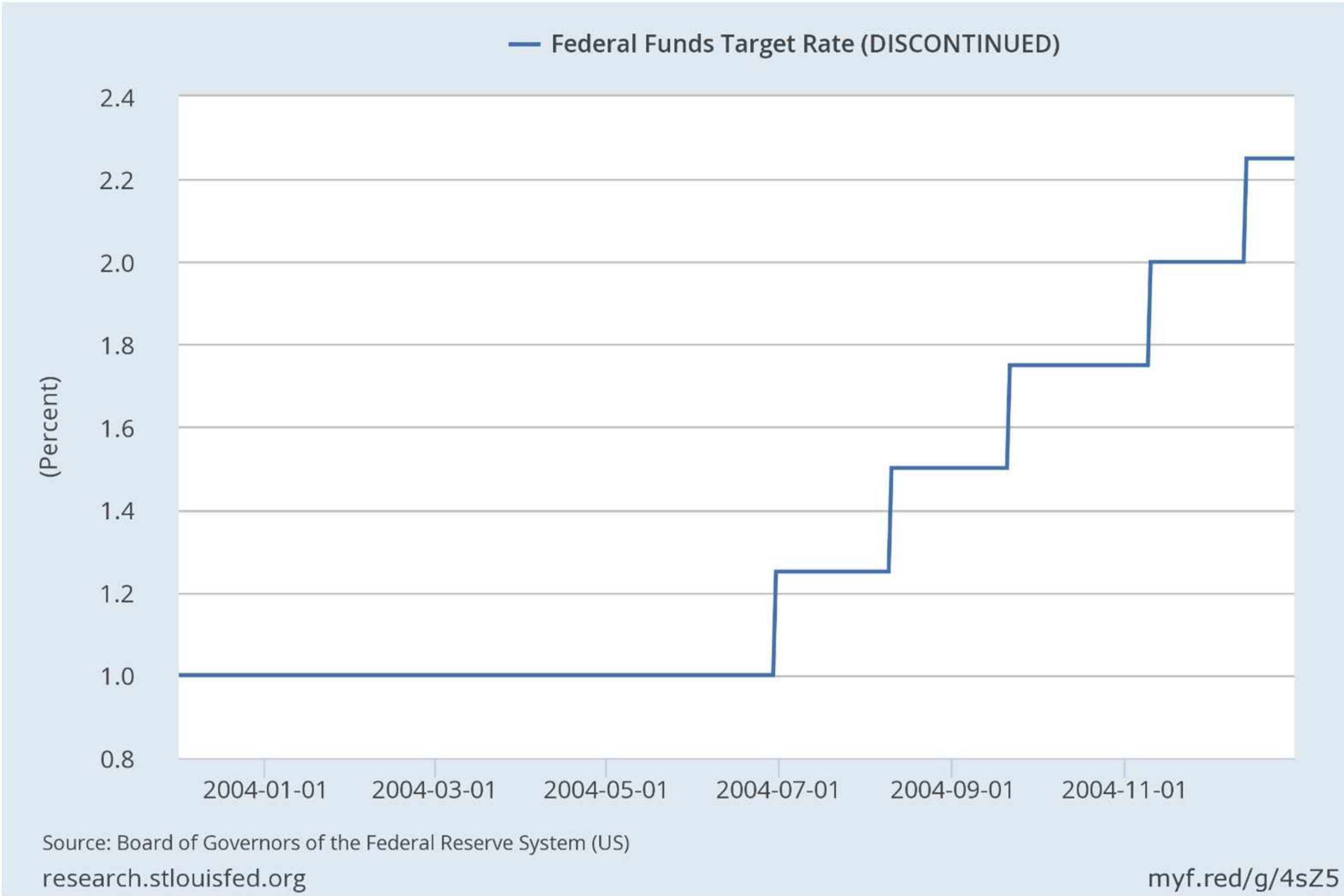
Forward guidance

A. A two-dimensional characterization of monetary shocks (Gürkynak, Sack, and Swanson, 2005)
B. Odyssean versus Delphic foreign guidance (Campbell et al., 2012)
C. A 3-dimensional characterization of monetary shocks (Bauer, 2015)

Fed funds target during 2004

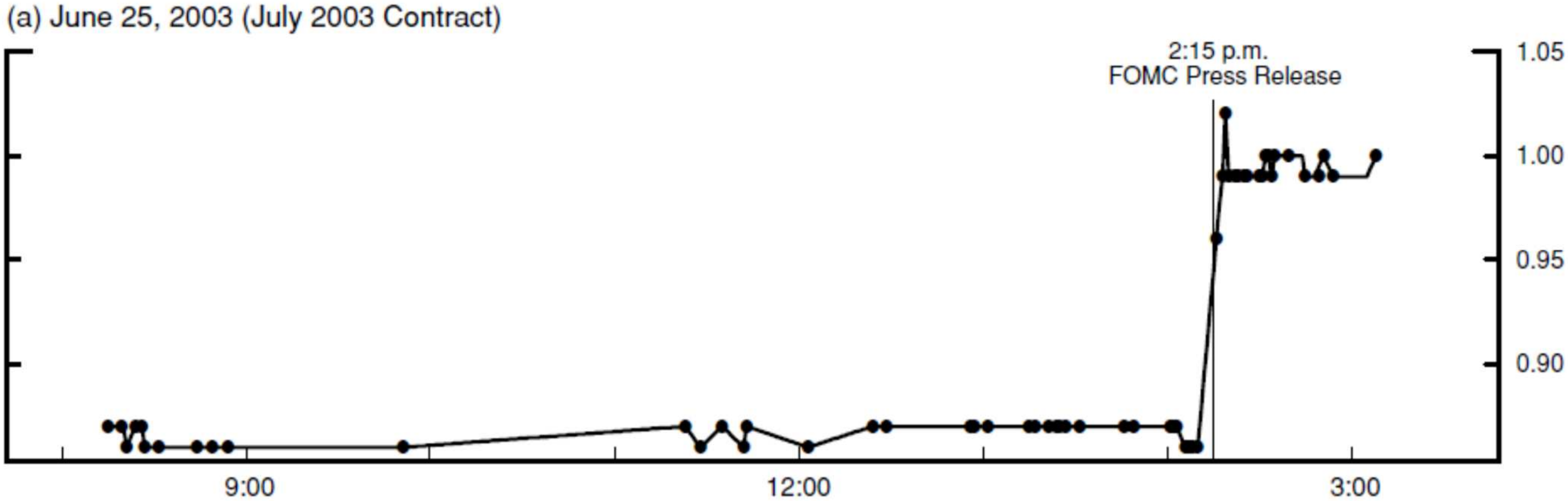


- FOMC Dec 9, 2003 meeting statement:
  - "… However, with inflation quite low and resource use slack, the Committee believes that policy accommodation **can be maintained for a considerable period**."
- FOMC Jan 28, 2004 meeting statement:
  - "… With inflation quite low and resource use slack, the Committee believes that it **can be patient in removing its policy accommodation**."

	Jan_27	Jan_28
Jan FF	0.995	0.995
Mar FF	1.005	1.01
Aug FF	1.185	1.27
2y Treasury	1.70	1.87
5 yr Treasury	3.07	3.22

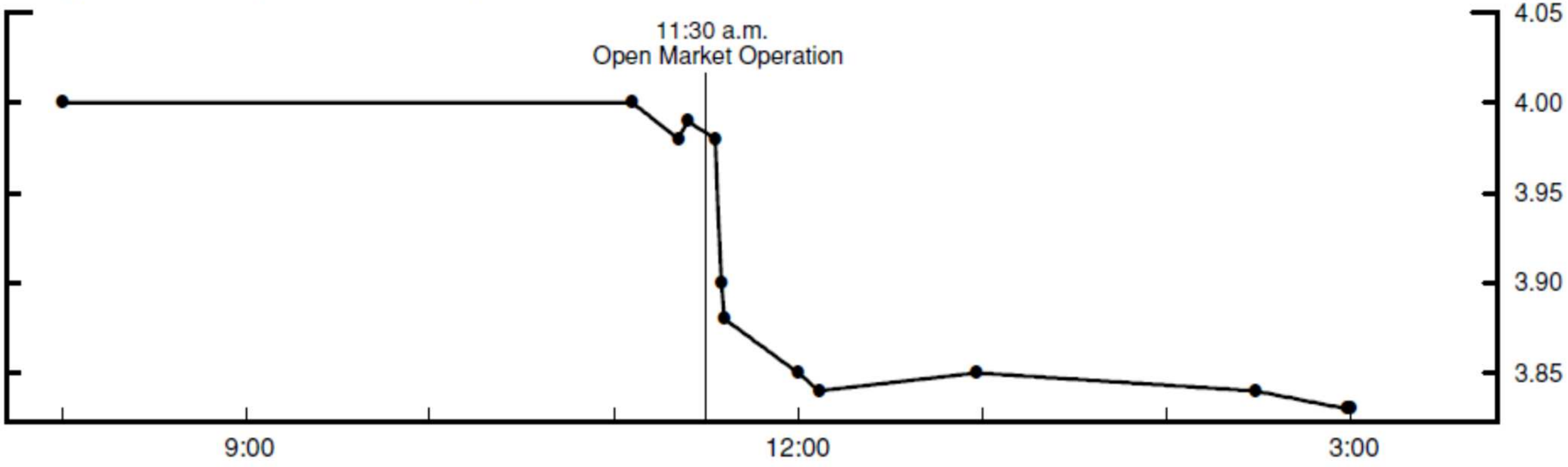
- Gürkaynak, Sack and Swanson (2005) focused on narrow window 10 minutes before to 20 minutes after a major Fed communication
- In recent data communication took the form of a statement issued at the close of FOMC meeting

June 25, 2003: Fed lowered target from 1.25% to 1.00% (market anticipated might have gone to 0.75%)



- In earlier data, Fed communicated its plans with an unanticipated open market operation
- E.g., if Fed added reserves when the rate was below its previous target, market correctly inferred that Fed had lowered its target.

(b) April 9, 1992 (April 1992 Contract)



Collected observations on $j = 1, \ldots, n$ changes in the price of $n = 11$ different assets in 30-minute interval around communication for $t = 1, \ldots, T = 138$ different communications.

x_{t1} = Kuttner-adjusted change in current-month fed funds futures contract

x_{t2} = change in 3-month-ahead fed funds futures

Also change in 2-, 3-, and 4-quarter-ahead Eurodollar futures, $3m$, 6m, 2y, 5y, 6y Treasury yields and S&P 500

$$\underset{(n\times n)}{\hat{\mathbf{\Omega}}}$$

row i, col j $\hat{\sigma}_{ij} = T^{-1}\sum(x_{it} - \bar{x}_i)(x_{jt} - \bar{x}_j)$

Factor structure:

$$\underset{(n\times n)}{\mathbf{\Omega}} = \underset{(n\times r)}{\mathbf{\Lambda}}\underset{(r\times n)}{\mathbf{\Lambda}}' + \underset{(n\times n)}{\mathbf{\Sigma}} = \mathbf{\Omega}(\mathbf{\theta})$$

$\mathbf{\Sigma}$ diagonal

$$\underset{(nr+n\times 1)}{\mathbf{\theta}} = (\text{vec}(\mathbf{\Lambda})', \text{vec}(\text{diag}(\mathbf{\Sigma}))')'$$

Use minimum chi-square to test for number of factors r

$$T^{1/2}[\text{vech}(\hat{\boldsymbol{\Omega}}) - \text{vech}(\boldsymbol{\Omega})] \xrightarrow{L} N(\mathbf{0}, \mathbf{V})$$

Element of $\mathbf{V}$ corresponding to covariance between $\hat{\sigma}_{ij}$ and $\hat{\sigma}_{\ell m}$ can be estimated as $\hat{v}_{ij} = \hat{\sigma}_{i\ell}\hat{\sigma}_{jm} + \hat{\sigma}_{im}\hat{\sigma}_{j\ell}$ (Hamilton 1994, p. 301).

GSS instead use

$$\hat{v}_{ij} = T^{-1} \sum_{t=1}^{T} \{[(x_{ti} - \bar{x}_i)(x_{tj} - \bar{x}_j) - \hat{\sigma}_{ij}] \times [(x_{t\ell} - \bar{x}_\ell)(x_{tm} - \bar{x}_m) - \hat{\sigma}_{\ell m}]$$

Minimum chi square:

$$\min_{\theta} T[\text{vech}(\hat{\boldsymbol{\Omega}}) - \text{vech}(\boldsymbol{\Omega}(\boldsymbol{\theta}))]'\hat{\mathbf{V}}^{-1} \times$$

$$[\text{vech}(\hat{\boldsymbol{\Omega}}) - \text{vech}(\boldsymbol{\Omega}(\boldsymbol{\theta}))]$$

minimum value achieved is asymptotically $\chi^2(q)$ for $q = n(n+1)/2 - (nr+n) + r(r-1)/2$ (last term from $r(r-1)/2$ possible rotations of $\boldsymbol{\Lambda}$)

Result: reject $H_0 : r = 1$

fail to reject $H_0' : r = 2$

Conclusion: monetary policy surprises are a 2-dimensional object.

Can estimate space spanned by monetary policy surprises by ξ_{1t}, ξ_{2t} = first two principal components of $\mathbf{x}_t$

Useful alternative normalization:

$\boldsymbol{\xi}_t^* = \mathbf{Q}\boldsymbol{\xi}_t$ where ξ_{2t}^* has no effect on x_{1t} and ξ_{2t}^* is uncorrelated with ξ_{1t}^*

Usual normalization: $T^{-1}\sum_{t=1}^{T}\boldsymbol{\xi}_t\boldsymbol{\xi}_t' = \mathbf{I}_2$

Would also hold for $\boldsymbol{\xi}_t^* = \mathbf{Q}\boldsymbol{\xi}_t$

$$\mathbf{Q} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \quad (\mathbf{Q}\mathbf{Q}' = \mathbf{I}_2)$$

x_{t1} = Kuttner-adjusted change in current-month fed funds futures

= conventional measure of monetary policy

h_{11} = first element of first eigenvector of $\hat{\mathbf{\Omega}}$

= loading of x_{t1} on ξ_{t1}

h_{12} = first element of second eigenvector of $\hat{\mathbf{\Omega}}$

= loading of x_{t1} on ξ_{t2}

loading of $\mathbf{x}_t$ on $\boldsymbol{\xi}_t$ is $\underset{(n\times 2)}{\mathbf{H}}$

$$\mathbf{x}_t \simeq \mathbf{H}\boldsymbol{\xi}_t = \mathbf{H}\mathbf{Q}'\mathbf{Q}\boldsymbol{\xi}_t = \mathbf{H}^*\boldsymbol{\xi}_t^*$$

loading of $\mathbf{x}_t$ on $\boldsymbol{\xi}_t^*$ is $\underset{(n\times 2)}{\mathbf{H}^*} =$

$$\mathbf{H}^* = \mathbf{H}\mathbf{Q}' = \mathbf{H}\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

$$\boldsymbol{\xi}_t^* = \mathbf{Q}\boldsymbol{\xi}_t$$

$$h_{12}^* = h_{11}\sin\theta + h_{12}\cos\theta$$

In order for x_{t1} not to load on $\boldsymbol{\xi}^*_{t2}$, we want

$$h^*_{12} = h_{11}\sin\theta + h_{12}\cos\theta = 0$$

Find $\theta \in [-\pi, \pi]$ such that

$$\frac{\sin\theta}{\cos\theta} = \frac{-h_{12}}{h_{11}}$$

$$\theta^* = \tan^{-1}(-h_{12}/h_{11})$$

$$\begin{bmatrix} \xi^*_{t1} \\ \xi^*_{t2} \end{bmatrix} = \begin{bmatrix} \cos\theta^* & -\sin\theta^* \\ \sin\theta^* & \cos\theta^* \end{bmatrix} \begin{bmatrix} \xi_{t1} \\ \xi_{t2} \end{bmatrix}$$

Can further normalize so that $h_{11}^{*} = 1$

$\tilde{\xi}_{1t} = \lambda \xi_{1t}^{*}$

(one-unit shock to $\tilde{\xi}_{1t}$ raises fed funds target by one basis point)

Normalize $\tilde{\xi}_{2t}$ so that 1-year eurodollar futures increases by 0.55 bp

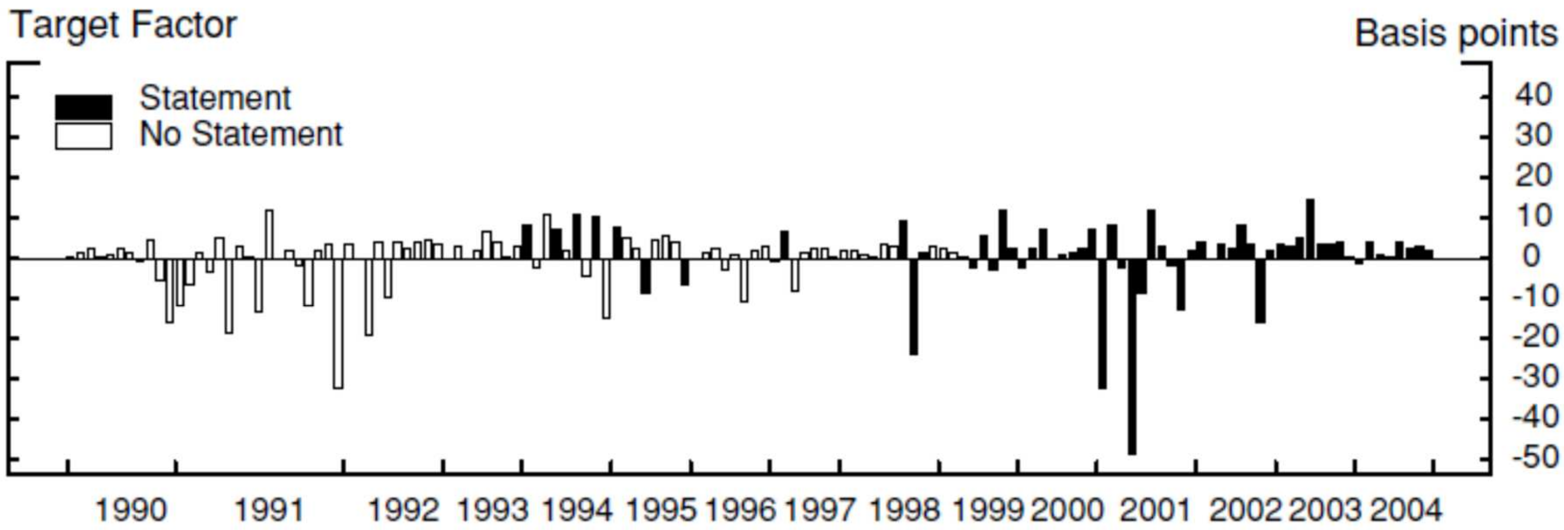
(= response of 1-year eurodollar to $\tilde{\xi}_{1t}$)

GSS call $\tilde{\xi}_{1t}$ the "target factor" and $\tilde{\xi}_{2t}$ the "path factor"

Note this makes $\tilde{\xi}_{1t}$ close to x_{1t} but not identical to x_{1t}

($\tilde{\xi}_{1t}$ is inference based on full vector $\mathbf{x}_t$)

Figure 6. Monetary Policy Surprises as Two Factors



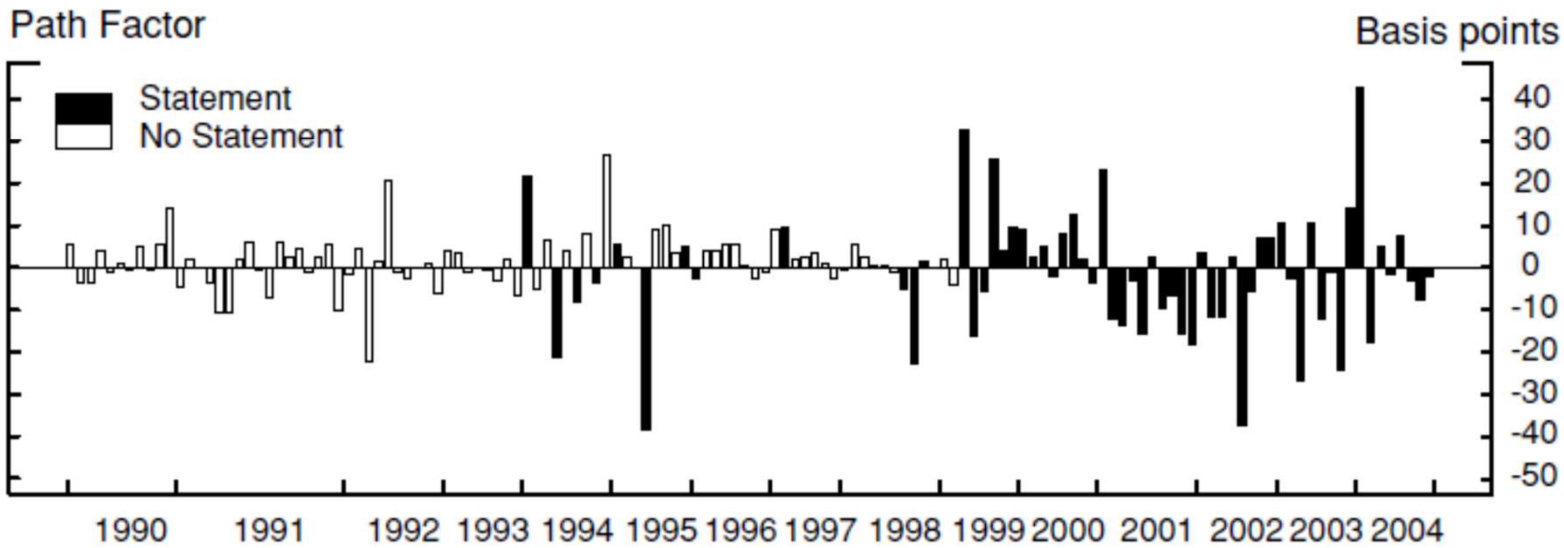


Table 5. Response of Asset Prices to Target and Path Factors

	One Factor			Two Factors			
	Constant (std. err.)	*Target Factor (std. err.)*	R^2	*Constant (std. err.)*	*Target Factor (std. err.)*	*Path Factor (std. err.)*	R^2
MP Surprise	–0.021*** (0.003)	1.000*** (0.047)	.91	–0.021*** (0.003)	1.000*** (0.048)	0.001 (0.026)	.91
One-Year-Ahead Eurodollar Future	–0.018*** (0.006)	0.555*** (0.076)	.36	–0.017*** (0.001)	0.551*** (0.017)	0.551*** (0.014)	.98
S&P 500	–0.008 (0.041)	–4.283*** (1.083)	.37	–0.008 (0.040)	–4.283*** (1.144)	–0.966 (0.594)	.40
Two-Year Note	–0.011** (0.005)	0.485*** (0.080)	.41	–0.011*** (0.002)	0.482*** (0.032)	0.411*** (0.023)	.94
Five-Year Note	–0.006 (0.005)	0.279*** (0.078)	.19	–0.006** (0.002)	0.276*** (0.044)	0.369*** (0.035)	.80
Ten-Year Note	–0.004 (0.004)	0.130** (0.059)	.08	–0.004* (0.002)	0.128*** (0.039)	0.283*** (0.025)	.74
Five-Year Forward Rate Five Years Ahead	0.001 (0.003)	–0.098** (0.049)	.06	0.001 (0.003)	–0.099** (0.047)	0.157*** (0.028)	.34

B. Odyssean versus Delphic foreign guidance (Campbell et al., 2012)

- 2-year rate jumped 17 bp on Jan 28, 2004 when Fed replaced
  - “policy accommodation can be maintained for a considerable period”
- with
  - “the Committee believes that it can be patient in removing its policy accommodation.”

- Is this Odyssean?
    - Fed is promising to raise rates soon
- Or is it Delphic?
    - Fed is predicting it is going to raise rates soon
- If Delphic
    - Is Fed predicting its future policy shock?
    - Or is Fed passing along its superior information about the economy?

- Campbell, et al. studied correlation between GSS “path” factor in 30-minute interval around FOMC statement and month-to-month change in Blue Chip forecast
- A statement that increased interest rates was associated with market expectations of increased inflation and decreased unemployment
- Interpretation: typically we observe Delphic component (Fed has superior information about economy)

Table 3. Regressions Estimating Private Forecast Responses to Target and Path Factors, 1990–2007 and 1994–2007[a]

Forecast	*February 1990–June 2007 sample*			*February 1994–June 2007 sample*		
	Target factor	*Path factor*	*Adjusted R^2*	*Target factor*	*Path factor*	*Adjusted R^2*
Unemployment rate						
Current quarter	–0.21***	–0.08	0.07	–0.01	–0.08	0.01
	(0.08)	(0.06)		(0.08)	(0.07)	
Next quarter	–0.18**	–0.12	0.05	0.07	–0.16**	0.03
	(0.09)	(0.08)		(0.10)	(0.08)	
2 quarters hence	–0.27***	–0.13*	0.09	–0.06	–0.16*	0.03
	(0.08)	(0.07)		(0.11)	(0.09)	
3 quarters hence	–0.26***	–0.08	0.07	–0.03	–0.19**	0.04
	(0.09)	(0.08)		(0.09)	(0.08)	
CPI inflation						
Current quarter	0.25	0.47	0.02	–0.13	0.57*	0.02
	(0.33)	(0.36)		(0.34)	(0.31)	
Next quarter	0.14	0.30	0.03	0.25**	0.12	0.03
	(0.11)	(0.24)		(0.13)	(0.12)	
2 quarters hence	0.11	–0.06	0.01	0.14	–0.04	0.01
	(0.14)	(0.13)		(0.10)	(0.16)	
3 quarters hence	0.13	0.07	0.01	0.04	0.27	0.03
	(0.20)	(0.20)		(0.14)	(0.25)	

t quarterly

$$r_t = \mu + \rho_1 r_{t-1} + \rho_2 r_{t-2} + (1 - \rho_1 - \rho_2)[\psi_\pi(\pi_t - \pi^*) + \psi_u(u_t - u_t^*)] + \sum_{j=0}^{M} v_{t-j,j}$$

$v_{t,0}$ decided at t

$v_{t-1,1}$ decided at $t - 1$

$\vdots$

$v_{t-M,M}$ decided at $t - M$

$\mathbf{v}_t = (v_{t0}, v_{t1}, \ldots, v_{tM})' =$ new decisions at t

$\mathbf{v}_t$ serially uncorrelated

$$r_t = \mu + \rho_1 r_{t-1} + \rho_2 r_{t-2} + (1 - \rho_1 - \rho_2)[\psi_\pi(\pi_t - \pi^*) + \psi_u(u_t - u_t^*)] + \sum_{j=0}^{M} v_{t-j,j}$$

Expectation at $t - M$

$$\hat{r}_{t|t-M} = \mu + \rho_1 \hat{r}_{t-1|t-M} + \rho_2 \hat{r}_{t-2|t-M} + (1 - \rho_1 - \rho_2)[\psi_\pi(\hat{\pi}_{t|t-M} - \pi^*) + \psi_u(\hat{u}_{t|t-M} - \hat{u}_{t|t-M}^*)] + v_{t-M,M}$$

Expectation at $t - M + 1$

$$\hat{r}_{t|t-M+1} = \mu + \rho_1 \hat{r}_{t-1|t-M+1} + \rho_2 \hat{r}_{t-2|t-M+1}$$
$$+ (1 - \rho_1 - \rho_2)[\psi_\pi(\hat{\pi}_{t|t-M+1} - \pi^*)$$
$$+ \psi_u(\hat{u}_{t|t-M+1} - \hat{u}^*_{t|t-M+1})] + v_{t-M+1,M+1} + v_{t-M,M}$$

Difference

$$\hat{r}_{t|t-M+1} - \hat{r}_{t|t-M} = \rho_1(\hat{r}_{t-1|t-M+1} - \hat{r}_{t-1|t-M})$$
$$+ \rho_2(\hat{r}_{t-2|t-M+1} - \hat{r}_{t-2|t-M+1})$$
$$+ (1 - \rho_1 - \rho_2)[\psi_\pi(\hat{\pi}_{t|t-M+1} - \hat{\pi}_{t|t-M})$$
$$+ \psi_u(\hat{u}_{t|t-M+1} - \hat{u}_{t|t-M} - \hat{u}^*_{t|t-M+1} + \hat{u}^*_{t|t-M})] + v_{t-M+1,M+1}$$

We observe:

$\hat{r}_{t|t-j+1} - \hat{r}_{t|t-j}$ from change in fed funds futures

$\hat{\pi}_{t|t-j+1} - \hat{\pi}_{t|t-j}$ and $\hat{u}_{t|t-j+1} - \hat{u}_{t|t-j}$ from revision in Blue Chip forecast

$\hat{u}^*_{t|t-j+1} - \hat{u}^*_{t|t-j}$ from revision in Blue Chip long-run forecast

$\Rightarrow$ we observe $v_{t-j,j}$ for $j = 0, 1, .., M-1$

Estimate parameters by GMM

$$r_t = \underset{(0.02)}{-0.05} + \underset{(0.02)}{1.60} \times r_{t-1} - \underset{(0.02)}{0.66} \times r_{t-2}$$

$$-(1-0.94) \times \underset{(0.28)}{1.10}\ \tilde{u}_t + (1-0.94)$$

$$\times \underset{(0.18)}{2.32}\ \pi_t + \sum_{j=0}^{4} \nu_{t-j,j}.$$

FOMC communicates 40% of variance of shock 1 quarter ahead and another 40% in 3 quarters before that.

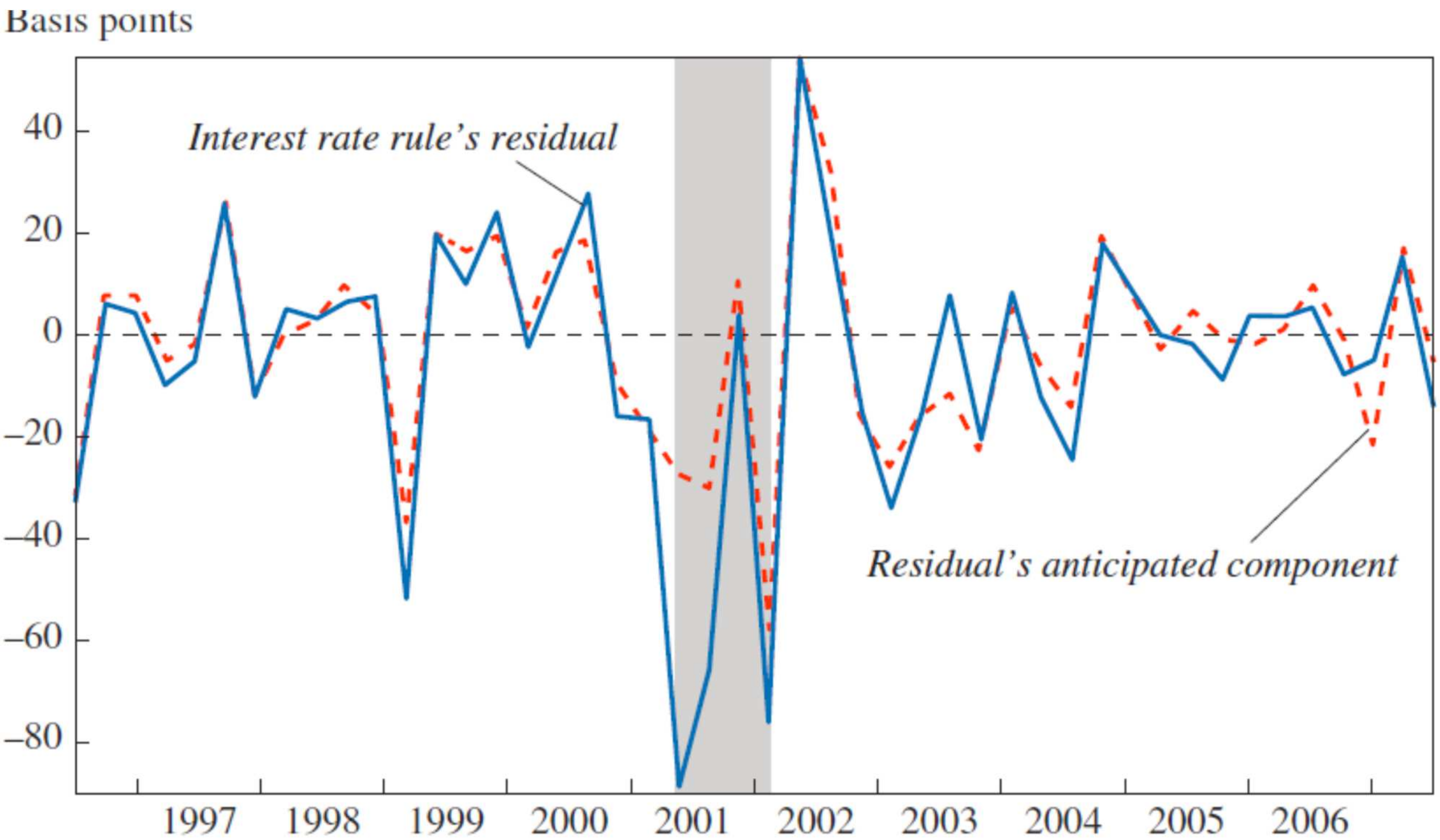


Table 8. Regressions Estimating Asset Price Responses to Forward Guidance Shocks Identified from an Interest Rate Rule, 1996Q1–2007Q2[a]

Asset	*Constant*	*Shock* $\nu_{t,0}$	$\nu_{t,1}$	$\nu_{t,2}$	$\nu_{t,3}$	$\nu_{t,4}$	*Adjusted* R_2
Treasuries							
2 years to maturity	5.90	1.08***	1.98***	1.56***	0.70*	0.89*	0.77
	(4.47)	(0.37)	(0.22)	(0.33)	(0.42)	(0.50)	
5 years to maturity	3.46	0.61*	1.83***	1.91***	1.43***	1.25**	0.78
	(4.31)	(0.36)	(0.21)	(0.32)	(0.40)	(0.49)	
10 years to maturity	1.57	0.38	1.48***	1.60***	1.41***	1.29***	0.70
	(4.44)	(0.37)	(0.22)	(0.33)	(0.42)	(0.50)	
Corporate bonds[b]							
Aaa/AAA-rated	0.60	0.19	0.65***	0.75**	0.86**	0.17	0.33
	(4.63)	(0.38)	(0.23)	(0.34)	(0.43)	(0.52)	
Baa/BBB-rated	0.57	0.13	0.69***	0.71**	1.00***	0.37	0.42
	(4.01)	(0.33)	(0.20)	(0.30)	(0.38)	(0.45)	

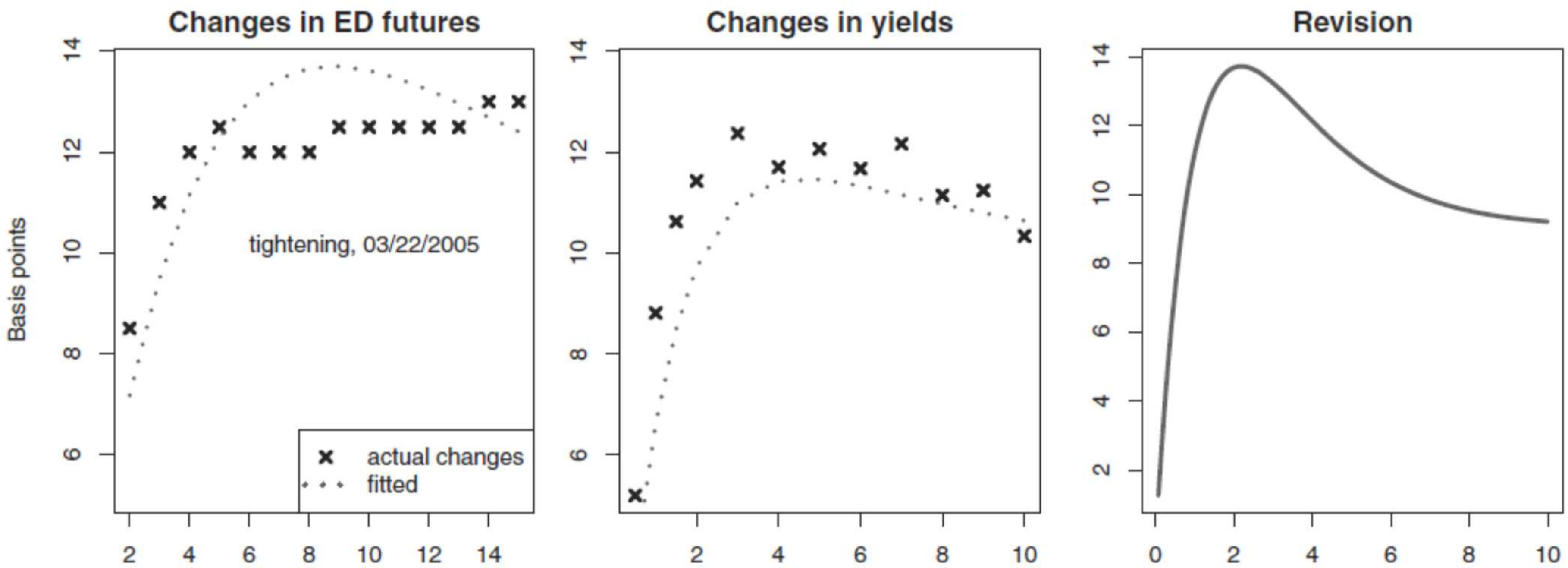
C. A 3-dimensional characterization of monetary shocks (Bauer, 2015)

- Estimated Dynamic Nelson-Siegel model using daily data on
  - Fed funds futures over each of the next 4 months
  - Eurodollar futures contracts for each of the next 14 quarters
  - Zero-coupon Treasury yields 6m, 12m, 18m, 2y, 3y, … 10y
- Gives summary of entire yield curve for every day along with term premium and expectations components

- Allows for heteroscedasticity by grouping days by kind of news release (e.g., monetary policy release days have different variance matrix from others)
- Allows us to summarize how entire yield curve changes in response to any given day's news

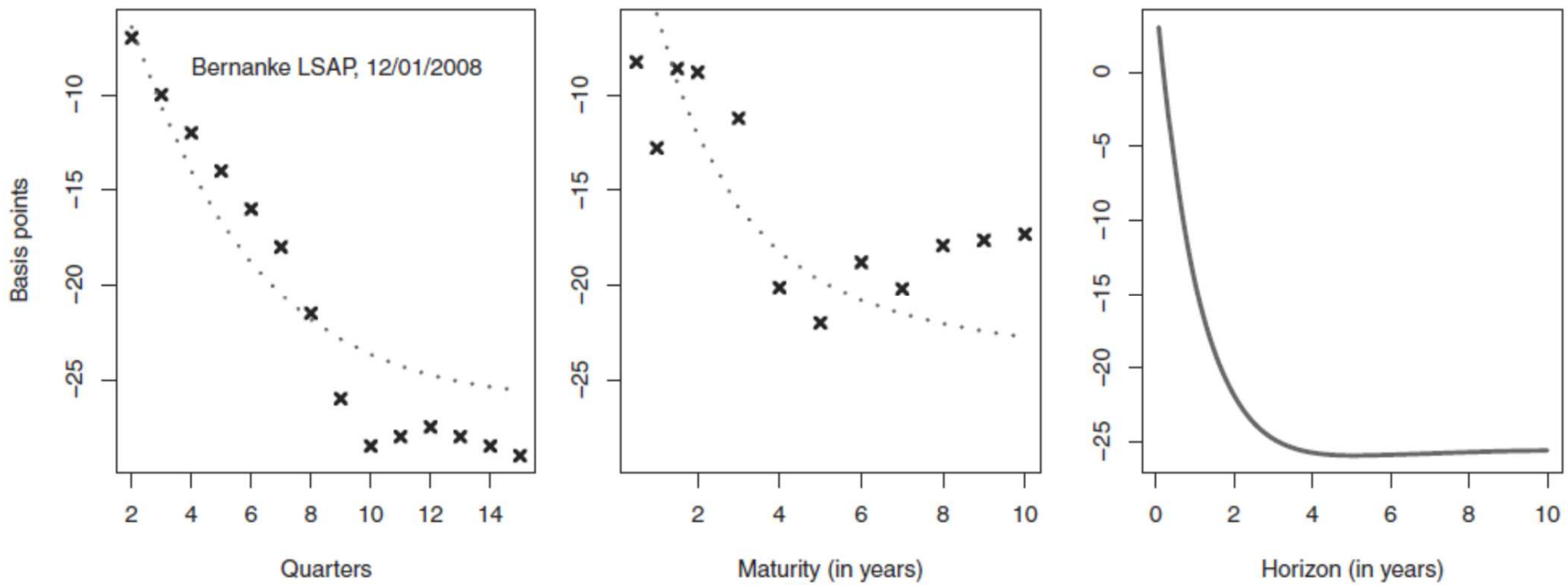
- Example: FOMC statement March 22, 2005
- Fed announced 25 bp increase
  - This had been fully anticipated, current futures contract unchanged
- Added hawkish forward guidance
  - “pressures on inflation have picked up in recent months”

Response of yield curve to FOMC statement Mar 22, 2005
(revision = change in expected future short rates)

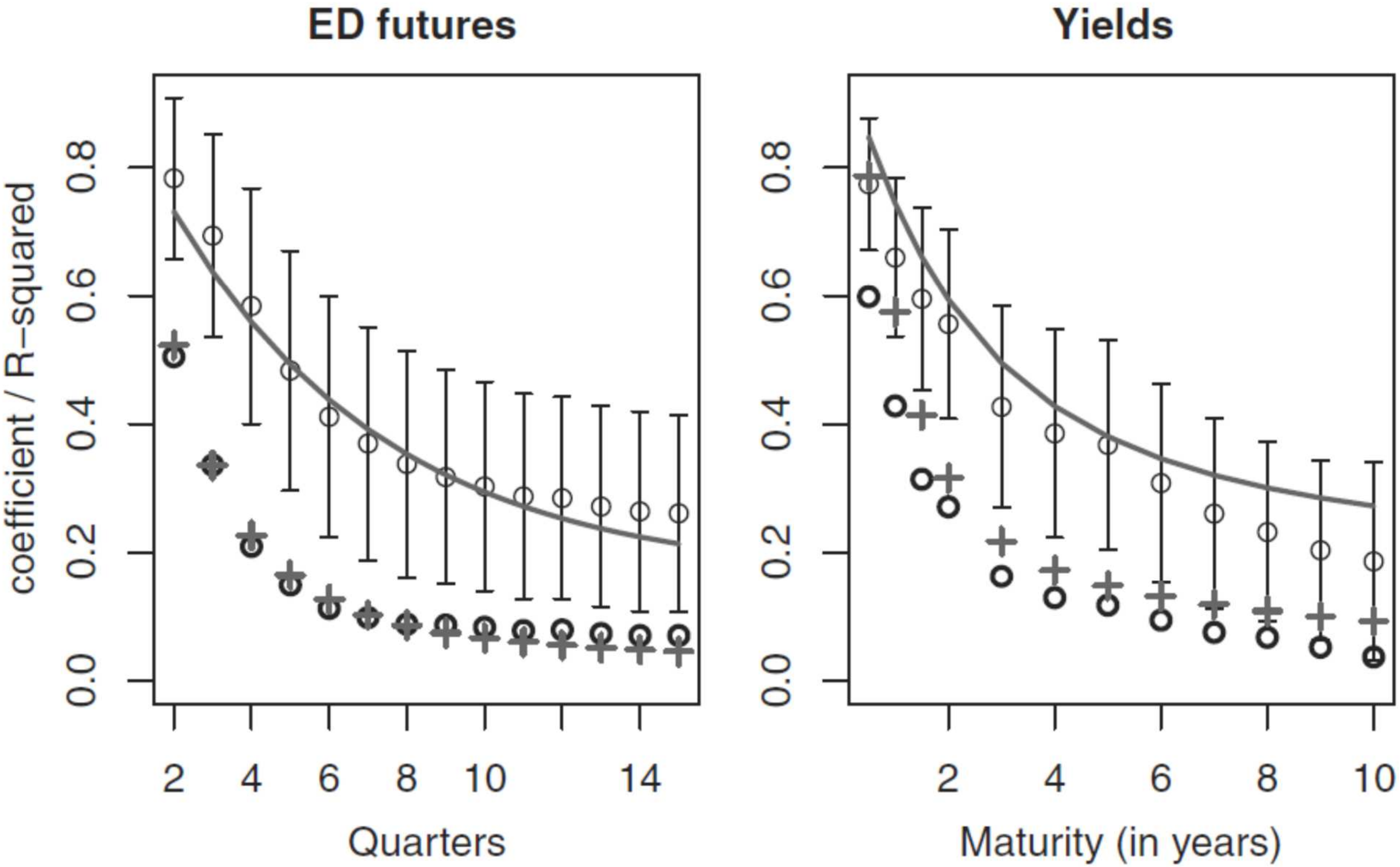


Horizontal axis: quarters for left panel, years for second and third

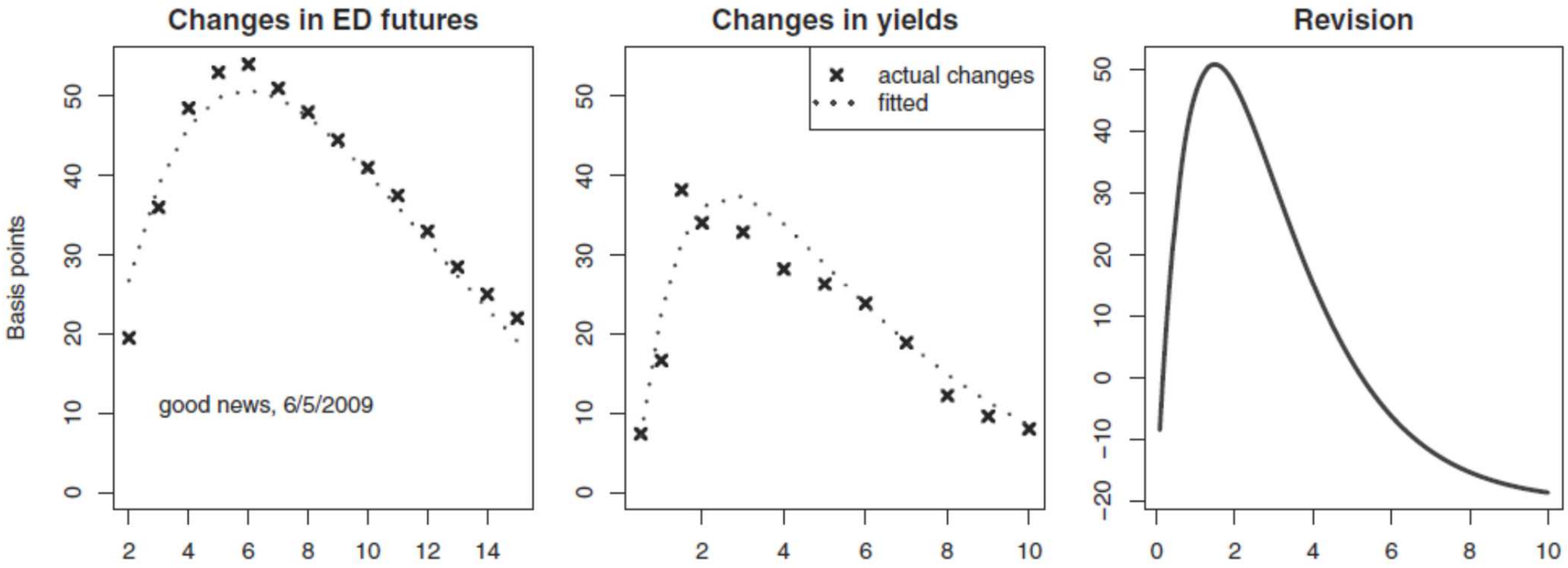
Response of yield curve to Bernanke announcement Dec 1, 2008 that Fed was “likely to purchase longer term securities … in substantial quantities”



Model predicted coefficients (solid curve) and R^2 (crosses) from Kuttner estimates of effects of monetary policy shocks and direct estimates (circles with confidence bars)

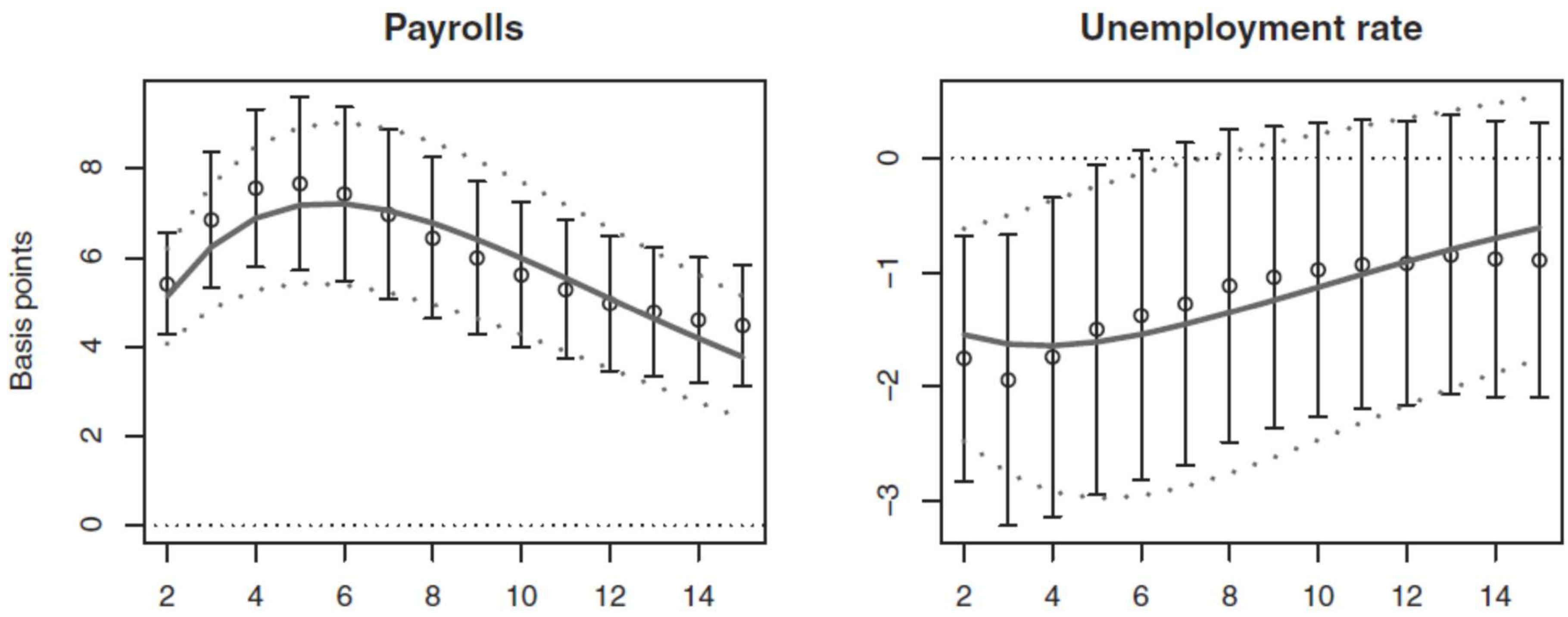


Change in yield curve June 5, 2009 (market expected drop in nonfarm payrolls of 500,000, actual drop was 345,000)



Horizontal axis: quarters for left panel, years for second and third

Model predicted responses (solid curve) to a one-standard deviation surprise in macro release and direct estimates (circles) (horizontal axis = quarters)



Model predicted responses (with 95% confidence interval) of expected future short rates to a one-standard deviation surprise in macro release (horizontal axis = quarters)