UNBUNDLING QUANTITATIVE EASING: TAKING A CUE FROM TREASURY AUCTIONS

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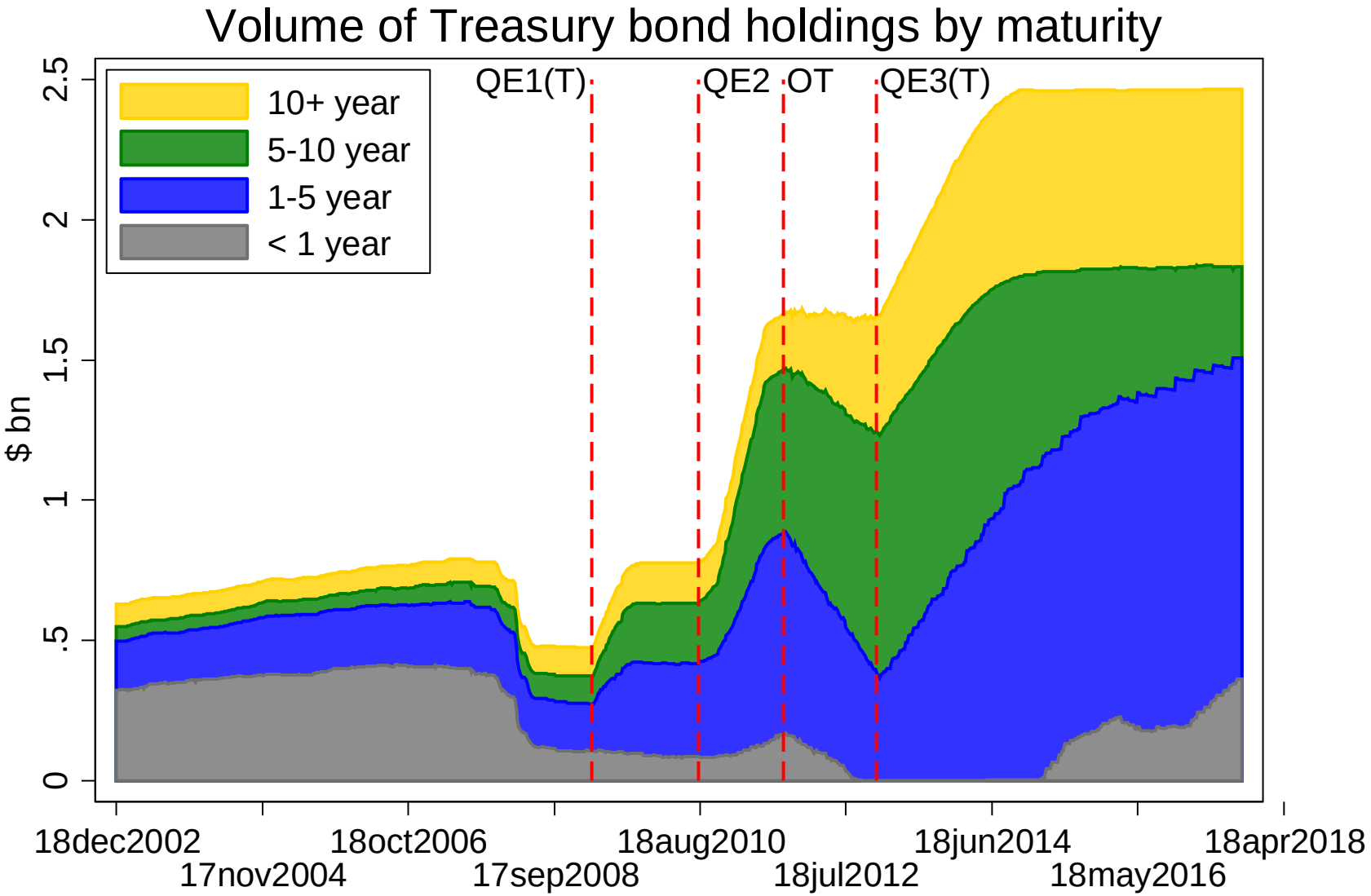
QUANTITATIVE EASING



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- Standard macro-finance framework: demand for financial assets is determined by intertemporal substitution (hence, no clear role for QE)

How did QE work?

Possible channels:

- Forward guidance

  FOMC (Dec 16, 2008): "The Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time."

- "Delphic" effect

  Bernanke (Dec 1, 2008): "As you know, this extraordinary period of financial turbulence is now well into its second year."

- Preferred habitat

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  - How can we test these theories with a handful (3?) of QE events?
  - Can we have natural experiments when we can rule out some channels? (e.g., the Chinese central bank announces its plans to spend $300 bn to buy U.S. Treasuries to commemorate some anniversary)

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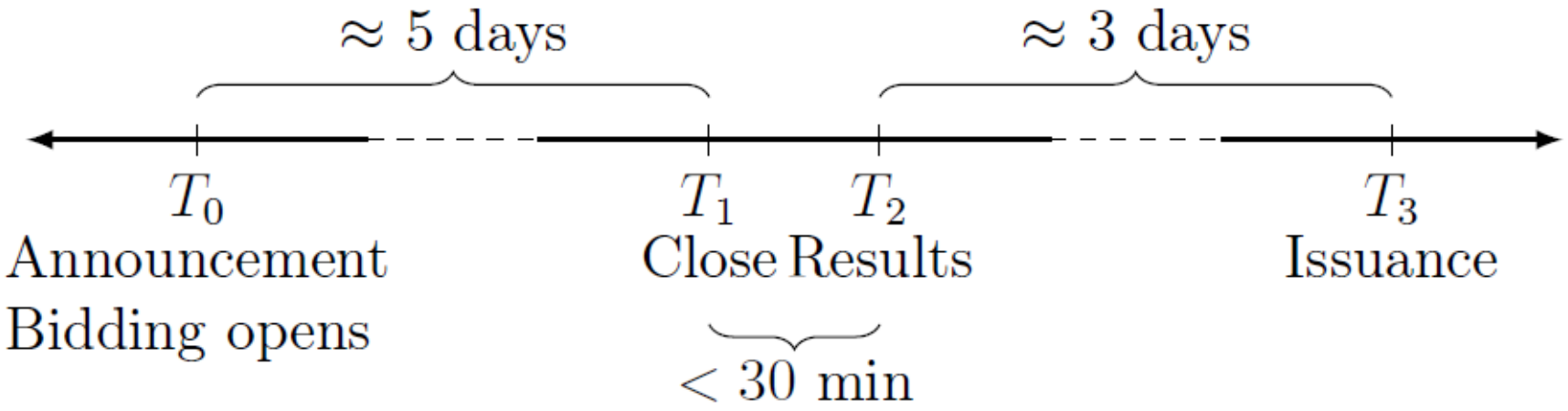
    - Comparison (Chodorow-Reich 2014): Bernanke's speech on Dec 1, 2008 reduced yields (5-year maturity) by 9 b.p.
  - Isolate demand shocks (mostly institutional investors)
- Main result: "preferred habitat" accounts for most of QE effects

TREASURY AUCTIONS



TREASURY OFFERING ANNOUNCEMENT [1]

Term and Type of Security	30-Year Bond
Offering Amount	$16,000,000,000
Currently Outstanding	$0
CUSIP Number	912810QS0
Auction Date	August 11, 2011
Original Issue Date	August 15, 2011
Issue Date	August 15, 2011
Maturity Date	August 15, 2041
Dated Date	August 15, 2011
Series	Bonds of August 2041
Yield	Determined at Auction
Interest Rate	Determined at Auction
Interest Payment Dates	February 15 and August 15
Accrued Interest from 08/15/2011 to 08/15/2011	None
Premium or Discount	Determined at Auction
Minimum Amount Required for STRIPS	$100
Corpus CUSIP Number	912803DT7
Additional TINT(s) Due Date(s) and	August 15, 2041
CUSIP Number(s)	912834KP2
Maximum Award	$5,600,000,000
Maximum Recognized Bid at a Single Yield	$5,600,000,000
NLP Reporting Threshold	$5,600,000,000
NLP Exclusion Amount	$0

TREASURY AUCTION RESULTS

Term and Type of Security	30-Year Bond
CUSIP Number	912810QS0
Series	Bonds of August 2041
Interest Rate	3-3/4%
High Yield[1]	3.750%
Allotted at High	41.74%
Price	100.000000
Accrued Interest per $1,000	None
Median Yield[2]	3.629%
Low Yield[3]	3.537%
Issue Date	August 15, 2011
Maturity Date	August 15, 2041
Original Issue Date	August 15, 2011
Dated Date	August 15, 2011

	Tendered	Accepted
Competitive	$33,305,800,000	$15,985,160,000
Noncompetitive	$14,855,600	$14,855,600
FIMA (Noncompetitive)	$0	$0
Subtotal[4]	**$33,320,655,600**	**$16,000,015,600[5]**
SOMA	$489,928,400	$489,928,400
Total	**$33,810,584,000**	**$16,489,944,000**

	Tendered	Accepted
Primary Dealer[6]	$23,734,000,000	$10,921,532,000
Direct Bidder[7]	$6,567,000,000	$3,119,654,000
Indirect Bidder[8]	$3,004,800,000	$1,943,974,000
Total Competitive	**$33,305,800,000**	**$15,985,160,000**

TREASURY FUTURES

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  - Millions of contracts are traded every day
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- **Four maturities**
  - 2 year (remaining maturity 1 year 9 months to 2 years)
  - 5 year (4 years 2 months to 5 years 3 months)
  - 10 year (6 years 6 months to 10 years)
  - 30 year (at least 15 years)

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- **We match futures prices to maturities of auctioned securities**
  - For example, 10-year futures is matched to 7-year Treasury auction

DEMAND SHOCK FOR TREASURIES

$$D_t^{(m)} = \left(\log P_{t,post}^{(m)} - \log P_{t,pre}^{(m)}\right) \times 100$$

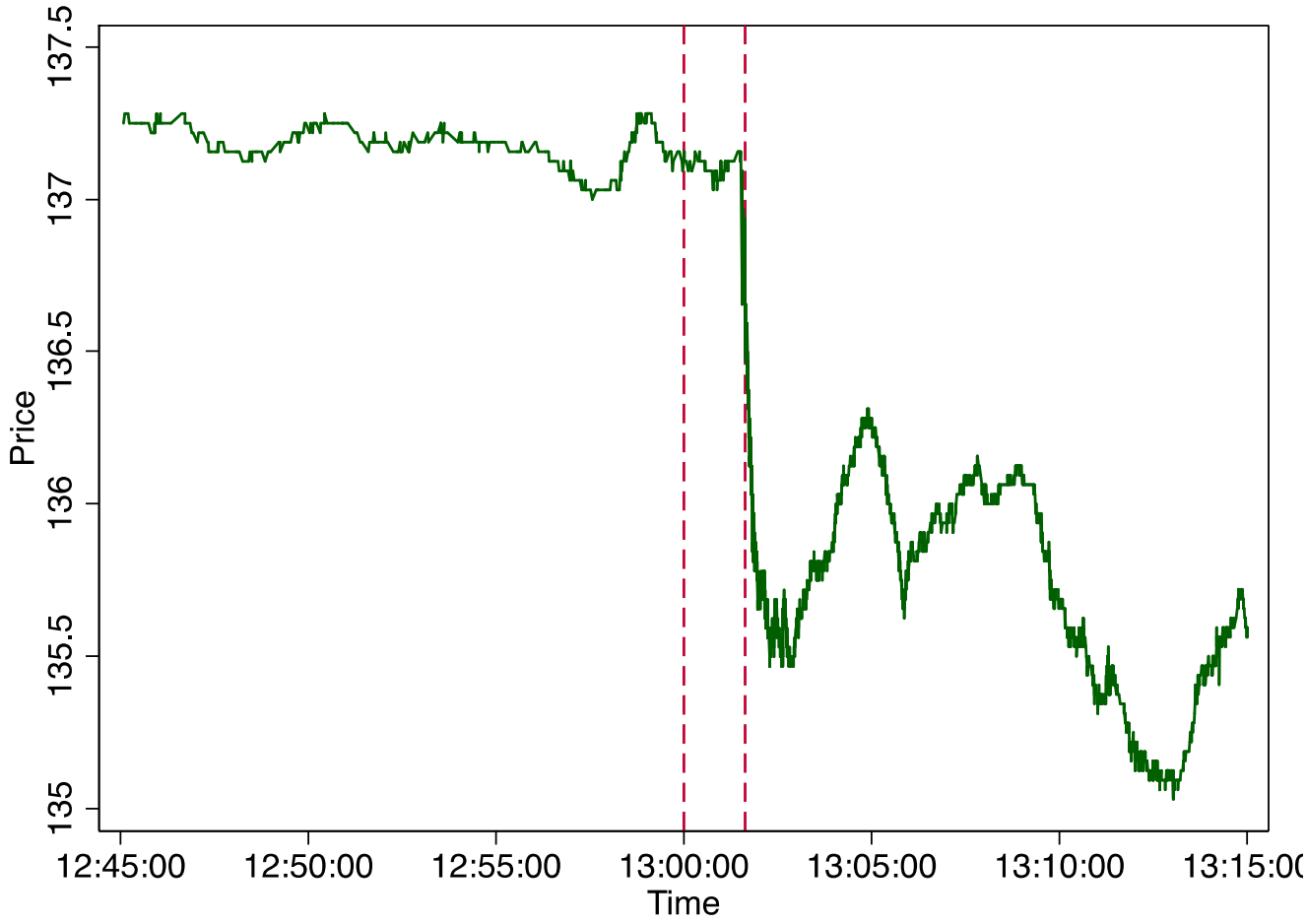
t = time of auction

m = maturity

$P_{t,post}^{(m)}$ = futures price 30 minutes after auction results are announced

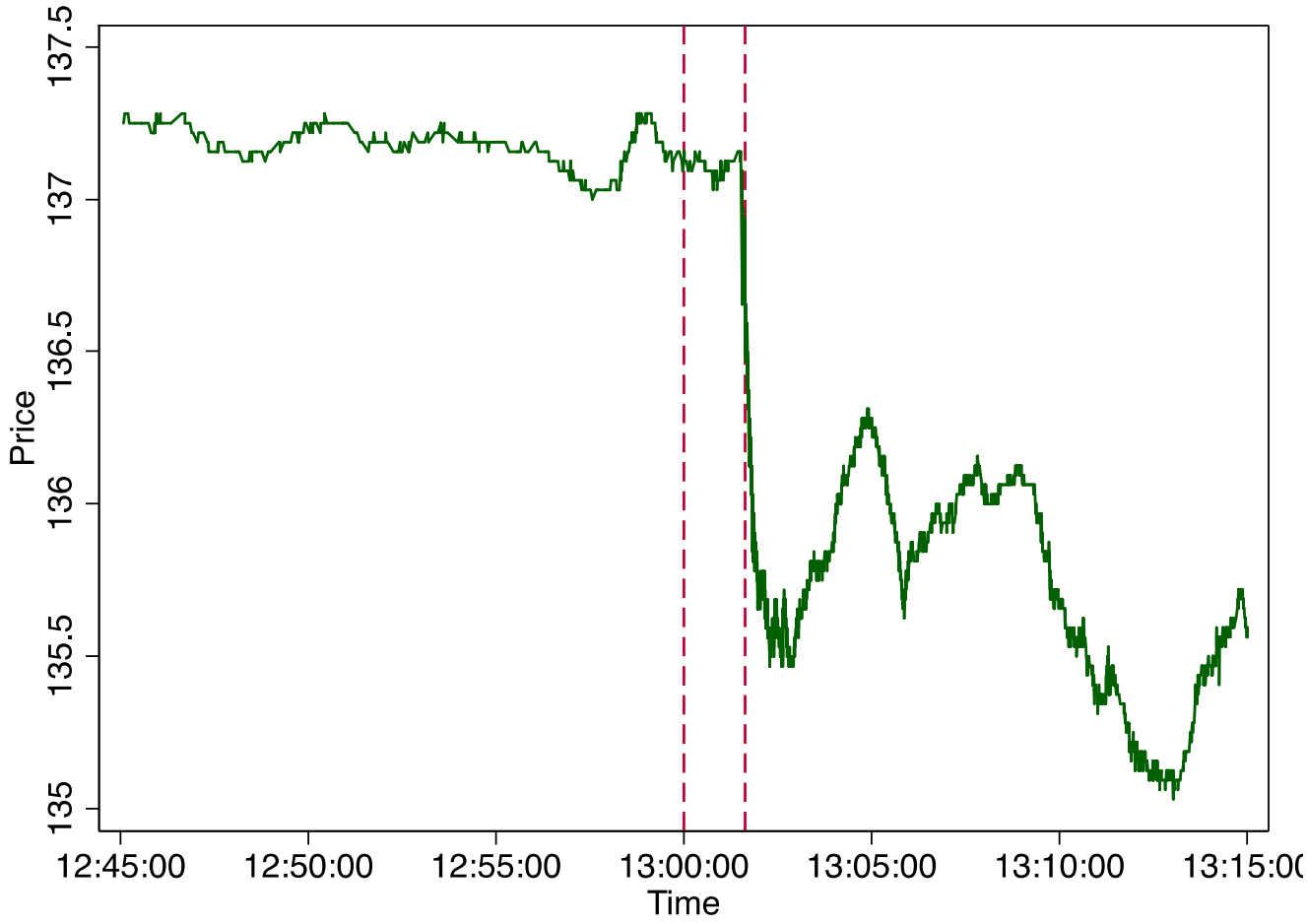
$\log P_{t,pre}^{(m)}$ = futures price 30 minutes before auction closes

DEMAND SHOCK FOR TREASURIES



August 11, 2011: $D_t^{(30y)} = \left(\log P_{t,post}^{(30y)} - \log P_{t,pre}^{(30y)}\right) \times 100$

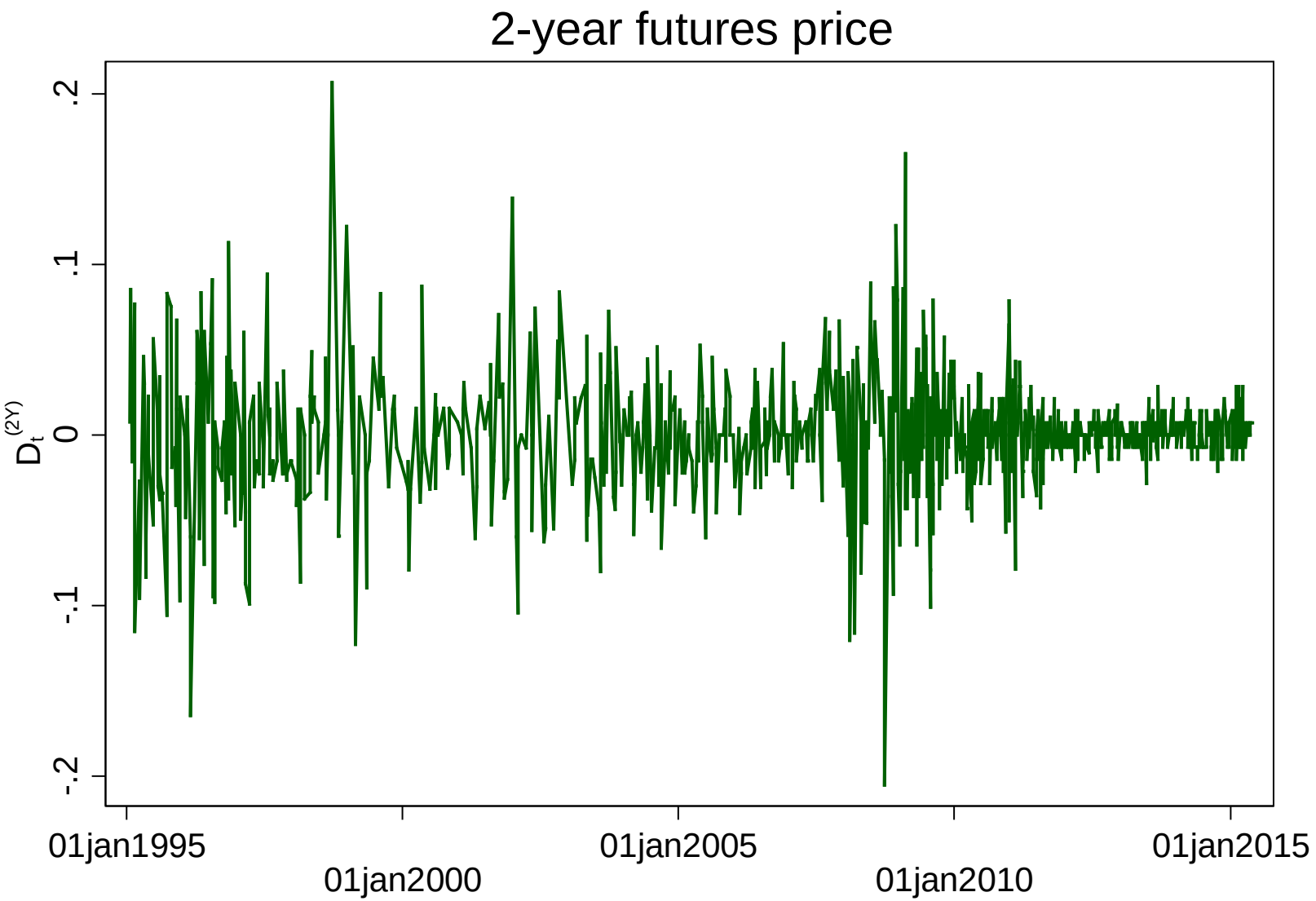
DEMAND SHOCK FOR TREASURIES



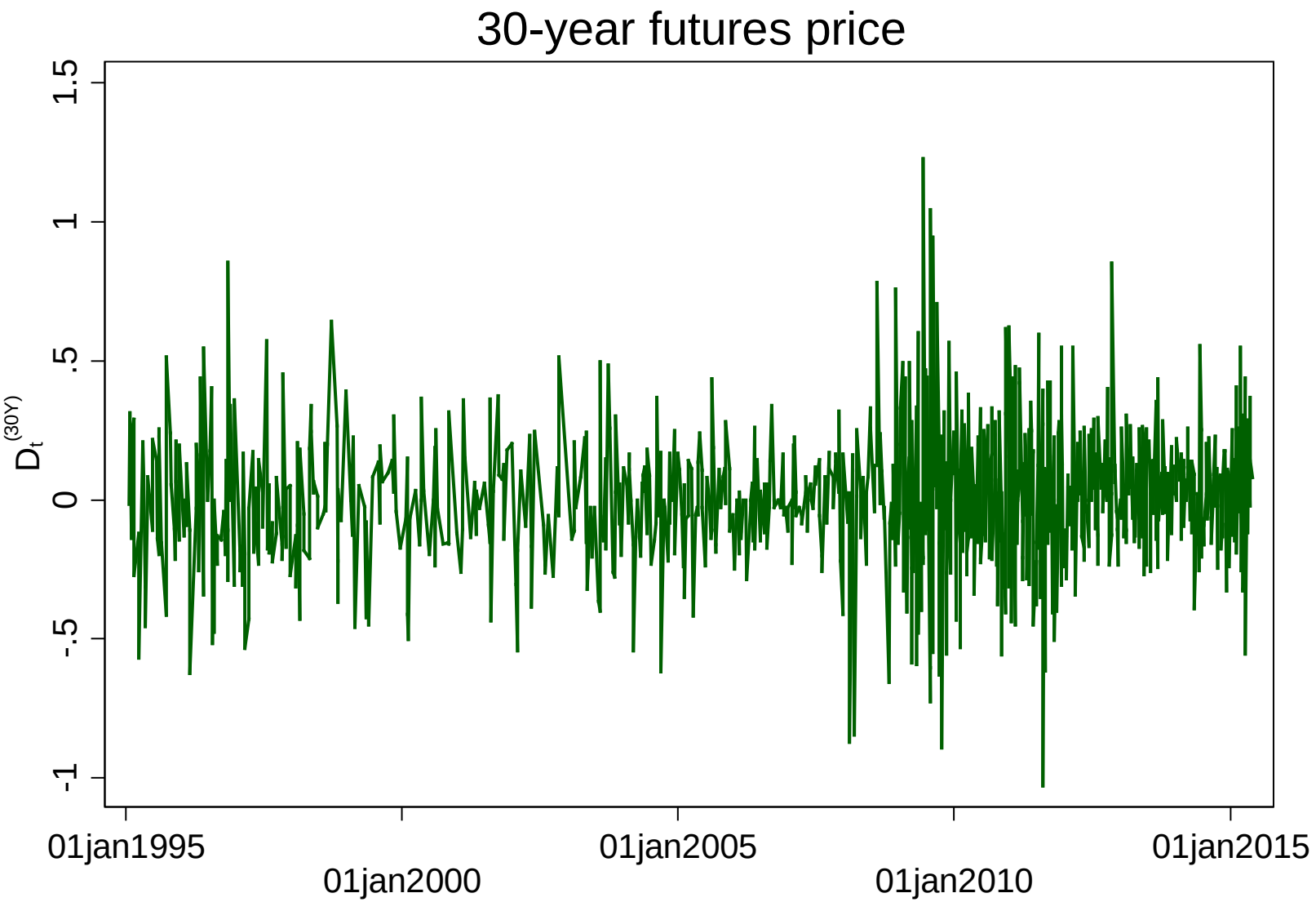
August 11, 2011: $D_t^{(30y)} = \left(\log P_{t,post}^{(30y)} - \log P_{t,pre}^{(30y)}\right) \times 100$

The amount auctioned is fixed days before auction closes so that $D_t^{(m)}$ can move only in response to changes in demand conditions

SHOCKS


2-year futures price
$D_t^{(2Y)}$
.2
.1
0
-.1
-.2
01jan1995
01jan2000
01jan2005
01jan2010
01jan2015

SHOCKS


30-year futures price
$D_t^{(30Y)}$
1.5
1
.5
0
-.5
-1
01jan1995
01jan2000
01jan2005
01jan2010
01jan2015

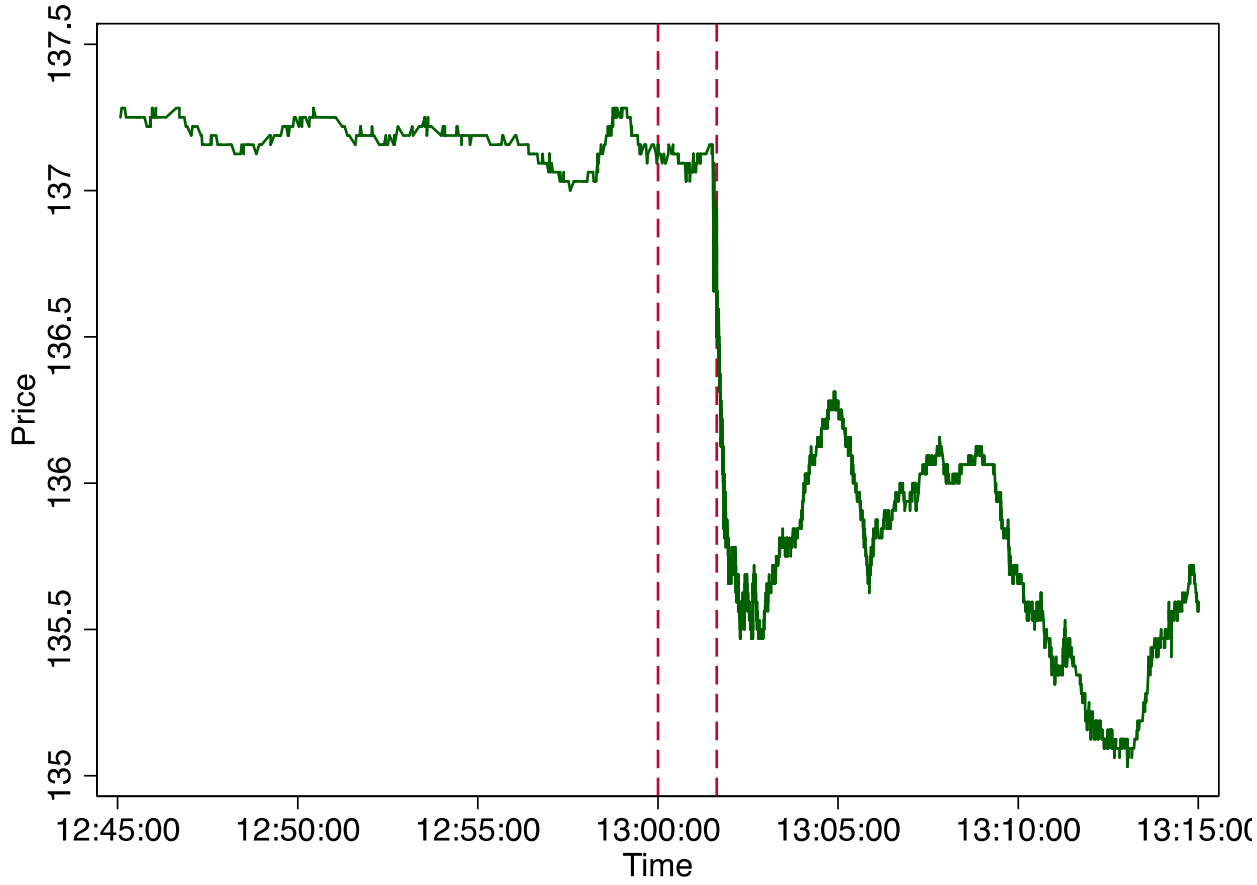
DESCRIPTIVE STATS FOR SHOCKS

Futures	Mean	St. Dev.	N
	(1)	(2)	(3)
$D^{(2Y)}$	-0.000	0.034	871
$D^{(5Y)}$	0.002	0.092	871
$D^{(10Y)}$	0.007	0.143	871
$D^{(30Y)}$	0.006	0.245	871

DESCRIPTIVE STATS FOR SHOCKS

Futures	Mean	St. Dev.	N	Correlations			
				$D^{(2Y)}$	$D^{(5Y)}$	$D^{(10Y)}$	$D^{(30Y)}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$D^{(2Y)}$	-0.000	0.034	871	1.000			
$D^{(5Y)}$	0.002	0.092	871	0.866	1.000		
$D^{(10Y)}$	0.007	0.143	871	0.782	0.958	1.000	
$D^{(30Y)}$	0.006	0.245	871	0.672	0.848	0.922	1.000

WHAT DETERMINES SHOCKS?



August 11, 2011; Financial Times: “An auction of 30-year US Treasury bonds saw weak demand... bidders such as pension funds, insurers and foreign governments shied away. ‘There's not too many ways you can slice this one, it was a very poorly bid auction.’”

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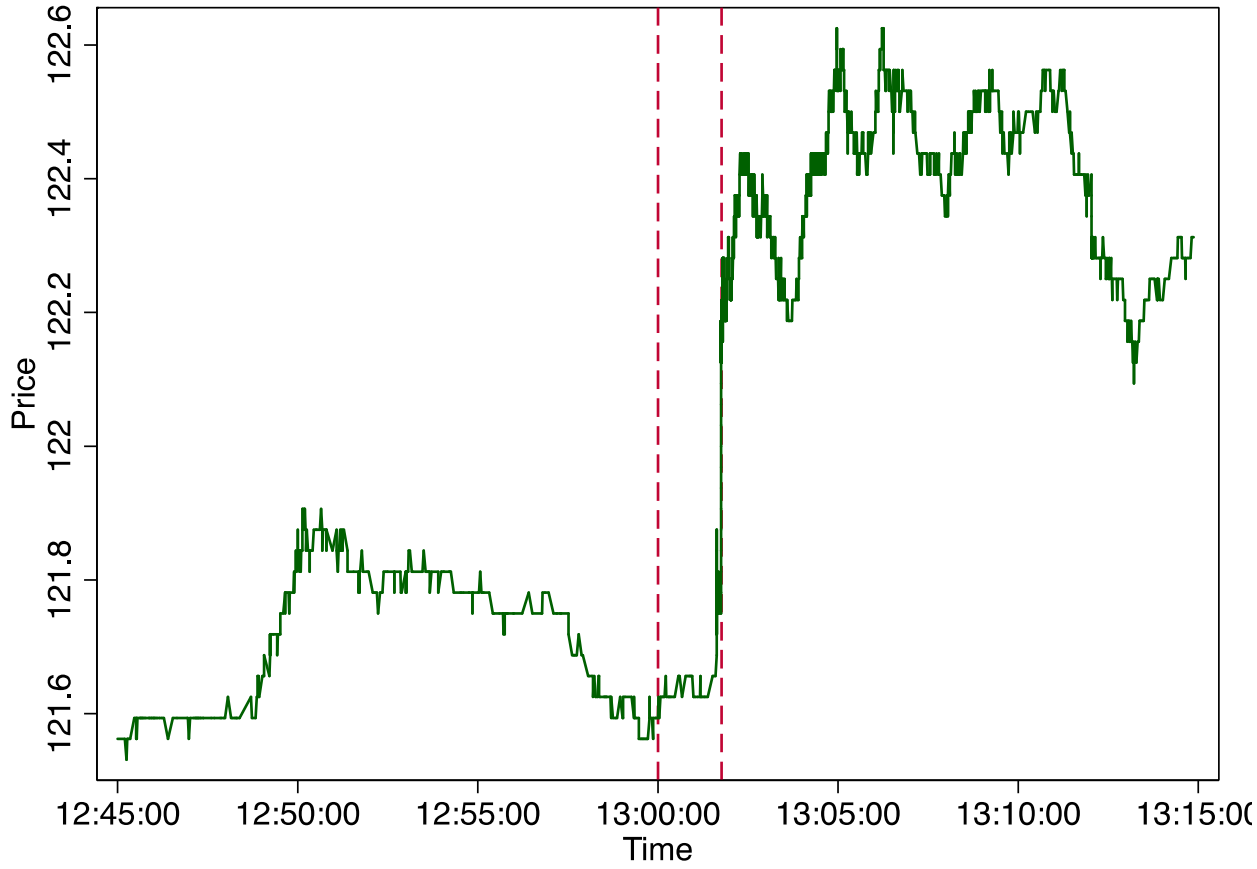

December 12, 2010; Financial Times: “Large domestic financial institutions and foreign central banks were big buyers at an auction of 30-year US Treasury bonds on Thursday. ‘Investors weren't messing around...You don’t get the opportunity to buy large amounts of paper outside the auctions and ‘real money’ were aggressive buyers.’”

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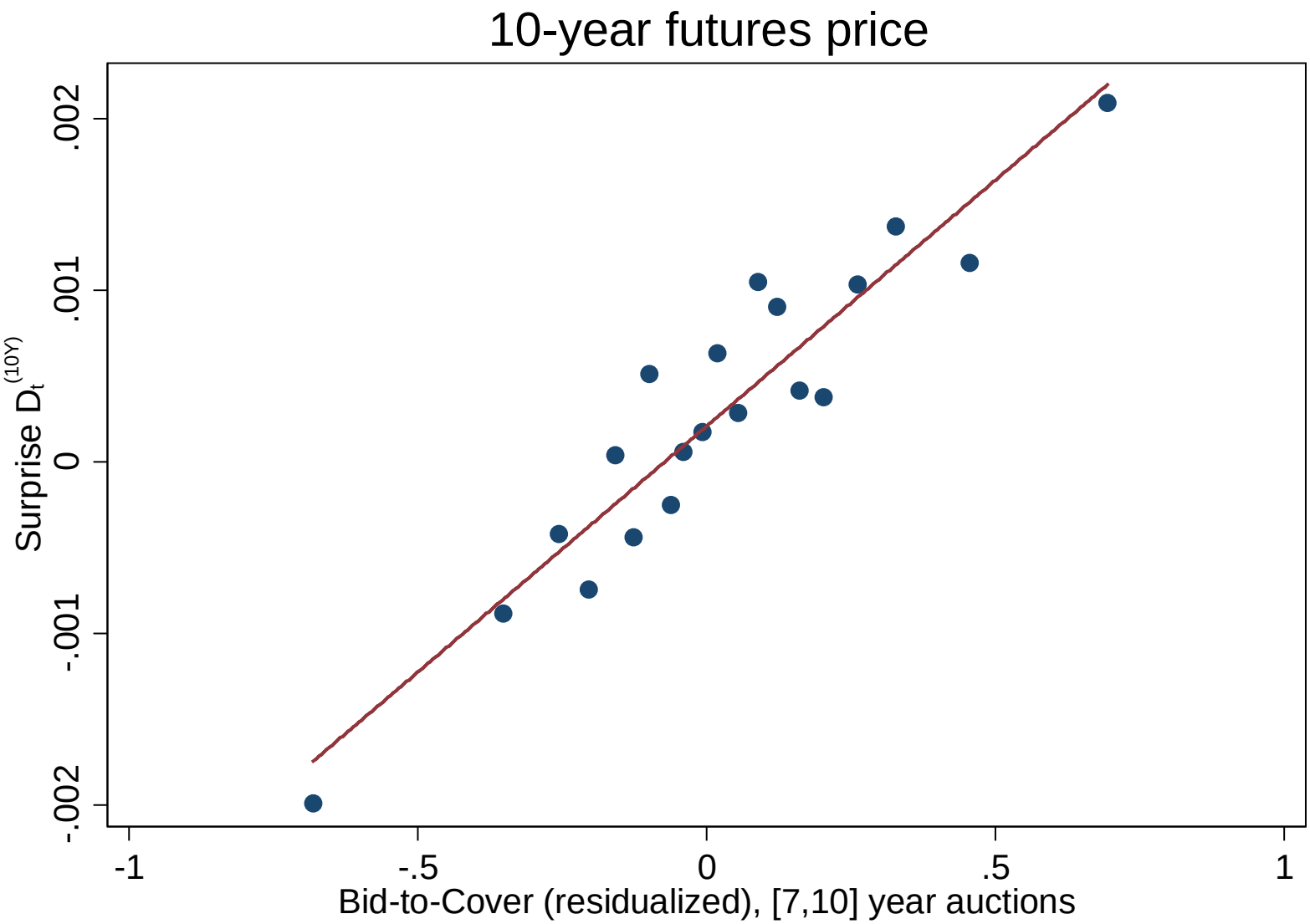


WHAT DETERMINES SHOCKS?

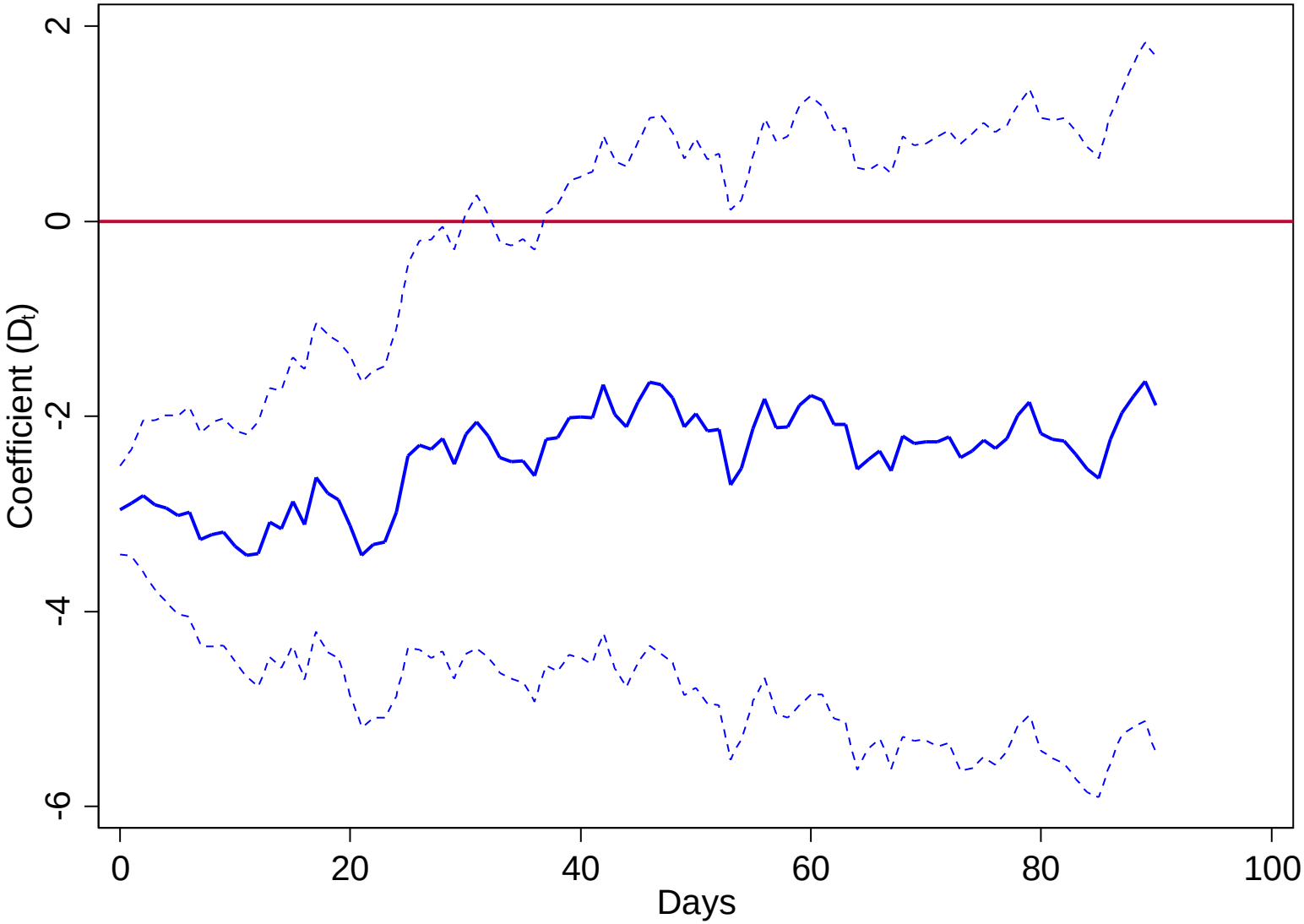
	$D^{(2Y)}$	$D^{(5Y)}$	$D^{(10Y)}$	$D^{(30Y)}$	Pooled
	(1)	(2)	(3)	(4)	(5)
Bid-to-Cover	0.03	-0.04	-0.45*	-1.37	-0.08
[expected]	(0.11)	(0.12)	(0.24)	(1.65)	(0.08)
Bid-to-Cover	1.38***	1.37***	2.11***	2.16***	1.65***
[unexpected]	(0.24)	(0.24)	(0.22)	(0.63)	(0.14)
Observations	238	306	227	100	871
R^2	0.124	0.189	0.294	0.215	0.198

WHAT DETERMINES SHOCKS?

	$D^{(2Y)}$	$D^{(5Y)}$	$D^{(10Y)}$	$D^{(30Y)}$	Pooled
	(1)	(2)	(3)	(4)	(5)
By bidder type:					
Indirect Bidders	2.79***	3.91***	4.48***	8.86***	4.44***
	(0.40)	(0.72)	(0.46)	(1.23)	(0.42)
Direct Bidders	2.16***	1.27*	0.35	1.32	1.23***
	(0.83)	(0.74)	(0.84)	(1.02)	(0.44)
Primary Dealers	0.73**	0.73**	1.58***	-0.03	0.88***
	(0.36)	(0.31)	(0.31)	(0.63)	(0.17)
Observations	138	228	187	80	633
R^2	0.362	0.339	0.399	0.679	0.376

PERSISTENCE OF THE RESPONSE

$$R_{t+h}^{(10Y)} - R_{t-1}^{(10Y)} = \gamma_{(h)} + \phi_{(h)} D_t + error$$



COMOVEMENT ACROSS MARKETS

$$y_t = \gamma + \phi D_t + error$$

D_t = first principal component in $D_t^{(m)}$ (intraday change)

y_t = outcome variable (intraday or daily change)

COMOVEMENT ACROSS MARKETS

$$y_t = \gamma + \phi D_t + error$$

Corporate debt and secondary market for Treasuries

	Estimate (s.e.)	N	R^2	Sample
LT Treasuries	0.312***	662	0.679	2002-2015
	(0.016)			
ST Treasuries	0.022***	662	0.528	2002-2015
	(0.001)			
LQD ETF	0.110***	662	0.544	2002-2015
	(0.008)			
Aaa†	-2.295***	871	0.173	1995-2015
	(0.212)			

† = daily frequency for the dependent variable

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$$y_t = \gamma + \phi D_t + error$$

Inflation expectations and commodities

	Estimate (s.e.)	N	R^2	Sample
10Y Inflation Swap†	-0.172	618	0.003	2004-2015
	(0.131)			
2Y Inflation Swap†	0.044	618	0.000	2004-2015
	(0.229)			
GOLD ETF	0.021	595	0.004	2004-2015
	(0.015)			
GSCI (commodity index)†	0.008	871	0.000	1995-2015
	(0.056)			

† = daily frequency for the dependent variable

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$$y_t = \gamma + \phi D_t + error$$

Default risk, volatility, and liquidity

	Estimate (s.e.)	N	R^2	Sample
Baa-Aaa†	-0.056	871	0.001	1995-2015
	(0.074)			
CDS (auto industry)†	-3.254	627	0.000	2004-2015
	(5.796)			
CDS (banks industry)†	0.426	627	0.004	2004-2015
	(0.450)			
VIX†	0.058	871	0.001	1995-2015
	(0.082)			
LIBOR-OIS spread†	-0.001	871	0.001	1995-2015
	(0.001)			

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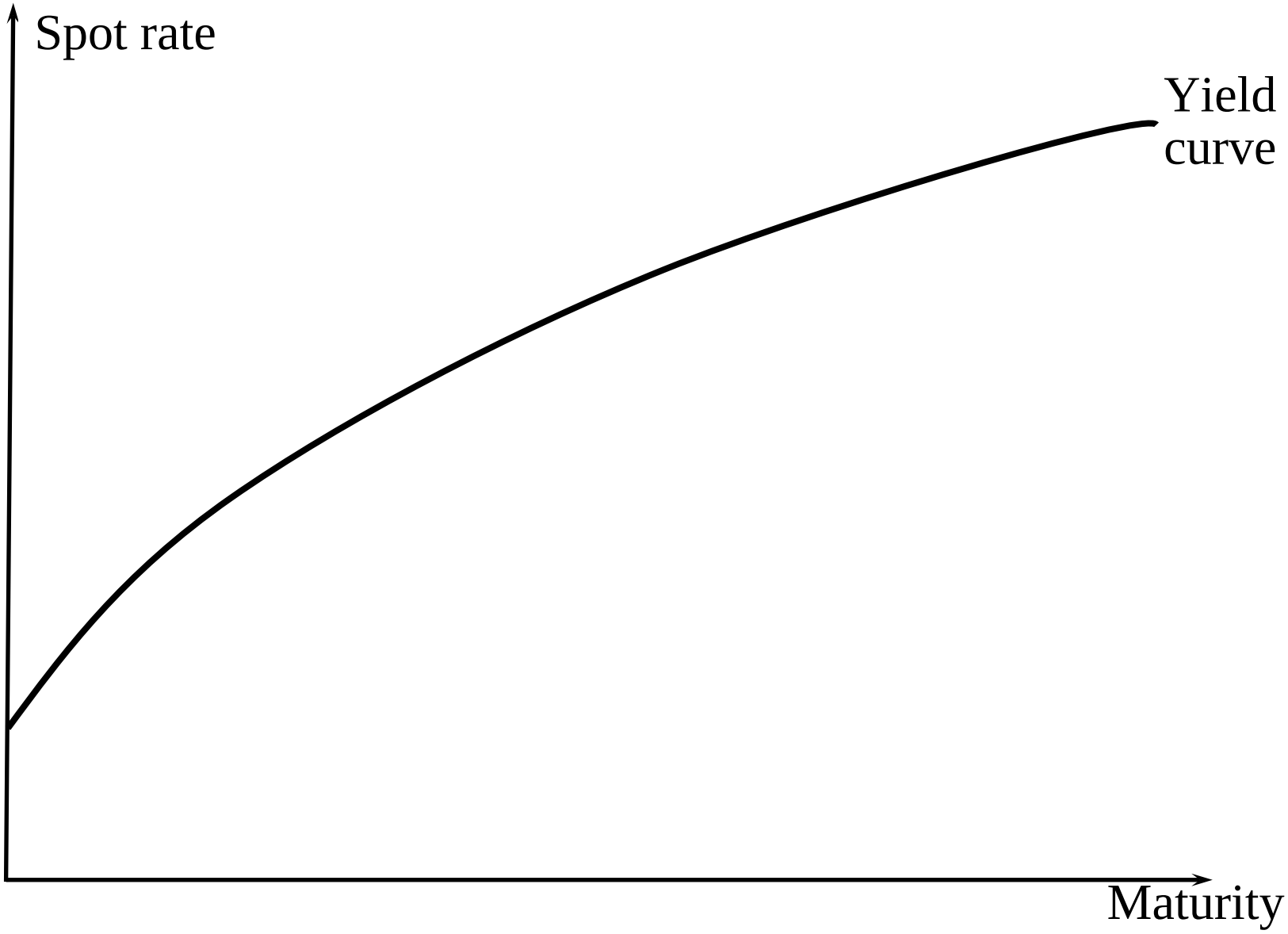

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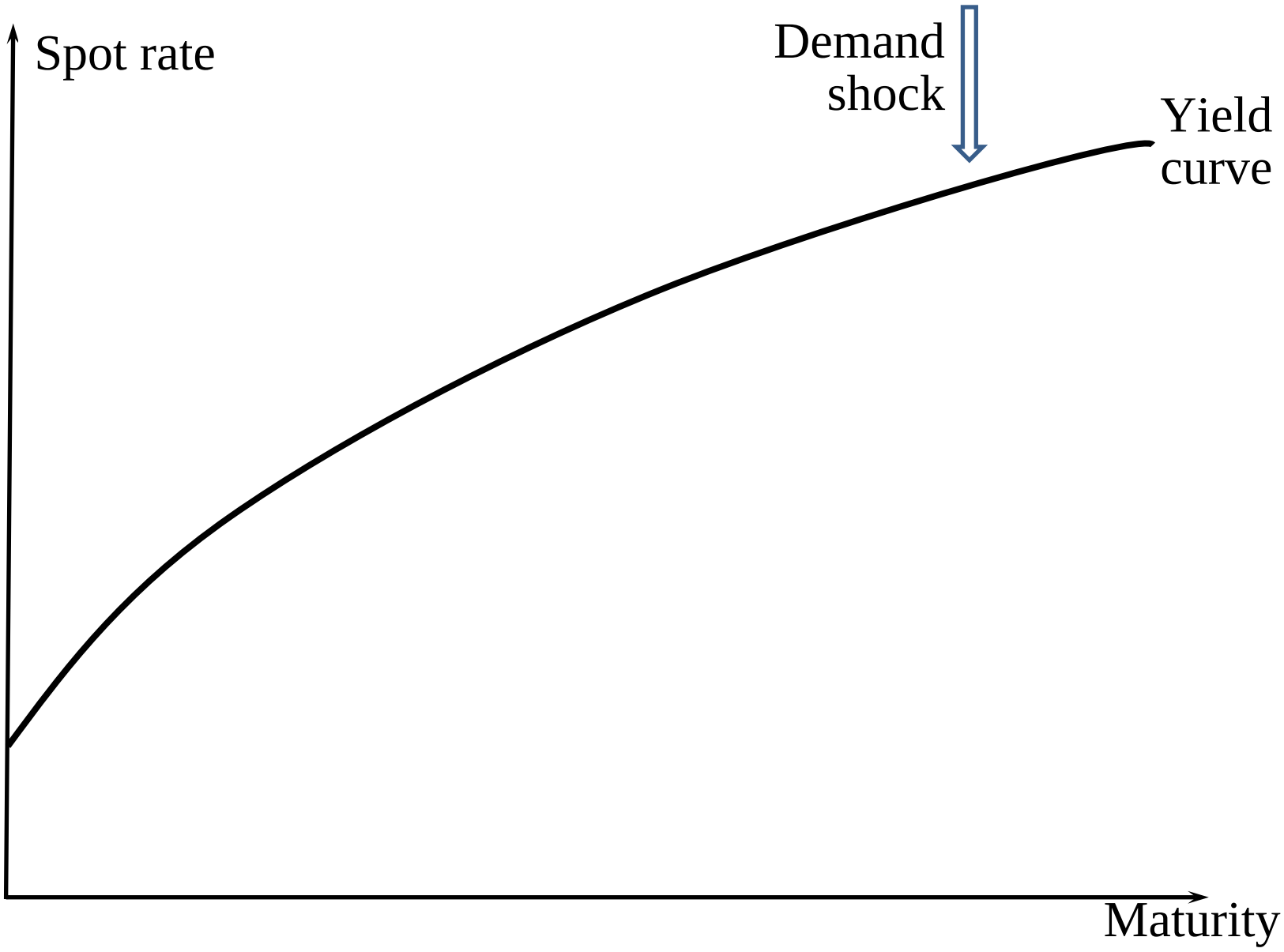

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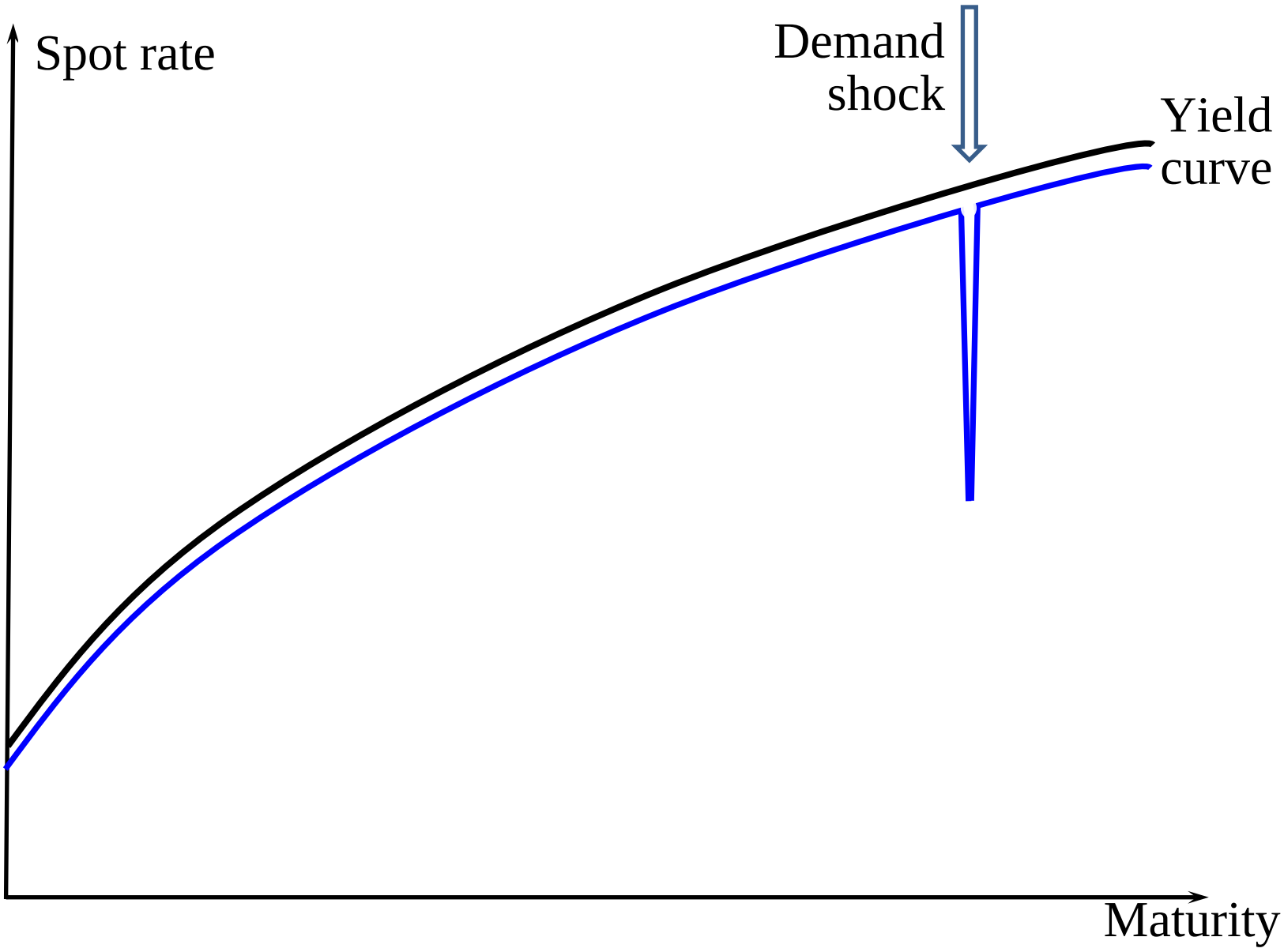

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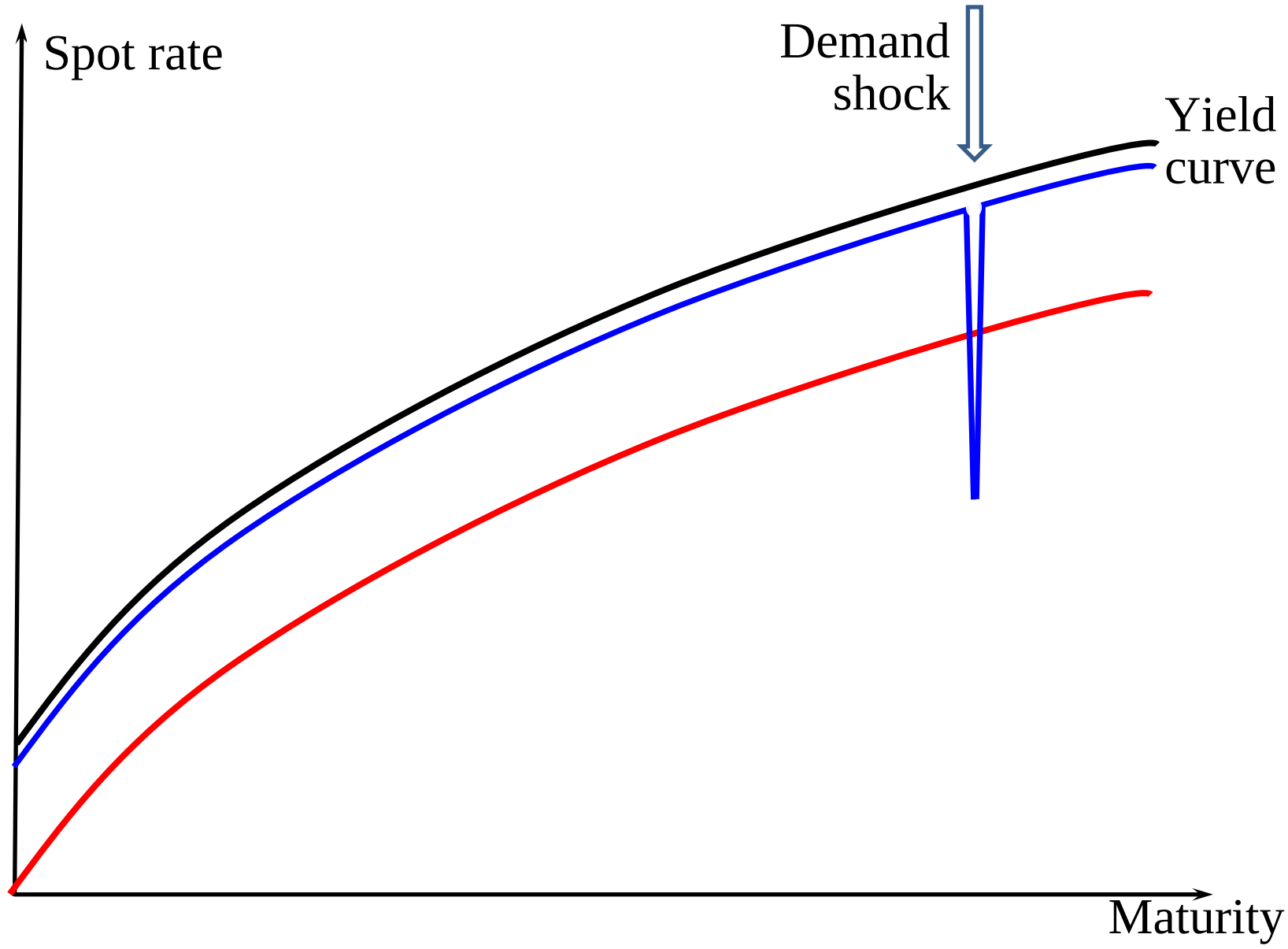

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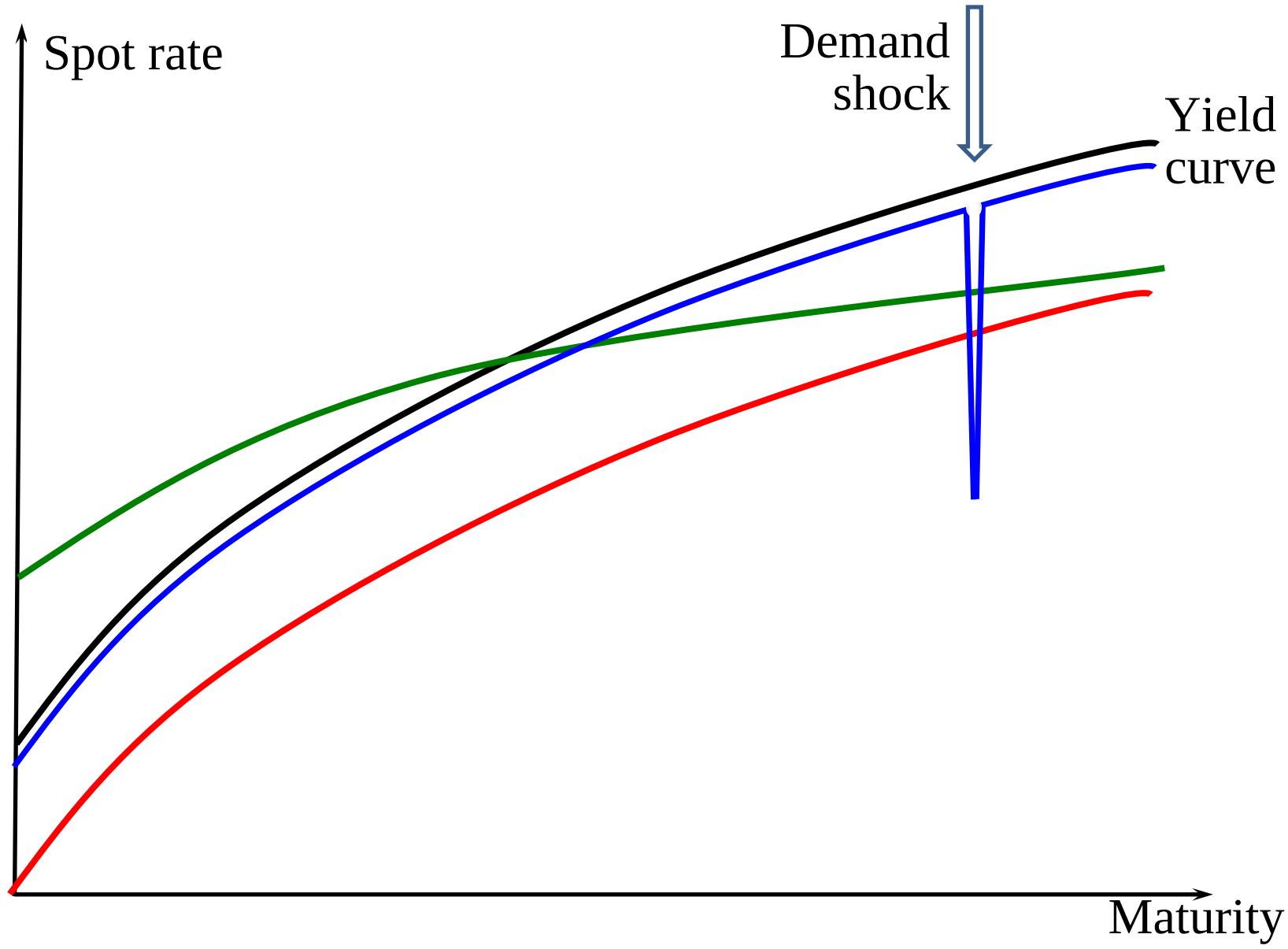

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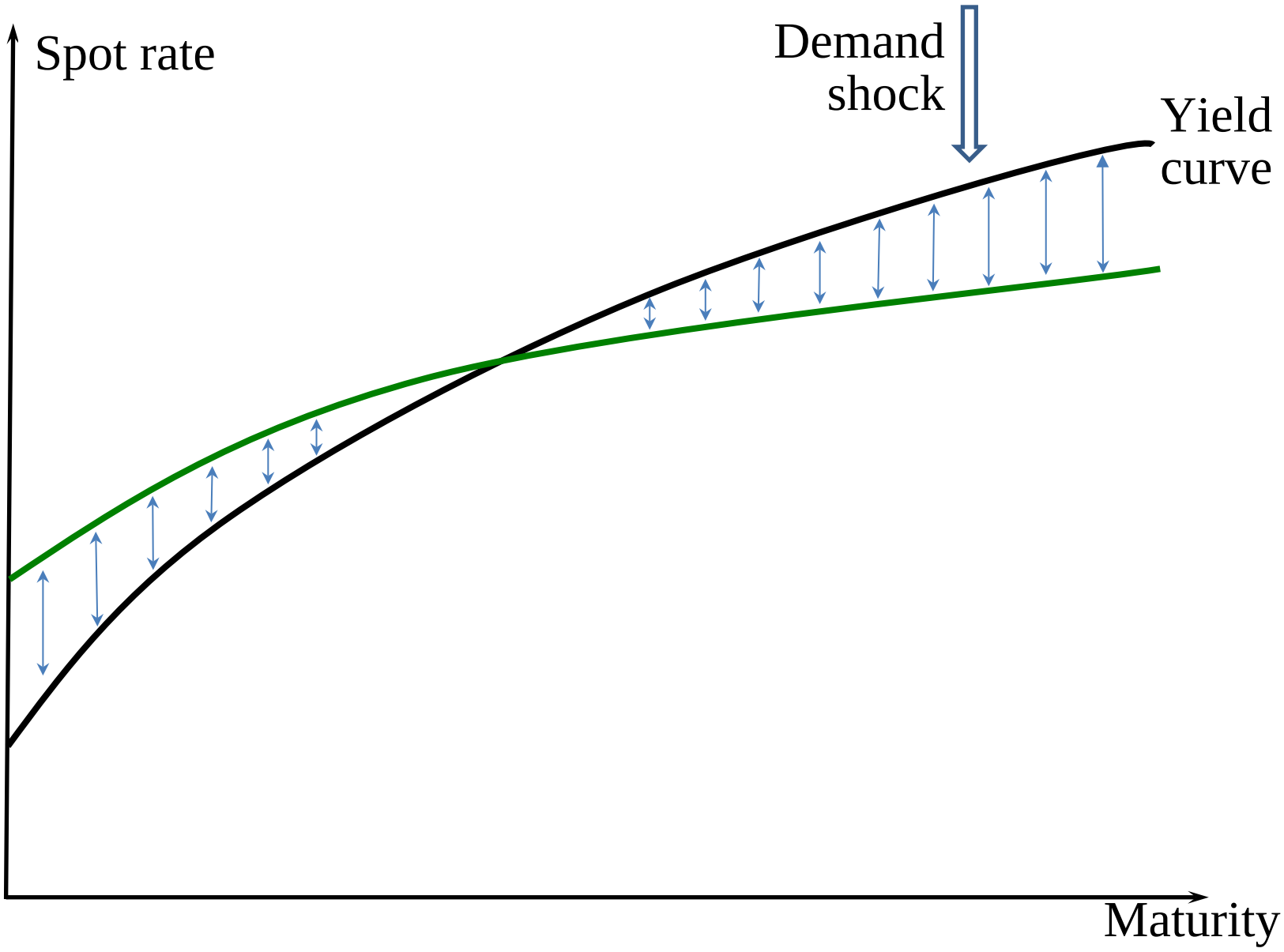

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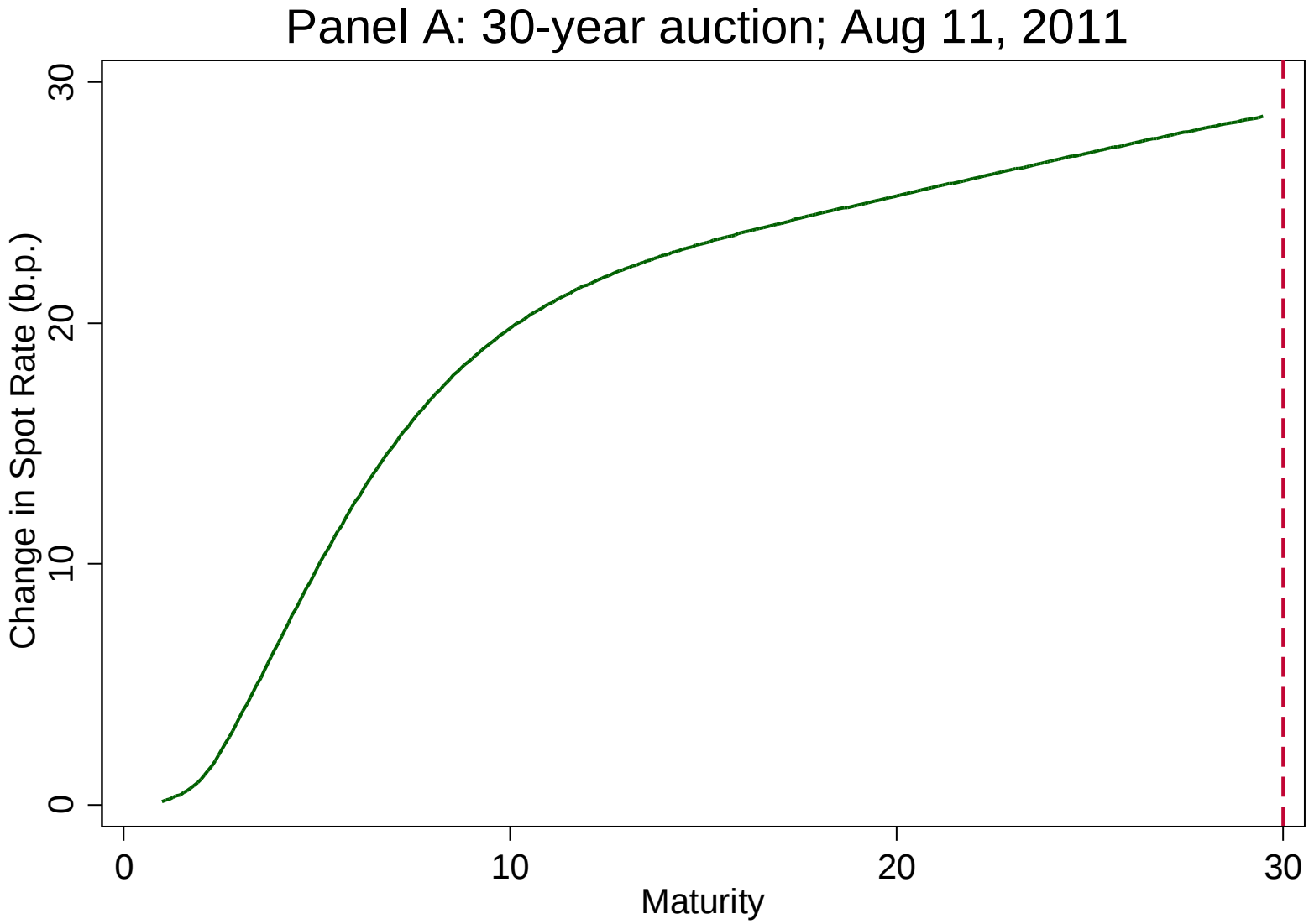

Changes in zero-coupon spot rates as in Gurkaynak et al. (2007)

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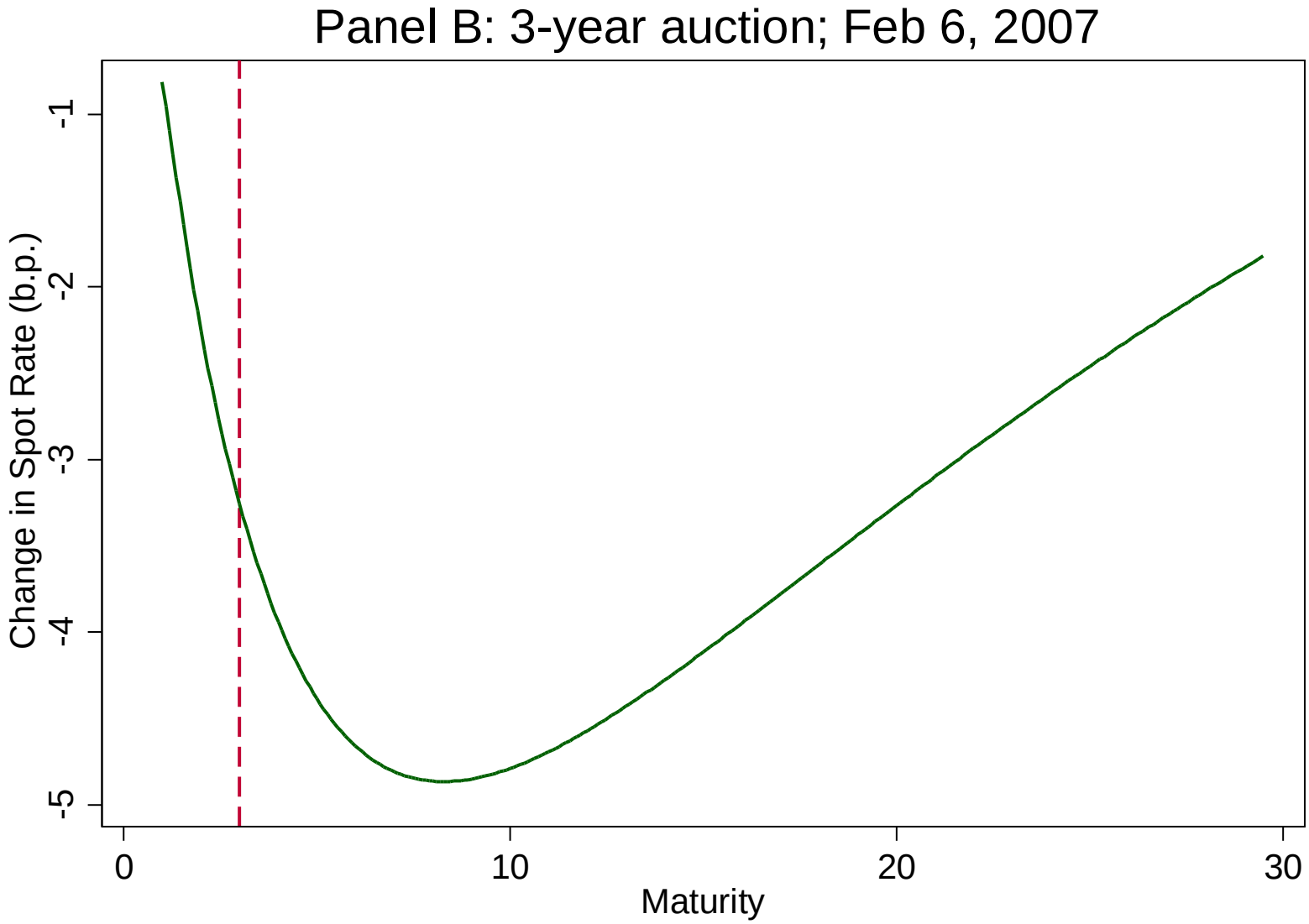

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EMPIRICAL FRAMEWORK

$$\Delta R_t^{(m)} = \alpha^{(m)} + \beta^{(m)} D_t^{(m')} + \epsilon_t^{(m)}$$

m = maturity

t = auction date

$\Delta R_t^{(m)}$ = daily changes in spot rates for

$D_t^{(m')}$ = intraday surprise movement in Treasury futures price at maturity m'

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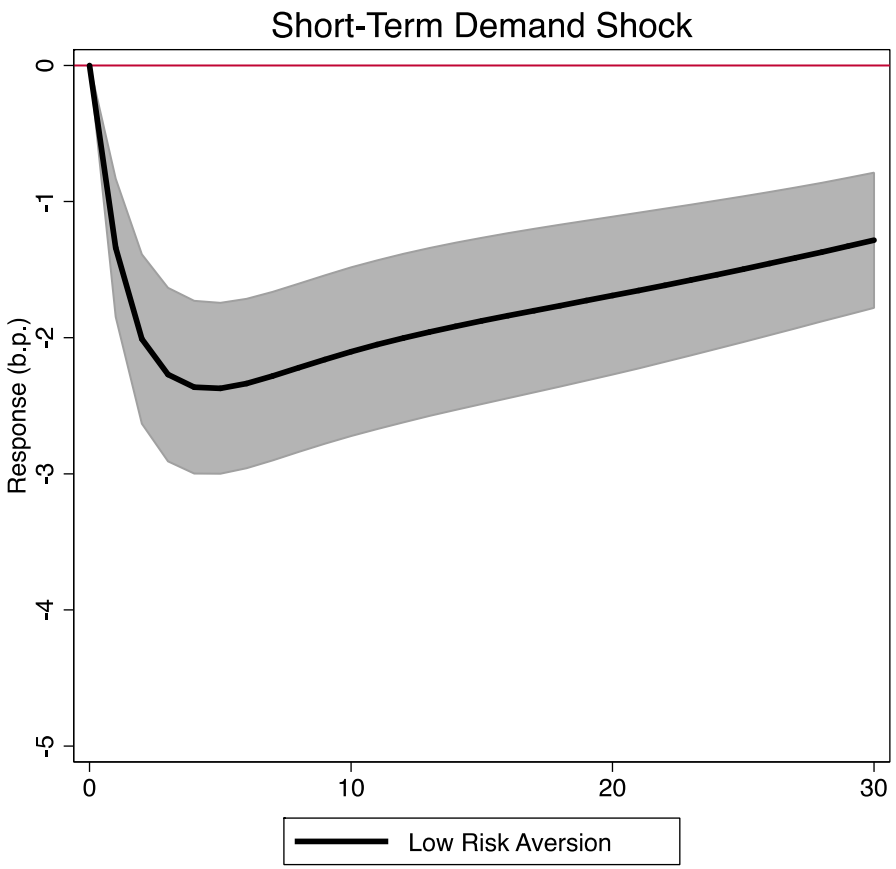
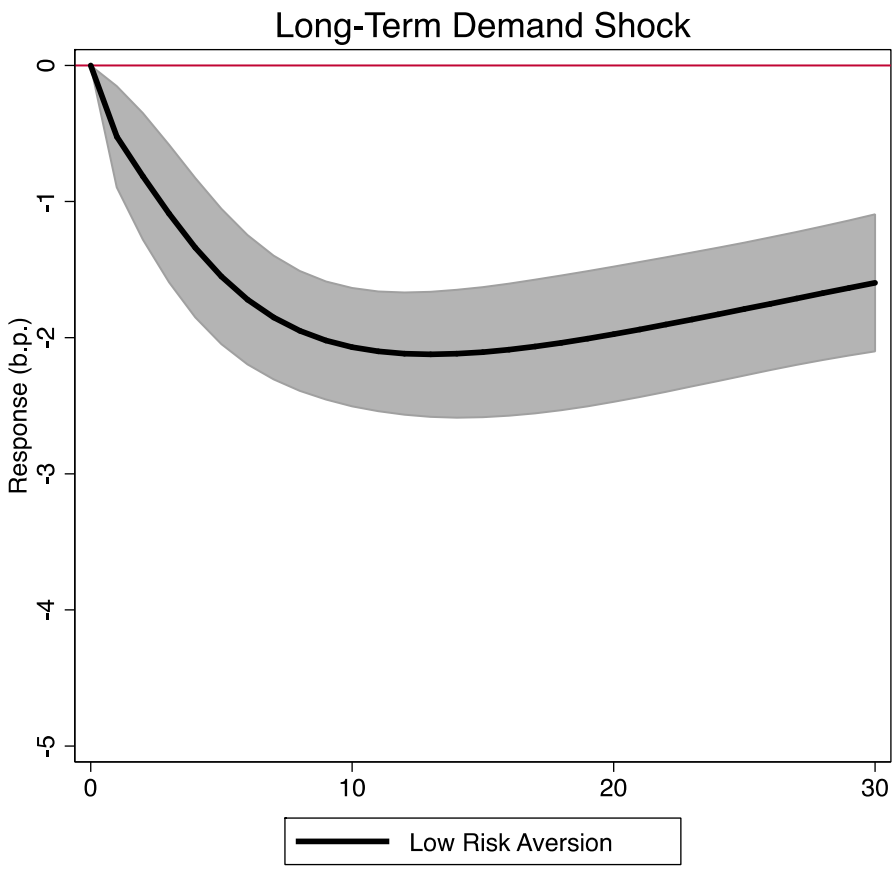
Plot $\beta^{(m)}$ against m for

- short auctions (m' =2-7 years) vs long auctions (m' =10-30 years)
- low- vs high-risk aversion periods (Romer and Romer 2017)

RATE RESPONSE $\beta^{(m)}$ BY RISK AVERSION AND SHOCK TYPE





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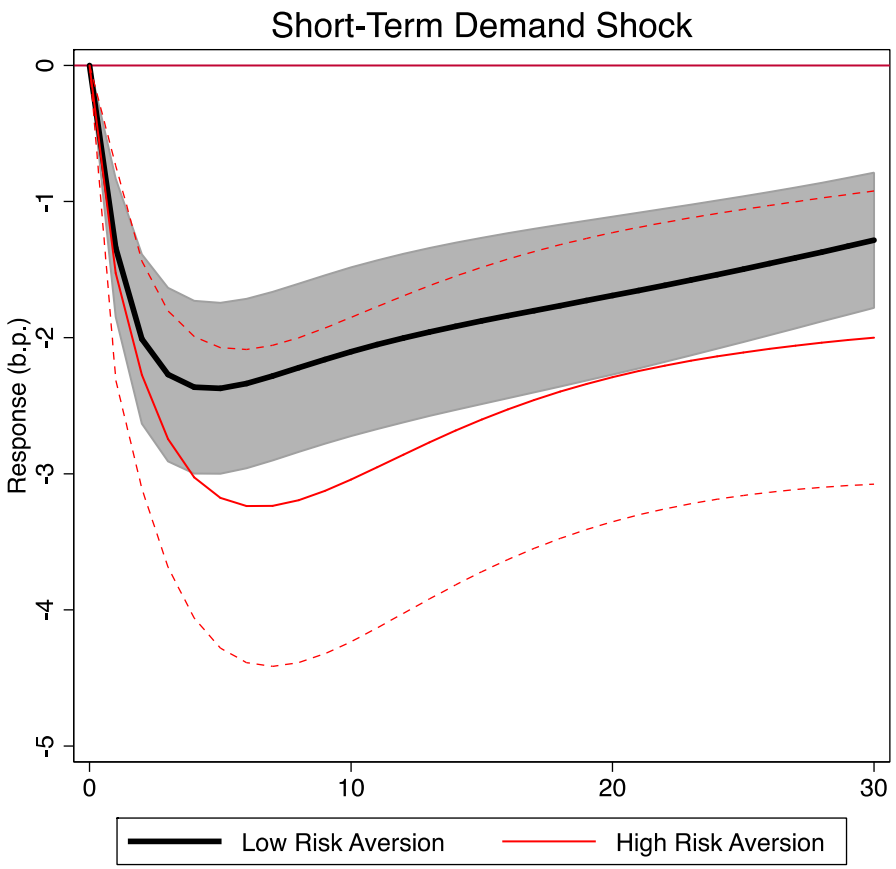

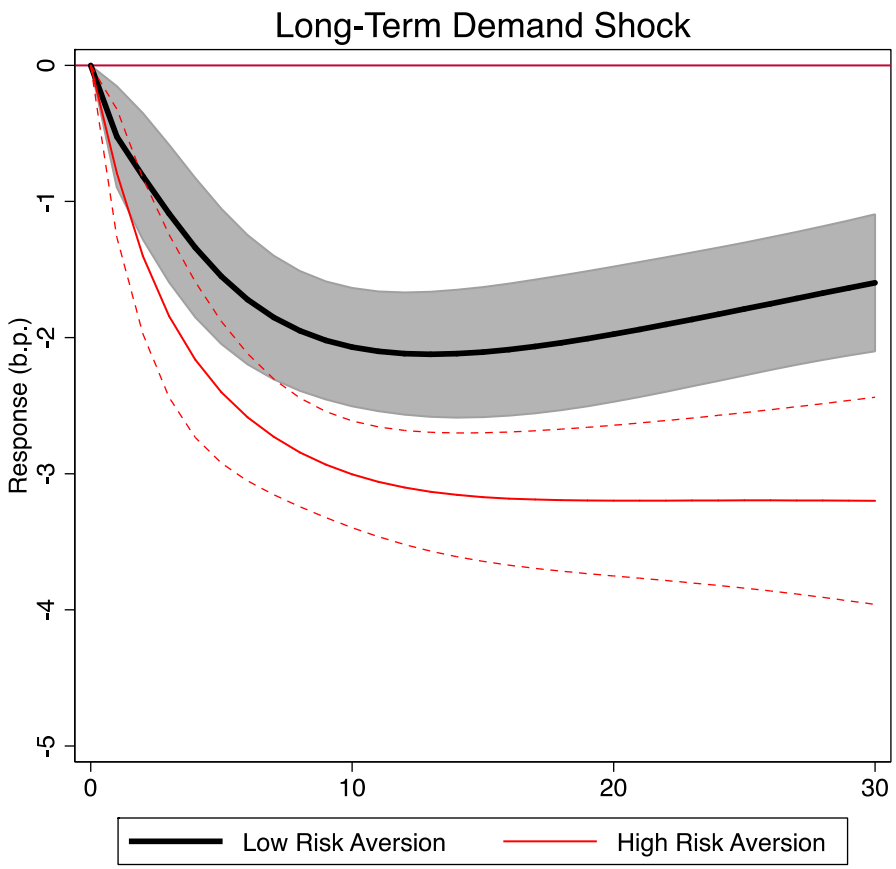

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  - Unlikely during a financial crisis
  - But the Fed can intervene in multiple segments ("Operation Twist")

IMPLICATIONS FOR QE

- What is the quantitative significance of preferred habitat?

$$\Delta R_t = \alpha \times X_{1t} + \beta \times X_{2t} + \gamma \times X_{3t} + \cdots + \psi \times X_{nt} + error_t$$

where

X_{1t} is purchases of assets (preferred habitat)

X_{2t} is forward guidance

X_{3t} is "Delphic" effects

X_{nt} is the nth theory of how quantitative easing works

IMPLICATIONS FOR QE

- What is the quantitative significance of preferred habitat?

Date	Event
November 25, 2008	the Fed announced purchases of $100 billion in GSE debt and $500 billion in MBS.
December 1, 2008	Chairman Bernanke stated that the Fed could purchase long-term Treasuries.
December 16, 2008	the FOMC announced possible purchases of long-term Treasuries
January 28, 2009	the FOMC announced it is ready to expand agency debt and MBS purchases, and to begin purchasing long-term Treasuries
March 18, 2009	the FOMC announced it will purchase $300 billion in long-term Treasuries, along with an additional $750 billion in agency MBS and $100 billion in agency debt.

IMPLICATIONS FOR QE

- What is the quantitative significance of preferred habitat?

Response of 5-year Treasury rate

Date	Chodorow-Reich (2014) [intraday window]	Krishnamurthy and Vissing-Jorgensen (2011) [2-day window]
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A big part of the reaction may be rationalized within preferred habitat!

CONCLUDING REMARKS

- We use regular Treasury auctions to understand better QE
  - Lots of data!
  - Nature of demand shocks for Treasuries allows us to rule out a number of alternative explanations (forward guidance, signaling, inflation expectations)
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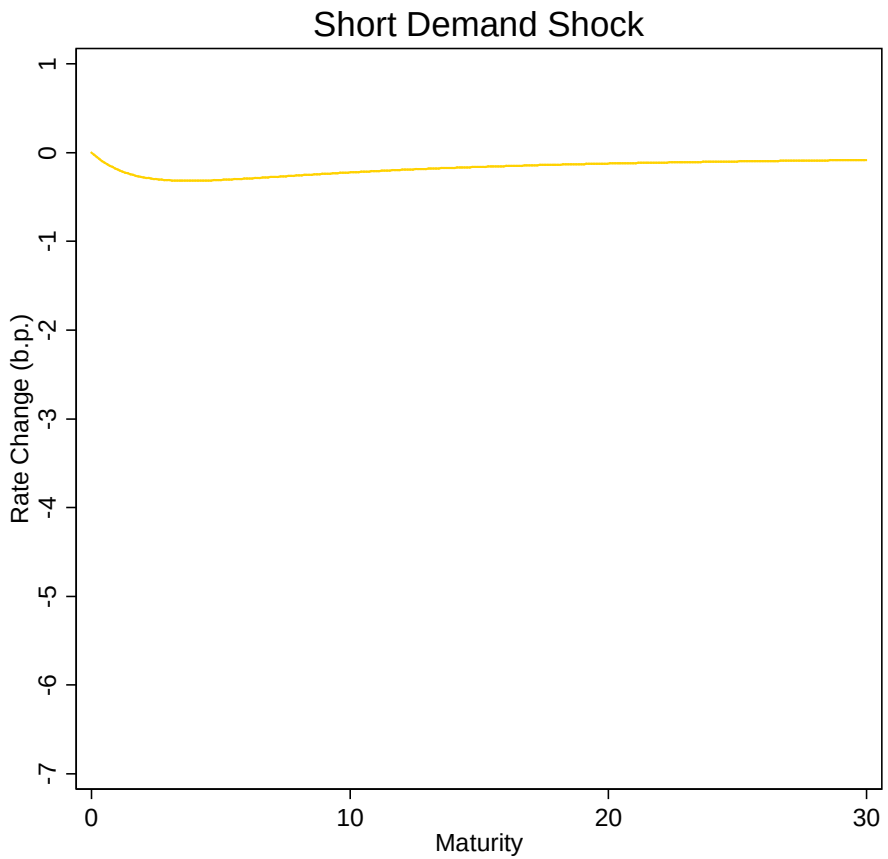
- QE is an effective policy tool in crises and less likely to be so in normal times.

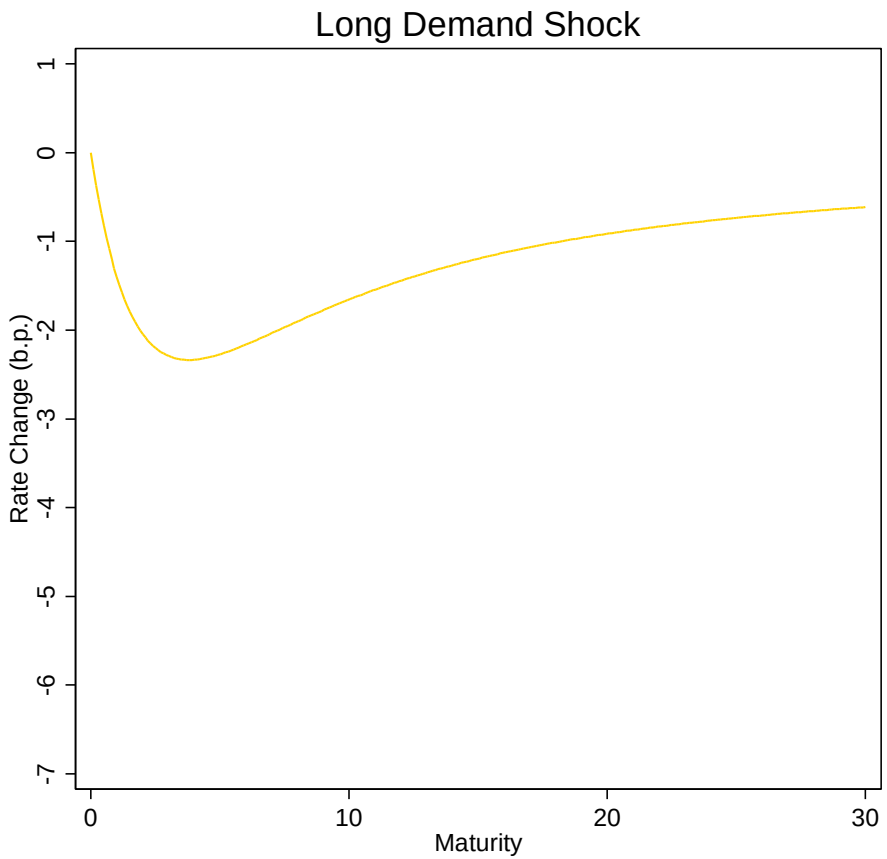
COMOVEMENT ACROSS MATURITIES: VAYANOS & VILA

Vayanos and Vila (2009) model:

- Clientele with preferences over maturity space
- Arbitrageurs:
  - integrate maturity markets
  - are risk averse
  - maximize a mean-variance objective
- Three sources of uncertainty:
  - Instantaneous interest rate
  - Short-maturity demand factor (3 years)
  - Long-maturity demand factor (20 years)

COMOVEMENT ACROSS MATURITIES: VAYANOS & VILA





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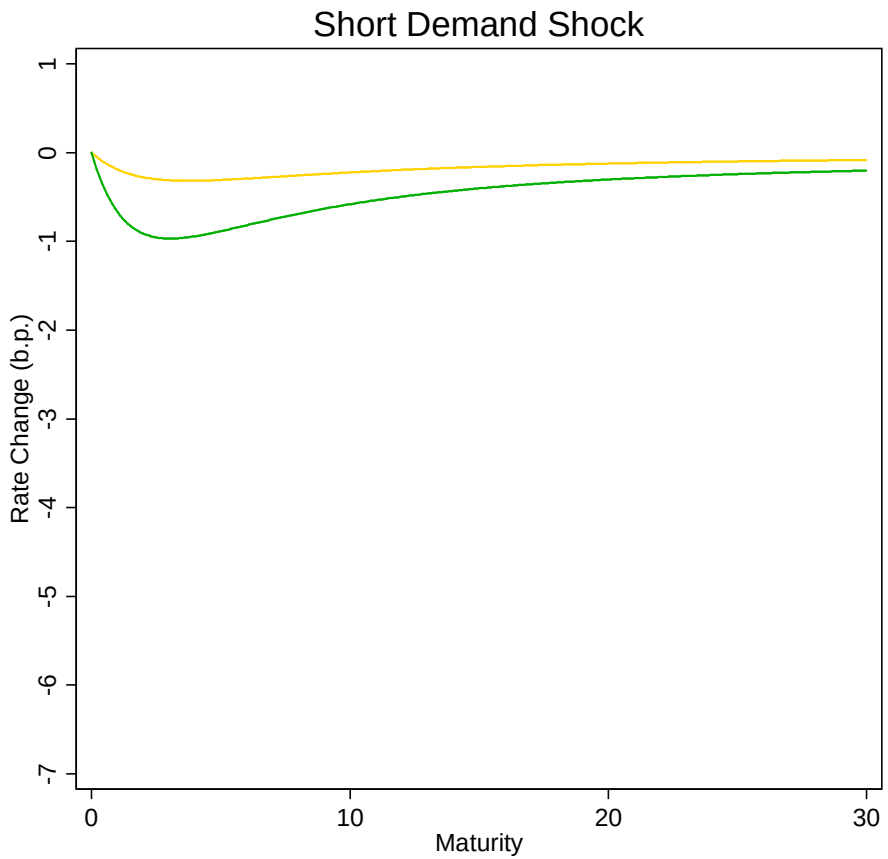

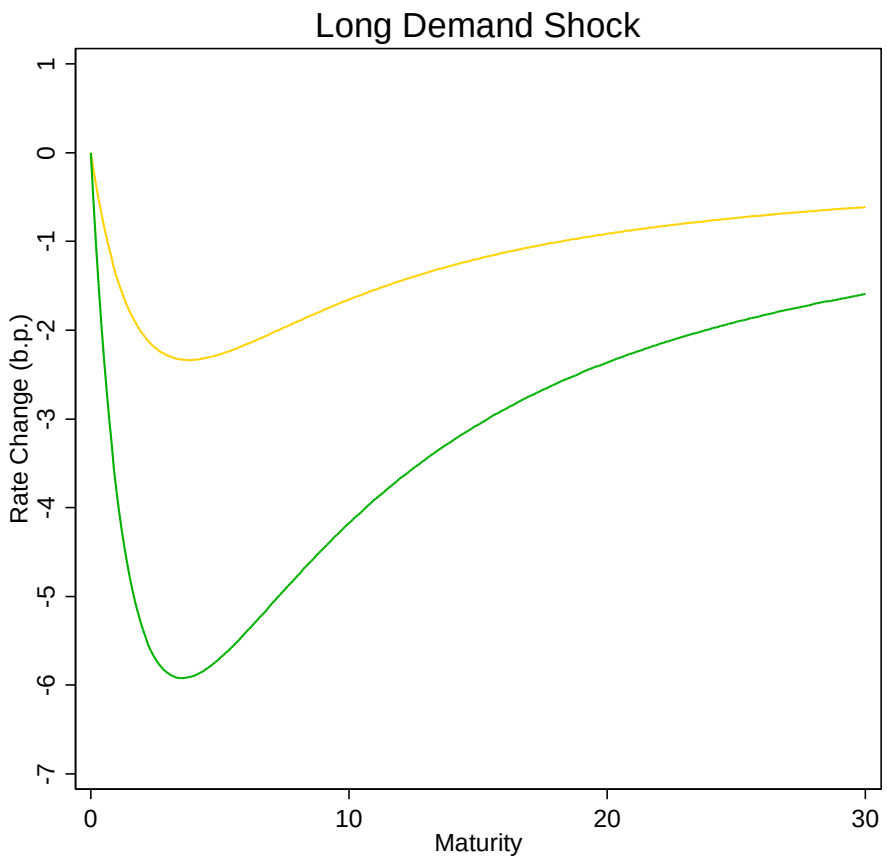

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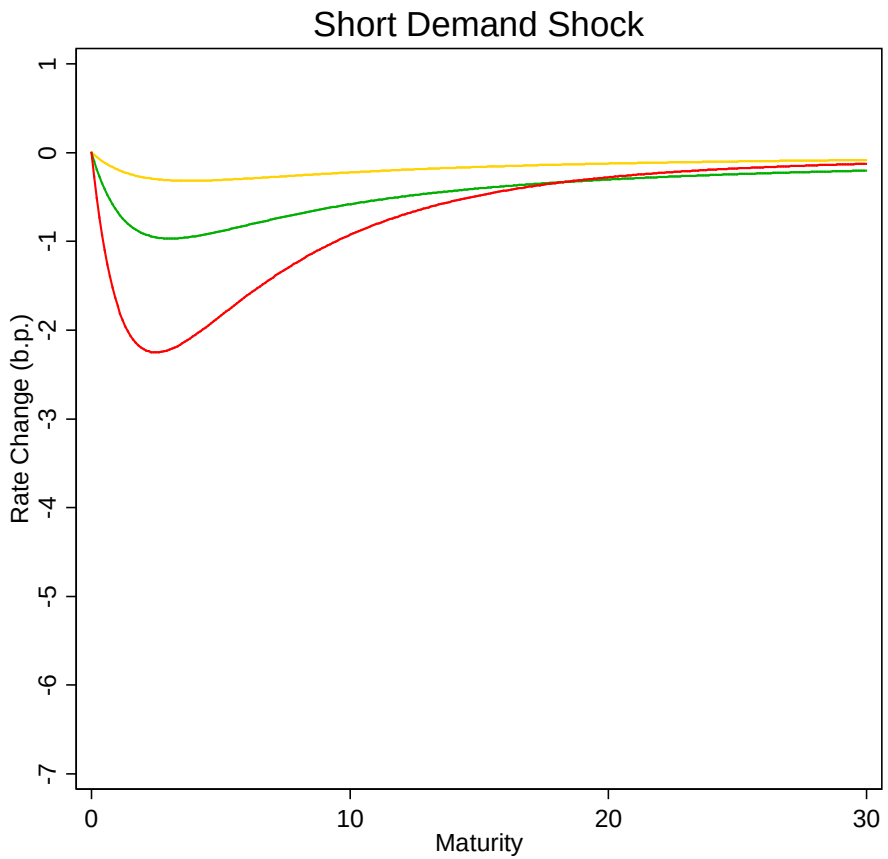

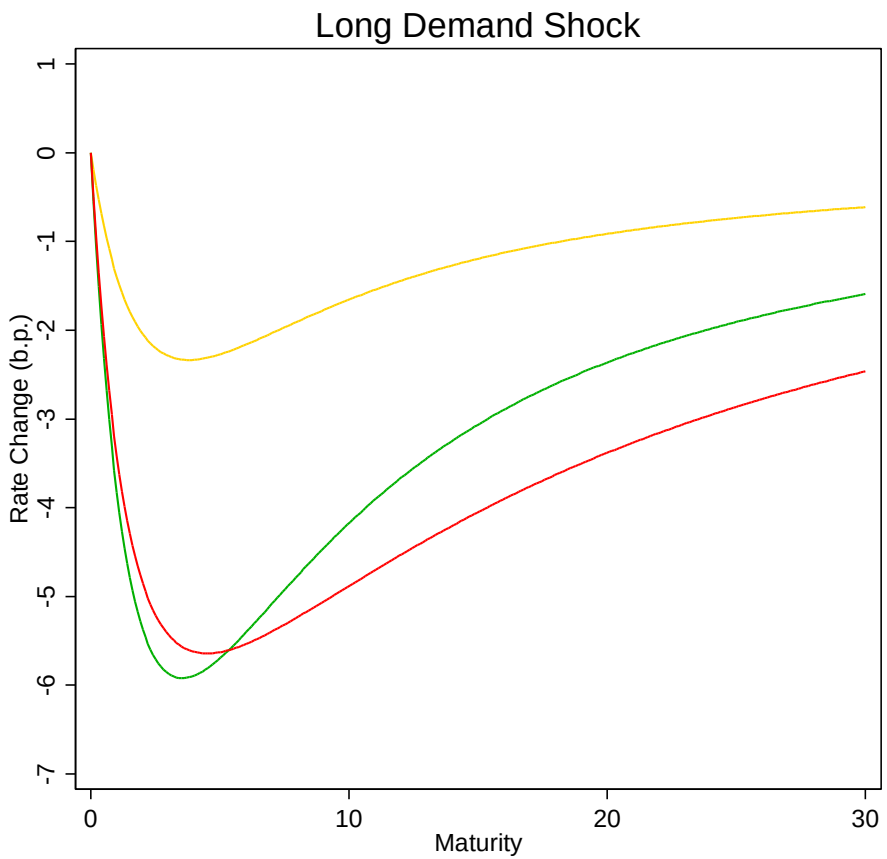

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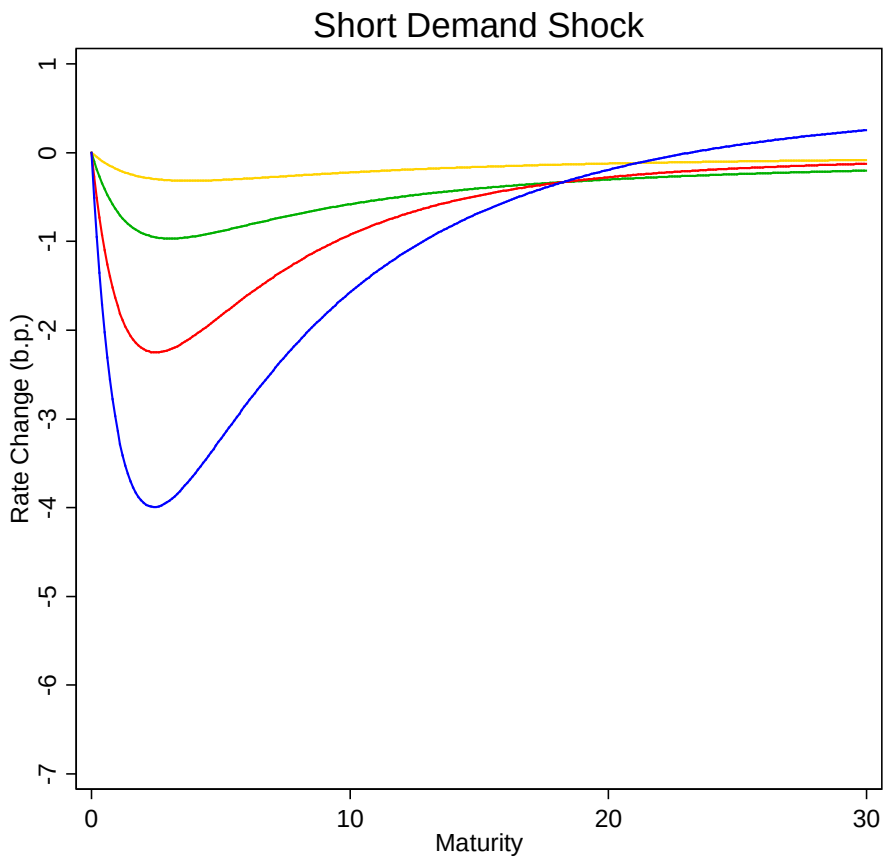

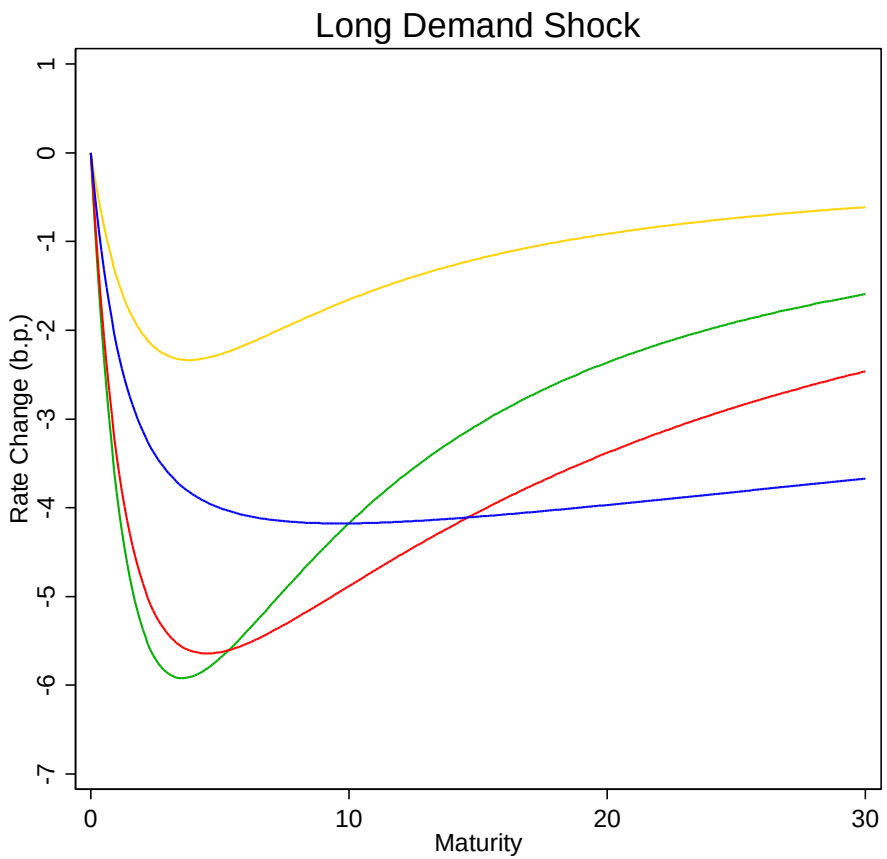

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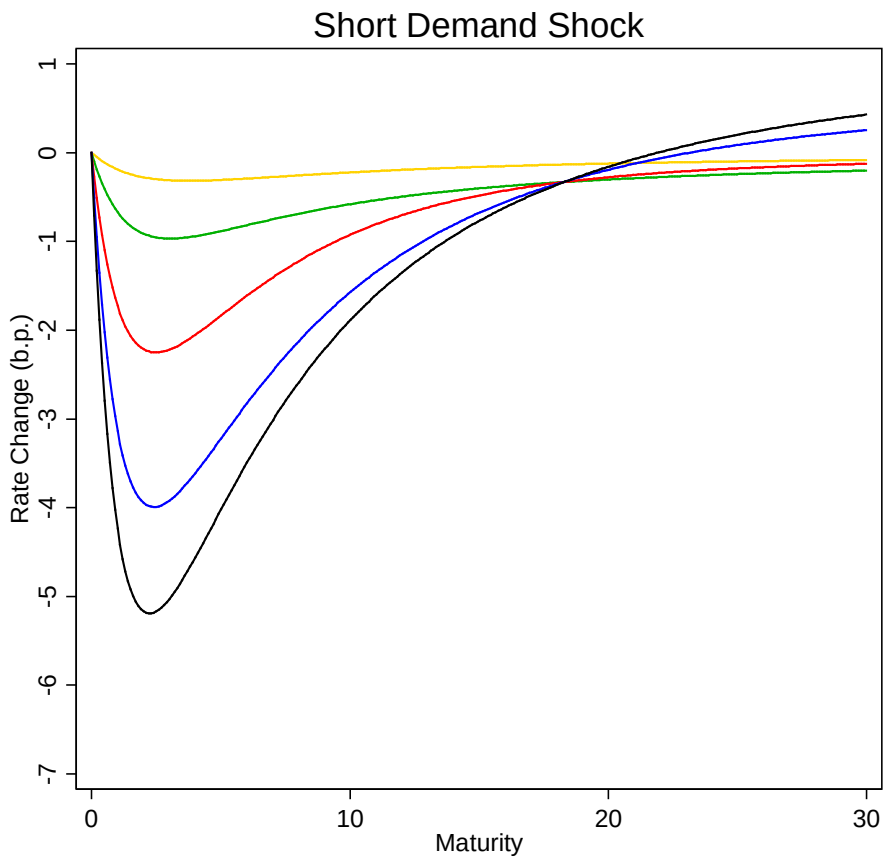
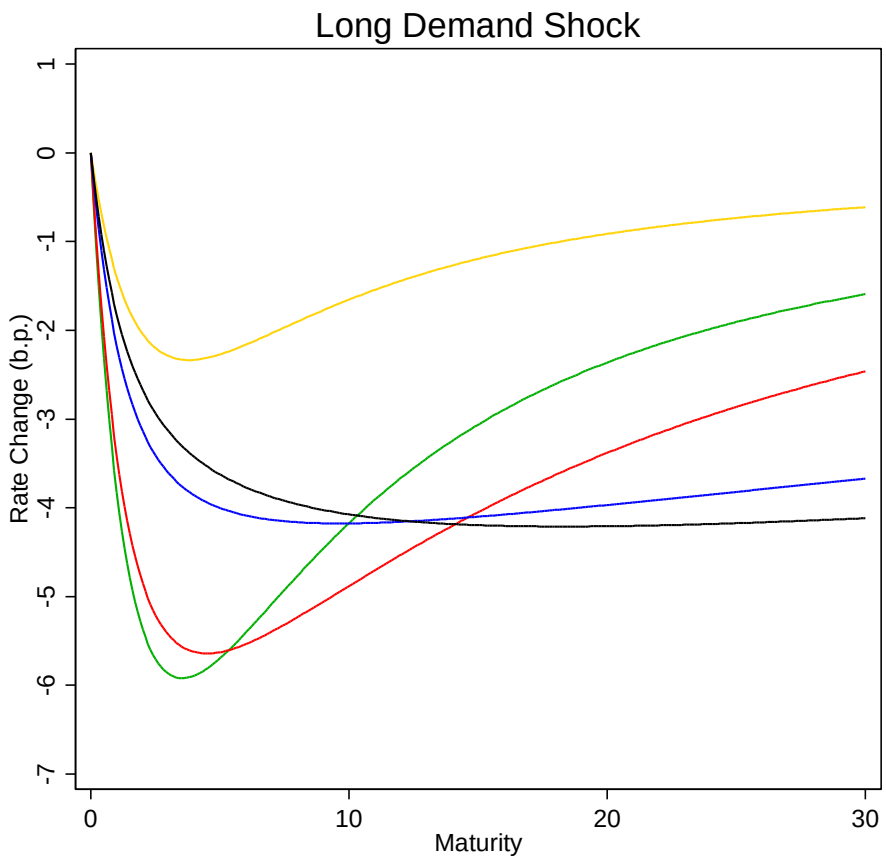
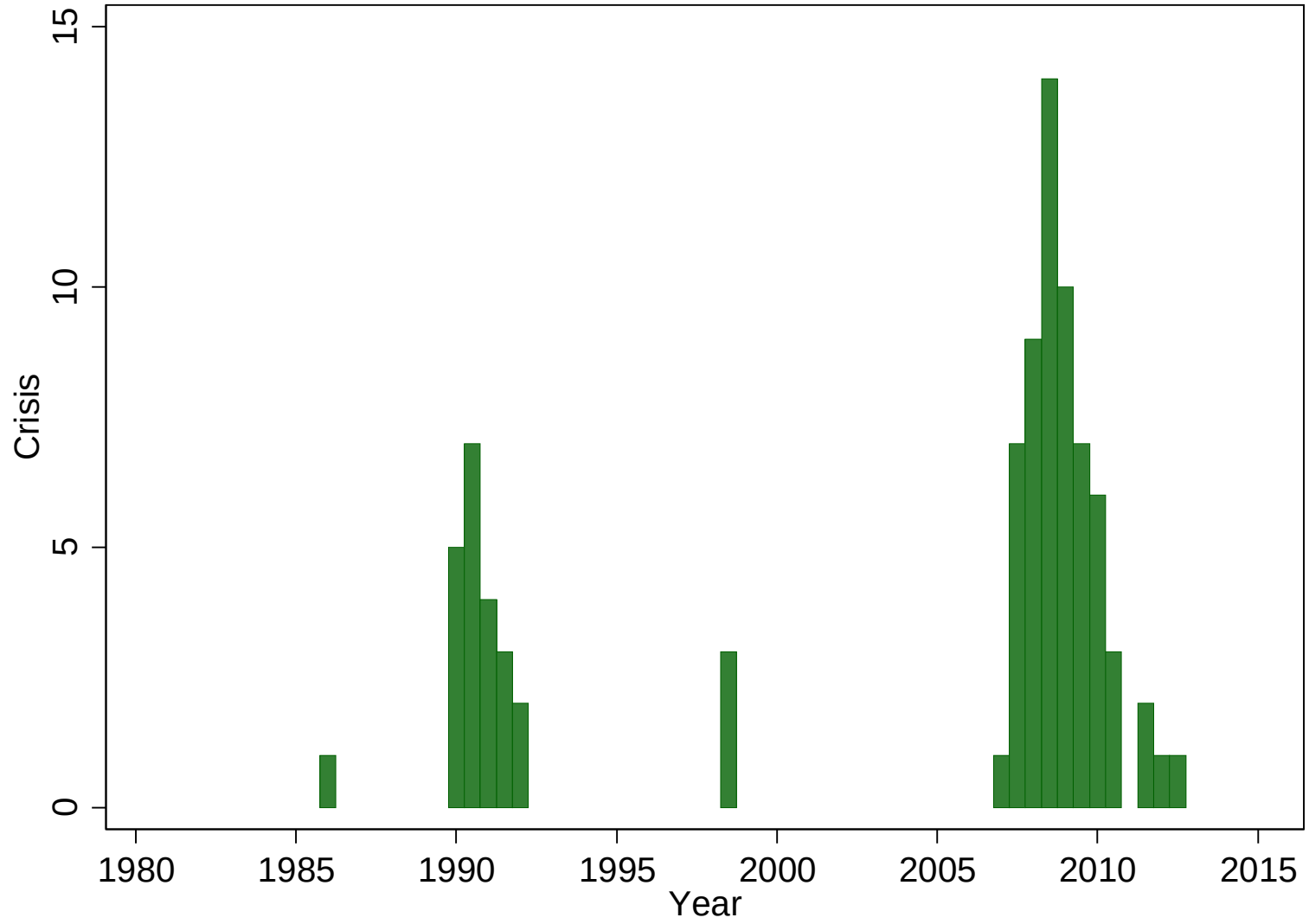


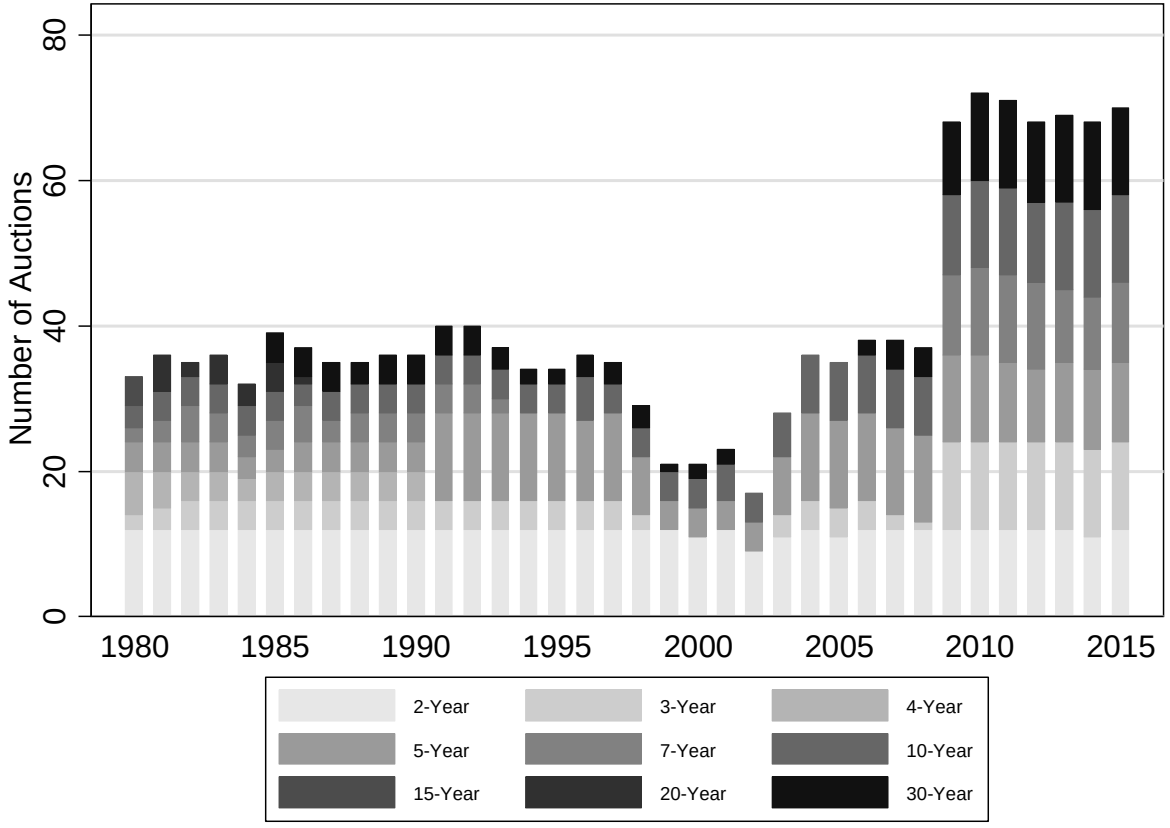


ROMER AND ROMER (2017): FINANCIAL DISTRESS



TREASURY AUCTIONS

- Regular auctions:
  - 2-, 5- and 7-year notes are auctioned monthly
  - 10- and 30-year notes and bonds are auctioned in Feb, May, Aug and Nov with “re-openings” in other 8 months.



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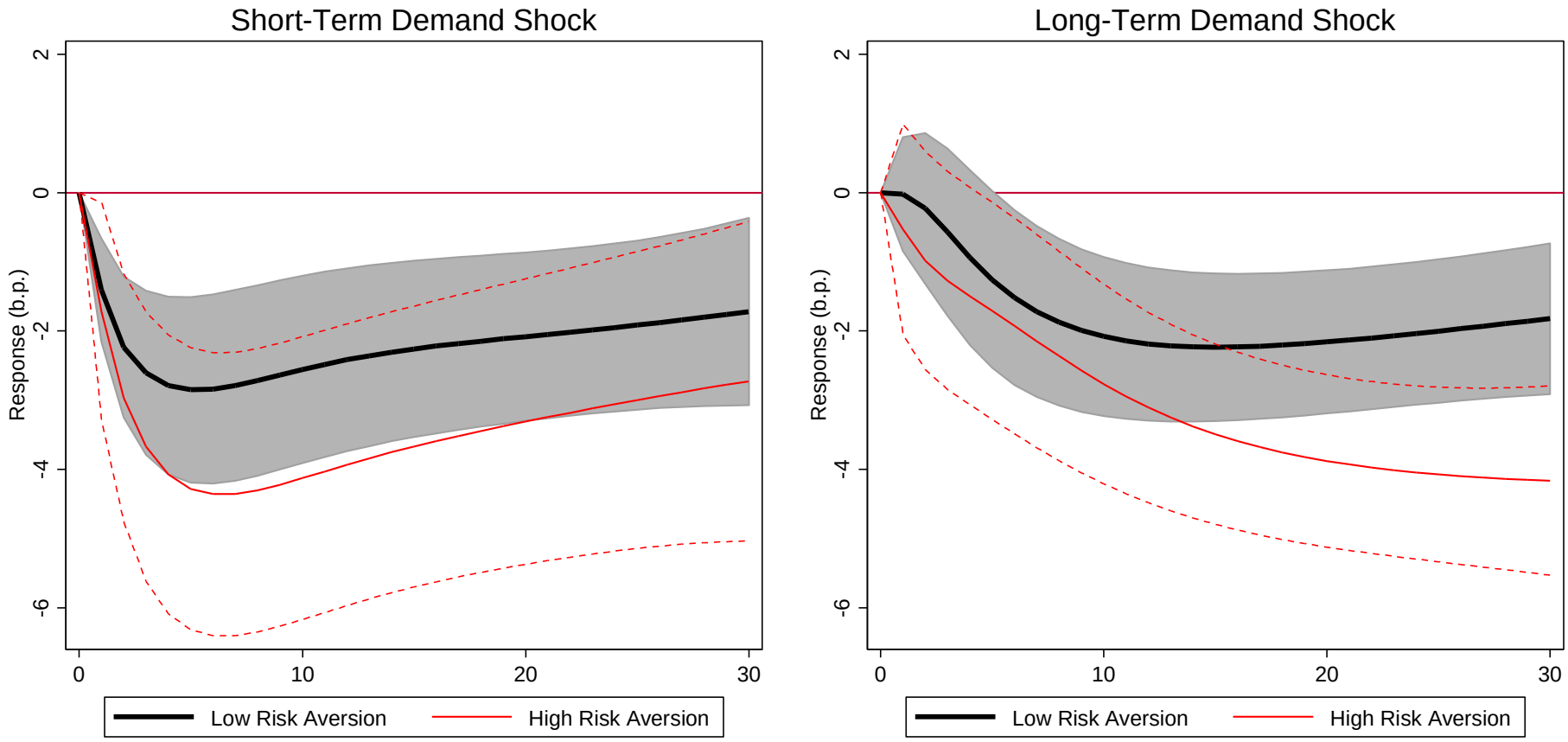
  - Competitive
  - Non-competitive (includes the Fed)
- Bidders by type:
  - Investment Funds;
  - Pension Funds and Insurance Companies;
  - Depository Institutions;
  - Individuals;
  - Primary Dealers and Brokers;
  - Foreign and International;
  - Federal Reserve System;
  - Other

RATE RESPONSE $\beta^{(m)}$ BY RISK AVERSION AND SHOCK TYPE



Specification: Use Bid-to-Cover shocks as instruments for $D_t^{(m')}$, the intraday surprise movement in Treasury futures price at maturity m'.

COMOVEMENT ACROSS MARKETS

$$y_t = \gamma + \phi D_t + error$$

Equities

	Estimate (s.e.)	N	R^2	Sample
SPY ETF	-0.020	871	0.005	1995-2015
	(0.018)			
IWM ETF	-0.081***	706	0.034	2000-2015
	(0.024)			
SP500†	-0.072	871	0.004	1995-2015
	(0.064)			
Russell 2000†	-0.169**	871	0.013	1995-2015
	(0.069)			

† = daily frequency for the dependent variable