Forward Guidance, Monetary Policy Uncertainty, & the Term Premium

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Forward guidance & LSAPs were key tools in & after Great Recession

Bernanke (2013) on their effects:

"Both LSAPs and forward guidance for the federal funds rate support the economy by putting downward pressure on longer-term interest rates, but they affect longer-term rates through somewhat different channels."

Forward guidance & LSAPs were key tools in & after Great Recession

Bernanke (2013) on their effects:

"To understand the difference, it is useful to decompose longer-term interest rates into two components: One reflects the expected path of short-term interest rates, and the other is called a term premium."

Forward guidance & LSAPs were key tools in & after Great Recession

Bernanke (2013) on their effects:

"The term premium is the extra return that investors require to hold a longer-term security to maturity compared with the expected yield from rolling over short-term securities for the same period."

Dichotomy Between Tools & Their Effects

"**Forward rate guidance affects longer-term interest rates primarily by influencing investors' expectations of future short-term interest rates.**

LSAPs, in contrast, most directly affect term premiums."

– Bernanke (2013)

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Woodford (2012) uses example to argue against this dichotomy

Woodford (2012) on Forward Guidance & the Term Premium

"Suppose that FOMC forward guidance were to convince market participants that there was no possibility of a funds rate above zero for the next ten years...

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An absence of arbitrage opportunities would require the ten-year zero-coupon yield to fall to zero – meaning that both the expectations component and the term premium would be reduced to zero by such a change in expectations about the short-rate process...

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Term premia are affected by expectations about the short-rate process (in particular, the degree of uncertainty about future short rates)."

Monetary Policy Uncertainty & the Term Premium

We empirically test Woodford's claim

Does forward guidance significantly affect term premia?

If policy announcement lowers uncertainty about future short rates,
does it also lower term premia in longer-term bonds?

Our Analysis

Use Eurodollar options to measure short-rate uncertainty

- Apply the VIX methodology, denote our measure **EDX**
- Measure 1- to 5-quarter ahead uncertainty
- $\Rightarrow$ Term structure of implied short-rate volatility

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Examine daily changes in **EDX** & term premia after FOMC meetings

- To isolate forward guidance, use 1994–2008 period
- Use two different daily measures of term premia
  - Adrian, Crump, & Moench (2013); Kim & Wright (2005)

Our Findings

Empirically validate Woodford's claim:

$\Rightarrow$ Lowering short-rate uncertainty does decrease term premia

Two components describe uncertainty changes after FOMC meetings

Level – Implied volatility next quarter

Slope – Relative changes in uncertainty over following year

Changes in slope factor significantly affect term premia

Typical negative shock lowers term premium by 2 basis points

Leads to significant expansion of economic activity

Simple Model of a Representative Household

Simple, stylized model to guide intuition & empirical specifications

Household maximizes utility from consumption C_t

- Endowment income Y_t each period

Invest in nominal bonds with maturities from 1 to n

- Yield of n-period bond y_t^n

Assume central bank sets the short-term policy rate r_t

Two Key Testable Predictions

$$c_t = \mathbb{E}_t\Big\{c_{t+n}\Big\} - \frac{1}{2}\,\mathbb{VAR}_t\Big\{c_{t+n}\Big\} - n\left(y_t^n + \log(\beta)\right),$$

$\Rightarrow$ Lower bond yield y_t^n leads to higher consumption

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$\Rightarrow$ Lower bond yield y_t^n leads to higher consumption

$$y_t^n \approx \frac{1}{n}\left[\sum_{i=0}^{n-1}\mathbb{E}_t\Big\{r_{t+i}\Big\} + \frac{1}{2}\mathbb{VAR}_t\left\{\sum_{i=0}^{n-1} r_{t+i}\right\}\right]$$

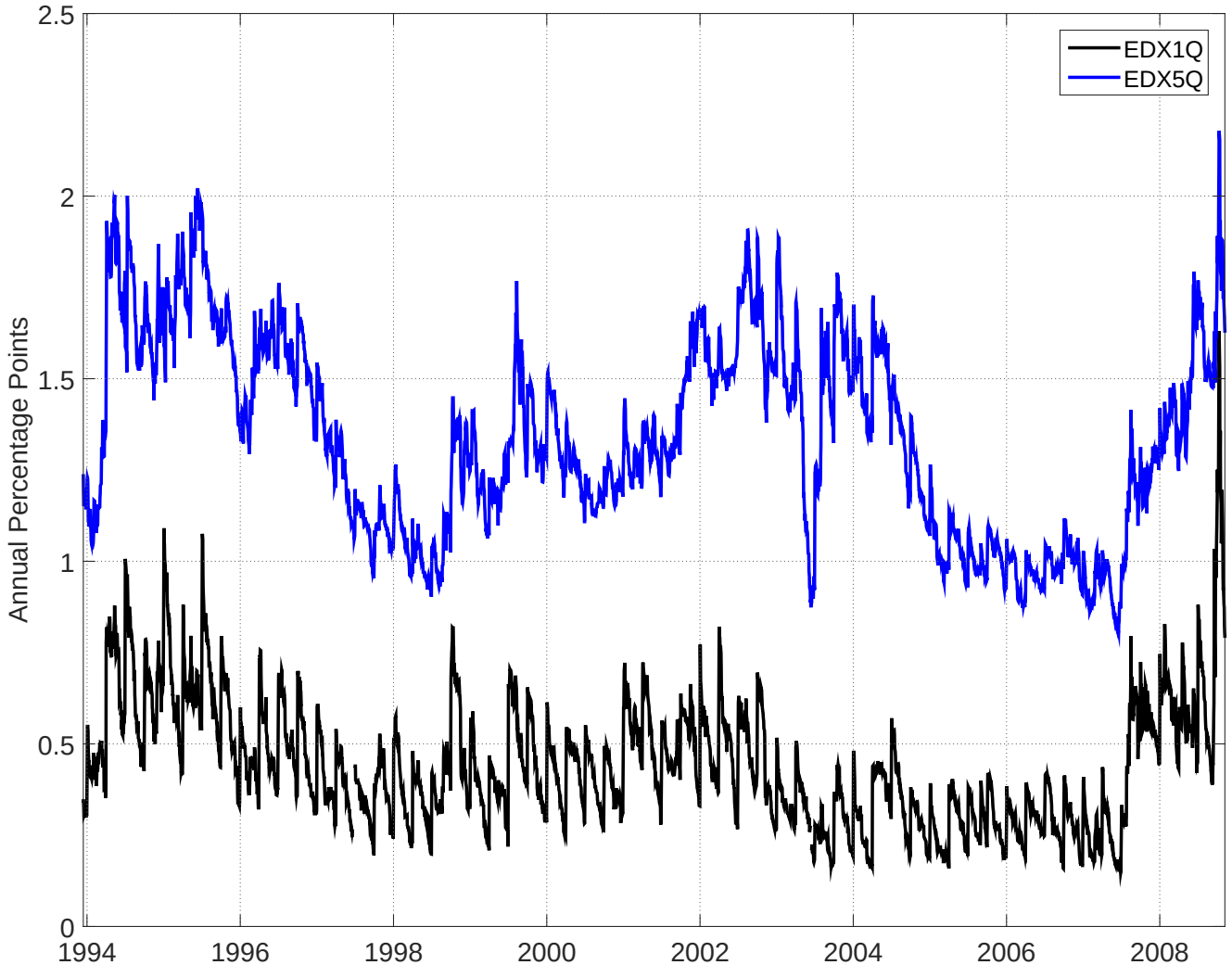
$$TP_t^n \triangleq y_t^n - \tilde{y}_t^n \approx \frac{1}{n}\,\mathbb{VAR}_t\left\{\sum_{i=0}^{n-1} r_{t+i}\right\}$$

$\Rightarrow$ Term premia depends on future short-rate uncertainty

Measuring Uncertainty About Future Short-Rates

Apply VIX methodology to Eurodollar options, denote as **EDX**

Measures 1- to 5-quarter ahead short-rate uncertainty



Characterizing Uncertainty Around FOMC Meetings

Interest: How do changes in uncertainty affect term premium?

Examine daily changes around FOMC meetings

Need two principal components to characterize changes

Explain over 94% of variation in daily changes

Components already have straightforward interpretation

$\Rightarrow$ Level & slope of implied volatility term structure

Scale each factor to reinforce this interpretation

1 bp change level factor = 1 bp change in EDX 1Q

1 bp change slope factor = 1 bp change in EDX 5Q - EDX 1Q

EDX Level & Slope Factor Loadings

Eurodollar VIX	EDX Level Factor	EDX Slope Factor
EDX 1Q	0.87	−0.44
EDX 2Q	0.95	−0.21
EDX 3Q	0.95	0.10
EDX 4Q	0.95	0.22
EDX 5Q	0.94	0.31
Cumulative R^2	0.86	0.94

Bond Market Term Premia & Monetary Policy Uncertainty

$$\Delta TP_t^n = \alpha + \beta^L \Delta L_t + \beta^S \Delta S_t + \varepsilon_t$$

$\Delta TP_t^n \triangleq$ Daily change in maturity n term premium after meeting

$\Delta L_t \triangleq$ Daily change in level factor

$\Delta S_t \triangleq$ Daily change slope factor

Term Premia & Interest Rate Uncertainty

Table: Adrian, Crump & Moench (2013) Term Premium on EDX Factors

Dependent Variable	EDX Level Factor	EDX Slope Factor	R^2	Slope Only R^2
1-Year Term Premium	0.07	0.43***	0.18	0.17
2-Year Term Premium	0.11	0.59***	0.20	0.19
5-Year Term Premium	0.13	0.56***	0.11	0.11
10-Year Term Premium	0.11	0.51**	0.05	0.05

Simply Another Proxy for Macroeconomic Uncertainty?

Bloom (2009) documents that uncertainty measures move together

Are we merely generating another proxy for the VIX or MOVE?

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No

VIX or MOVE cannot explain term premia around FOMC meetings

- VIX & MOVE correlated with EDX level factor, not slope

- Slope of interest rate uncertainty matters for term premia

The Term Premium and Interest Rate Uncertainty

Table: ACM Term-Premium Regressions Controlling for VIX & MOVE

Dependent Variable	EDX Level Factor	EDX Slope Factor	VIX Index	MOVE Index
1-Year Term Premium	0.09	0.43***	0.13	−0.03
	0.07	0.43***		
2-Year Term Premium	0.14	0.59***	0.13	−0.04
	0.11	0.59***		
5-Year Term Premium	0.17	0.55***	0.14	−0.05
	0.13	0.56***		
10-Year Term Premium	0.12	0.50**	0.30	−0.04
	0.11	0.51**		

FOMC Communication & Interest Rate Uncertainty

Do movements in interest rate uncertainty line up with the narrative of FOMC communication?

Examine statements associated with large slope factor shocks

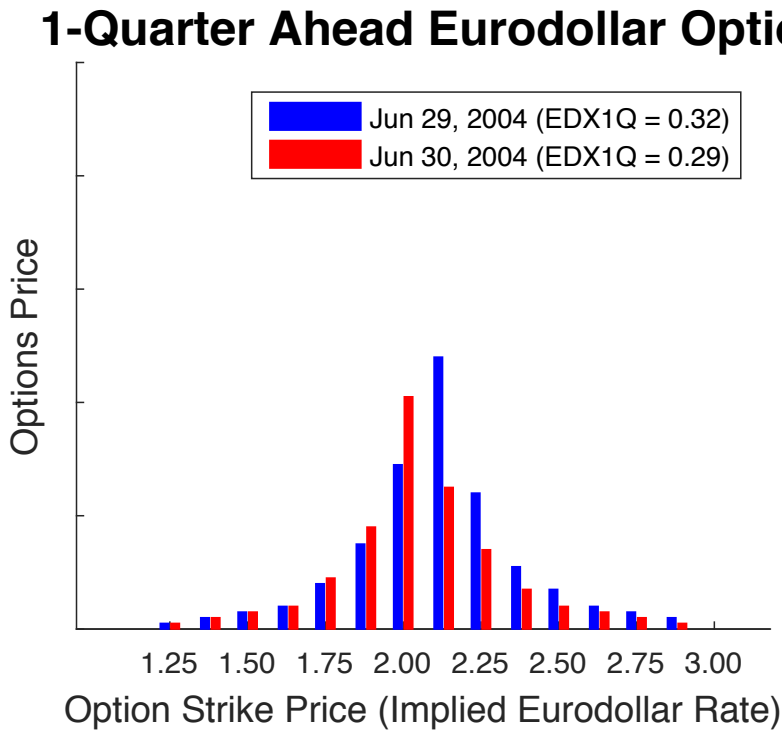
- February 1994: Preemptive strike on inflation
- May 2003: Uncertainty prior to Iraq War
- June 2004: Introduction of "Measured Pace" language

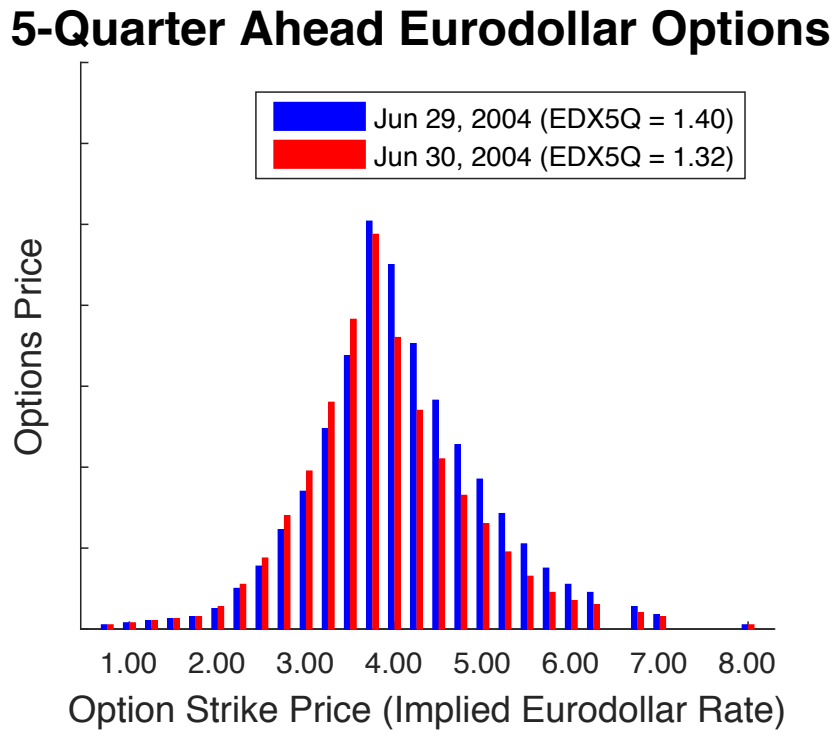
Statements that provide more clarity about future rate changes

- $\Rightarrow$ Decrease in slope factor
- $\Rightarrow$ Decline in bond market term premium

Expect "Measured Pace" of Rate Increases in June 2004

"Policy accommodation can be removed at a pace that is likely to be measured." – June 2004 FOMC Statement





EDX 5Q fell more than EDX 1Q

$\Rightarrow$ Decrease in slope factor & lower term premia

The Macroeconomic Effects of Policy Uncertainty

Forward guidance announcement which lowers uncertainty

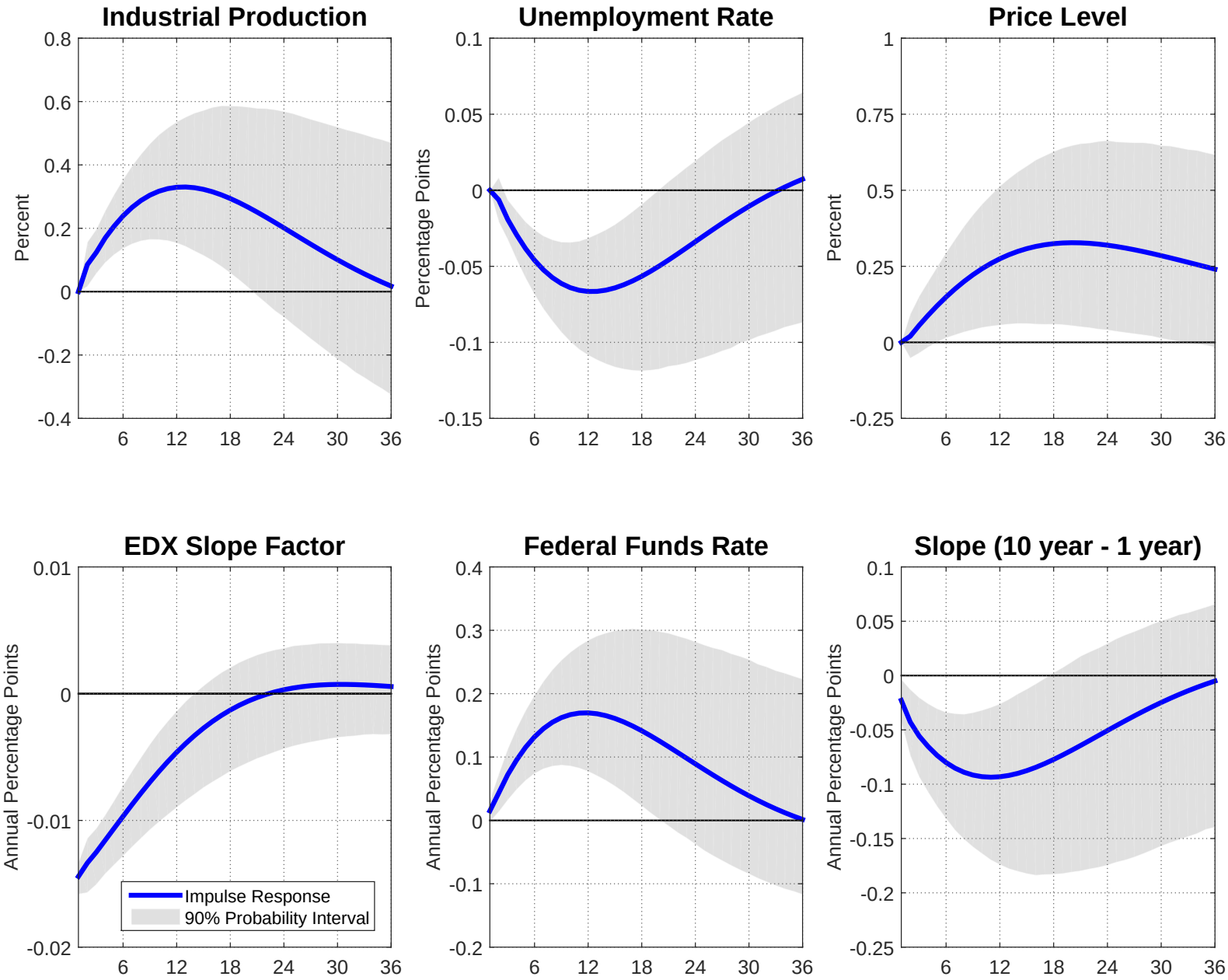
$\Rightarrow$ Decline in term premia

Simple model implies that outcome should be expansionary

Embed our slope factor shock into standard recursive VAR

1. Industrial production
2. Unemployment rate
3. Prices
4. Slope factor
5. Federal funds rate
6. Yield curve slope

Empirical Responses to Slope Factor Shock



Generality of Our Findings

Hard to disentangle effects of LSAPs & guidance in recent data

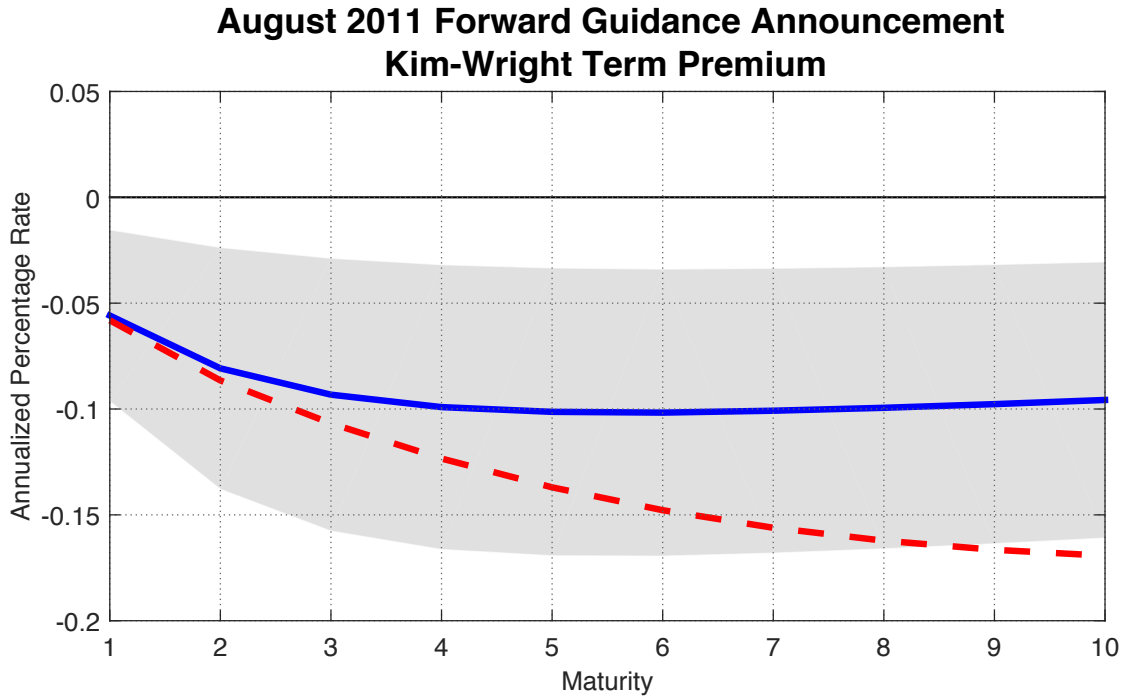
Use 1994–2008 period in our baseline

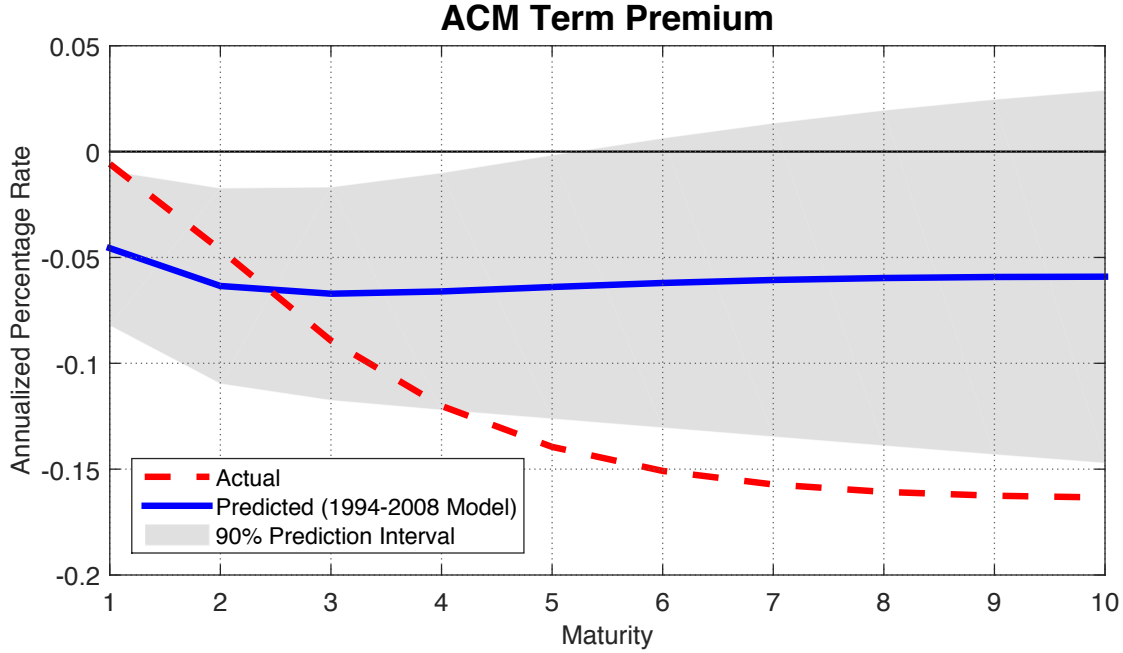
August 2011 meeting provides opportunity to test our findings

Significant forward guidance annoucement, no LSAP changes

Use baseline empirical model to predict term premia movements

- Only use our estimated level and slope factors


August 2011 Forward Guidance Announcement
Kim-Wright Term Premium
Annualized Percentage Rate
0.05
0
-0.05
-0.1
-0.15
-0.2
1
2
3
4
5
6
7
8
9
10
Maturity


ACM Term Premium
Annualized Percentage Rate
0.05
0
-0.05
-0.1
-0.15
-0.2
1
2
3
4
5
6
7
8
9
10
Maturity
Actual
Predicted (1994-2008 Model)
90% Prediction Interval

Conclusion

Forward guidance announcements have term premia implications

Don't necessarily have to rely on LSAPs to affect term premia

May need to revisit existing estimates of LSAP effects

- Need to control for changes in interest rate uncertainty

Optimality Conditions for Bond Holdings

$$P_t^1 = \mathbb{E}_t \left\{ \beta \frac{C_t}{C_{t+1}} \frac{P_t}{P_{t+1}} \right\}$$

$$P_t^n = \mathbb{E}_t \left\{ \beta \frac{C_t}{C_{t+1}} \frac{P_t}{P_{t+1}} P_{t+1}^{n-1} \right\}$$

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For analytical tractability only, make three assumptions:

1. Central bank sets nominal rate R_t, equal to inverse of P_t^1
2. All bonds are in zero net supply
3. Aggregate prices are fixed $P_t = P$

Scaling EDX Factors

Table 2: EDX (Eurodollar VIX) Level and Slope Regressions on EDX Components

Dependent Variable	EDX Level Factor	EDX Slope Factor	R^2	Slope Only R^2
EDX 1Q	1.00***	−0.60***	0.97	0.20
	(0.02)	(0.03)		
	[54.93]	[23.62]		
EDX 5Q - EDX 1Q	0.00	1.00***	0.91	0.91
	(0.02)	(0.03)		
	[0.17]	[37.36]		

Term Premia & Interest Rate Uncertainty

Table: Kim & Wright Term Premium on EDX Factors

Dependent Variable	EDX Level Factor	EDX Slope Factor	R^2	Slope Only R^2
1-Year Term Premium	0.19	0.43***	0.18	0.14
2-Year Term Premium	0.29*	0.61***	0.19	0.14
3-Year Term Premium	0.34*	0.70***	0.19	0.15
5-Year Term Premium	0.36*	0.76***	0.20	0.15
10-Year Term Premium	0.34*	0.71***	0.19	0.15

The Term Premium and Interest Rate Uncertainty

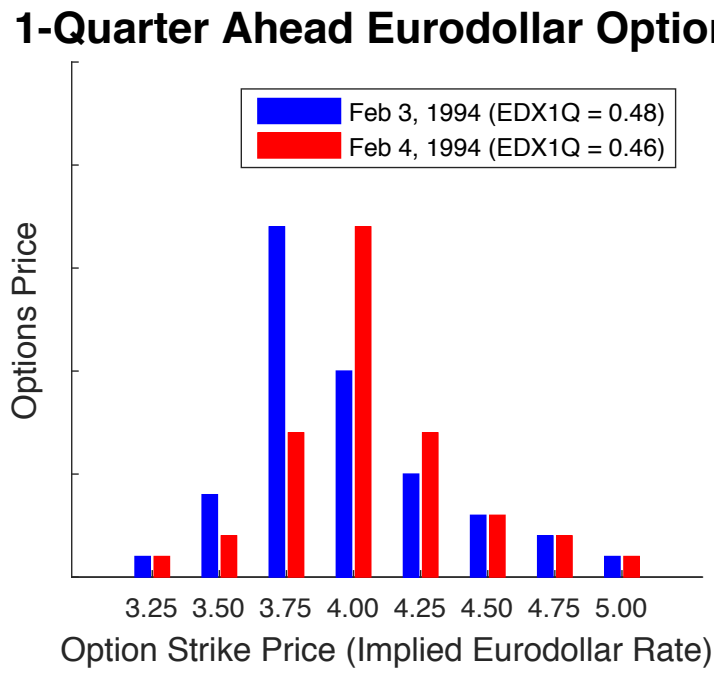
Table: KW Term-Premium Regressions Controlling for VIX & MOVE

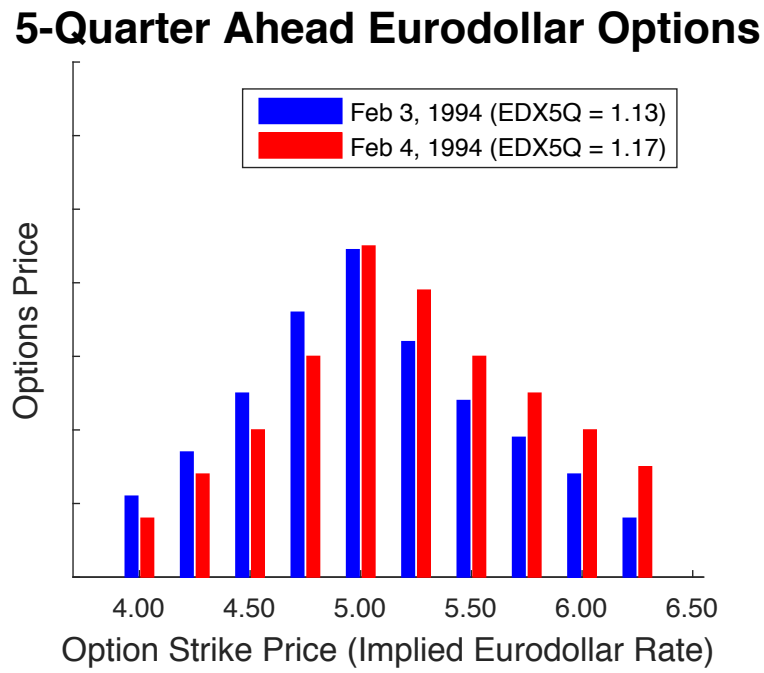
Dependent Variable	EDX Level Factor	EDX Slope Factor	VIX Index	MOVE Index
1-Year Term Premium	0.30**	0.44***	−0.28	−0.05
	0.19	0.43***		
2-Year Term Premium	0.43***	0.62***	−0.39	−0.07
	0.29*	0.61***		
3-Year Term Premium	0.50***	0.71***	−0.43	−0.09
	0.34*	0.70***		
5-Year Term Premium	0.54***	0.77***	−0.43	−0.09
	0.36*	0.76***		
10-Year Term Premium	0.49***	0.72***	−0.32	−0.09
	0.34*	0.71***		

Preemptive Strike on Inflation in February 1994

Unexpected increase in federal funds rate

- Issued statement signaling start of tightening cycle
- No clarity on timing or pace of future rate increases





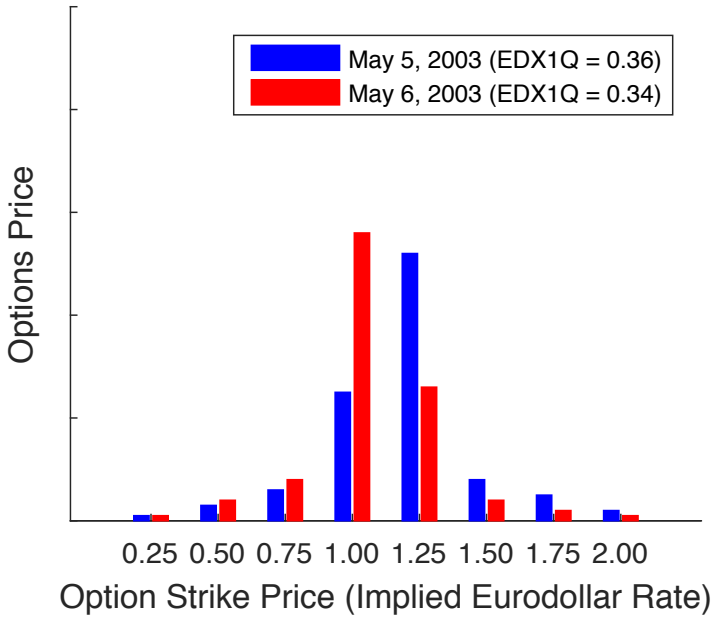
Options implied additional rate hikes, uncertain about pace

- Increase in slope factor $\Rightarrow$ Higher term premia

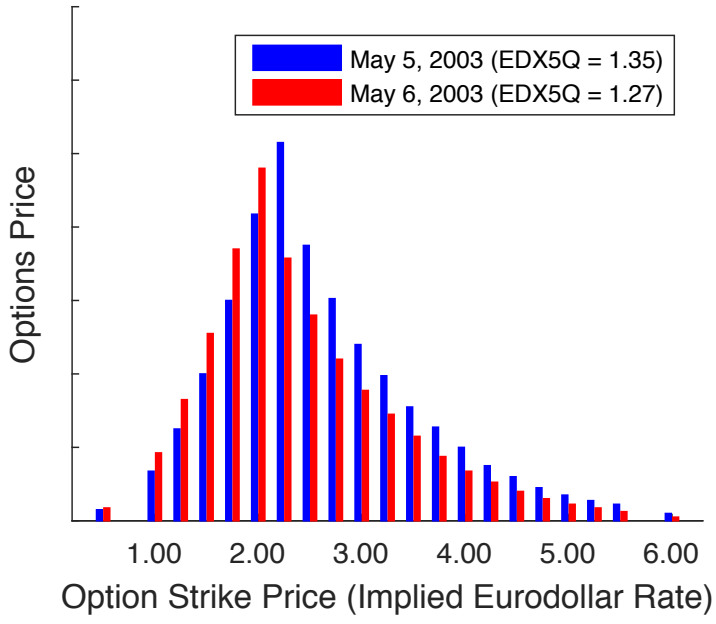
Increased Uncertainty Preceding Iraq War in 2003

"Balance of risks to achieving its goals is weighted towards weakness over foreseeable future." – May 2003 FOMC Statement

1-Quarter Ahead Eurodollar Options



5-Quarter Ahead Eurodollar Options



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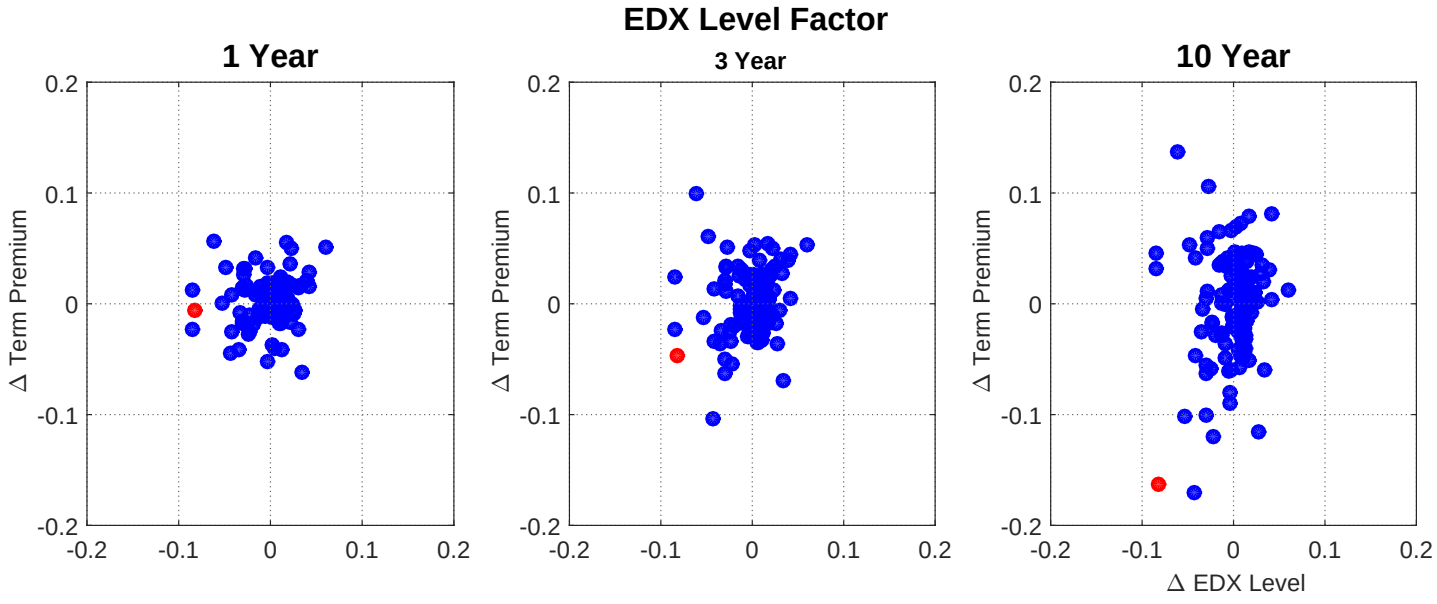
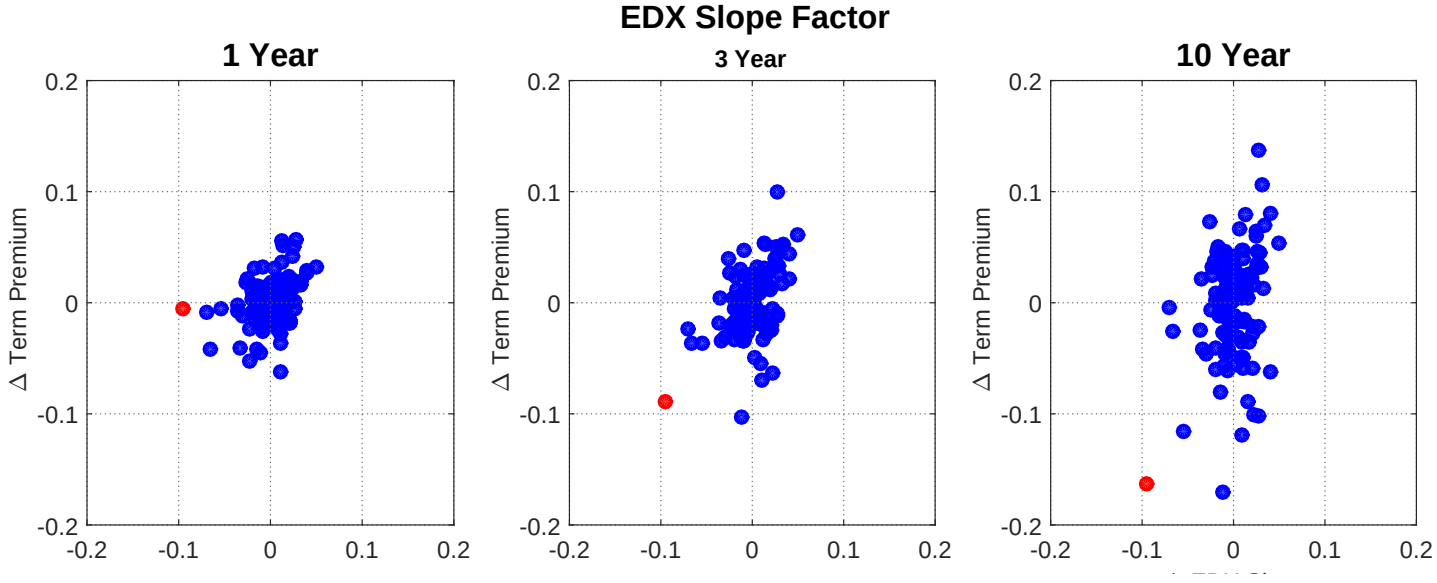
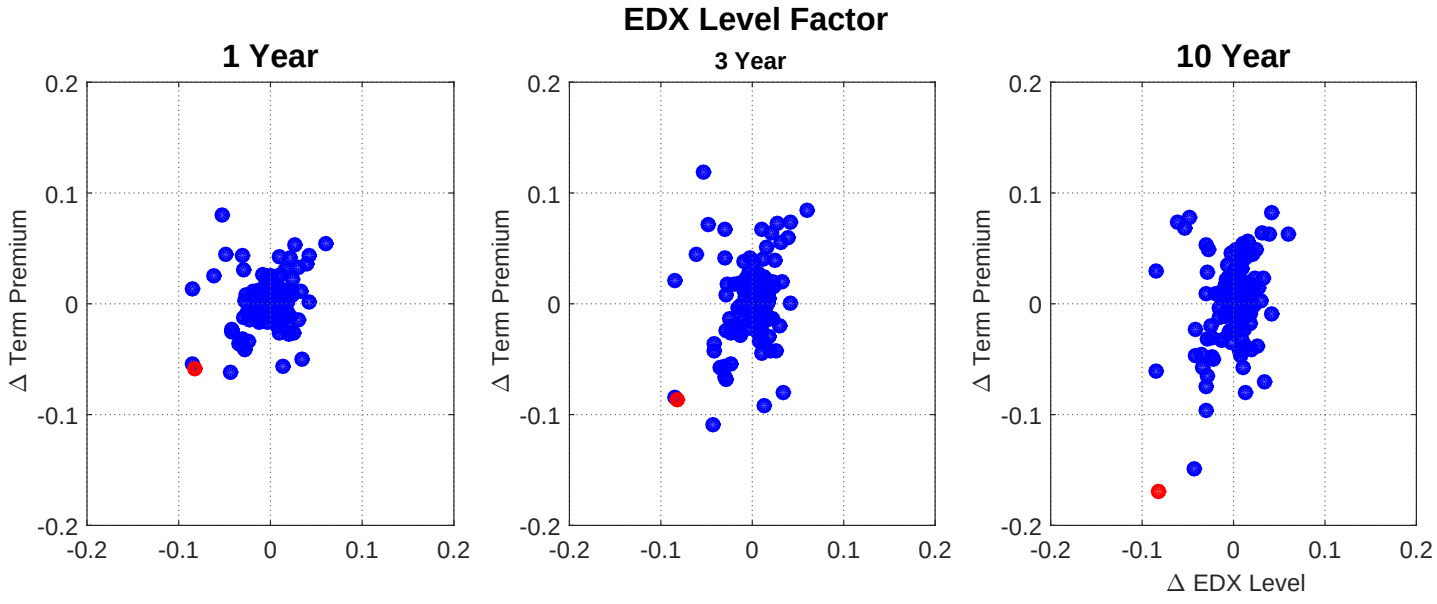
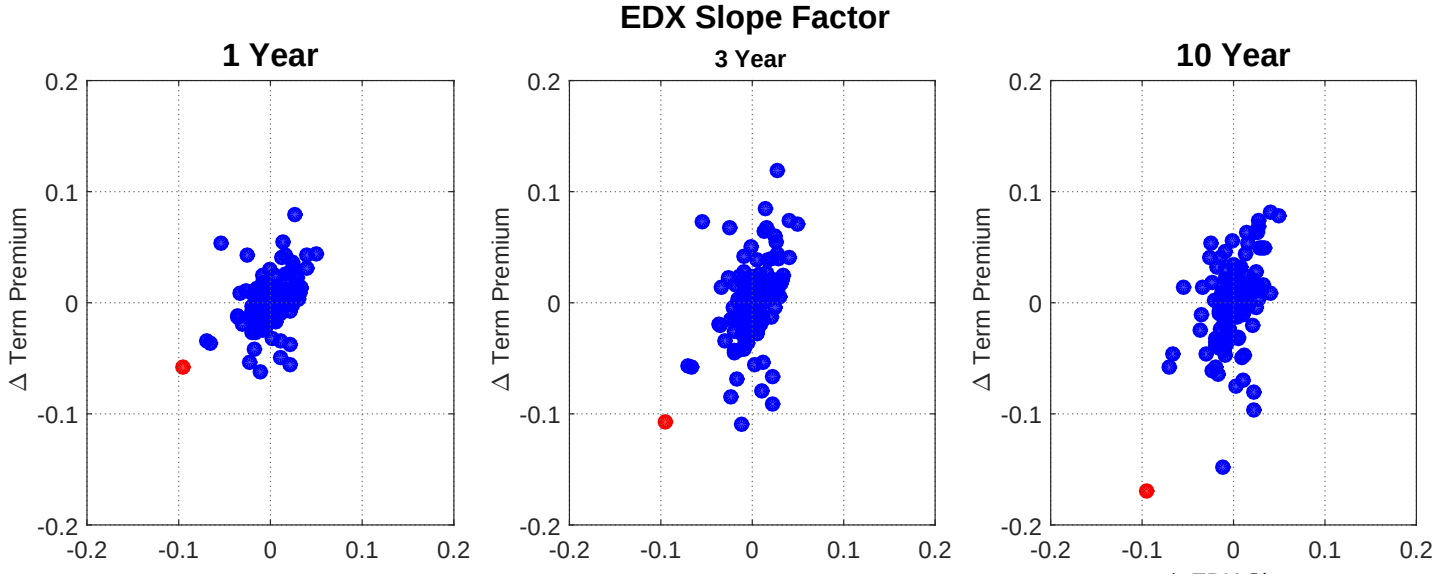
ACM Term Premium & EDX Factors



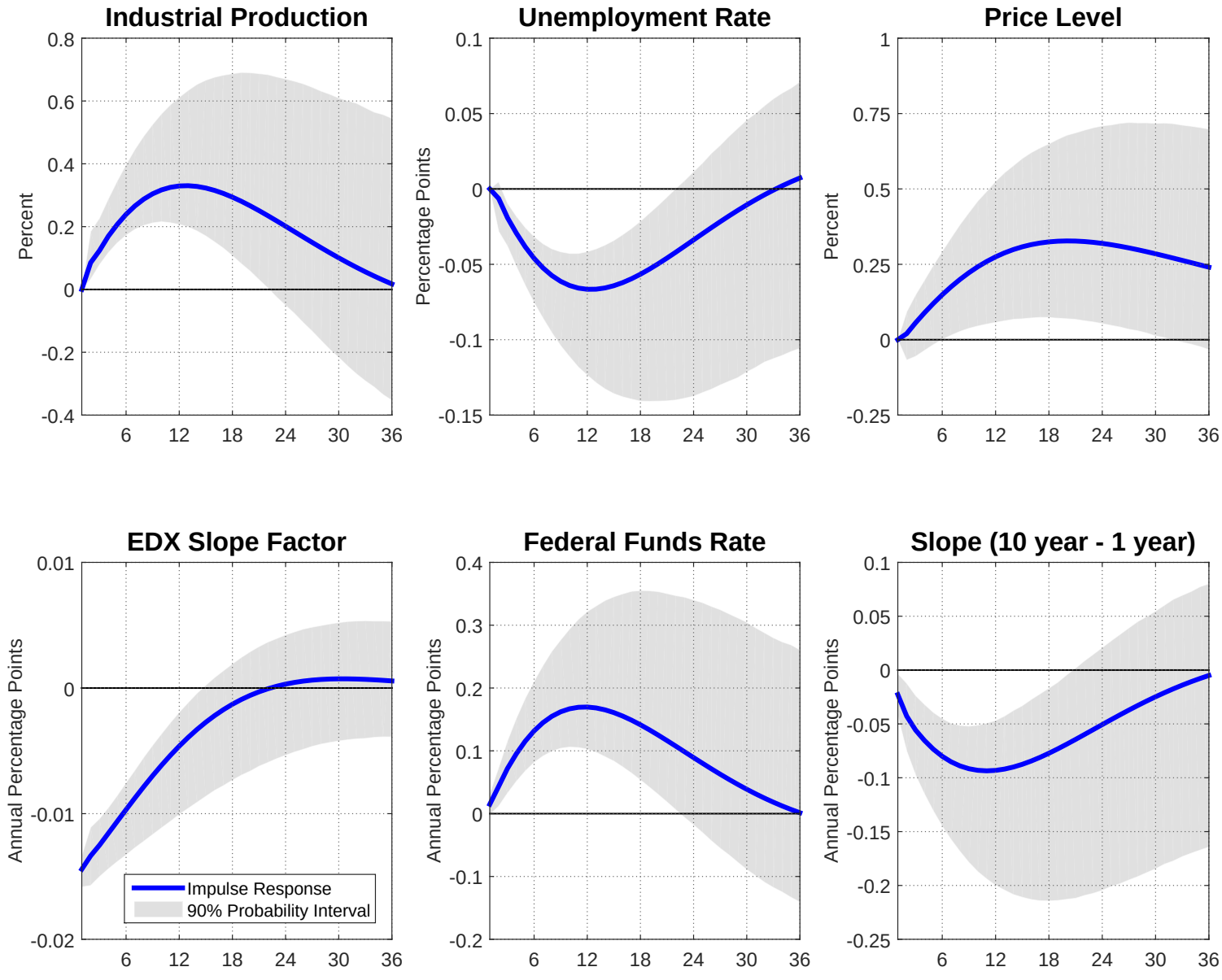


KW Term Premium & EDX Factors





Controlling for GSS Target & Path in VAR



Ordering Slope Factor First in VAR