Economics 210c/236a
Fall 2018

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LECTURE 4
The Effects of Monetary Changes: The Monetary Transmission Mechanism

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I. Overview

Monetary Transmission Mechanism

- The mechanism through which monetary developments have real (and other) effects.

Possible Transmission Mechanisms

- Intertemporal substitution (changes in the real interest rate affect C and I).
- Credit channel (monetary changes affect spreads, ability of banks to make loans, etc.).
- Relaxing liquidity constraints for some households by raising income (Cloyne, Ferreira, and Surico).
- Redistribute income to high MPC consumers (Hausman, Rhode, and Weiland).
- Information revelation (Nakamura and Steinsson).

II. Cloyne, Ferreira and Surico, "Monetary Policy When Households Have Debt: New Evidence on the Transmission Mechanism"

What is the main idea of the paper?

- CFS believe the conventional interest-rate channel is important, but there is an another channel that is also.
- It involves heterogeneity in the MPC related to balance sheets.
- Proxies for balance sheets using housing status.
- Why do they look at both the US and the UK?

Data

- Household-level consumption data
  - UK: Living costs and food survey
  - US: Consumer expenditure survey
  - Both survey have disaggregated consumption data, demographic variables, and information on mortgage payments or rent.
- Group households according to housing status (owner, borrower, renter).

Data (continued)

- Monetary policy shocks for both countries
    - Updated Romer and Romer (2004) for US
    - Cloyne and Huertgen (2016) for UK
- Concerns about the data?

Monetary Shock Series

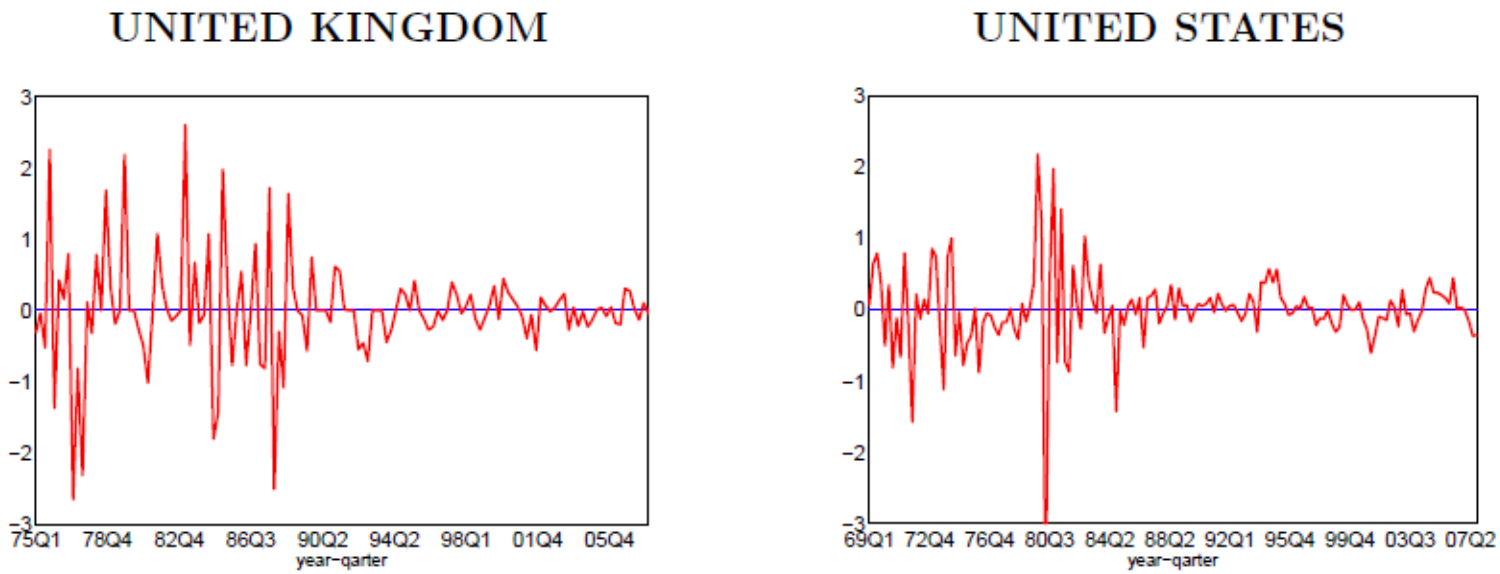


Figure 2: Monetary policy shocks series. United Kingdom: Cloyne and Huertgen (2016); United States: updated version of Romer and Romer (2004).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Empirical Specification

$$X_{i,t} = \alpha_0^i + \alpha_1^i trend + B^i(L)X_{i,t-1} + C^i(L)S_{t-1} + \sum_{q=2}^{4} D_q^i Z_q + u_{i,t} \qquad (1)$$

where $X_{i,t}$ is real non-durable consumption, durable expenditure or income recorded by households interviewed at time t.[9] The monetary policy shocks are denoted by S and Z is a vector of quarterly dummies.

Finally, $i \in Mortgagors, OutrightOwners, Renters$ refers to the relevant housing tenure group.

In all cases, we simulate the effects of a *temporary* 25 basis points (bp) cut in the policy rate.

- Comments? Concerns?

Response of Non-Durables Expenditure

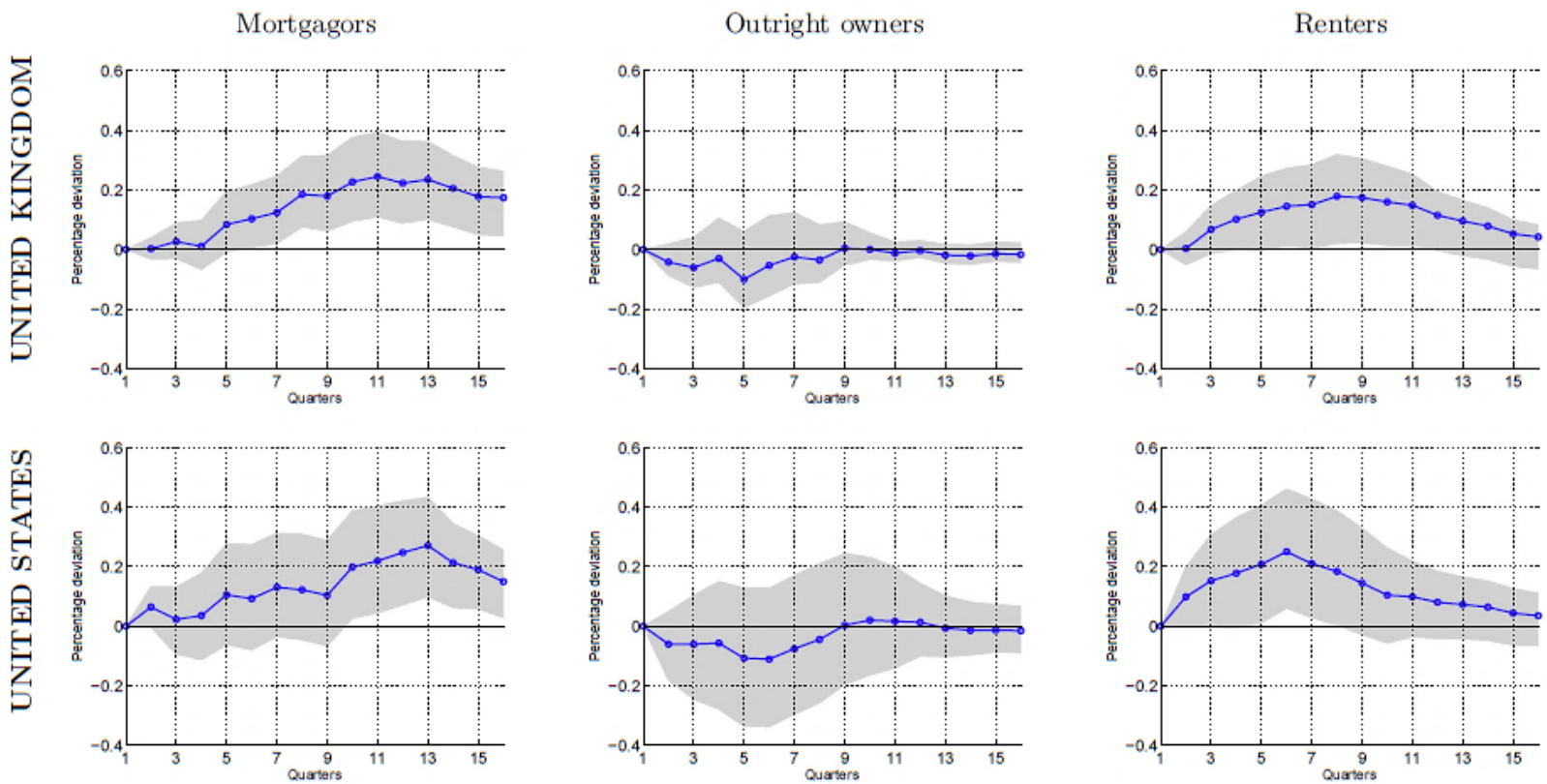


Figure 3: Dynamic effects of a 25 basis point unanticipated interest rate cut on the consumption of non-durable goods and services by housing tenure group. Grey areas are bootstrapped 90% confidence bands. Top row: UK (FES/LCFS data). Bottom row: US (CEX data).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Response of Durables Expenditure

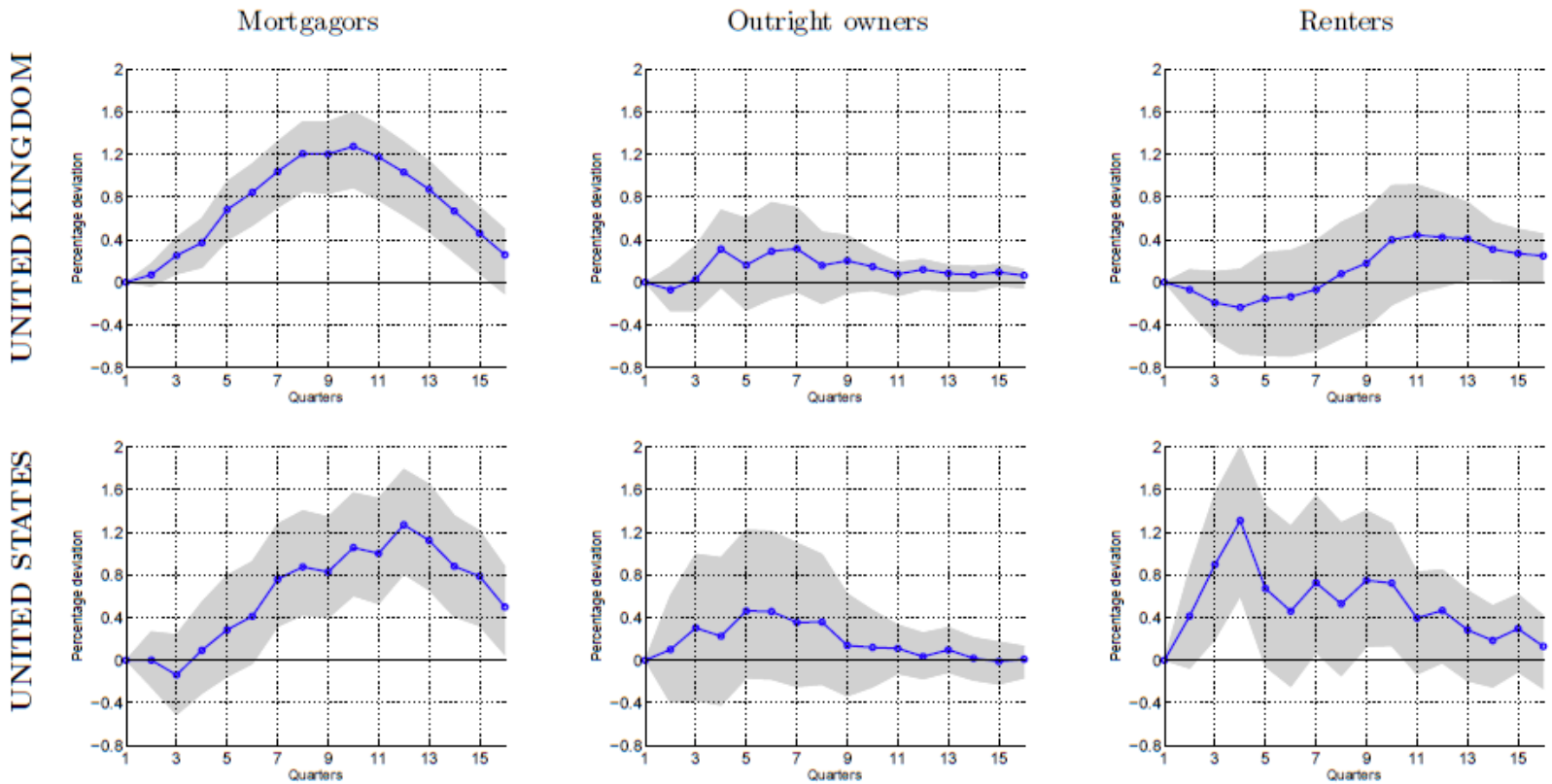


Figure 4: Dynamic effects of a 25 basis point unanticipated interest rate cut on the expenditure of durable goods by housing tenure group. Grey areas are bootstrapped 90% confidence bands. Top row: UK (FES/LCFS data). Bottom row: US (CEX data).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Response of Durables Expenditure, Same Age

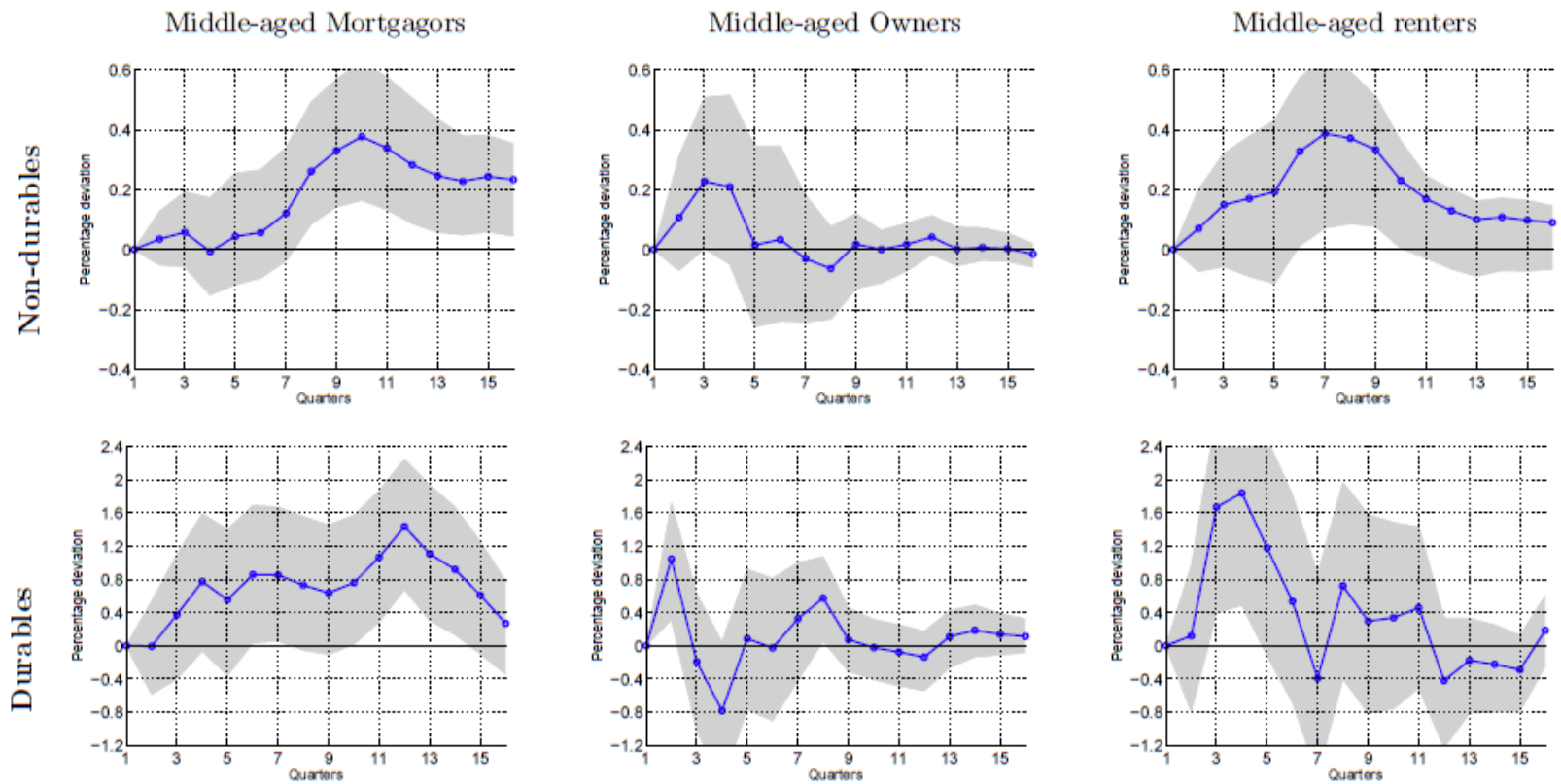


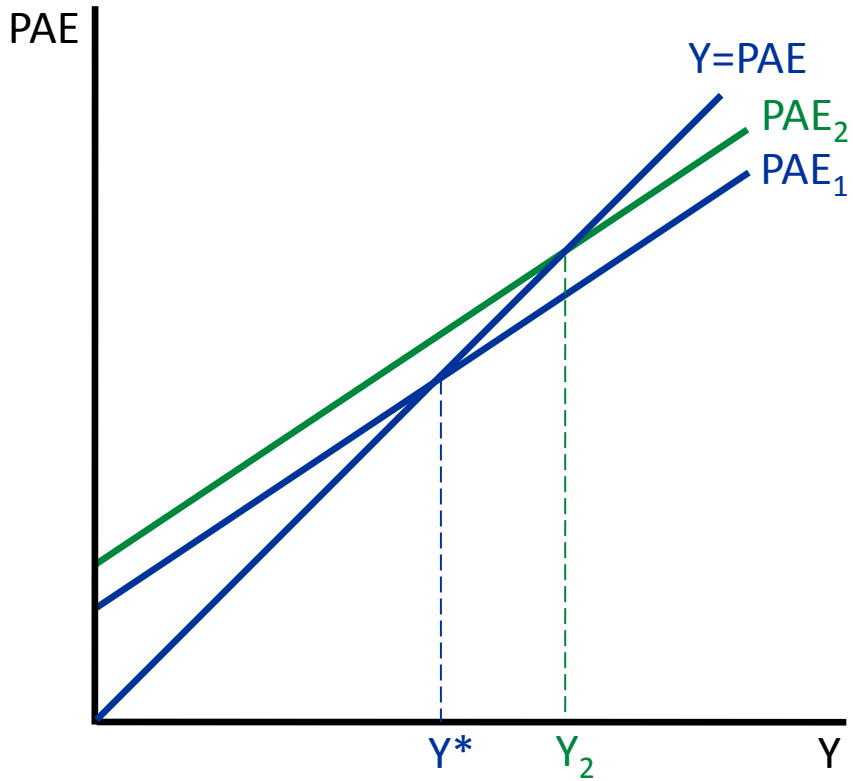
Figure 6: Dynamic effects of a 25 basis point unanticipated interest rate cut on non-durable consumption (top) and durable expenditure (bottom) for mortgagors born after 1949 (left column), mortgagors born between 1935 and 1949 (middle column) and outright owners born before 1935 (right column). Grey areas are bootstrapped 90% confidence bands. U.S. data: CEX (1981-2007).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Inspecting the Transmission Mechanism

- What is Cloyne, et al.'s preferred interpretation?
- Income rises for all groups, but mortgagors and renters spend it, while outright owners do not.
- Fits with mortgagors and renters being liquidity constrained.

Cloyne, et al. and the Keynesian Cross



- What causes the initial rise in PAE?
- Role of balance-sheet factors and heterogeneous MPCs.

Response of Investment

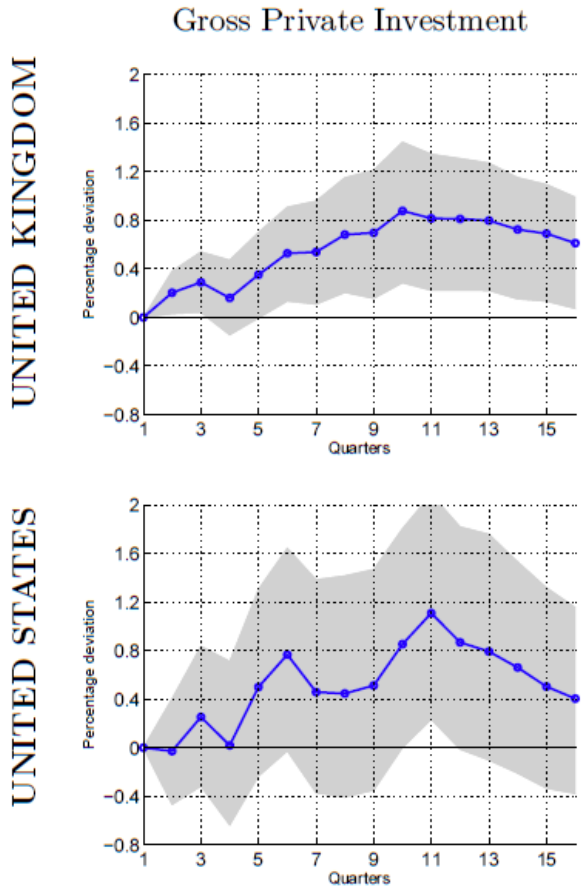


Figure 13: Dynamic effects of a 25 basis point unanticipated interest rate cut on gross private investment

From: Cloyne, Ferreira, and Surico, “New Evidence on the Transmission Mechanism.”

Response of Income

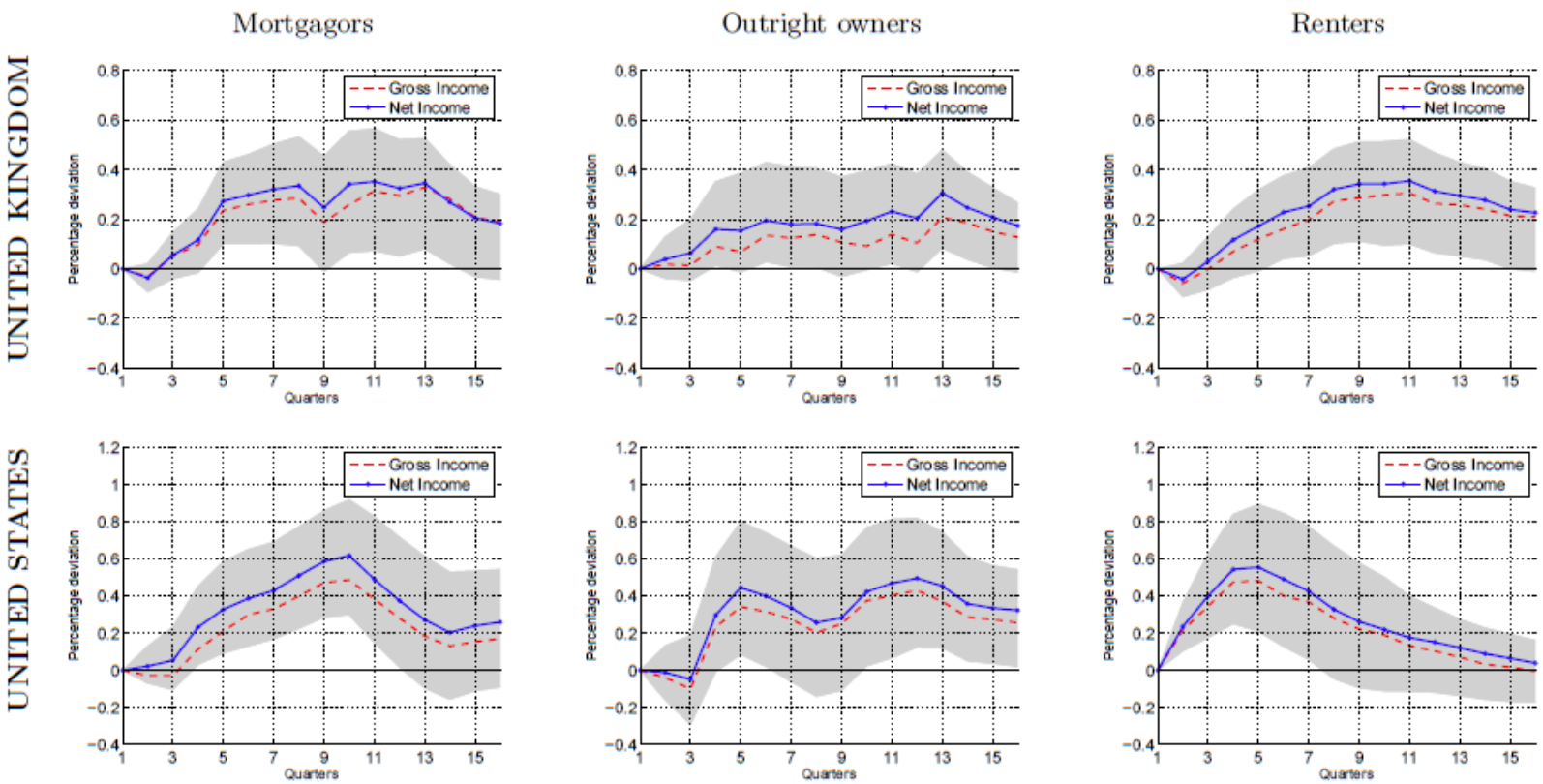


Figure 9: Dynamic effects of a 25 basis point unanticipated interest rate cut on net income (blue) and gross income (red). Mortgagors (left), outright owners (center) and renters (right). Grey areas are bootstrapped 90\% confidence bands for net income. Top row: UK (FES/LCFS data). Bottom row: US (CEX data).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Table 1: Cumulative changes over four years in US$

Panel A: United Kingdom

	Non-durable consumption	*Durable expenditure*	*Mortgage or rental payments*	*After-tax income*
Mortgagors	308.3	292.3	-166.4	695.9
	[112.8, 516.1]	[189.2 , 369.0]	**[-272.2 , -41.7]**	[186.5 , 1105.1]
Outright owners	-62.6	46.5		451.7
	[-148.2 , 77.4]	[-24.6 , 107.6]		[122.5 , 797.2]
Renters	155.3	19.0	64.7	397.3
	[17.9 , 261.8]	[-36.5 , 62.9]	[4.4 , 118.7]	[94.2 , 596.1]

Panel B: United States

	Non-durable consumption	*Durable expenditure*	*Mortgage or rental payments*	*After-tax income*
Mortgagors	305.8	229.3	-56.3	757.3
	[58.3 , 554.3]	[122.0 , 350.8]	**[-112.8 , -4.3]**	[196.8 , 1302.0]
Outright owners	-72.3	54.8		585.3
	[-324.8 , 186.0]	[-10.5 , 127.8]		[83.3 , 1012.8]
Renters	223.3	123.5	64.8	439.3
	[32.3 , 412.3]	[30.3 , 213.8]	[9.8 , 121.5]	[112.8 , 699.8]

Evidence that Mortgagors are Liquidity Constrained

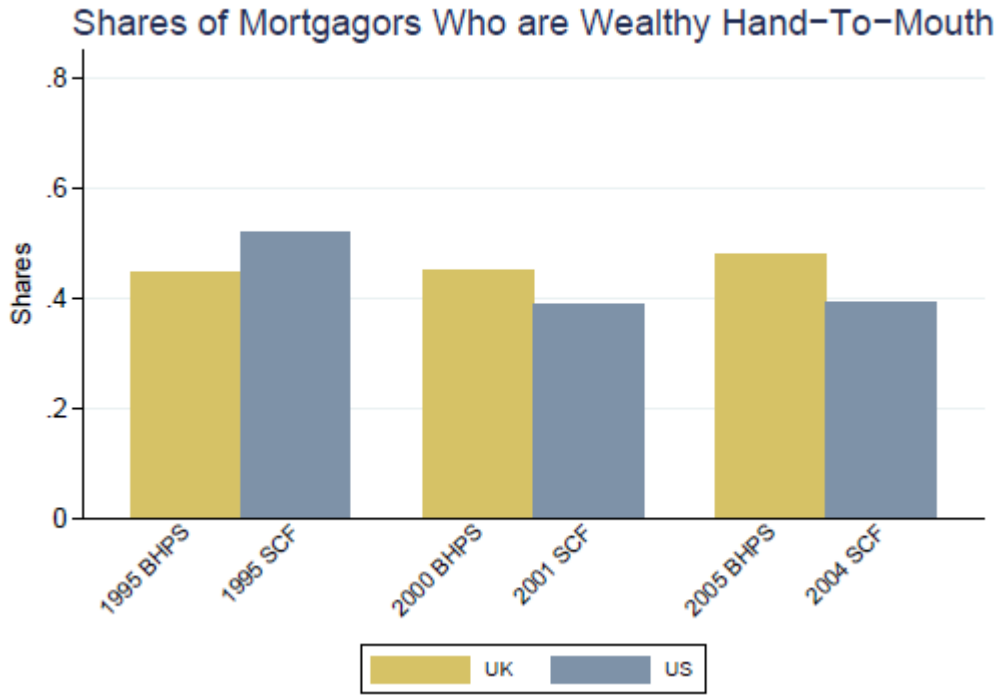


Figure 10: Shares of Wealthy Hand-To-Mouth (WHTM) mortgagors. U.K. (U.S.) data: 1995, 2000, 2005 waves of the British Household Panel Survey (Survey of Consumer Finances). A household is defined as WHTM if at any given point in time both (i) their net illiquid wealth is positive and (ii) their net liquid wealth is less than half of their total monthly household labor income.

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

Were you convinced?

Alternative Explanations

- Mortgagors get a direct benefit from the decline in interest rates and that is why they spend.

Response of Mortgage and Rental Payments

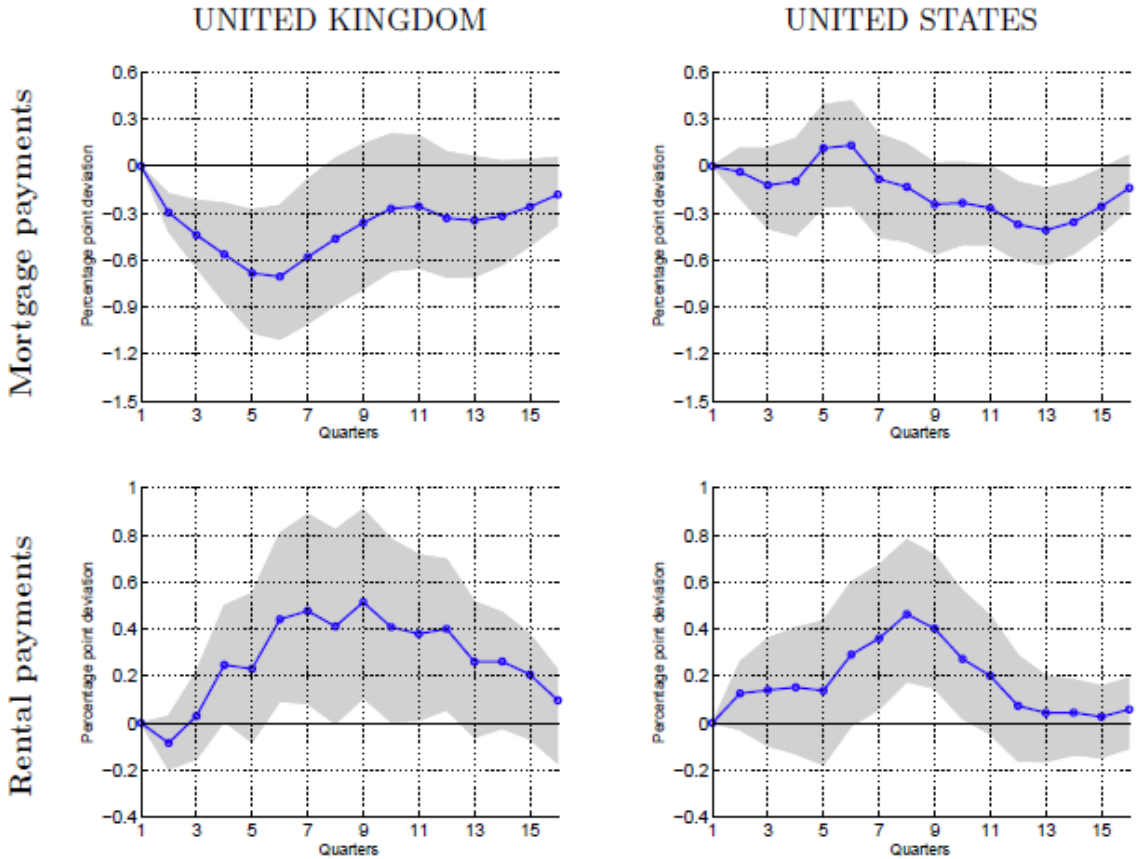


Figure 11: Dynamic effects of a 25 basis point unanticipated interest rate cut on mortgage and rental payments. Grey areas are bootstrapped 90% confidence bands. Left: UK (FES/LCFS data). Right: US (CEX data).

From: Cloyne, Ferreira, and Surico, "New Evidence on the Transmission Mechanism."

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	[32.3 , 412.3]	[30.3 , 213.8]	[9.8 , 121.5]	[112.8 , 699.8]

Alternative Explanations (continued)

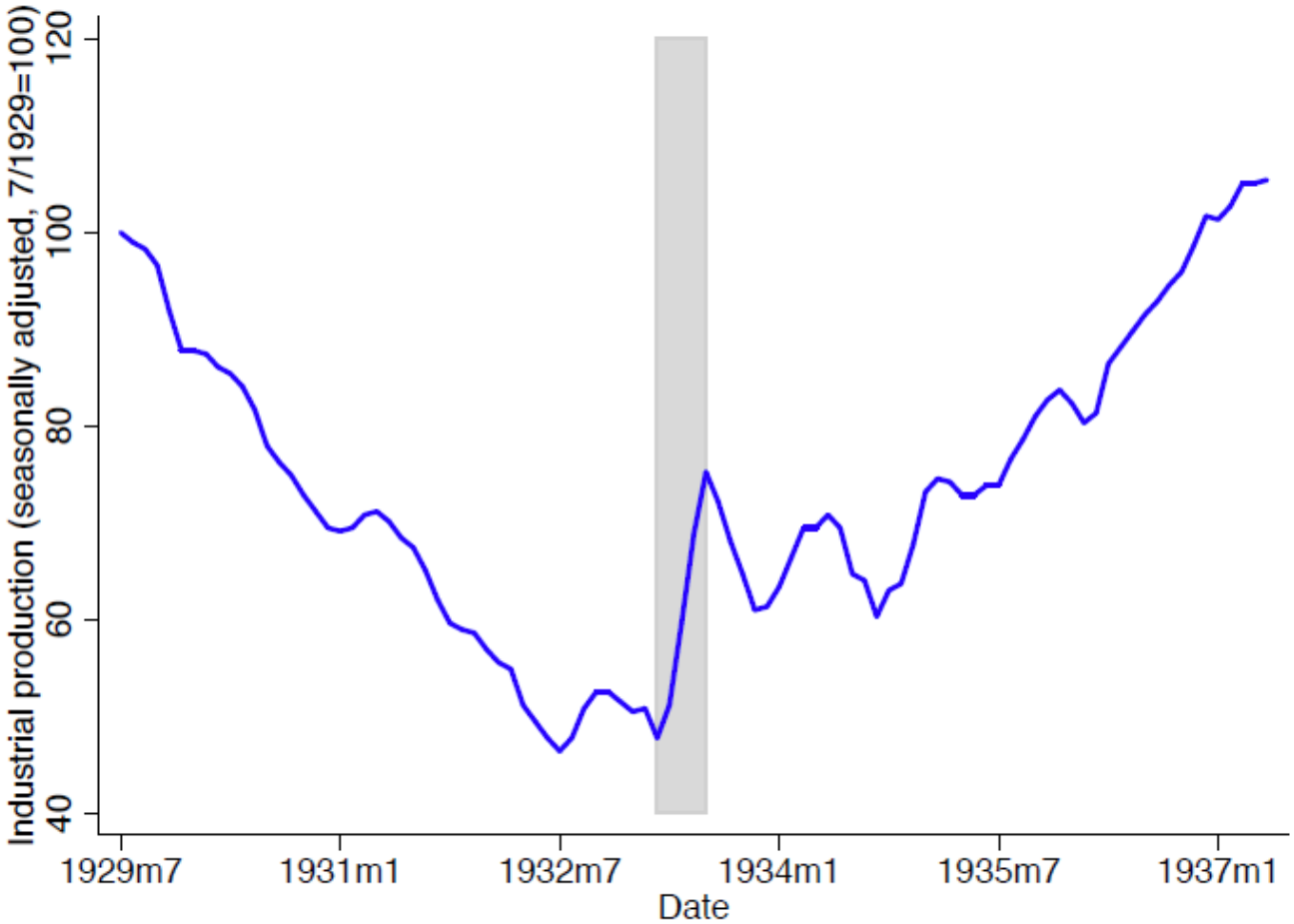
- Mortgagors get a direct benefit from the decline in rates and that is why they spend.
- Different elasticities of intertemporal substitution.
- Monetary shock causes a redistribution of wealth.

Overall Evaluation

- Nice paper!
- What do you think of the appendix?
- Possible implications for policy

III. Hausman, Rhode, and Weiland, "Recovery from the Great Depression: The Farm Channel in Spring 1933"

Figure 1 – Industrial production, 1929-1937



Note: Shading indicates March-July 1933. Source: FRED series INDPRO.

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Role of Devaluation

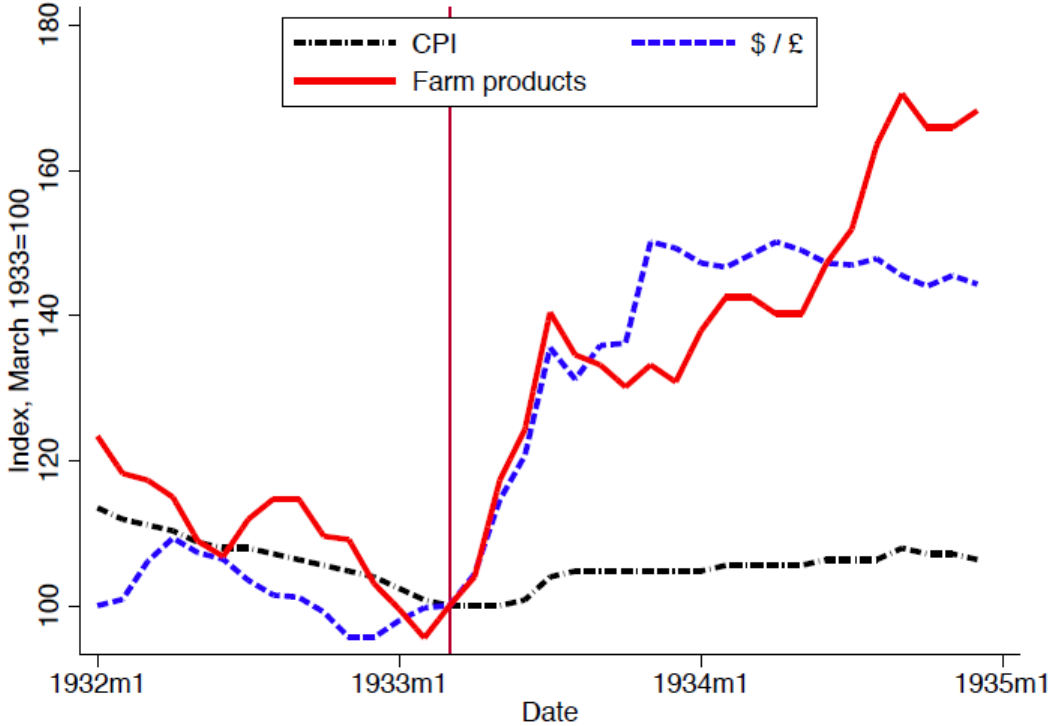
- U.S. went off the gold standard in April 1933; dollar depreciated rapidly.
- A kind of monetary shock.
- HRW are interested in the direct effect of devaluation as something that raised farm income.
- The transmission mechanism involves heterogeneous MPCs.

How does HRW fit into the lecture?

- Much in common with Cloyne, et al.
- Both are about heterogeneous MPCs, and that size depends on debt.
- But, the initial shock is quite different.
- Related to a large literature on distributional effects as part of the transmission mechanism.

Devaluation and Farm Prices

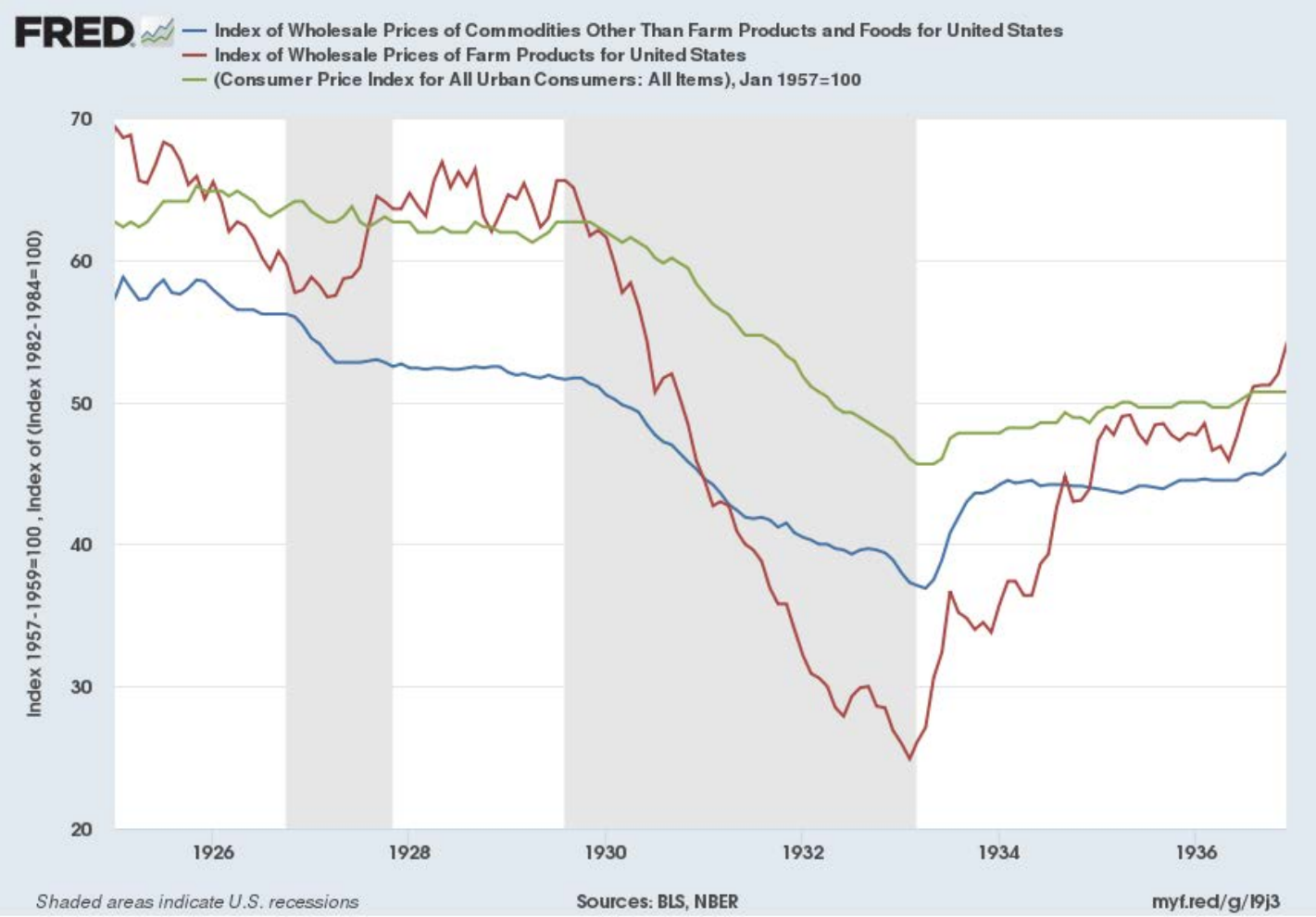
Figure 2 – The CPI, the exchange rate, and farm prices



Note: The vertical line indicates March 1933, the month before the U.S. devalued. Sources: CPI data from FRED series CPIAUCNS; exchange rate from *Survey of Current Business*, 12/32 p. 32, 12/33 p. 31, 12/34 p. 32, 12/35 p. 33; farm product price index from *Federal Reserve Bulletin*, 12/32 p. 788, 12/33 p. 783, 4/35 p. 237.

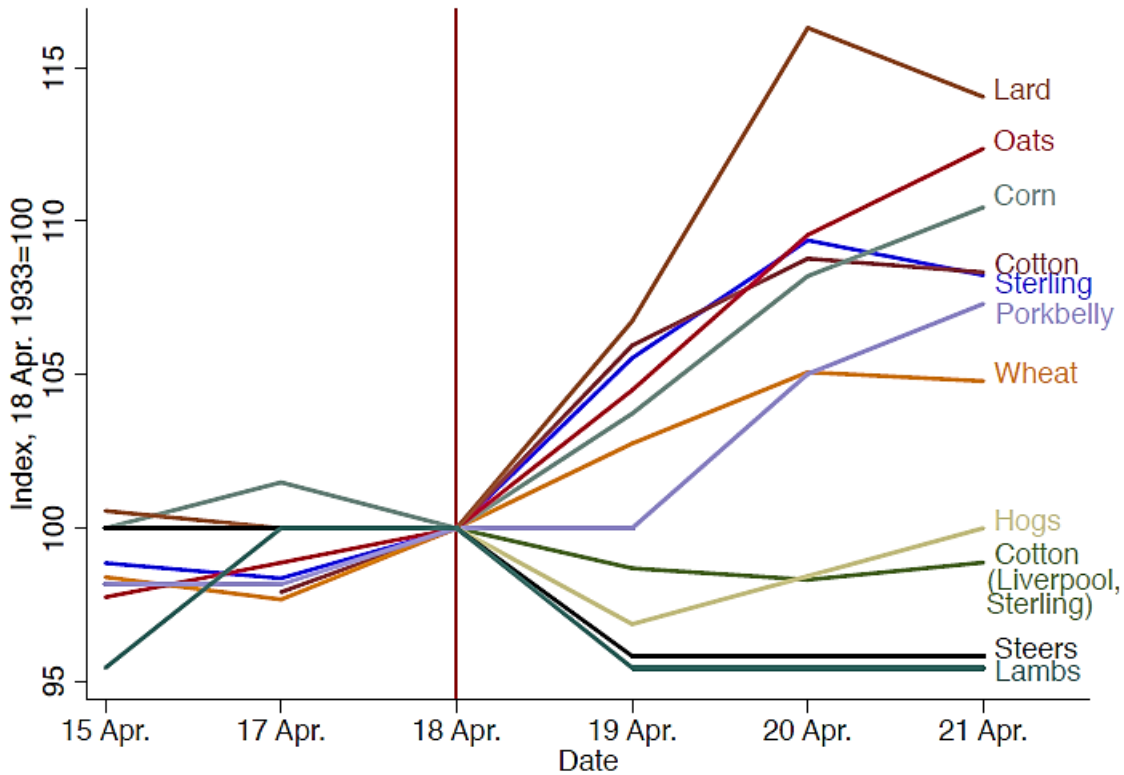
From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Behavior of Other Price Series



Daily Data on Farm Prices and Exchange Rate

Figure 3 – The exchange rate and farm prices after devaluation

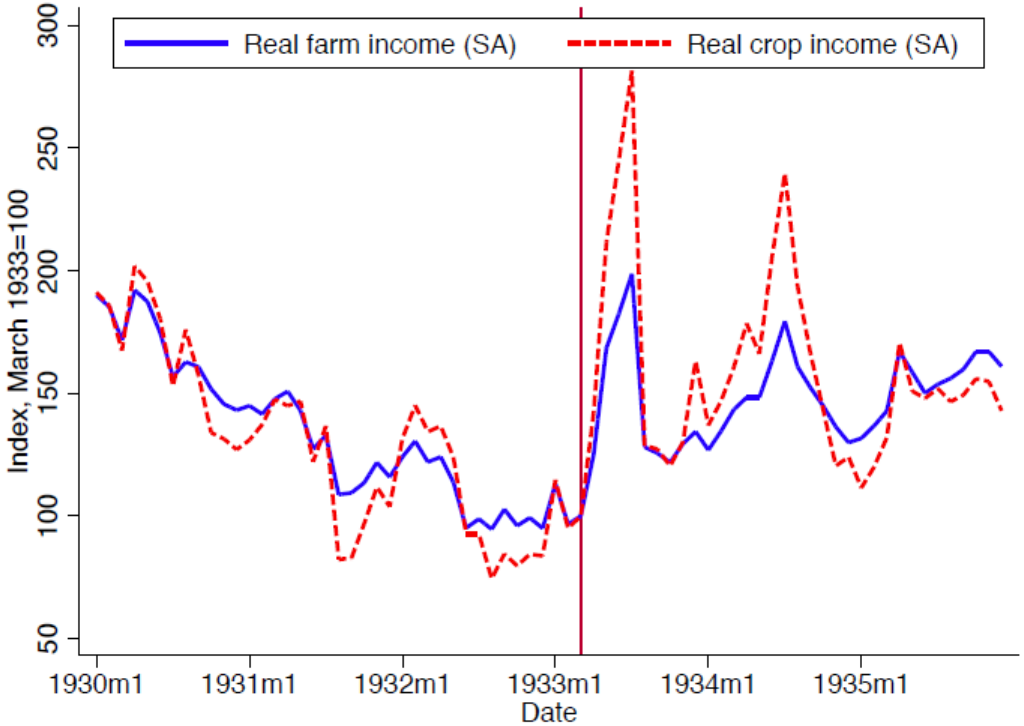


Note: The vertical line indicates 4/18/33, the day before the U.S. devalued. All prices are indexed to 100 on

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Devaluation and Farm Income

Figure 5 – Farm income



Note: The vertical line indicates March 1933, the month before the U.S. devalued. Sources: 1930-31 income: U.S. Department of Commerce, 1934a, p. 19; 1932-35 income: U.S. Department of Commerce, 1936, p. 9. Deflated with FRED CPI series CPIAUCNS.

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Estimating the Response of Consumption to Agricultural Exposure

We estimate cross-sectional regressions of the form:

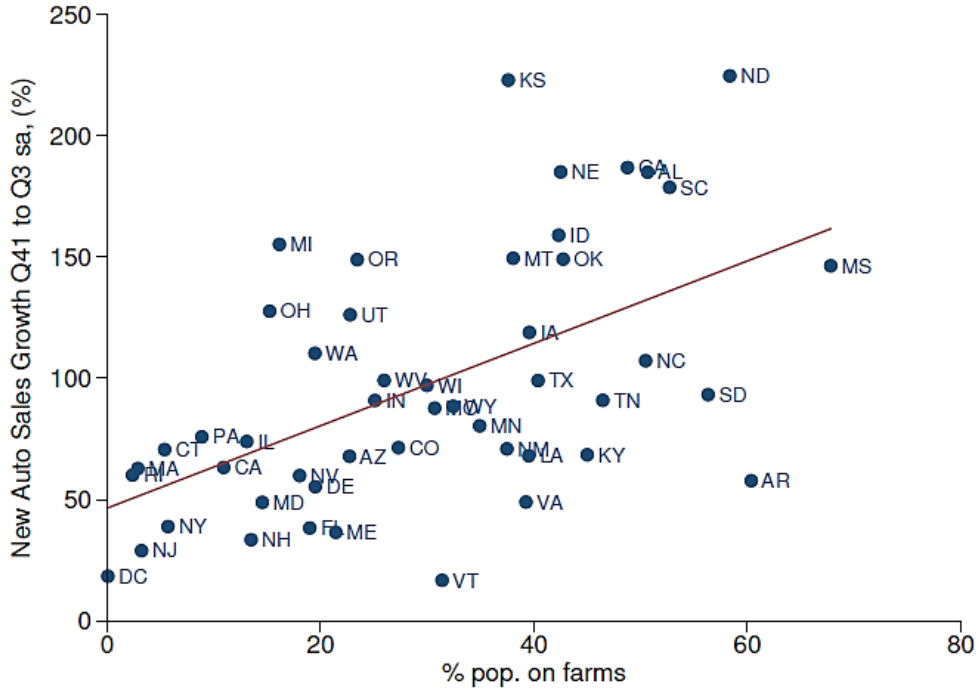
$$\%\Delta\text{Auto sales}_{i,\text{Spring 1933}} = \beta_0 + \beta_1\text{Agricultural exposure}_i + \gamma' X_i + \varepsilon_i, \tag{1}$$

where $\%\Delta\text{Auto sales}_{i,\text{Spring 1933}}$ is auto sales growth in spring 1933, "Agricultural exposure" is a state or county i's exposure to the farm channel in spring 1933, and X is a set of control variables. We use new auto sales as our main indicator of local economic conditions. Unlike

- Are auto sales a good proxy for consumption?
- How do they measure agricultural exposure?

Car Sales and Farm Population Share

Figure 6 – Percent change in car sales and farm channel exposure



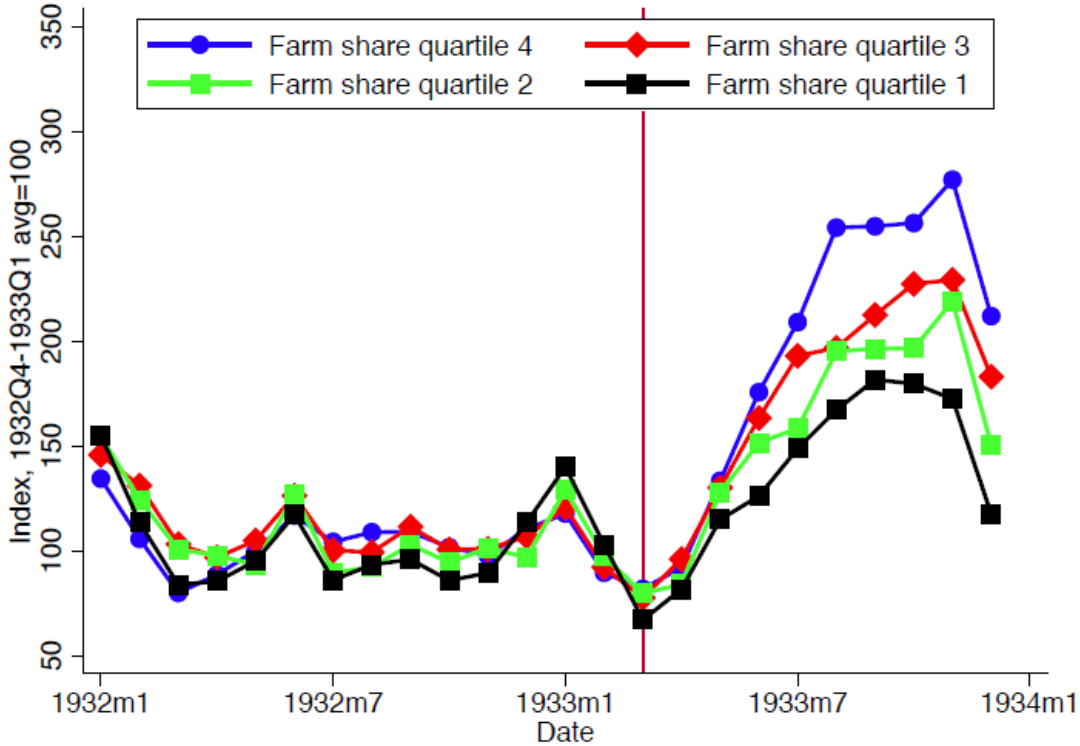
(a) Farm population share

Notes: Auto sales growth is measured as the percent change in seasonally-adjusted auto sales from the 1932:Q4-1933:Q1 quarterly average to 1933:Q3. The straight line is the OLS regression line. Sources: Auto sales - see text. Farm share - the 1930 Census as reported in Haines and ICPSR (2010). Crops sold - the 1940 Census as reported in Haines et al. (2015).

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Checking for Pre-Trends

Figure 7 – Auto sales by farm share quartile



Note: Quartiles are based on 1930 farm population share. They are constructed by first indexing each state to 100 for 1932:Q4-1933:Q1 and then averaging across states in a quartile. Sources: Auto sales - see text. Farm share - the 1930 Census as reported in Haines and ICPSR (2010).

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Table 3 – County New Auto Sales 1932-1933

Dependent variable:	New auto sales growth (%)									Change p.c.
Geography:	State		County							County
Frequency:	Q41-Q3	1932-33	1932-33							1932-33
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Right hand side variables ($ p.c.):										
Change farm product value	1.49**	1.99**	1.54***	1.49***	1.20***	0.84**	1.05***	0.92***		5.30**
	(0.62)	(0.93)	(0.57)	(0.42)	(0.34)	(0.38)	(0.38)	(0.34)		(2.34)
Farm product value 1932	−0.55	−0.40**	−0.26**	−0.33***	−0.25***	−0.023	−0.16**	−0.16***		−1.09**
	(0.42)	(0.16)	(0.098)	(0.081)	(0.058)	(0.034)	(0.061)	(0.058)		(0.44)
AAA Transfers 1933					3.26**			2.66		
					(1.61)			(1.89)		
Cotton, tobacco, and wool value 1932									2.33***	
									(0.23)	
Corn, oats, and wheat value 1932									0.35**	
									(0.13)	
Hay, potato, and fruit value 1932									0.14	
									(0.18)	
Livestock value 1932									−0.11	
									(0.17)	
Milk and egg value 1932									−0.42***	
									(0.10)	
Control Variables	No	No	No	Yes	Yes	No	Yes	Yes	No	No
State Fixed Effects	No	No	No	No	No	Yes	Yes	Yes	No	No
Drought Interactions	No	No	No	Yes	Yes	No	Yes	Yes	No	No
R^2	0.27	0.19	0.09	0.31	0.36	0.31	0.40	0.43	0.26	0.06
Observations	48	48	2,100	2,079	2,079	2,100	2,079	2,079	2,100	2,093

Notes: The dependent variable is the percent growth of new auto sales in columns (1) through (9) and the change in per capita new auto sales multiplied by 100,000 in column (10) over the frequency indicated in the table header. County regressions exclude counties with fewer than 500 car registrations in 1929. Control variables are population, the FDR vote share, the black population share, the rural nonfarm share, car registrations per capita in 1929, deposits suspended from 1929-1932 as a fraction of 1929 deposits, and the fraction of farms mortgaged in 1930. Drought interactions are based on monthly dummy variables for 1932 and 1933 for whether a county was in a severe or extreme drought, per the Palmer drought index. These are interacted with both the change in farm product value per capita and farm product value per capita. Standard errors clustered at the state level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

From: Hausman, Rhode, and Weiland, “Recovery from the Great Depression.”

What have HRW shown so far?

- Farm prices rose more than other prices following devaluation.
- Farm incomes rose following devaluation.
- Auto sales rose more in states more exposed to agriculture.
- Do you believe the story so far?

Were the effects of devaluation on farm prices expansionary for the entire economy?

- All of the results so far are about *relative* changes in consumption.
- Three mechanisms by which higher crop prices could have been expansionary for the whole US economy:
    - Differential MPCs (related to debt burdens)
    - The banking system
    - Inflationary expectations

Differential MPCs

- Similar to Cloyne, et al.
- Devaluation transferred income to high MPC farmers and away from workers or businesses paying more for farm products.
- How do they test this?

$$\begin{aligned}\%\Delta\text{Auto sales}_i = \beta_0 &+ \beta_1 \Delta\text{farm product value p.c.}_i \times \%\text{ farms mortgaged}_i \\ &+ \beta_2 \text{farm product value p.c.}_i \times \%\text{ farms mortgaged}_i + \beta_3 \Delta\text{farm product value p.c.}_i \\ &+ \beta_4 \%\text{ farms mortgaged}_i + \beta_5 \text{farm product value p.c.}_i + \gamma' X_i + \varepsilon_i.\end{aligned} \tag{4}$$

Table 5 – Auto sales growth in spring 1933 (% changes) and farm debt

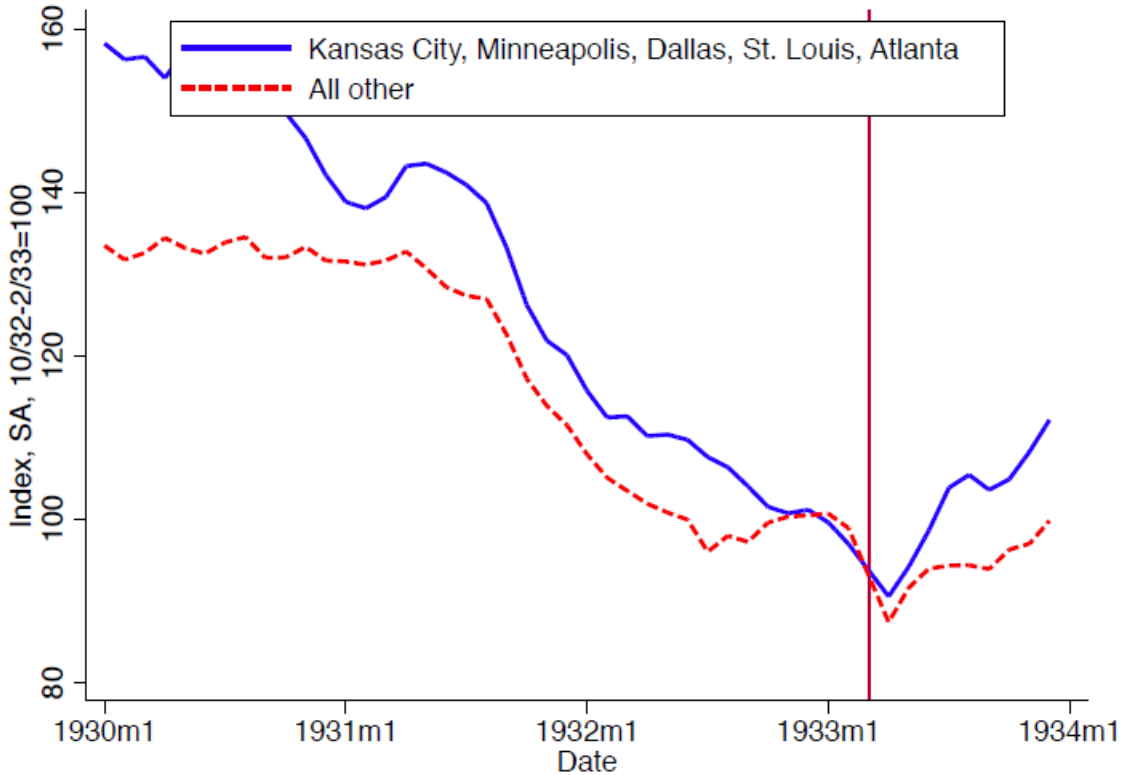
Panel A: Linear interaction with % farms mortgaged

	(1)	(2)	(3)	(4)
Linear Interaction	0.37*	0.77***	0.57**	0.72***
	(0.19)	(0.24)	(0.23)	(0.24)
Change farm product value p.c. ($)	1.39**	0.089	0.49	0.018
	(0.61)	(0.50)	(0.52)	(0.51)
State Fixed Effects	No	Yes	No	Yes
Control Variables	No	No	Yes	Yes
Drought Interactions	Yes	Yes	Yes	Yes
R^2	0.23	0.40	0.37	0.44
Observations	2,094	2,094	2,073	2,073

From: Hausman, Rhode, and Weiland, “Recovery from the Great Depression.”

Behavior of Bank Deposits

Figure 12 – Net demand deposits, 1930-33



Notes: The vertical line indicates March 1933. Deposit data for March 1933 are missing. For details on the seasonal adjustment, see appendix E. Sources: See appendix E.

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Farm Prices and Expected Inflation

(b) Tires

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Aggregation

- Paper estimates how much of the growth in cars sales right after devaluation was due to the farm channel.
- Basics of the calculation are the upward shift in PAE caused by the redistribution times a multiplier.
- Get the upward shift in PAE from their regression (effect of farm population share on sales times farm population share).
- Use an aggregate multiplier from other studies.
- Conclude that the farm channel accounts for about 1/3 of the increase in auto sales in spring 1933.

Aggregate Effect of the Farm Channel

Table 7 – Implied aggregate effect

Redistribution from high MPC consumers, $\xi \frac{\theta^w}{\theta^f}$	Predicted %ΔCars: Aggregate Multiplier $\mu = 1$	$\mu = 2$	$\mu = 3$	Fraction of actual %ΔCars: Aggregate Multiplier $\mu = 1$	$\mu = 2$	$\mu = 3$
0.7	8.0	15.9	23.9	9.2	18.4	27.6
0.6	10.6	21.2	31.9	12.3	24.6	36.8
0.5	13.3	26.6	39.8	15.4	30.7	46.1
0.4	15.9	31.9	47.8	18.4	36.8	55.3
0.3	18.6	37.2	55.8	21.5	43.0	64.5

Notes: Columns 2-4 display the implied new car sales growth rate from equation (8) given the indicated parameter values, and $\beta = 1.7$, $\phi^f = 0.248$, $\frac{Y_{p.c.,a}}{Y_{p.c.}} = 0.63$. Columns 5-7 show the fraction of actual new car sales growth (86.5%) explained.

From: Hausman, Rhode, and Weiland, "Recovery from the Great Depression."

Evaluation

Overall, what do we learn from the first two papers?

- The transmission mechanism for monetary shocks is more complicated than just the effects of interest rates working through intertemporal substitution.
- Different MPCs related to debt burdens may be a fundamental feature of the economy and of the transmission mechanism of monetary (and other) shocks.
- Redistribution effects of monetary developments could be important.

IV. Nakamura and Steinsson: "High-Frequency Identification of Monetary Non-Neutrality: The Information Effect"

Starting Point

- The Fed may have information about the economy that isn't known to private agents.
- And since the Fed bases policy on its information, monetary policy actions can reveal some of its additional information.

If the Fed Has Additional Information, What We Mean By a "Monetary Shock" Is Ambiguous

1. An unexpected change in monetary policy (may be correlated with Fed information).

2. A random change in monetary policy (done independently of Fed information, but that isn't known).

3. A random change in monetary policy that's known to be random.

- With definitions 1 and 2, some of the subsequent behavior of the economy is the result of the fact that the Fed has additional information.

Nakamura and Steinsson's Approach

- Look at relatively high-frequency responses of nominal and real interest rates, expected inflation, and expected output growth to unexpected changes in monetary policy.

- Show that the responses are inconsistent with standard models if they lack the information effect.

- Build a model incorporating the information effect, estimate its key parameters, and analyze its implication for the size of the information effect.

Data for the High-Frequency Analysis

- Sample periods: ≈ 1995 until recently.
- Fed funds futures; eurodollar futures. (Very high frequency.)
- Other interest rates; TIPS (starting ≈ 2000); inflation swaps. (Roughly daily.)
- Times of Fed announcements. (Using scheduled FOMC meetings only.)

Some Subtleties Involving the Data

- Their "policy news shock" is the first principal component of the unanticipated change in: the funds rate, the expected funds rate immediately following the next FOMC meeting, and expected 3-month eurodollar interest rates at horizons of 2, 3 ,and 4 quarters.
- Going from interest rates on bonds of various horizons to implied expected instantaneous forward rates.
- The expectations theory doesn't hold perfectly. For example, the 1-year interest rate equals the average expected daily rate over the coming year *plus a term premium*. N&S need to worry about the possibility that premiums change over their 30-minute windows.

A General Issue in Using High-Frequency Financial Market Data

- How much expertise do we think there is in financial markets about whatever it is we're trying to learn about?

- Consider, for example: (1) the differential impact of the Trump tax cut on corporate profits of firms of different types, vs. (2) the slope of the Phillips curve.

$$\Delta s_t = \alpha + \gamma \Delta i_t + \epsilon_t$$

	Nominal	Real	Inflation
3M Treasury yield	0.67		
	(0.14)		
6M Treasury yield	0.85		
	(0.11)		
1Y Treasury yield	1.00		
	(0.14)		
2Y Treasury yield	1.10	1.06	0.04
	(0.33)	(0.24)	(0.18)
3Y Treasury yield	1.06	1.02	0.04
	(0.36)	(0.25)	(0.17)
5Y Treasury yield	0.73	0.64	0.09
	(0.20)	(0.15)	(0.11)
10Y Treasury yield	0.38	0.44	−0.06
	(0.17)	(0.13)	(0.08)
2Y Treasury inst. forward rate	1.14	0.99	0.15
	(0.46)	(0.29)	(0.23)
3Y Treasury inst. forward rate	0.82	0.88	−0.06
	(0.43)	(0.32)	(0.15)
5Y Treasury inst. forward rate	0.26	0.47	−0.21
	(0.19)	(0.17)	(0.08)
10Y Treasury inst. forward rate	−0.08	0.12	−0.20
	(0.18)	(0.12)	(0.09)

From: Nakamura and Steinsson, “The Information Effect.”

Digression: The Rigobon Approach—Overview

- The issue: Unless we look at very short windows, some of the movements in *i* aren't coming from monetary policy, so we can't just run a regression of Δs on Δi to estimate the impact of monetary policy.

- Rigobon: Assume that the "background noise" (movements in *i* and *s* coming from sources other than monetary policy) is constant over time.

- Allows us to use information from observations without monetary policy developments to correct for the background noise.

Digression: The Rigobon Approach—Mechanics

- Assume $\Delta i_t = \eta_t + \theta_t$, where η and θ are nonmonetary and monetary influences on Δi, and $\Delta s_t = \beta\eta_t + (\gamma + \upsilon_t)\theta_t + \delta_t$. Everything relevant is assumed to be uncorrelated and homoskedastic.
- Notes: (1) Think of β as reflecting a projection of Δs on η, not a causal effect. (2) υ is included to allow Δs to have greater variance for observations with policy actions.
- Implications: For nonpolicy observations, $\mathrm{Variance}(\Delta i) = V_\eta$, $\mathrm{Covariance}(\Delta i, \Delta s) = \beta V_\eta$; for policy observations, $\mathrm{Variance}(\Delta i) = V_\eta + V_\theta$, $\mathrm{Covariance}(\Delta i, \Delta s) = \beta V_\eta + \gamma V_\theta$.
- So, we can estimate γ as the difference in the covariance between policy and nonpolicy days divided by the difference in the variance between policy and nonpolicy days.

TABLE II

ALLOWING FOR BACKGROUND NOISE IN INTEREST RATES

	2-year forward		5-year forward		10-year forward	
	Nominal	Real	Nominal	Real	Nominal	Real
Policy news shock, 30-minute window						
OLS	1.14	0.99	0.26	0.47	−0.08	0.12
	[0.23, 2.04]	[0.41, 1.57]	[−0.12, 0.64]	[0.14, 0.80]	[−0.43, 0.28]	[−0.12, 0.36]
Rigobon	1.10	0.96	0.22	0.46	−0.12	0.11
	[0.31, 2.36]	[0.45, 1.82]	[−0.14, 0.64]	[0.15, 0.84]	[−0.46, 0.24]	[−0.13, 0.35]
Policy news shock, 1-day window						
OLS	1.24	1.00	0.44	0.48	0.05	0.15
	[0.80, 1.69]	[0.57, 1.43]	[0.18, 0.70]	[0.20, 0.76]	[−0.20, 0.29]	[−0.10, 0.39]
Rigobon	0.93	0.82	−0.11	0.33	−0.51	−0.04
	[−0.64, 2.08]	[0.38, 3.20]	[−1.23, 0.33]	[−0.07, 1.12]	[−1.93, −0.08]	[−0.51, 0.45]
2-year nominal yield, 1-day window						
OLS	1.23	0.94	0.64	0.54	0.18	0.20
	[1.07, 1.38]	[0.69, 1.20]	[0.43, 0.84]	[0.31, 0.76]	[0.01, 0.35]	[0.02, 0.38]
Rigobon (90% CI)	1.14	0.82	−0.11	0.33	−0.51	−0.04
	[0.82, 1.82]	[0.62, 2.98]	[−7.94, 0.60]	[−0.01, 7.48]	[−10.00, −0.21]	[−4.57, 0.38]

Notes. Each estimate comes from a separate "regression." The dependent variable in each regression is the one-day change in the variable stated at the top of that column. The independent variable in the first panel of results is the 30-minute change in the policy news shock around FOMC meeting times, in the second panel it is the one-day change in the policy news shock, and in the third panel it is the one-day change in the two-year nominal yield. In each panel, we report results based on OLS and Rigobon's heteroskedasticity-based estimation approach. We report a point estimate and 95% confidence intervals except in the last row of Rigobon estimates, which reports 90% confidence intervals. The sample of "treatment" days for the Rigobon method is all regularly scheduled FOMC meeting days from 1/1/2000 to 3/19/2014; this is also the period for which the policy news shock is constructed in all "regressions." The sample of "control" days for the Rigobon analysis is all Tuesdays and Wednesdays that are not FOMC meeting days over the same period of time. In both the treatment and control samples, we drop July 2008 through June 2009 and 9/11/2001–9/21/2001. For two-year forwards, the sample starts in January 2004. Confidence intervals for the OLS results are based on robust standard errors. Confidence intervals for the Rigobon method are calculated using the weak-IV robust approach discussed in Online Appendix C with 5,000 iterations.

From: Nakamura and Steinsson "The Information Effect."

Are the Δi's in N&S's Regressions ($\Delta s_t = \alpha + \gamma \Delta i_t + \varepsilon_t$) Conventional Monetary Policy Shocks?

- If so, we'd expect private sector forecasts of output growth to fall when there's a contractionary shock.
- Test: Regress change in private sector forecast of growth over the coming year on the shock.
- The change is over an entire month. Is this a problem?

TABLE III

RESPONSE OF EXPECTED OUTPUT GROWTH OVER THE NEXT YEAR

	1995–2014	2000–2014	2000–2007	1995–2000
Policy news shock	1.01	1.04	0.95	0.79
	(0.32)	(0.35)	(0.32)	(0.63)
Observations	120	90	52	30

Notes. We regress changes from one month to the next in survey expectations about output growth over the next year from the Blue Chip Economic Indicators on the policy news shock that occurs in that month (except that we drop policy news shocks that occur in the first week of the month because we do not know whether these occurred before or after the survey response). Specifically, the dependent variable is the change in the average forecasted value of output growth over the next three quarters (the maximum horizon over which forecasts are available for the full sample). See Online Appendix F for details. We present results for four sample periods. The longest sample period we have data for is 1995m1–2014m4; this is also the period for which the policy news shocks are constructed. We also present results for 2000m1–2014m4 (which corresponds to the sample period used in Table I), 2000m1–2007m12 (a precrisis sample period), and 1995m1–1999m12. As in our other analysis, we drop data from July 2008 through June 2009. Robust standard errors are in parentheses.

From: Nakamura and Steinsson "The Information Effect."

Nakamura and Steinsson's Illustrative Model Incorporating a Fed Information Effect

- Starting point is the standard 3-equation new Keynesian model (new Keynesian IS curve, new Keynesian Phillips curve, interest rate rule).

- Includes internal habits in the IS curve and a backward-looking component in the Phillips curve.

- The "natural rate of interest," $\hat{r}$, varies over time, the Fed has some information about $\hat{r}$, and the Fed moves the real rate in response to that information.

Estimation of the Model

- All parameter values are fixed, except: the fraction of shifts in the intercept of the interest rate rule that the private sector interprets as conveying information about $\hat{r}$ (that is, the strength of the information effect); the slope of the Phillips curve; and two parameters governing the dynamics of the interest rate rule.

- Choose those parameters to match the response of real rates, expected inflation, and expected output growth at various horizons to the policy news shock as well as possible.

- "Simulated method of moments."

TABLE IV

ESTIMATES OF STRUCTURAL PARAMETERS

	ψ	$\kappa\hat{\zeta} \times 10^{-5}$	ρ_1	ρ_2
Baseline	0.68	11.2	0.9	0.79
	[0.33, 0.84]	[0.0, 60.2]	[0.83, 0.96]	[−0.69, 0.89]
No Fed information	0.00	3.4	0.9	0.79
($\psi = 0$)	—	[0.0, 24.1]	[0.83, 0.96]	[−0.69, 0.89]
Full Fed information	0.99	563	0.9	0.79
($\psi = 0.99$)	—	[0, 12,538]	[0.82, 0.96]	[−0.67, 0.89]
Lower IES	0.67	13.7	0.9	0.79
($\sigma = 0.25$)	[0.25, 0.89]	[0.0, 94.6]	[0.83, 0.96]	[−0.69, 0.89]
Higher IES	0.68	8.2	0.9	0.79
($\sigma = 1$)	[0.42, 0.81]	[0.0, 44.0]	[0.83, 0.96]	[−0.69, 0.89]
No habits	1	1,000	0.9	0.79
($b = 0$)	[0.92, 1.00]	[0, 43,236]	[0.83, 0.96]	[−0.69, 0.89]

From: Nakamura and Steinsson "The Information Effect."

Behavior after an Unexpected Change in Monetary Policy

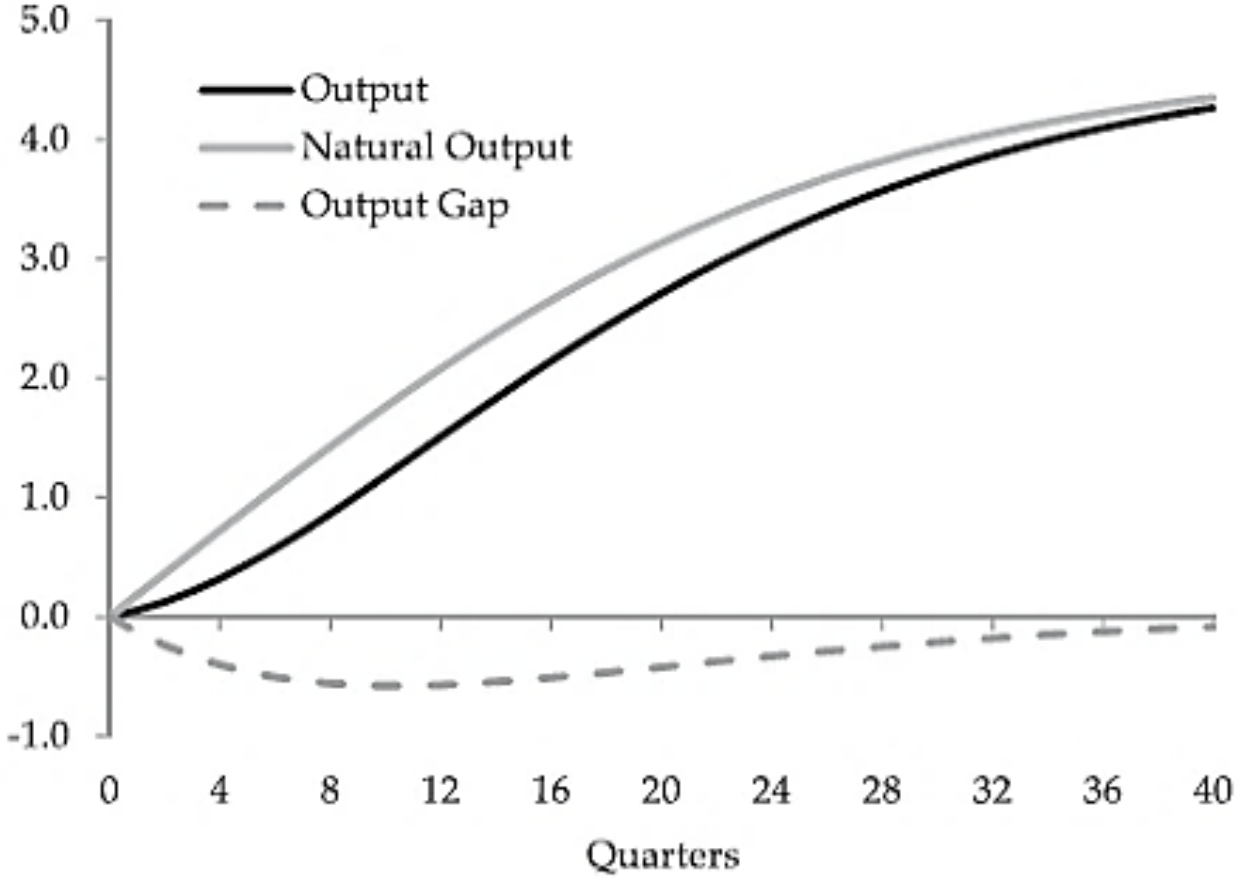


FIGURE VI

From: Nakamura and Steinsson "The Information Effect."

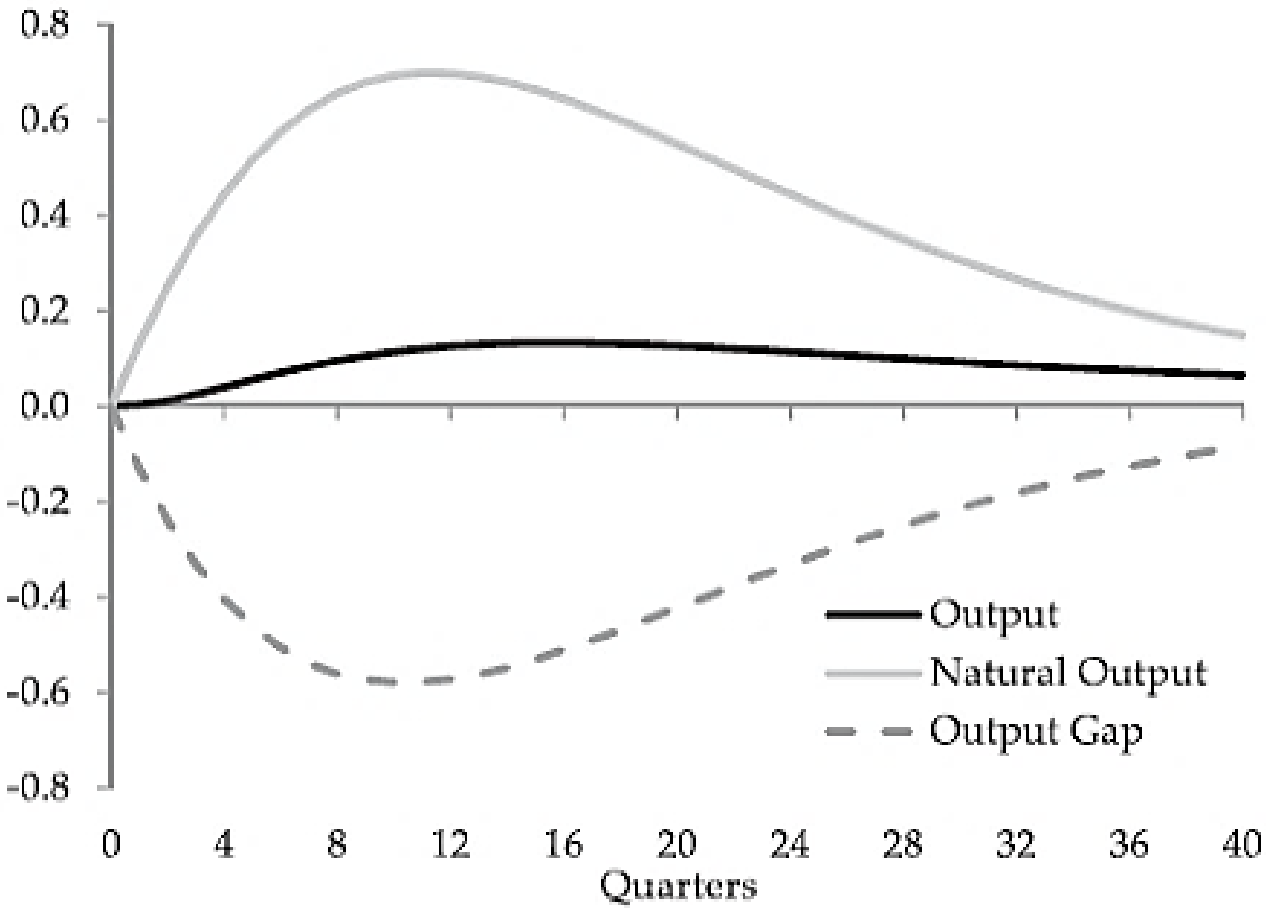


FIGURE VIII

Causal Effect of Monetary Shocks on Expected Output

From: Nakamura and Steinsson "The Information Effect."