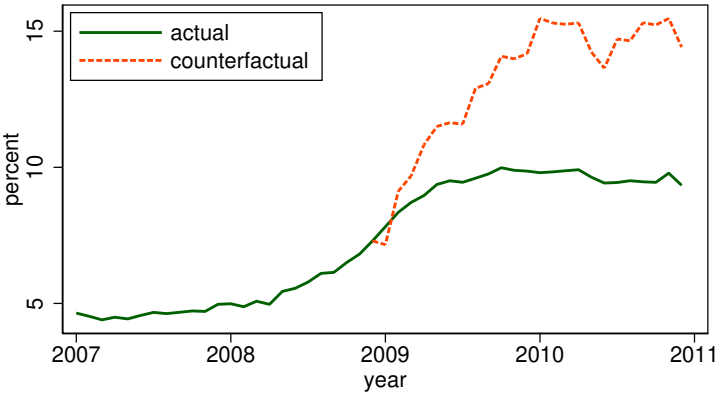
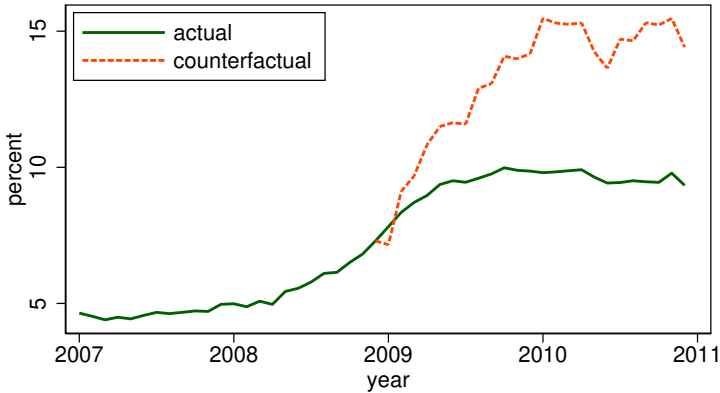
I created this macro counterfactual in a 2017 discussion published in 2019.

- I used Chodorow-Reich's estimated impulse responses of employment and his estimates of how much of the ARRA was spent by Dec. 2010.
- I created a counterfactual unemployment rate by adding the induced employment to the actual number unemployed.

Counterfactual U.S. Unemployment Rate for the ARRA



Counterfactual U.S. Unemployment Rate for the ARRA



- Counterfactual $\Rightarrow$ unemployment rate $\uparrow$ to 15.5% if no ARRA.
- Δ from Dec. 2008 to peak: actual = 2.7%, counterfactual = 8%

Reconciliation of State Estimates with Macro Counterfactual

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- State-level estimates not nationally representative (Ramey 2019 JEP)
  - Studies use per capita variables, so each state is weighted equally.
  - This could be a problem if there are hetergeneous treatment effects.
  - Most studies do not take into account induced state government spending.
  - When I weight states by population and include induced state spending, I estimate 0.9 jobs (s.e. 0.45) created per $100,000.

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  - When I weight states by population and include induced state spending, I estimate 0.9 jobs (s.e. 0.45) created per $100,000.
- The 0.9 estimate implies that the unemployment rate would have risen to around 12.4% with no ARRA.

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- I have illustrated this method using three examples from my work.
- The search for reconciliation between micro estimates and macro counterfactuals has led to new insights about better ways to model the macro effects and better estimates of the micro parameters.
- This method can be used for natural experiments in other countries as well as for other questions, including partial equilibrium questions.

Thank you!

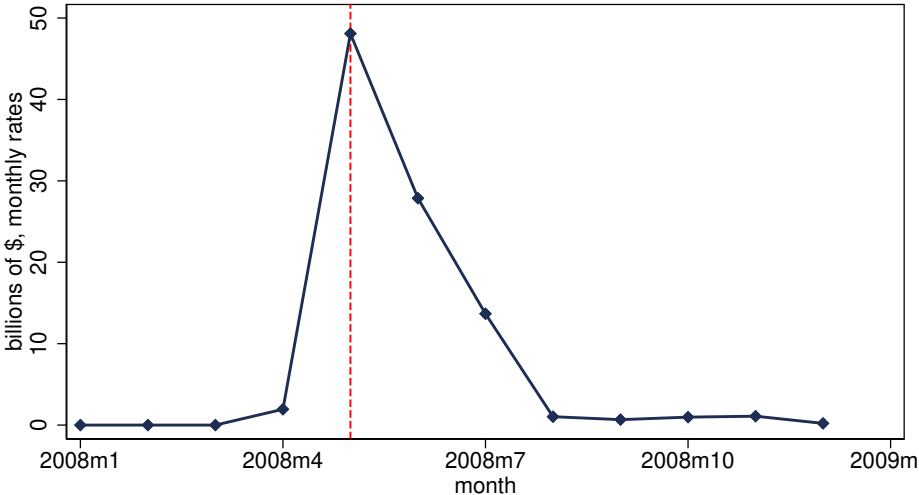
Narrative of 2008

Review of data and major economic events.

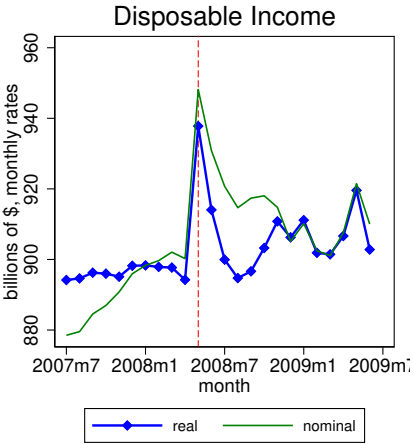
Details of the 2008 Rebate

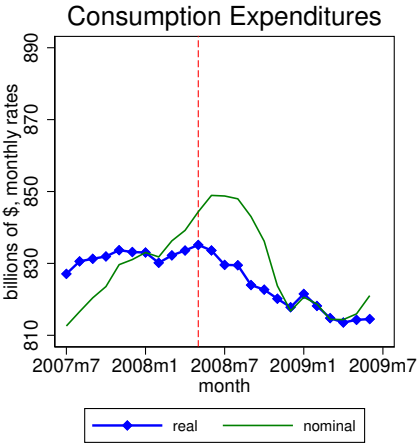
- Passed in February 2008, most funds distributed April - July.
- $100 billion, equal to 11% of January disposable income (monthly basis).
- 85% of "tax units" received a payment; phased out at higher income.
- Among households receiving a payment, the average check was $1,000.

2008 Tax Rebate



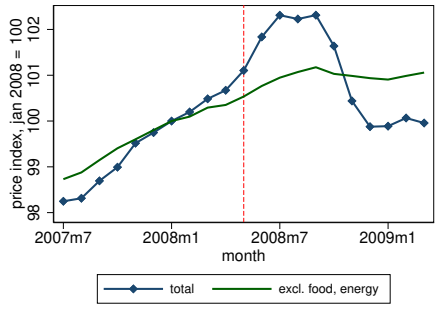
Disposable Income and Consumption

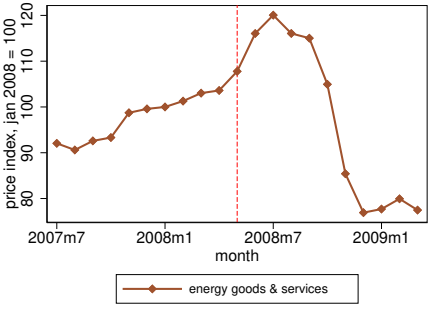




PCE by Product | Motor Vehicles

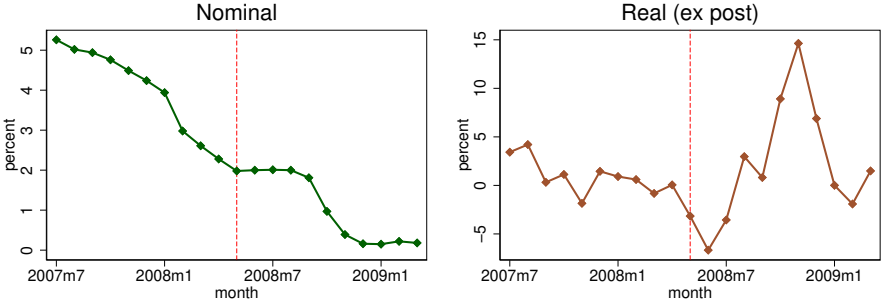
Consumption Price Indexes (PCE)





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

Behavior of Monetary Policy: Federal Funds Rate



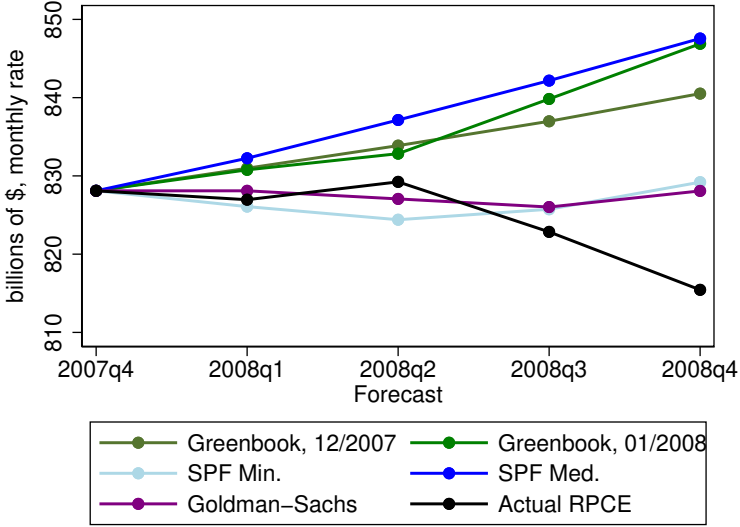
Note: Ex ante real interest rate constructed using the University of Michigan Consumer Survey median inflation expectations.

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

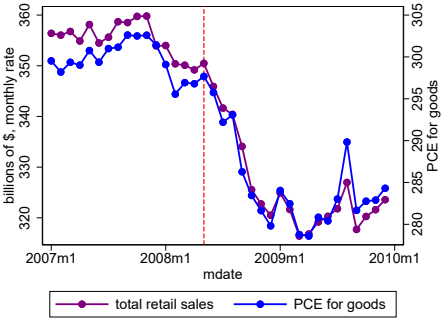
Professional Forecasters

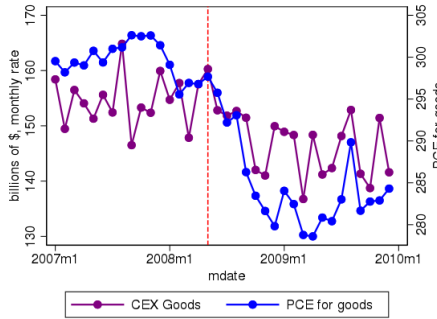


Alternative measures of Aggregate Consumption

- 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.

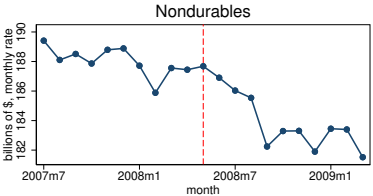
Comparison of PCE to Retail Sales and CEX

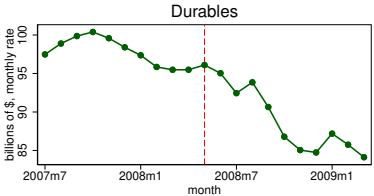


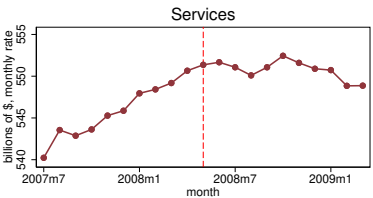


Difference in CEX and PCE Over Time

Real Consumption Expenditures by Type of Product

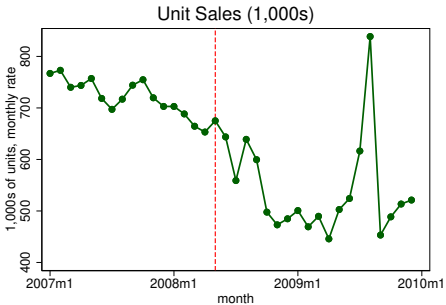


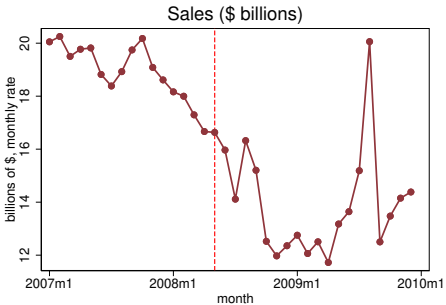




Return

New Motor Vehicle Sales to Consumers





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

Table: Counterfactual Real PCE Declines between April and July 2008

MPC	Decline
0.52	2.8 %
0.86	5.5 %

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 %

Back

Description of our forecasting equations

Included Variables

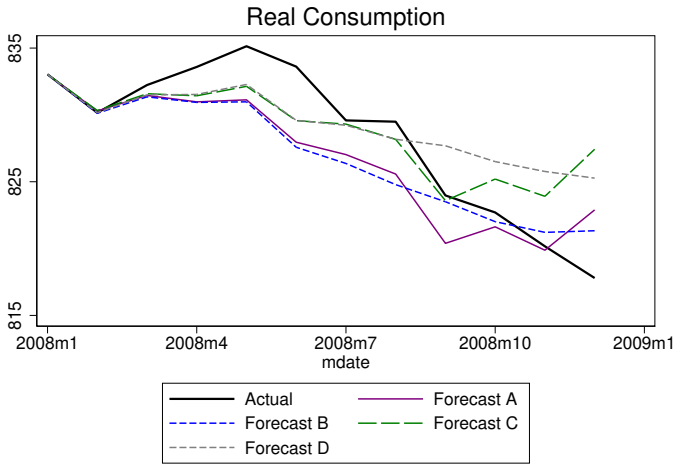
Endogenous variables	Endogenous or exogenous depending on specification
Log real consumption	Recession dummy
Log real disposable income	Log real oil prices
Log consumption deflator	Lehman bankruptcy dummy
Gilchrist-Zakrajek spread	

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

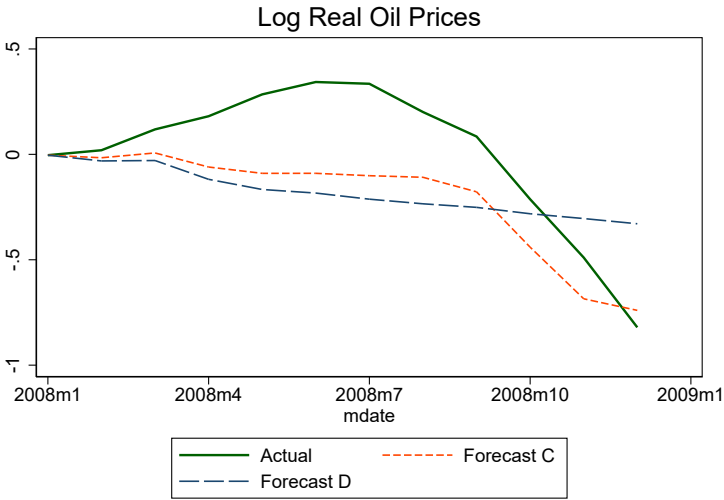
Forecast Model	Lehman dummies included?	Real Oil Prices
Model A	Yes	exogenous
Model B	No	exogenous
Model C	Yes	endogenous
Model D	No	endogenous

Forecasts from four models using information through 2008m1

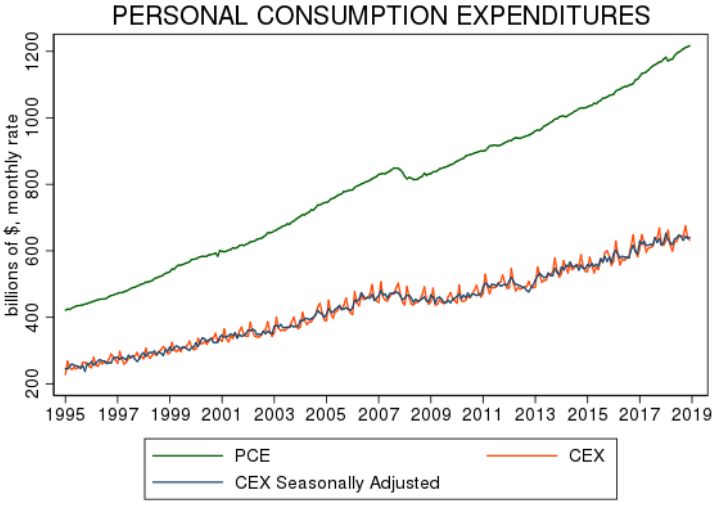


Return

Forecasts of Log Oil Prices

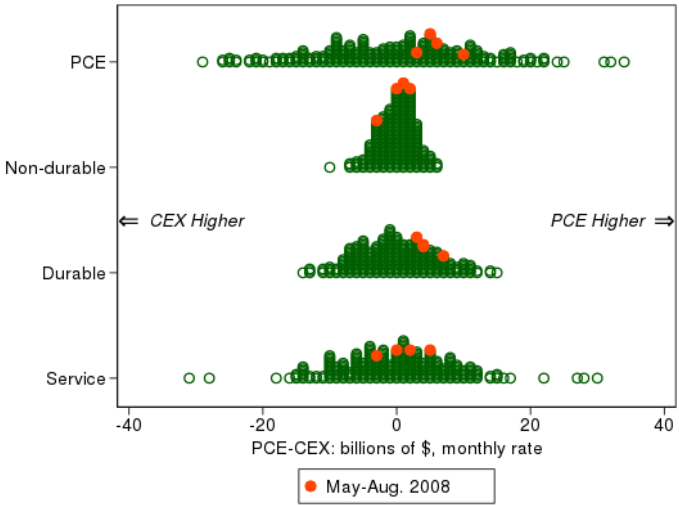


Difference CEX and PCE Over Time



Return

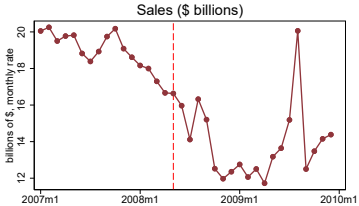
CEX v PCE Gap is Normal in Summer of 2008

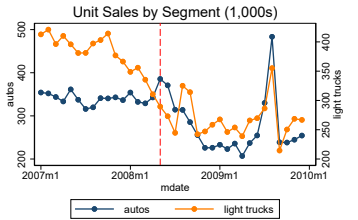


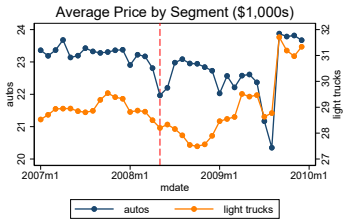
Note: Difference is demeaned and conditional on linear time-trend.

Return

Motor Vehicle Sales by Segment

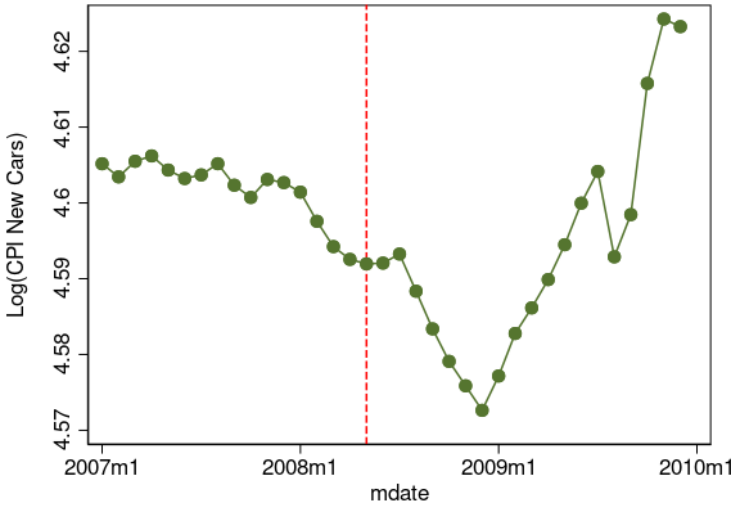






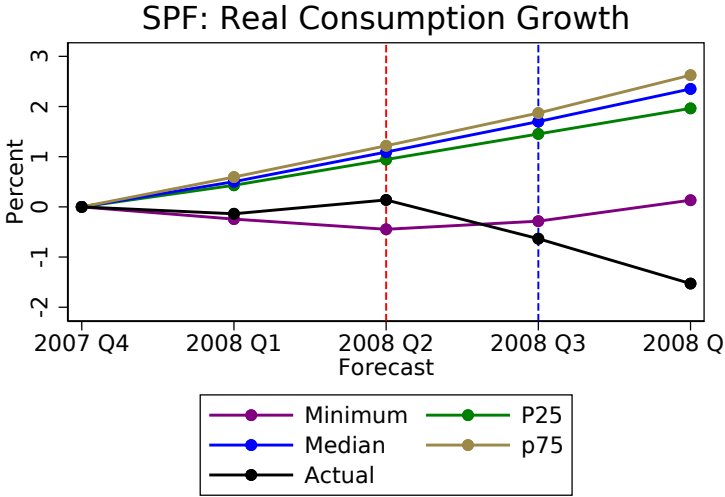
Return

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%
Feb-May-Aug-Nov	34%	35%	40%
Mar-Jun-Sep-Dec	36%	28%	32%

Notes: Data in column 1 come from the entire CEX Sample 2007-2009. Data in columns 2-4 come from our subsample.

Return

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
θ^d	varies	Calvo parameter on durable adjustment
σ^d	1	Utility curvature on durable service flow
mpx	varies	Hand-to-Mouth MPC on durables
ψ	0.189	Weight on durable service flow
δ^d	0.015	Depreciation of durable consumption goods
ϕ_b	0.1	Debt feedback coefficient in fiscal rule

Notes: The model is calibrated at a monthly frequency. The parameter γ is calibrated to either 0.34, 0.52, or 0.86, which corresponds to the aggregate MPC in the model. The parameter θ^d is calibrated such that for each value of γ to model replicates our empirical targets for the short-term interest elasticity of durable demand. For example, when $\gamma = 0.34$, then $\theta^d = 0.844$. See the text for details.

Return

Could the rise in oil prices have reduced consumption?

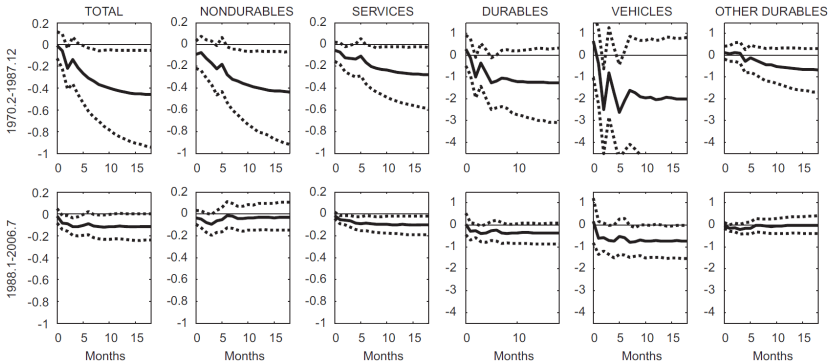


Fig. 4. Selected responses by sample period. *Notes*: Split-sample VAR estimates for U.S. data based on the purchasing power loss associated with an unanticipated change in weighted retail energy prices.

First Stage: Rebate Amount Conditional on Rebate Receipt

Full Sample

	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	948.60***	951.10***	950.54***	945.95***
	(10.37)	(10.29)	(10.19)	(10.07)
Lag Rebate Indicator		11.97***	0.59	−2.94**
		(3.17)	(0.54)	(1.20)
Lag Total Expenditure				0.00***
				(0.00)
Lag Motor Vehicle				−0.00*
				(0.00)
Income Decile FE	No	No	No	Yes
Observations	16,962	16,962	16,962	16,962

Return

First Stage: Rebate Amount Conditional on Rebate Receipt

Rebate Only Sample				
	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	931.69***	945.06***	939.42***	946.84***
	(13.11)	(12.73)	(12.53)	(13.25)
Lag Rebate Indicator		24.14***	−2.23	6.42
		(7.73)	(1.92)	(4.30)
Lag Total Expenditure				0.00***
				(0.00)
Lag Motor Vehicle				−0.00***
				(0.00)
Income Decile FE	No	No	No	Yes
Observations	10,076	10,076	10,076	10,076

Return

Household Motor Vehicle and Parts Response to Rebate

Full Sample				
	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	234.38	215.83	207.21	308.41***
	(164.25)	(155.01)	(158.89)	(114.69)
Lag Rebate Indicator		−88.74	−56.35	129.58
		(172.87)	(141.99)	(94.72)
Lag Total Expenditure				0.02***
				(0.01)
Lag Motor Vehicle				−1.04***
				(0.01)
Implied 3-month MPC	0.25	0.23	0.22	0.33
Implied 6-month MPC		0.36	0.38	0.46
6-Month MPC S.E.		(0.34)	(0.36)	(0.17)
Income Decile FE	No	No	No	Yes
Observations	16,962	16,962	16,962	16,962

Return

Household Motor Vehicle and Parts Response to Rebate

Rebate Only Sample				
	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	146.21	0.60	438.05	286.72*
	(258.31)	(263.57)	(380.64)	(173.35)
Lag Rebate Indicator		−262.88	276.01	138.07
		(297.04)	(325.18)	(120.18)
Lag Total Expenditure				0.02***
				(0.01)
Lag Motor Vehicle				−1.04***
				(0.01)
Implied 3-month MPC	0.16	0.00	0.47	0.30
Implied 6-month MPC		-0.27	1.23	0.44
6-Month MPC S.E.		(0.71)	(1.07)	(0.24)
Income Decile FE	No	No	No	Yes
Observations	10,076	10,076	10,076	10,076

Return

Other PCE

Full Sample

	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	272.78*	249.25*	181.13	−20.28
	(148.70)	(146.92)	(150.85)	(145.54)
Lag Rebate Indicator		−112.55	−32.24	−181.36
		(145.95)	(145.91)	(133.82)
Lag Total Expenditure				−0.28***
				(0.03)
Lag Motor Vehicle				0.30***
				(0.03)
Implied 3-month MPC	0.29	0.26	0.19	-0.02
Implied 6-month MPC		0.40	0.35	-0.22
6-Month MPC S.E.		(0.35)	(0.36)	(0.32)
Income Decile FE	No	No	No	Yes
Observations	16,962	16,962	16,962	16,962

Return

Other PCE

Rebate Only Sample				
	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	664.85***	543.76**	195.94	68.29
	(211.41)	(238.28)	(393.64)	(460.16)
Lag Rebate Indicator		−218.62	−479.35*	−483.39
		(202.67)	(271.64)	(343.67)
Lag Total Expenditure				−0.32***
				(0.02)
Lag Motor Vehicle				0.33***
				(0.03)
Implied 3-month MPC	0.71	0.58	0.21	0.07
Implied 6-month MPC		0.90	-0.09	-0.38
6-Month MPC S.E.		(0.62)	(1.07)	(1.14)
Income Decile FE	No	No	No	Yes
Observations	10,076	10,076	10,076	10,076

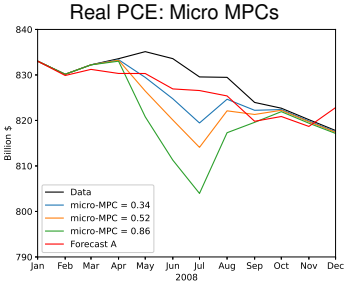
Return

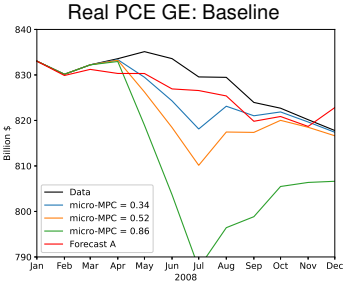
Future Rebate Predicts Low Current Expenditure

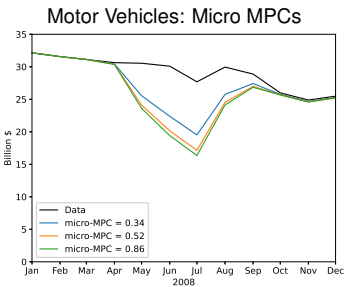
	Full Sample (1)	Rebate Recipients Only (2)
Lead Rebate Indicator	−866.5***	−562.0*
	(289.5)	(335.9)
Rebate Indicator	−383.4	246.1
	(303.8)	(377.8)
Observations	16,962	10,076

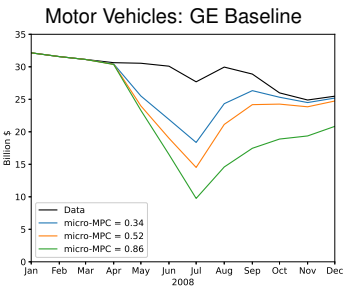
Return

Counterfactual Consumption Expenditure: Baseline Model



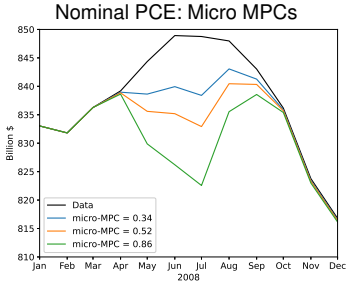


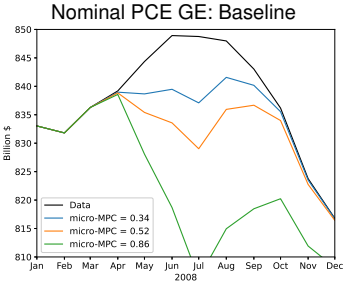


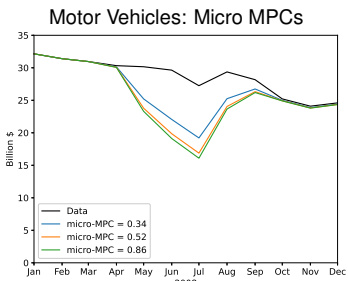


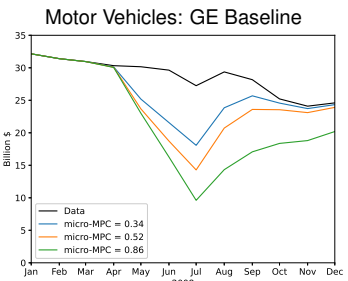
Return

Counterfactual Consumption Expenditure: Baseline Model



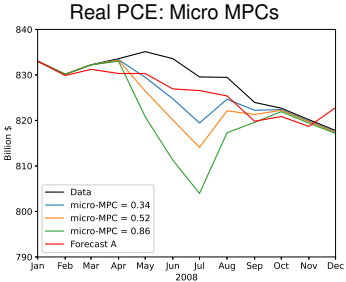


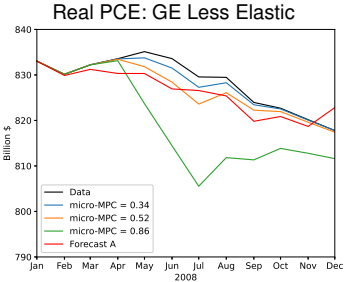


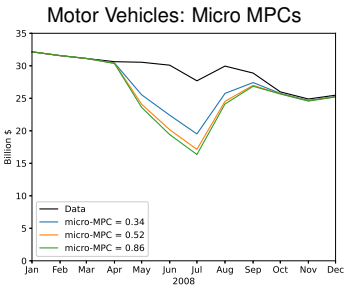


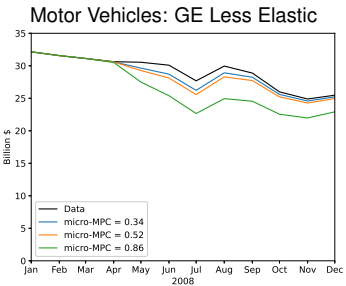
Return

Counterfactual: Less Elastic Durable Supply Model



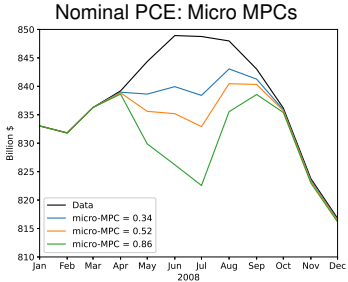


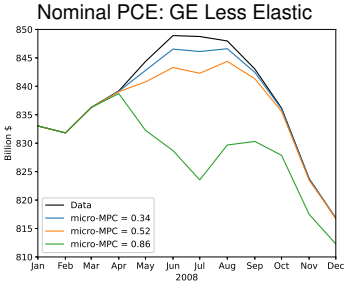


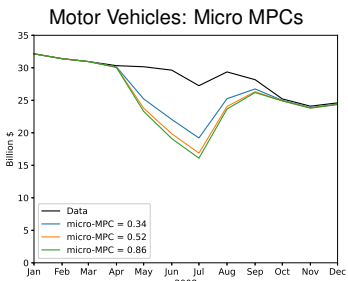


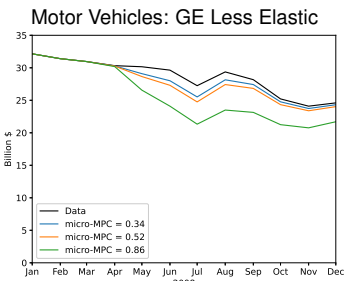
Return

Counterfactual: Less Elastic Durable Supply Model



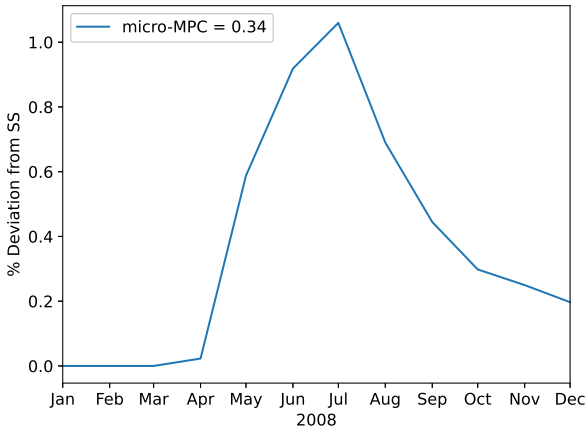






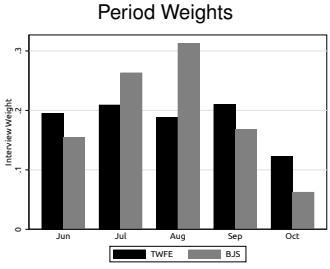
Return

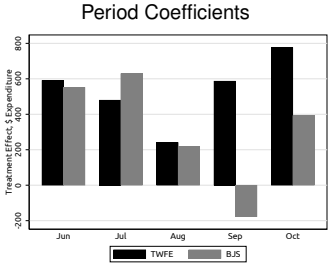
IRF of Relative Durable Price

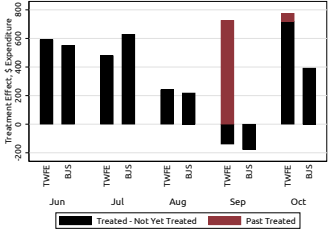


Return

Decomposing OLS v.DID Imputation







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