Household Aggregation

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Reminders

1. First project draft due May 4.

Outline

Outline

What is the MPC?

- MPC $=$ marginal propensity to consume.
- Very important parameter in old Keynesian models.
- In standard New Keynesian models ≈ 0.
  - Euler equation $\Rightarrow$ Permanent income consumer.
- TANK and HANK models.
  - How does the micro MPC matter in the aggregate?

Identification Problem

$$c_{it} = \alpha + \beta y_{it} + \varepsilon_{it}$$

- What could go wrong?

Jonathan Parker Oeuvre

- Johnson, Parker, Souleles, AER 2003: 20-40% of 2001 Rebate spent on nondurable goods within 3 months.
- Parker, Souleles, Johnson, McClelland, AER 2008: 50-90% of 2008 Rebate spent on nondurable and durable goods within 3 months.
- Broda, Parker, JME 2014: 2008 rebate caused 10% increase in spending in first week.
- Parker, Schild, Erhard, Johnson, WP 2022: 10% of 2020 stimulus was spent within 3 months.

Outline

THE 2008 EXPERIMENT

TABLE 1—THE TIMING OF THE ECONOMIC STIMULUS PAYMENTS OF 2008

Payments by electronic funds transfer		*Payments by mailed check*	
Last two digits of taxpayer SSN	Date ESP funds transferred to account by	Last two digits of taxpayer SSN	Date check to be received by
00–20	May 2	00–09	May 16
21–75	May 9	10–18	May 23
76–99	May 16	19–25	May 30
		26–38	June 6
		39–51	June 13
		52–63	June 20
		64–75	June 27
		76–87	July 4
		88–99	July 11

Source: Internal Revenue Service (http://www.irs.gov/newsroom/article/0,,id=180247,00.html).

Specification

$$C_{i,t+1} - C_{i,t} = \sum_s \beta_{0s} \times month_{s,i} + \beta_1' X_{i,t} + \beta_2 ESP_{i,t+1} + u_{i,t+1}$$

- Comments? Concerns?

Effects on Expenditure

Table 2—The Contemporaneous Response of Expenditures to ESP Receipt among All Households

	Food OLS	Strictly nondurables OLS	Nondurable spending OLS	All CE goods and services OLS	Food OLS	Strictly nondurables OLS	Nondurable spending OLS	All CE goods and services OLS
Panel A. Dollar change in spending								
ESP	0.016	0.079	0.121	0.516				
	(0.027)	(0.046)	(0.055)	(0.179)				
I(*ESP*)					10.9	74.8	121.5	494.5
					(31.7)	(56.6)	(67.2)	(207.2)
	Food OLS	Strictly nondurables OLS	Nondurable spending OLS	All CE goods and services OLS	Food 2SLS	Strictly nondurables 2SLS	Nondurable spending 2SLS	All CE goods and services 2SLS
Panel B. Percent change in spending					*Panel C. Dollar change in spending*			
ESP					0.012	0.079	0.128	0.523
					(0.033)	(0.060)	(0.071)	(0.219)
I(*ESP*)	0.69	1.74	2.09	3.24				
	(1.27)	(0.96)	(0.94)	(1.17)				

Notes: All regressions also include a full set of month dummies, age, change in the number of adults, and change in the number of children following equation (1). Reported standard errors are adjusted for arbitrary within-household correlations and heteroskedasticity. The coefficients in panel B are multiplied by 100 so as to report a percent change. The last four columns report results from 2SLS regressions where the indicator variable for ESP receipt and the other regressors are used as instruments for the amount of the ESP. All regressions use 17,478 observations except for the first two columns of panel B which have only 17,427 and 17,475, respectively.

SUB-SAMPLES

TABLE 3—THE RESPONSE TO ESP RECEIPT AMONG HOUSEHOLDS RECEIVING PAYMENTS

	Dollar change in		Percent change in		Dollar change in	
	Nondurable spending	All CE goods and services	Nondurable spending	All CE goods and services	Nondurable spending	All CE goods and services
	OLS	OLS	OLS	OLS	2SLS	2SLS
Panel A. Sample of all households ($N = 17{,}478$)						
ESP	0.117	0.507			0.123	0.509
	(0.060)	(0.196)			(0.081)	(0.253)
$I(ESP)$			2.63	3.97		
			(1.07)	(1.34)		
$I(ESP_{i,t} > 0 \text{ for any } t)_i$	9.58	21.21	−0.88	−1.17	8.23	20.77
	(36.07)	(104.00)	(0.50)	(0.63)	(38.79)	(112.18)
Panel B. Sample of households receiving ESPs ($N = 11{,}239$)						
ESP	0.185	0.683			0.252	0.866
	(0.066)	(0.219)			(0.103)	(0.329)
$I(ESP)$			3.91	5.63		
			(1.33)	(1.69)		
Panel C. Sample of households receiving only on-time ESPs ($N = 10{,}488$)						
ESP	0.214	0.590			0.308	0.911
	(0.070)	(0.217)			(0.112)	(0.342)
$I(ESP)$			4.52	6.05		
			(1.50)	(1.89)		

Persistence

Table 5—The Longer-Run Response of Expenditures to ESP Receipt

	Dollar change in		Percent change in		Dollar change in	
	Nondurable spending OLS	All CE goods and services OLS	Nondurable spending OLS	All CE goods and services OLS	Nondurable spending 2SLS	All CE goods and services 2SLS
ESP_{t+1} or $I(ESP_{t+1})$	0.201	0.517	3.92	4.96	0.254	0.757
	(0.067)	(0.211)	(1.55)	(1.96)	(0.110)	(0.360)
ESP_t or $I(\text{ESP}_t)$	−0.054	−0.288	−1.23	−2.22	−0.097	−0.278
	(0.080)	(0.214)	(1.50)	(1.92)	(0.113)	(0.330)
Implied spending effect in second three-month period	0.146	0.230	NA	NA	0.156	0.479
	(0.104)	(0.303)			(0.177)	(0.568)
Implied cumulative fraction of rebate spent over both three-month periods	0.347	0.747	NA	NA	0.410	1.235
	(0.155)	(0.477)			(0.273)	(0.892)

Notes: All regressions also include the change in the number of adults, the change in the number of children, the age of the household, and a full set of month dummies. The sample includes only households receiving only on-time ESPs. Standard errors are adjusted for arbitrary within-household correlations and heteroskedasticity. The coefficients in the second triplet of columns are multiplied by 100 so as to report a percent change. The final triplet of columns reports results from 2SLS regressions where $I(ESP)$ and the other regressors are used as instruments for ESP. The number of observations for all regressions is 10,488.

Heterogeneous Treatment Effects

Table 6—The Propensity to Spend across Different Households

Interaction:	*Panel A. By age*		*Panel B. By income*		*Panel C. By liquid assets*		*Panel D. By housing status*	
Dependent variable:	Dollar change in		Dollar change in		Dollar change in		Dollar change in	
	Non-durable spending	All CE goods and services	Non-durable spending	All CE goods and services	Non-durable spending	All CE goods and services	Non-durable spending	All CE goods and services
	Age Low: ≤ 40 High: > 58		Income Low: $\leq 32{,}000$ High: $> 74{,}677$		Liquid assets Low: ≤ 500 High: $> 7{,}000$		Housing status Low: own with mortgage High: own without	
ESP	0.345	0.952	0.215	0.568	0.275	0.851	0.213	0.431
	(0.133)	(0.398)	(0.124)	(0.442)	(0.164)	(0.558)	(0.153)	(0.455)
ESP × *Low*	−0.150	−0.461	0.024	0.715	−0.253	−0.844	0.043	0.543
(group difference)	(0.124)	(0.399)	(0.155)	(0.500)	(0.184)	(0.527)	(0.131)	(0.394)
ESP × *High*	0.044	0.414	−0.009	0.205	−0.075	0.083	0.260	0.800
(group difference)	(0.151)	(0.472)	(0.139)	(0.466)	(0.186)	(0.631)	(0.169)	(0.514)
Observations	10,488	10,488	8,592	8,592	5,071	5,071	10,380	10,380
Implied total spending								
Low group	0.195	0.491	0.239	1.283	0.022	0.007	0.256	0.974
	(0.114)	(0.394)	(0.180)	(0.564)	(0.205)	(0.566)	(0.112)	(0.364)
High group	0.389	1.366	0.206	0.773	0.200	0.934	0.473	1.231
	(0.168)	(0.498)	(0.133)	(0.463)	(0.202)	(0.677)	(0.175)	(0.508)

CONVINCING?

More MPCs

- Shapiro and Slemrod (AER 2003, AER, 2009): self-reported MPC of 25-30% out of rebates in 2001 / 2008.

- Japielli and Pistaferri (AEJ-Macro, 2014): self-reported MPC of 48% out of hypothetical transitory income shock.

- Faegereng, Holmn, and Natvick (AEJ-Macro, 2021): 50% MPC within one year of large lottery winnings in Norway. Consumption is resiaul from budget constraint: $C = Y - \Delta A$.

Outline

1936 Veterans' Bonus

Table 2—The Magnitude of the Bonus

	1936	2012	2012 bonus equivalent
Per capita annual income	\$530	\$39,409	\$40,673
Average annual wage of federal emergency workers	\$595	—	—
Average hourly earnings in manufacturing	\$0.62	\$19.08	\$16,853
CPI (Index, 1936 = 100)	100	1,656	\$ 9,053
Nominal house prices (Index, 1936 = 100)	100	2,506	\$13,702
Price of cheapest Ford	\$510	\$14,000	\$15,009

Note: The third column equals the average 1936 bonus amount, \$547, times the ratio of the second to the first column $\left(\text{e.g., in the first row, } \$40{,}673 = \$547 \times \frac{\$39{,}409}{\$530}\right)$.

Sources: Per capita income: NIPA table 2.1; annual wage of federal emergency workers: Darby (1976); average hourly earnings in manufacturing (production workers only): Sayre (1940) and FRED series AHEMAN; CPI: FRED series CPIAUCNS; house prices: Robert Shiller, http://www.econ.yale.edu/~shiller/data.htm; Ford price: *Automotive Industries*, "Ford Prices." November 14, 1936, p. 666, and http://www.ford.com.

Evidence

1. Cross-household evidence from consumption survey data.
2. Cross-state evidence on auto purchases.
3. Cross-city evidence on building permits.
4. Survey evidence on intentions to spend.

Household Consumption Survey

- Research design:

$$C_i = \mathbf{Z_i}'\beta_1 + \beta_2 V_i + \beta_3 P_i + \beta_4 V_i P_i + \varepsilon_i$$

- C_i is consumption of household i.
- V_i is a dummy equal to 1 if the household includes a veteran.
- $\mathbf{Z_i}$ is a vector of controls.
- P_i is a dummy equal to 1 if the household reported consumption after the bonus was paid.
- Why is this research design not feasible?

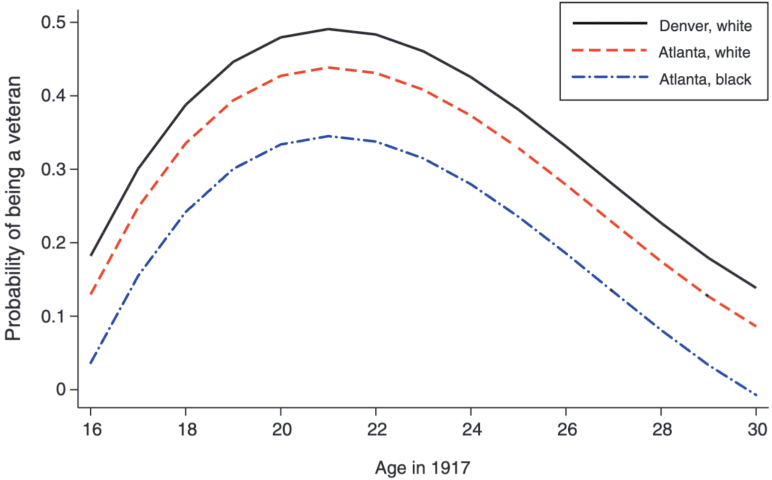
First Stage

- Research design (2):

$$V_j = \sum_{h=1}^{3} \beta_h \mathbb{1}(g_j = g_h) + \sum_{k=1}^{17} \gamma_h \mathbb{1}(s_j = s_k) + \sum_{l=1}^{17} \alpha_l \mathbb{1}(g_j = 2)\mathbb{1}(s_j = s_l) +$$
$$\sum_{m=1}^{3} \theta_m a_j^m + \sum_{n=1}^{3} \lambda_n \mathbb{1}(g_j = 2) a_j^n + \zeta r_j + \eta \mathbb{1}(g_j = 2) r_j + \mu_j$$

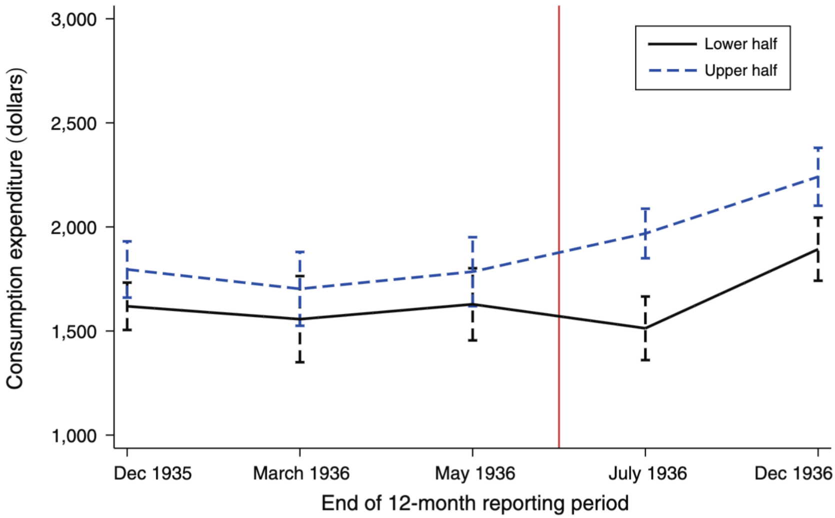
- g is age group in 1930: $< 28, 28 - 45, > 45$.
- s is an indicator for state.
- a is age.
- r is race.
- Why a linear probability model?

First Stage



Denver, white
Atlanta, white
Atlanta, black
Probability of being a veteran
0.5
0.4
0.3
0.2
0.1
0
16
18
20
22
24
26
28
30
Age in 1917

PRE-TRENDS



3,000
2,500
2,000
1,500
1,000
Consumption expenditure (dollars)
Lower half
Upper half
Dec 1935
March 1936
May 1936
July 1936
Dec 1936
End of 12-month reporting period

Second Stage

Table 5—Total Expenditure and Saving Regressions

	Total C (1)	Total C (2)	Insurance policies settled (3)	Gifts received (4)
Post bonus dummy	264.1***	198.2***	−5.590	0.0742
	(70.52)	(43.17)	(4.292)	(6.855)
Interaction	647.2*	403.1**	96.0***	152.4***
	(379.4)	(169.7)	(22.88)	(46.45)
Omit if expenditure > $5,000	No	Yes	Yes	Yes
Observations	2,745	2,681	2,681	2,339
R^2	0.152	0.186	0.034	0.048

Notes: All columns include the full set of second stage controls for age, race, and geography. See the text for details. Bootstrap standard errors clustered at the city level in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Cross-State Evidence

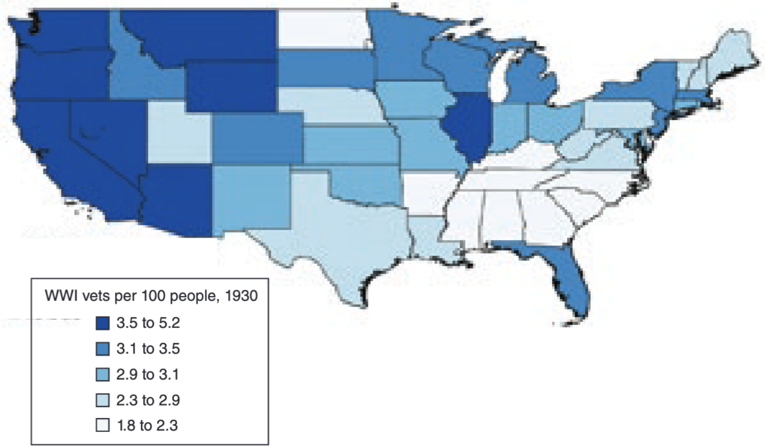


Figure 4. Veterans per 100 people in 1930

Convincing?

- What did you think of the other evidence?

Outline

de Chaisemartin and D'Haultfœuille, AER 2020

- Panel, binned into cells g, t (g=group).
- $Y_{i,g,t}$ outcome of unit i in cell g, t.
- $D_{g,t}$ treatment indicator.
- Expectation of OLS 2-way FE estimator:

$$\beta_{fe} = E\left(\sum_{(g,t):D_{g,t}=1} W_{g,t}\Delta_{g,t}\right)$$

  - $W_{g,t}$ are weights, $\sum_{(g,t):D_{g,t}=1} W_{g,t} = 1$.
  - $\Delta_{g,t}$ is the group-specific ATE.

What is the Problem?

- With homogeneous treatment effects, no problem:

$$\Delta_{g,t} = \Delta \Rightarrow \beta_{fe} = \Delta$$

- With heterogenous treatment effects β_{fe} may be poor guide to average ATE since weights $W_{g,t}$ may be negative.

Outline

Borusyak, Jaravel, and Spiess, ReStud 2024

Table 1: Two-Unit, Three-Period Example

$\mathbb{E}[Y_{it}]$	$i = A$	$i = B$
$t = 1$	α_A	α_B
$t = 2$	$\alpha_A + \beta_2 + \tau_{A2}$	$\alpha_B + \beta_2$
$t = 3$	$\alpha_A + \beta_3 + \tau_{A3}$	$\alpha_B + \beta_3 + \tau_{B3}$
Event date	$E_i = 2$	$E_i = 3$

Notes: without loss of generality, we normalize $\beta_1 = 0$.

- 2-way FE OLS population coefficient is:

$$\beta_{fe} = \tau_{A2} + \frac{1}{2}\tau_{B3} - \frac{1}{2}\tau_{A3}$$

- Not an ATE!
- What is OLS doing here?

Test for Pre-Trends

Table 1: Two-Unit, Three-Period Example

$\mathbb{E}[Y_{it}]$	$i = A$	$i = B$
$t = 1$	α_A	α_B
$t = 2$	$\alpha_A + \beta_2 + \tau_{A2}$	$\alpha_B + \beta_2$
$t = 3$	$\alpha_A + \beta_3 + \tau_{A3}$	$\alpha_B + \beta_3 + \tau_{B3}$
Event date	$E_i = 2$	$E_i = 3$

Notes: without loss of generality, we normalize $\beta_1 = 0$.

- Pre-trend coefficient for lag 2:

$$\beta_{fe,-2} = \tau_{A3} - \tau_{B3}$$

- What is OLS doing here?
- Identified?

Notation

- Binary treatment D_{it}, outcome Y_{it}
- Event date E_{it} where D_{it} switches from 0 to 1.
- Observations $\Omega_1 = \{it \in \Omega : D_{it} = 1\}$ and not-yet-treated Ω_0 (includes never treated).
  - Treated: $\Omega_1 = \{it \in \Omega : D_{it} = 1\}$, $|\Omega_1| = N_1$
  - Not-yet-treated: $\Omega_0 = \{it \in \Omega : D_{it} = 0\}$, $|\Omega_0| = N_0$
- $Y_{it}(0)$ potential outcome if never treated.
- Causal effect $\tau_{it} = E[Y_{it} - Y_{it}(0)]$.

Start from First Principles

- Estimation target:

$$\tau_w = \sum_{it \in \Omega_1} w_{it} \tau_{it} = w' \tau$$

- Assumption 1: Parallel trends

$$E[Y_{it}(0)] = \alpha_i + \beta_t \qquad \forall it \in \Omega$$

- Assumption 2: No anticipation

$$Y_{it} = Y_{it}(0) \qquad \forall it \in \Omega_0$$

- Assumption 3': Restricted causal effects

$$\tau = \Gamma \theta$$

  - θ is unknown $N_1 - M \times 1$, Γ is known $N_1 \times (N_1 - M)$
  - M restrictions on treatment effect. $M = N_1 - 1$ = homogenous effects.

BSJ Theorem 1 [Simplified]

- Suppose Assumptions 1, 2, 3', and 4 [homoscedastic errors] hold. Then among linear unbiased estimators of τ_w, the (unique) efficient estimator $\hat{\tau}_w^*$ can be obtained with the following steps:

1. Estimate θ by $\hat{\theta}$ from the linear regression

$$Y_{it} = \alpha_i + \beta_t + D_{it}\Gamma'_{it}\theta + \varepsilon_{it}.$$

2. Estimate the vector of treatment effects τ by $\hat{\tau} = \Gamma\hat{\theta}$.

3. Estimate the target τ_t by $\hat{\tau}_w^* = w'\hat{\tau}$

BSJ Theorem 2 [Simplified]

- With unrestricted treatment effects ($M = 0$), the unique efficient linear unbiased estimator $\hat{\tau}_w^*$ of τ_w from Theorem 1 can be obtained via an imputation procedure:

  1. Within the untreated observations only ($it \in \Omega_0$), estimate by OLS:
  $$Y_{it} = \alpha_i + \beta_t + \varepsilon_{it}.$$
  2. For each treated observations ($it \in \Omega_1$) with $w_{it} \neq 0$, set $\hat{Y}_{it}(0) = \hat{\alpha}_i + \hat{\beta}_t$ and $\hat{\tau}_{it} = \hat{Y}_{it} - \hat{Y}_{it}(0)$.
  3. Estimate the target τ_w by a weighted sum $\hat{\tau}_w^* = w' \hat{\tau}$

Inference

- Inference problem for treated units:

$$Y_{it} = \alpha_i + \beta_t + \tau_{it} + \varepsilon_{it}.$$

- How to distinguish between unrestricted τ_{it} and ε_{it}?
- "Conservative" standard errors: impose some homogeneity, so attribute some variance to ε_{it} that belongs to τ_{it}.
- Yields asymptotically weakly conservative standard errors.

Pre-trends

- To test for pre-trends augment model for untreated observations with additional pre-determined variables and test that the coefficients are zero.

- Does not distort inference conditional on test passing.

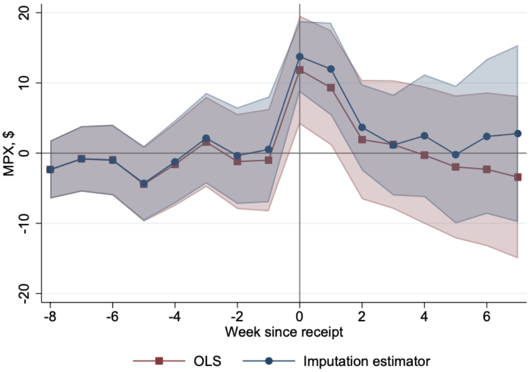
- What happens if we then include these variables in the regression model? Do we satisfy parallel trends?

Application to Broda and Parker, JME 2014

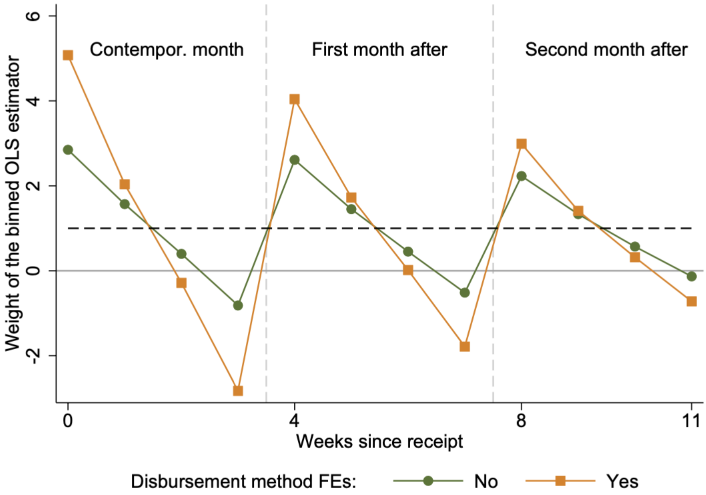
Panel B: With disbursement method fixed effects

	Dollars spent after tax rebate receipt		
	OLS Monthly binned (1)	OLS No binning (2)	Imputation Estimator (3)
Contemporaneous month	47.57	27.88	30.54
	(9.15)	(7.75)	(9.08)
First month after	26.26	−4.48	7.43
	(11.95)	(12.48)	(16.17)
Second month after	20.52	−13.82	4.01
	(14.57)	(16.38)	(29.89)
Three-month total	94.35	9.58	41.97
	(33.54)	(34.42)	(46.56)
N observations	1,127,880	1,127,880	536,553
N households	21,690	21,690	21,690

Dynamic Treatment Effects



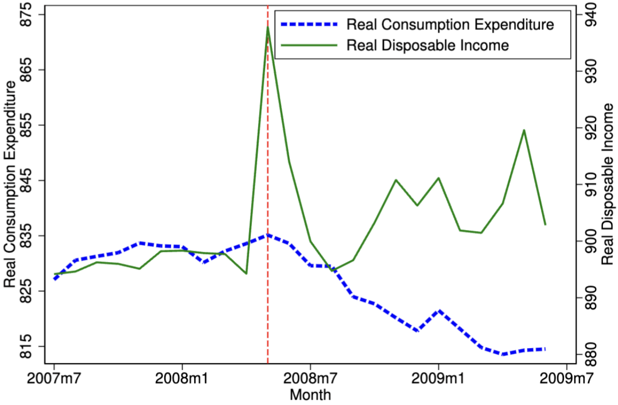
Weights


Weight of the binned OLS estimator
6
4
2
0
-2
Contempor. month
First month after
Second month after
0
4
8
11
Weeks since receipt
Disbursement method FEs:
No
Yes

Outline

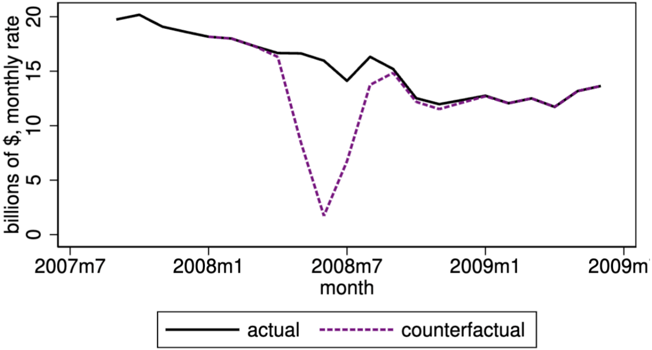
Feldstein (2018) and Taylor (2019) vs PSJM (2013)

Figure 3. Real Aggregate Disposable Income and Consumption Expenditure



Expenditures on New Motor Vehicles: Actual vs. Counterfactual

Figure 1. Expenditures on New Motor Vehicles: Actual vs. Counterfactual



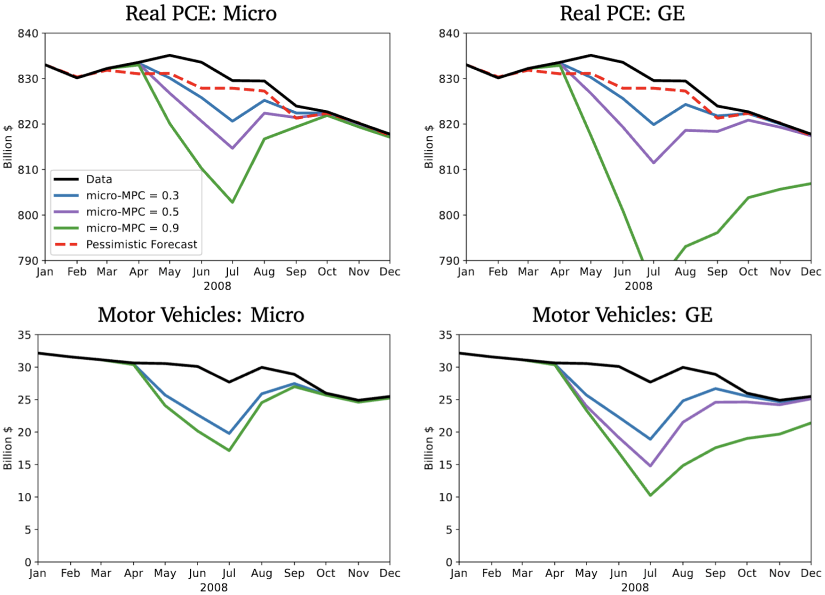
Update of Sahm, Shapiro, Slemrod (2012) calculation, no general equilibrium feedbacks.

Methodology for creating macro counterfactuals

- Construct a medium-scale two-good, two-agent New Keynesian model with nondurables and durables (interpreted as motor vehicles).
- Calibrate fraction of hand-to-mouth households to match micro MPCs.
- Simulate response of consumption to rebates.
- Subtract simulated responses from actual consumption data from 2008 to derive the counterfactual path with no rebate.

Counterfactual Consumption Expenditure

Figure 4. Counterfactual Real Consumption Expenditures: Baseline Model



Plausible?

Table 2. Model Counterfactuals Compared to Largest Historical Expenditure Decline

Panel A: Total PCE				
Largest Historical Declines			Model Counterfactuals	
Date	Episode	Decline	Calibration	Decline
Jan-Apr 2020	COVID lockdowns	17.4	micro MPC = 0.9	6.0
Jan-Apr 1980	Credit controls, Volcker	2.9	micro MPC = 0.5	2.7
Aug-Nov 1974	prior spike up	2.3	micro MPC = 0.3	1.6
Apr-Jul 1960	prior spike up	1.8		
Sep-Nov 2008	Lehman Collapse	1.1		

Panel B: Motor Vehicle Expenditures				
Largest Historical Declines			Model Counterfactuals	
Date	Episode	Decline	Calibration	Decline
Jan-Apr 2020	COVID lockdowns	31.2	micro MPC = 0.9	66.7
Aug-Nov 1974	prior spike up	25.3	micro MPC = 0.5	51.9
Jul-Oct 2005	prior spike up	25.3	micro MPC = 0.3	38.2
Jan-Apr 1980	Credit controls, Volcker	24.8		
Sep-Nov 2008	Lehman Collapse	16.9		

Reconciling Implausible Macro G.E. Effects

- **G.E. Dampening**
  - Key: 2/3 (or more) of estimated micro-mpc from new vehicle purchases
  - Durable good demand is elastic and if supply is less elastic, G.E. effects can dampen micro-effects
- **Micro MPCs**
  - Correct for three biases in PSJM (2013) estimates
  - Resulting micro-mpc is 0.3 (compared to 0.5-0.9 in PSJM).

Biases in PSJM (2013) Estimates

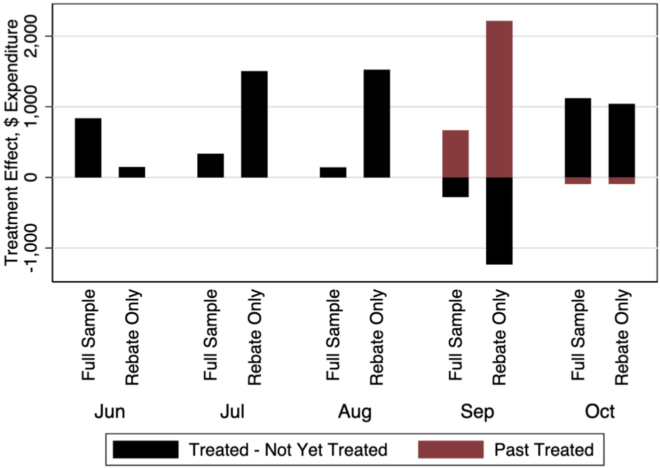
- What are they?

CORRECTING FOR BIASES

Panel A: Full Sample				
	Homogeneous Treatment		Heterogeneous Treatment	
	(1)	(2)	(3)	(4)
Rebate Indicator	470.13**	433.84**	347.40*	261.99
	(213.56)	(206.72)	(211.03)	(182.84)
Lag Rebate Indicator		−173.61	−82.52	−60.92
		(222.27)	(201.72)	(167.69)
Lag Total Expenditure				−0.26***
				(0.03)
Lag Motor Vehicle				−0.74***
				(0.03)
Implied 3-month MPC	0.50	0.46	0.37	0.28
Implied 6-month MPC		0.72	0.64	0.20
6-Month MPC S.E.		(0.48)	(0.49)	(0.37)
Income Decile FE	No	No	No	Yes
Observations	16,962	16,962	16,962	16,962

Correcting for Biases

Figure 6. TWFE Coefficients in the Full and Rebate Only Samples By Month

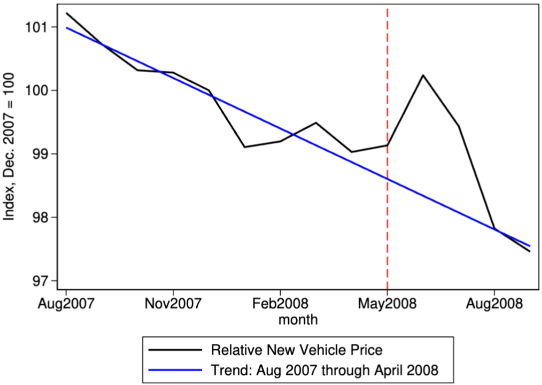


Biases in PSJM (2013) Estimates

- Why not just run BSJ?

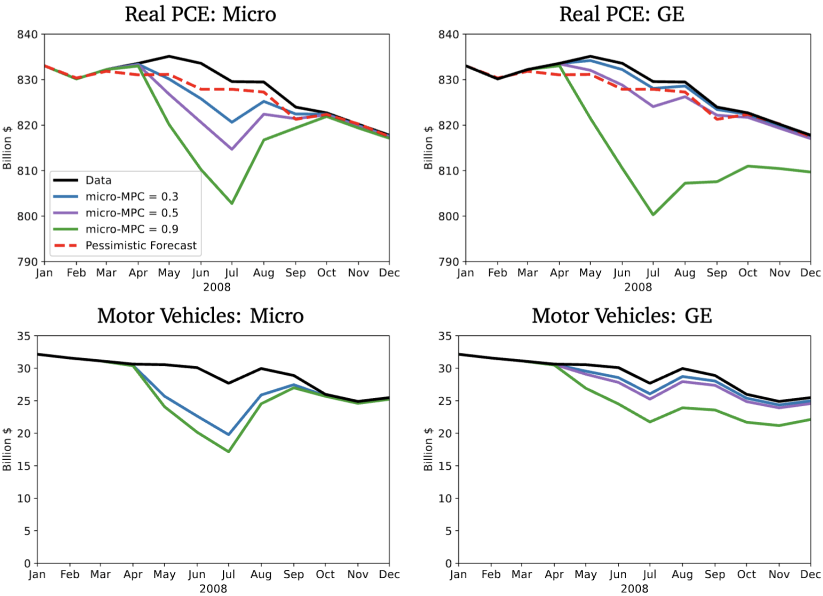
Vehicle Prices Spike

Figure 7. Motor Vehicle Relative Prices



Less Elastic Durable Supply Model

Figure 8. Counterfactual Real Consumption Expenditures: Less Elastic Supply



Convincing?

THOUGHTS?

- How do you think about Hausman (2019) in this context?