Birth of a Modern Money Market: the Federal Reserve and Interest Rate Determination on the Eve of the Great Depression

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How were money-market interest rates determined, policy implemented in late 1920s?

What was the nature of the 1930s liquidity trap?

How we think things work nowadays:

Longer-term rates = expected future ON rates + term premiums, etc.

Realized ON rate from R^D, R^S, central bank administered rates

Liquidity trap means rate on reserves set at minimum (zero?)

and "ample" R^S pushed ON rate to this floor

R^D is "inventory-theoretic" following Poole (1968):

- reserve accounts settled end of day, bank penalized for shortfall (e. g. credit at penalty rate)
- at time when bank can trade liquid assets, uncertainty about resulting balance at settlement
- uncertainty can be due to unpredictable payments that may occur *before* Fedwire closes, but *late in day* when fed funds market is illiquid (maybe bank can't find counterparty)

Result is....

Example: Ennis & Keister (2008)

Representative bank

Balance after settlement $R^D + P$

P uniform distn. on $-\overline{P}, \overline{P}$

Shortfall if $R^D + P < K$

required reserve ↗

must borrow $K - (R^D + P)$, pay r^P

Otherwise excess $R^D + P - K$.

At $R^D = S$,

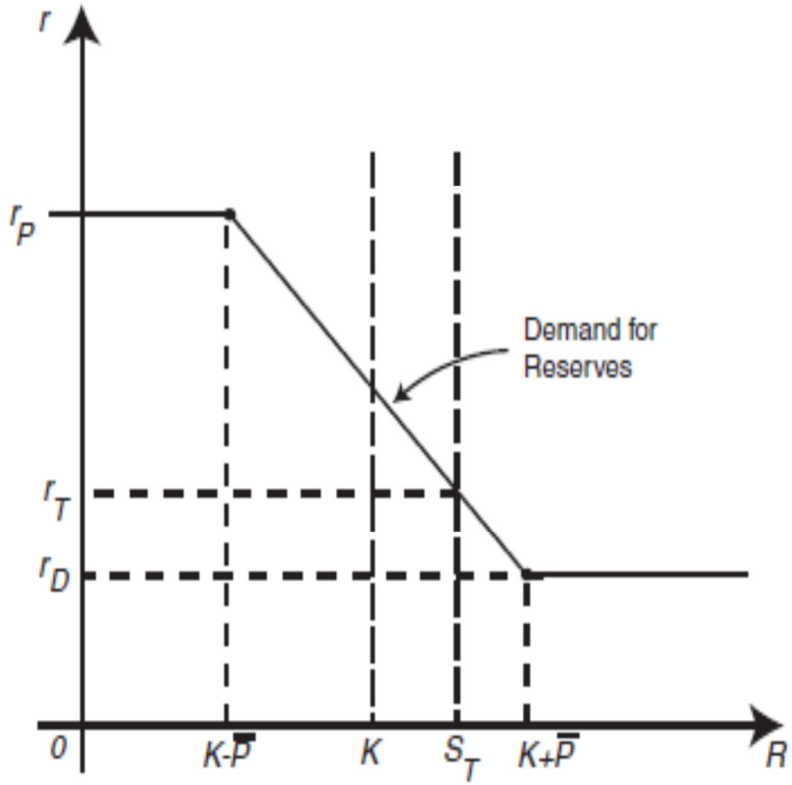
Prob. shortfall $\dfrac{r - r_D}{r^P - r_D}$

$$\partial r / \partial S = \frac{2\overline{P}}{r_p - r_D}$$

$$\frac{\partial E[Excess]}{\partial S} = \left(1 - \frac{r - r^D}{r^P - r^D}\right) \partial r / \partial S$$

↖ *effect goes to zero as r goes to ceiling*

Figure 6 A Conventional Corridor



Original model of this type: Poole (1968)

No interest on reserves ($r^D = 0$)

Cost of discount borrowing (r^P) is *discount rate + nonpecuniary cost*

("administrative control," harassment)

$(R^D - K)$ is demand for "free reserves."

What was true in the late 1920s? Looks like Poole (1968).

National market in overnight fed funds loans

No interest on reserves, banks cover shortfalls at *(discount rate + nonpecuniary cost)*

But existing literature on 1920s-30s has used "borrowing-function" model.

No excess reserves (or at least unaffected by interest rates)

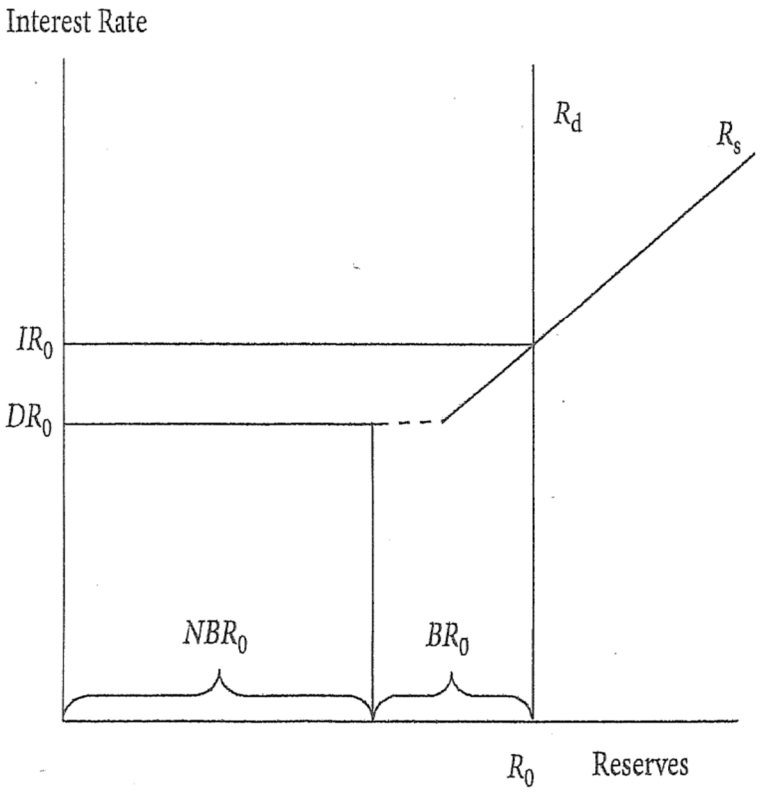
Discount rate < market short-term rates, but

nonpecuniary cost increases with amount of bank's discount borrowing, creates "Borrowing function": discount borrowing increases with spread between money-market rates (not necessarily overnight rate) and discount rate

Result is...

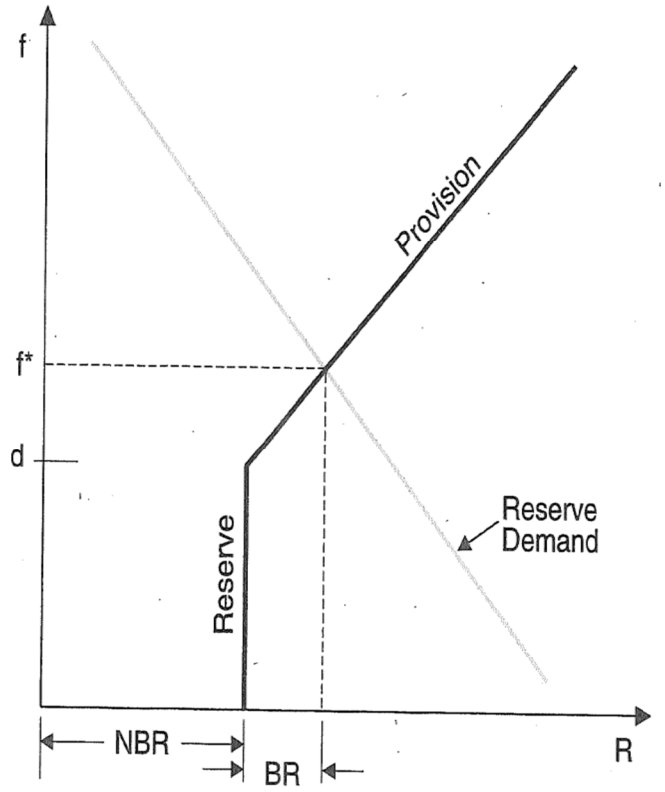
"Borrowing-function model" (cont):

Hetzel (2022) about 1920s



Goodfriend and Whelpley (1993) about 1980s

FIGURE 2



We argue late-1920s money market was essentially modern:

1) Expected future fed funds rates largely determined other money-market rates

3) Liquidity trap meant fed funds rate on lower bound due to ample reserve supply

4) R^D of large NYC & Chicago banks was like Poole (1968)

5) R^D of most other banks was inventory-theoretic but *looks* like borrowing-function model mainly because those banks held excess in accounts in correspondent banks, not reserve accounts.

What we'll do here:

1) Stylized facts about late 1920s money market

2) Outline our model (no details)

3) Evidence:

- effects of weekly exogenous shocks to R^S
- paths of reserve quantities 1928-32

Late-1920s money market, stylized facts

Interbank payments were made three ways:

1) Fedwire, only for large bank-to-bank transactions (not for customers)

2) Fed's check-clearing system

Credit given on fixed schedule, debits occur only after one day's warning.

3) City clearing houses. Payments are cleared overnight, net balances paid/received following morning in reserve accounts

Note: 2) & 3) do not create uncertainty about end-of-day settlement.

Money market instruments

Fed funds loans, call money loans,

banker's acceptances, commercial paper, short-term Treasuries

Payments associated with all money market instruments other than fed funds go through clearing house, hence affect reserve accounts on following day.

Late-1920s money market, stylized facts (cont).

More on fed funds loans

Floor is 1/8 percent (cost of lending)

Participation limited to large banks in New York city and (less so) Chicago

and (even less so) a few other cities (Boston, San Francisco)

More on call money loans

Effectively overnight (can be recalled or renegotiated after one day), but lagged settlement.

All member banks lend call money.

Two kinds of collateral:

- "standard," basket of stocks and bonds.
- acceptances or Treasuries.

Two ways to lend:

- "on the street," with brokers. Majority of total call money lending (1/2 - 3/4).

  Market rate, day-to-day rate changes as small as ¼%.

- through "money desk" on NYSE floor, rate set by NYSE officials.

  Not a market rate. Daily adjustments at least ½%

  Sometimes "pegged" above market (large NYC banks get to lend).

Federal Reserve standing credit facilities

- Acceptance purchase (outright) from banks and dealers

Buy at posted rates, which set ceiling for market rates.

Market rates often at or near ceiling, lots of Fed buying.

- Short-term repo loans against acceptances, Treasuries, to dealers only

Do not set ceiling for standard-collateral rates, but often lots of Fed lending.

Late-1920s money market, stylized facts (cont).

Correspondent banking system

Large NYC member banks

- take demand deposits from "respondent" banks all over the country, pay common, fixed rate of interest. ***Almost all member banks outside NYC have accounts in NYC.***
- Do not hold deposits in other domestic banks.
- Act as agents for respondents in NYC call money market, both "street" and NYSE.
- Respondents use Fedwire to transfer funds between correspondent and reserve accounts.
- Fedwire payments ordered by respondents caused reserve shortfalls & discount borrowing:

  Benjamin Strong in 1925: *"unexpected wire transfers ...made for individual banks which keep New York accounts" result in "unexpected impairment of reserves" for the New York correspondents.*

  Federal Reserve Board meeting 1928: *wire transfers "ordered late in the afternoon" could leave a respondent bank "short in its reserves."*

Correspondent banking system (cont.)

Chicago member banks

Take respondent deposits like NYC banks (same fraction of assets as NYC banks').

but also hold accounts in NYC correspondents.

Reserve city member banks (regional banking centers)

Like Chicago banks, but respondents' deposits are smaller fraction of assets.

Country member banks

Most do not take respondent deposits.

Model

"Money center" banks (like large NYC banks)

Active in all money markets. Arbitrage ensures $i_{d-1}^{Call} = E[i_d^{FF}] + \tau_1$.

τ_1 ↖ *call money transactions cost*

→ Poole-model inventory-theoretic problem, same results.

"Regional city banks" (like most banks outside NYC, Chicago)

Lend call money, no fed funds, maybe take deposits from respondents.

Call money lending affects *(reserve + correspondent balance)* on *following* day.

On following day, borrow from discount window if *(reserve + correspondent balance)* < *RR*

Leave just *RR* in reserve account, any excess in correspondent to earn interest.

Inventory-theoretic problem. Result:

- no excess reserves
- discount borrowing depends on call money rate *versus* (discount rate + nonpecuniary cost)
- correspondent balance behaves like money center banks' excess reserves.

Model (cont.)

Interest rate determination

Market-clearing fed funds rate solves

Money-center banks' free reserve demand = *"**noncredit reserve supply**"*
+ *discount borrowing by regional city banks*
+ *credit created by Fed acceptance, repo facilities*
- *total required reserves*

Expected future fed funds rates determine other money-market rates.

Testing the model

Data:

Fed funds rates, daily (starting April 1928)

Other interest rates, daily: NYSE call money, acceptances, commercial paper, Treasuries

Weekly Wednesday or weekly average:

- Reserve supply factors
- Excess reserves in aggregates: New York city, Chicago, reserve cities.
- Correspondent balances due to weekly reporters in same aggregates

Identification problem

Both interest rates & reserve quantities affected by many unobservables.

Fed administered rates & open-market operations responded to money-market conditions.

(Fed did not have interest-rate targets, but sometimes acted to stabilize)

International gold inflow (adds to reserve supply) responds to interest rates.

Testing the model (cont.)

Identification strategy

There is a reserve supply factor (a drain) unrelated to money-market conditions, Fed actions:

$$(-Treasury\ Money + Treasury\ daily\ certificates\ held\ by\ Fed)$$

Mostly Treasury Fed accounts ↗ ↖ *Short-term financing around quarterly debt issuance*

Reflects spending, tax revenue, debt payments & issuance.

Fed did not respond to this.

Observe effects on:

- interest rates
- excess reserves
- respondents' deposits in correspondent banks.

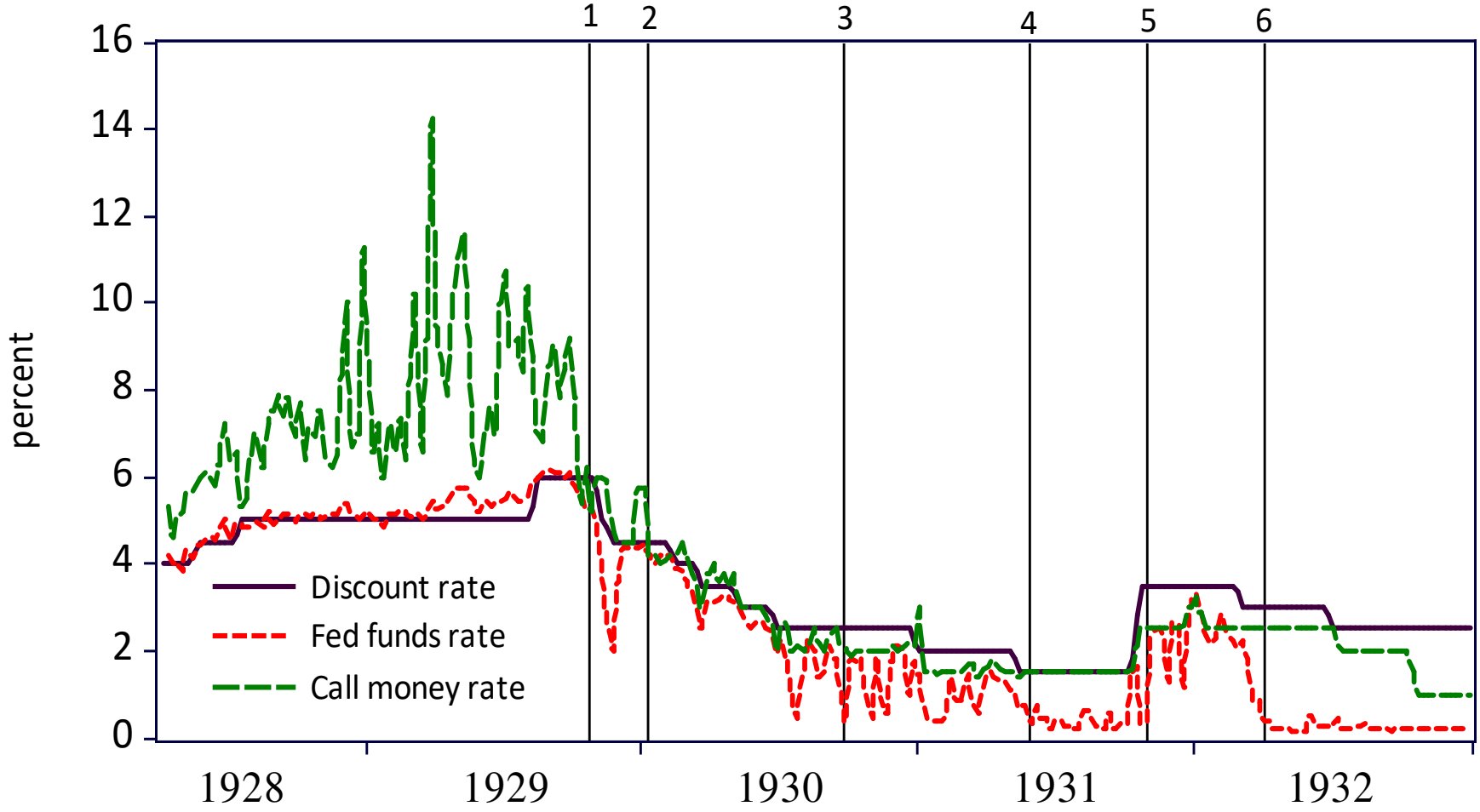
Regressions:

$$\Delta i, Q = \beta \Delta R^{S\ shock} + dummies\ (weeks\ around\ year\text{-}end,\ other\ quarterly\ call\ reports)$$

Exclude weeks with changes in discount rates.

To observe effects on interest rates, exclude weeks when call money rate pegged and/or fed funds rate on floor, and crash weeks (1-2, after 3)

Figure 1 Federal funds, NYSE call money and FRBNY discount rates, April 1928-December 1932 (weekly average)



Within this sample, weekly changes in net Treasury money:

- are largely unrelated to other reserve supply factors, except for float.
- have effects on nonborrowed & discount borrowing like Burgess-Riefler, borrowing-function
- are transitory, mostly reversed after two weeks.

Table 1 Treasury reserve supply shocks and reserve quantities 1928-1930

102 observations Coefficient
[SE]
p-value

LHS vars.	Other supply factors (+) adds (-) drains					Noncredit reserve supply	Fed standing facilities	Nonbor. reserve supply	Discount credit	Treasury money	
	(+)Fed holdings (1)	(+)Gold (2)	(+)Float (3)	(-)Curr. (4)	(-)Other (5)	(6)	(7)	(8)	(9)	+1 (10)	+2 (11)
Treasury money net	0.04 [0.04] *0.38*	-0.04 [0.05] *0.43*	-0.17 [0.08] *0.05*	-0.04 [0.20] *0.84*	-0.02 [0.03] *0.55*	-1.13 [0.21] *0.00*	0.21 [0.13] *0.12*	-0.92 [0.23] *0.00*	1.24 [0.23] *0.00*	-0.39 [0.09] *0.00*	-0.21 [0.10] *0.04*
R^2	*0.01*	*0.01*	*0.04*	*0.00*	*0.00*	*0.22*	*0.03*	*0.14*	*0.23*	*0.14*	*0.04*

important source of fluctuation!

Fed funds and call money rates: reserve supply shocks affect both.

Not true for ΔFed Treasury holdings (open-market operations); less true for ΔNoncredit reserves.

Effects on fed funds and call money rates are *transitory,* reversed following week.

1928-1930 Coefficient [Robust SE] *p-value* 102 observations Reserve quantities in $millions Week avg. interest rates ending Saturday

LHS var.	Fed funds rate							Call money		
Δ Overnight rate	Wed. (1)	Wed. (2)	Wed. (3)	Wed. (4)	Week avg. (5)	Thurs. (6)	Wed(+1) (7)	Wed. (8)	Week avg. (9)	Wed(+1) (10)
Treasury money or net /1000	4.217 [0.968] *0.00*	3.997 [1.418] *0.01*			3.093 [0.982] *0.00*	4.882 [1.251] *0.00*	-3.289 [1.293] *0.01*	20.022 [8.954] *0.03*	15.492 [7.298] *0.04*	-29.768 [10.019] *0.00*
One-day certificates /1000		-4.571 [1.737] *0.01*								
Fed Treas. holdings /1000			2.697 [2.496] *0.28*							
Noncredit reserves /1000				-1.124 [0.478] *0.02*						
	+quarter	*end*	*dummies*							
R^2	*0.28*	*0.28*	*0.23*	*0.21*	*0.15*	*0.18*	*0.24*	*0.21*	*0.25*	*0.24*

One SD ΔTreasury Money changes fed funds rate Wednesday-Wednesday ≈ 10 b.p.'s.

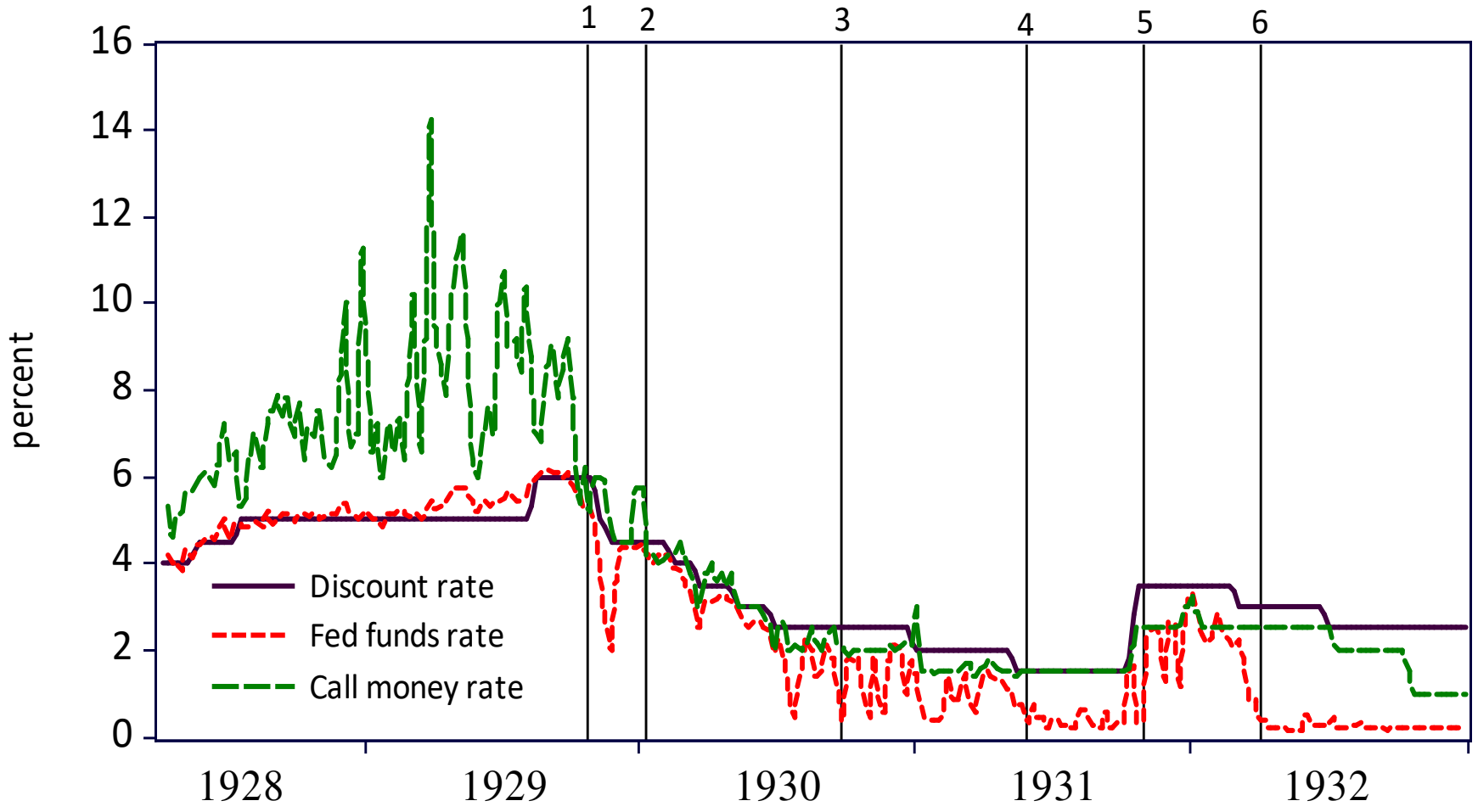
Longer term rates: no effects

1928-1930 Coefficient 102 observations Reserve quantities in $millions
[Robust SE] Week avg. interest rates ending Saturdays
p-value

LHS var.	Commercial paper		Acceptances 90-day		Treasuries 3-6 month	Treasuries Long-term bonds	
Interest rate	Wed. (1)	Week avg. (2)	Wed. (3)	Week avg. (4)	Week avg. (5)	Wed. (6)	Week avg. (7)
Treasury money net /1000	0.000 [0.496] *0.98*	0.000 [0.356] *0.87*	0.232 [0.320] *0.47*	0.200 [0.278] *0.47*	-0.359 [0.646] *0.58*	-0.273 [0.224] *0.22*	0.000 [0.113] *0.97*
+quarter end dummies							
R^2	*0.01*	*0.01*	*0.12*	*0.09*	*0.03*	*0.03*	*0.01*

To observe effects on excess reserves, compare weeks before 1 with 2-4 + 5-6

Figure 1 Federal funds, NYSE call money rate and FRBNY discount rates,
April 1928-December 1932 (weekly average)



Excess reserves: reserve supply shocks do not affect reserve cities'
affect NYC & Chicago only in 1930-32 (when i^{FF} far below ceiling)

A) Weekly averages, excluding weeks of change in local reserve bank discount rate

	New York City				Chicago		Reserve cities	
	Fed funds rate		Excess reserves		Excess reserves		Excess reserves	
	1929	1930-32	1929	1930-32	1929	1930-32	1929	1930-32
	(1)	(2)	(3)	(4)	(7)	(8)	(11)	(12)
N. obs.	40	78	40	78	42	84	37	58
Treasury money net /1000	3.149	5.698	2.572	-89.216	4.192	-24.995	11.709	2.350
	[1.181]	[0.864]	[45.412]	[18.511]	[7.531]	[0.010]	[17.882]	[11.742]
	0.01	*0.00*	*0.96*	*0.00*	*0.58*	*0.02*	*0.52*	*0.84*
+ quarter end dummies								
R^2	*0.17*	*0.26*	*0.11*	*0.14*	*0.02*	*0.41*	*0.13*	*0.45*

B) Estimates from Wednesday weekly reporters' reserves and deposits

	New York City				Chicago			
larger	Fed funds		Excess reserves		Fed funds		Excess reserves	
sample →	1928-1929	1930-32	1928-29	1930-1932	1928-32	1930-32	1928-1929	1930-32
	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
N. obs	74	78	74	78	76	84	76	84
Treasury money net /1000	2.838	6.068	109.566	-200.885	2.999	5.816	37.008	-44.803
	[0.853]	[1.012]	[80.875]	[50.676]	[0.8400]	[0.997]	[28.610]	[20.380]
	0.00	*0.00*	*0.18*	*0.00*	*0.00*	*0.00*	*0.20*	*0.03*
+ quarter end dummies								
R^2	*0.34*	*0.24*	*0.20*	*0.54*	*0.33*	*0.23*	*0.27*	*0.22*

Correspondent bank balances: apparent effect on reserve cities' only in 1930-32
NYC and Chicago are different

Weekly Wednesdays, all samples excluding weeks of change in NYCH banks' demand deposit rate

A) Also excluding weeks of change in any reserve bank discount rate

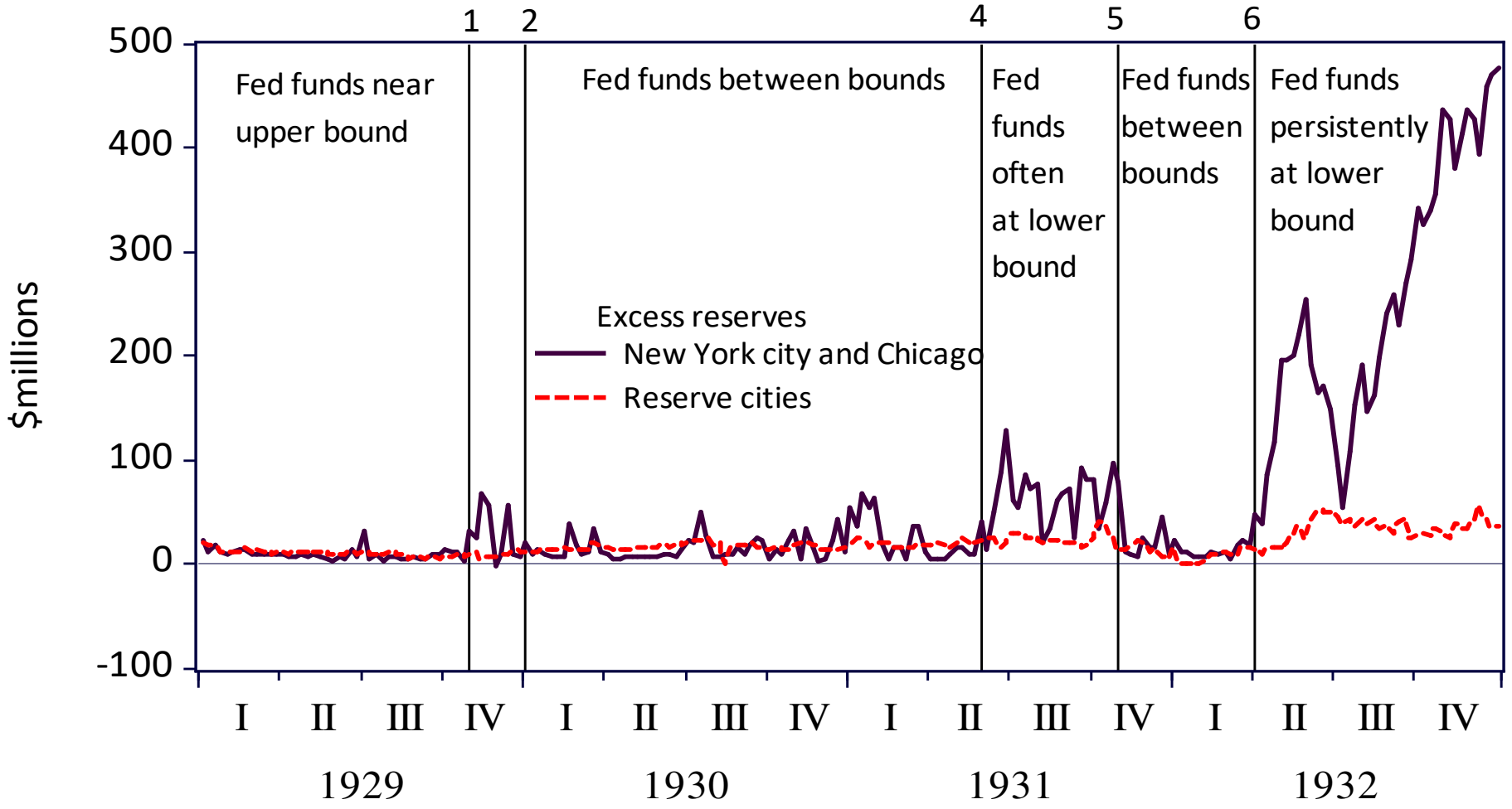
	Call money rate		Demand deposits due from banks: Reserve cities		Demand deposits due from banks: New York City		Demand deposits due from banks: Chicago	
	1928-29	1930-32	1928-29	1930-32	1928-29	1930-32	1928-29	1930-32
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
N. obs	59	52	59	52	59	52	59	52
Treasury money net /1000	26.641	0.933	-128.428	-322.433	-101.970	-99.463	-42.961	-0.193
	[0.011]	[0.592]	[167.615]	[90.768]	[0.058]	[26.181].	[0.051]	[25.534]
	0.02	*0.12*	*0.45*	*0.00*	*0.09*	*0.00*	*0.40*	*0.99*
+ quarter end dummies								
R^2	*0.37*	*0.37*	*0.30*	*0.19*	*0.22*	*0.34*	*0.19*	*0.04*

B) Also excluding weeks of change in local discount rate

	Demand deposits due from banks: New York Federal Reserve district				Demand deposits due from banks: Chicago Federal Reserve district			
	New York City		Outside the city		Chicago city		Outside the city	
	1928-29	1930-32	1928-29	1930-32	1928-29	1930-32	1928-29	1930-32
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Observations	74	76	74	76	76	81	76	81
Treasury money net /1000	-139.258	-100.984	-1.176	-23.405	-96.122	-3.227	14.668	-45.633
	[53.526]	[24.816]	[17.943]	[11.139]	[57.920]	[21.691]	[26.189]	[0.006]
	0.01	*0.00*	*0.95*	*0.04*	*0.10*	*0.88*	*0.58*	*0.00*
+ quarter end								
R^2	*0.20*	*0.21*	*0.34*	*0.14*	*0.13*	*0.02*	*0.19*	*0.17*

Excess reserves of NYC + Chicago banks are close to zero when fed funds rate close to ceiling, fluctuating when fed funds rate between bounds, grow without limit when fed funds rate stays at lower bound.

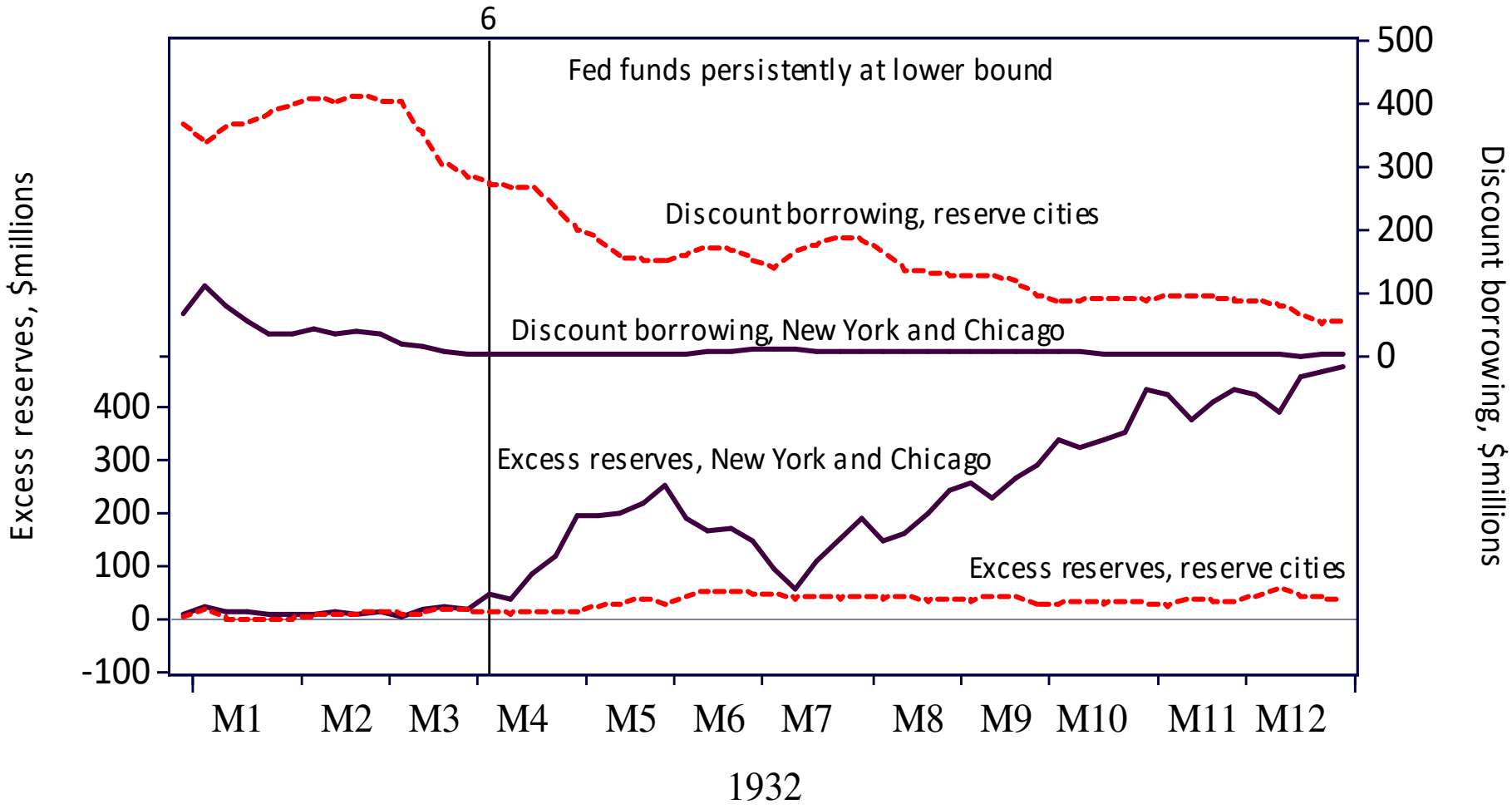
Figure 2 Excess reserves of New York + Chicago and reserve city banks, 1929-1932 (weekly)



Discount borrowing includes seasonal & liquidity crisis, important in reserve cities.

In NYC & Chicago, no borrowing when fed funds on lower bound.

Figure 3 Excess reserves, discount borrowing of New York + Chicago and reserve city banks, 1932 (weekly)



In the first half of 1932 Fed bought bonds, then stopped in July 1932.

Did stopping harm recovery?

Was it indeed "a policy mistake of monumental proportions" (Hsieh and Romer, 2006)?

Figure 4 Federal Reserve holdings of Treasury debt and interest rates, 1932 (weekly)

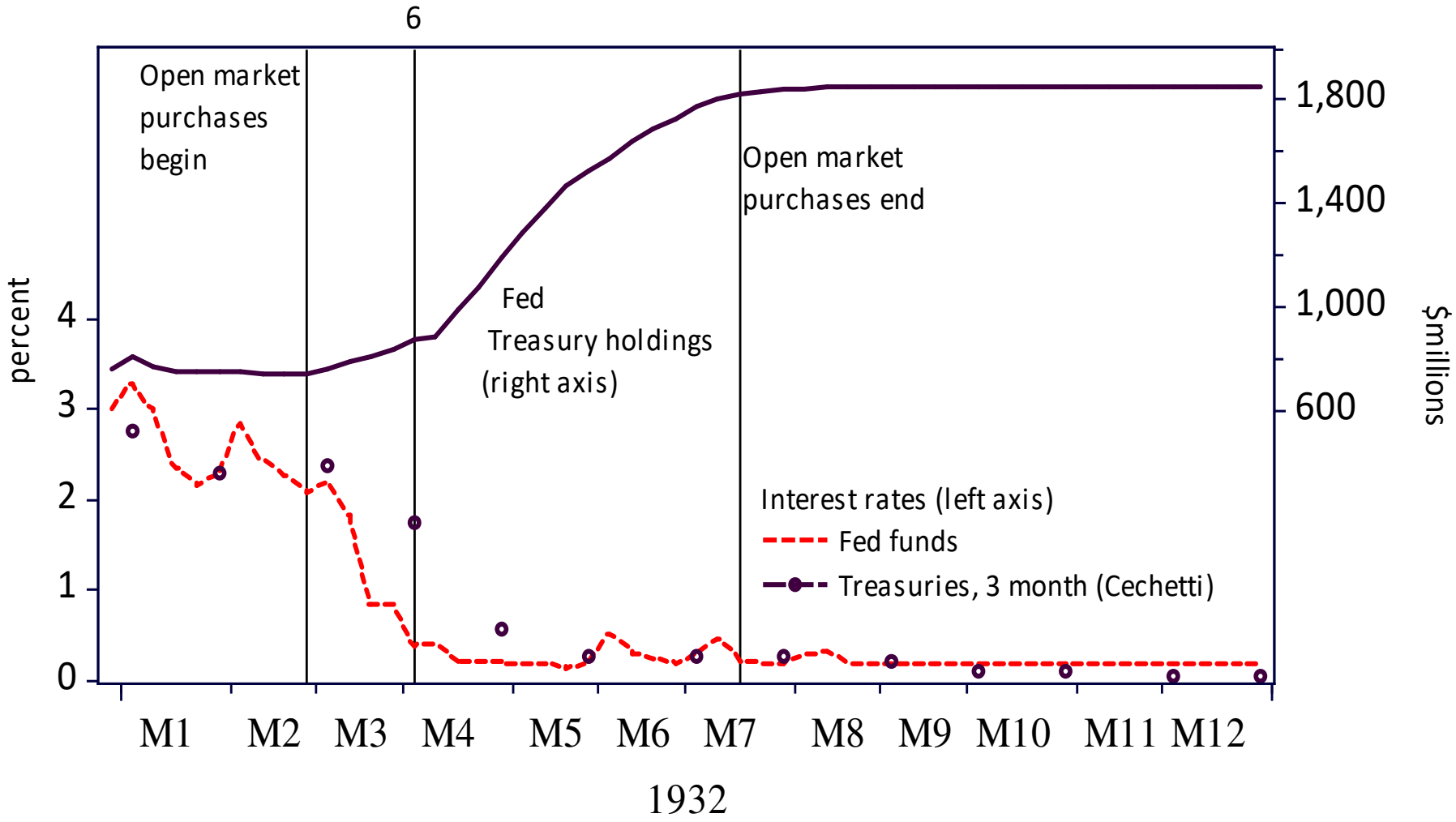


Table 6 Fed acceptance and repo operations 1928-1930

Coefficient 102 observations Reserve quantities in $millions
[Robust SE]
p-value

.	Outstanding credit			Market rate - Federal Reserve rate spread (Week avg. ending Wednesday)			Outstanding credit		
	Accept. repo (1)	Treasury repo (2)	Accept. purchase (3)	Accept. repo (4)	Treasury repo (5)	Accept. (30/60/90-day) (6)	Accept. repo (7)	Treasury repo (8)	Accept. purchase (9)
Treasury money net	0.212 [0.068] *0.00*	0.042 [0.048] *0.38*	-0.102 [0.095] *0.28*	0.017 [0.005] *0.00*	0.017 [0.005] *0.00*	0.000 [0.000] *0.88*			
Interest rate spread							4.481 [1.302] *0.00*	1.602 [0.643] *0.01*	54.623 [31.313] *0.08*
+quarter-end dummies									
R^2	*0.19*	*0.06*	*0.02*	*0.28*	*0.29*	*0.03*	*0.21*	*0.12*	*0.03*