Economic Uncertainty and the Relative Price of SPX Put Options

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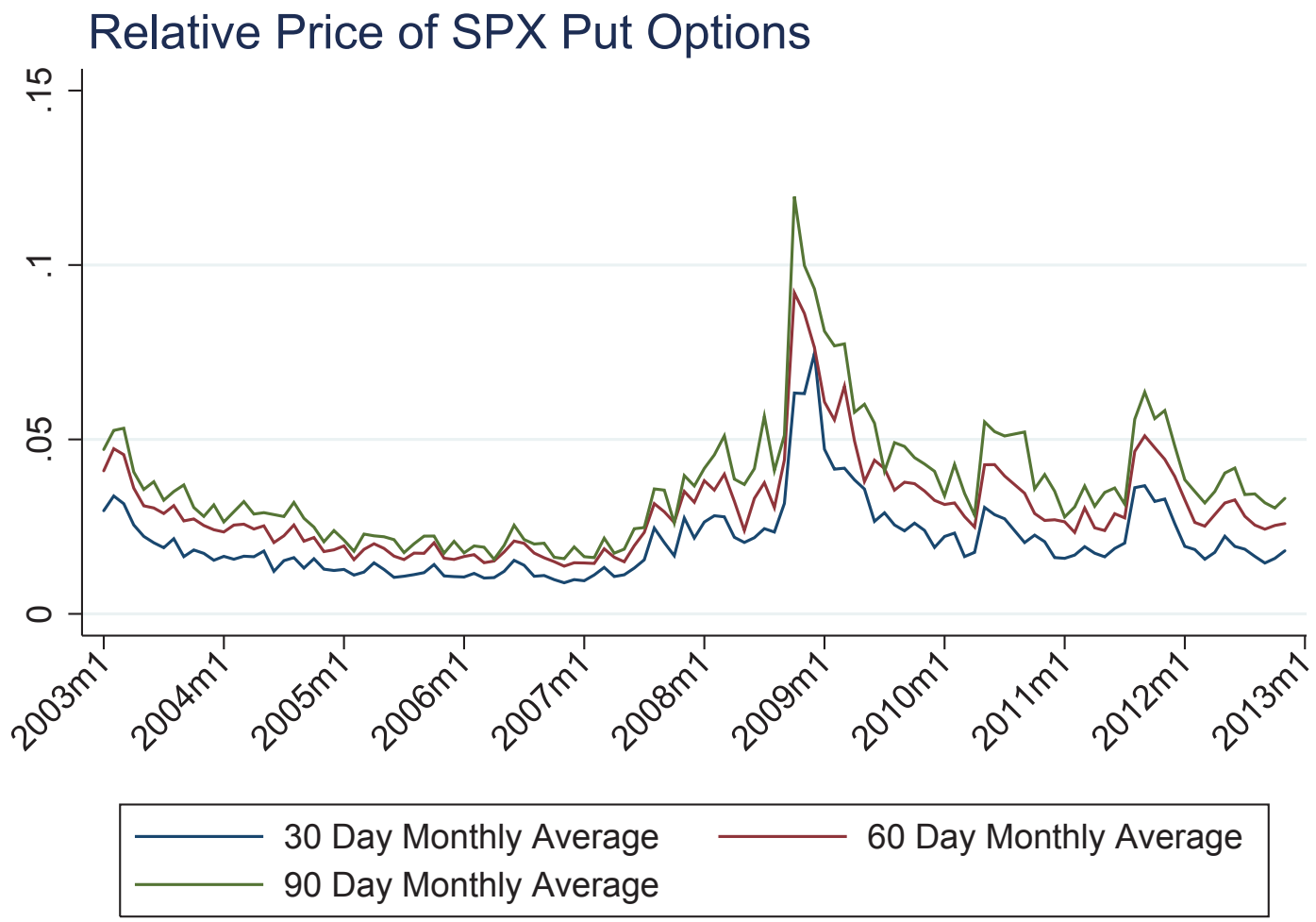
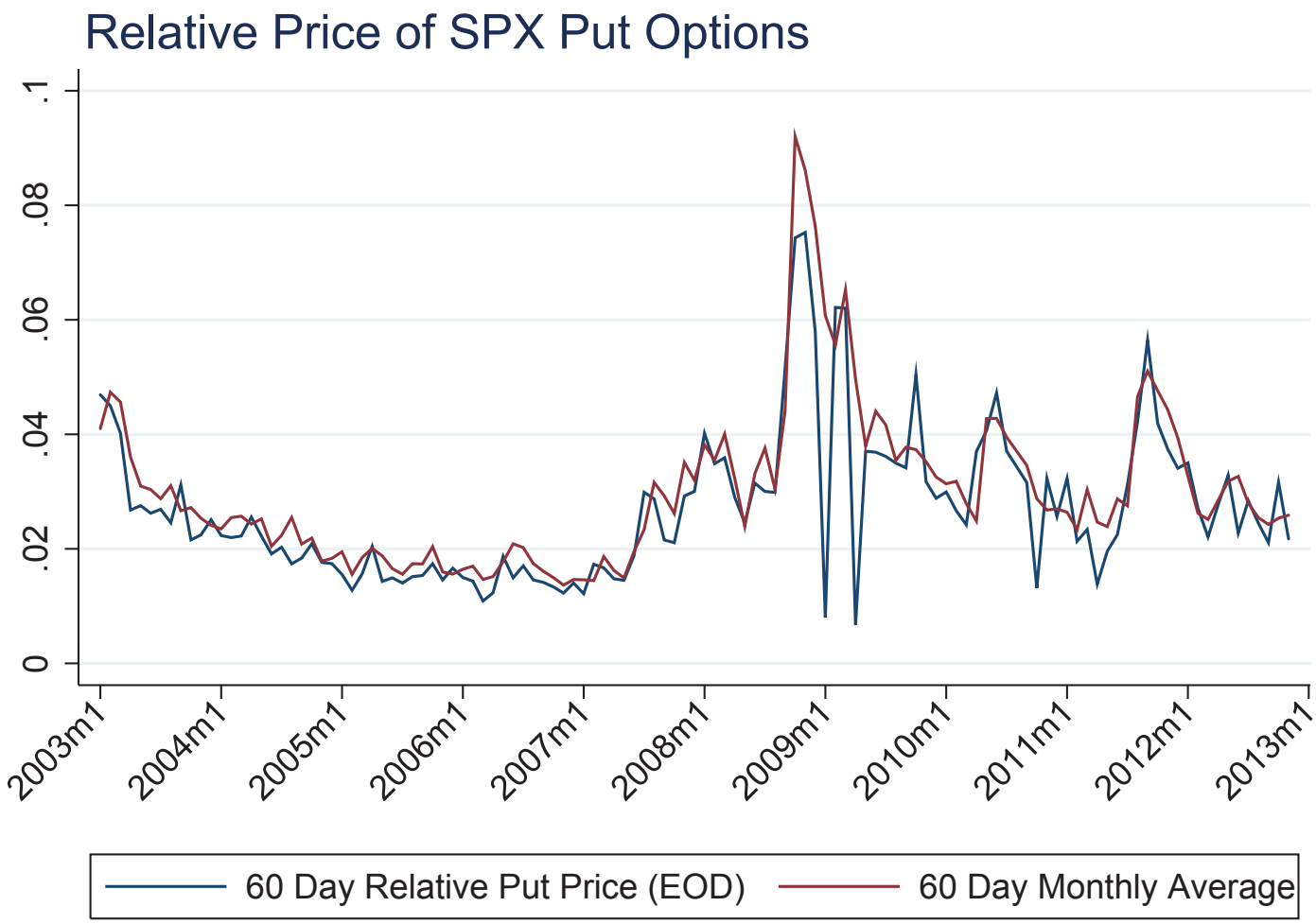
Time Series of Relative Put Price



Comparing End of Month and Monthly Average



Uncertainty Measures in the Literature

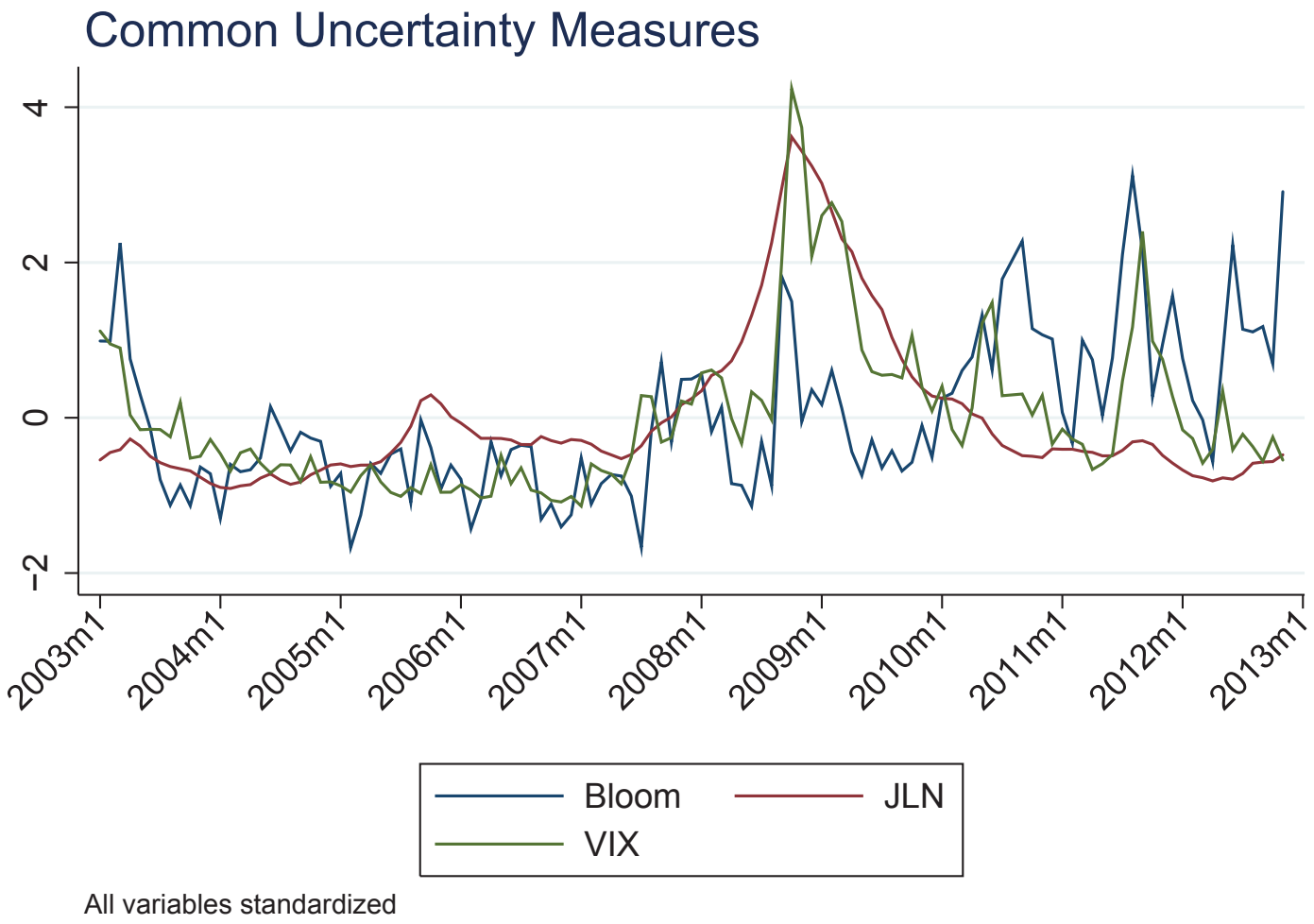
Some well known uncertainty measures include:

- Economic Policy Uncertainty Index [Bloom et al. 2013]
- Macro Uncertainty [Jurado et al. 2013] (JLN)
- VIX Index [CBOE 2009]
- Implied Volatility from [Black and Scholes 1973]
- Realized Volatility of Stock Returns

Bloom index is news based, JLN based on common unforcastable component in macroeconomic series, VIX is computed from OTM calls/puts, implied volatility is calculated numerically by inverting the Black Scholes formula and realized volatility is calculated as the standard deviation of returns

Uncertainty Measures in the Literature

Many series seem to capture similar information:



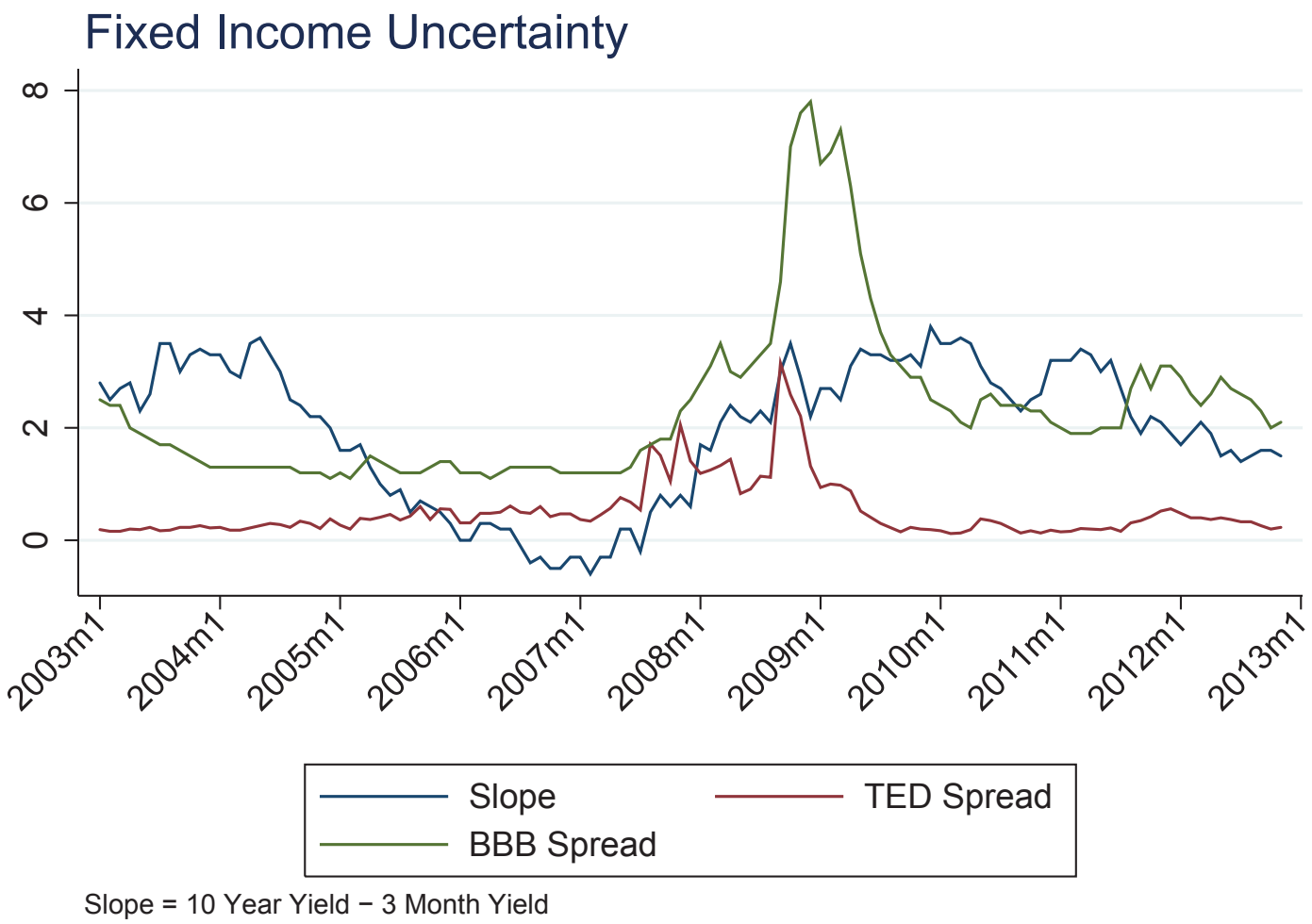
Uncertainty Measures in the Literature

In addition to measures in the literature, several fixed income quantities are used to predict uncertainty:

- TED Spread
- BBB Spread
- Slope of Yield Curve

Note: Some series are available daily, while others are computed monthly. To merge the two types, we tried using end-of-month data, as well as monthly averages of daily data.

Uncertainty Measures in the Literature



Relation to Our Previous Work

This paper is related *Implied Volatility and the Risk-Free Rate of Return in Options Markets (with Scott MacLachlan)* [Bianconi et al. 2015]:

- We used option-implied volatility to forecast the VIX
- Implied volatility calculated with a varying risk-free rate was better for forecasting the VIX than traditional implied volatility (as measured by the Diebold-Mariano test)
- The relative put price is easier to compute than implied volatility, as it only requires the price of one option and doesn't rely on numerical solutions

Theil's U

We use Theil's U test to evaluate forecast accuracy with different measures of uncertainty.
We obtain out-of-sample predictions by running regressions of the following form:

$$Vol_t = \alpha + \sum_1^m \beta_i Vol_{t-i} + \sum_1^n \gamma_i X_{t-i}$$

Where *Vol* is the standard deviation of S&P 500 returns over the next three months and X is the uncertainty measure of interest

Note: Lags for each covariate were selected using the Akaike information criterion

Theil's U

Of all the univariate tests, the EOM 60 day relative price has the smallest test statistic

Covariates	Theil's U	RP Price	Theil's U
None	0.559675	30 AVG	0.52341
VIX	0.509049	60 AVG	0.509461
TED Spread	0.559419	90 AVG	0.555401
JLN 3m	0.517557	30 EOM	0.541269
Bloom	0.55175	60 EOM	0.429091
All AVG	0.302637	90 EOM	0.541329
All EOM	0.315993		

EOM - End of month, AVG - Monthly Average
All AVG has all covariates, as well as all monthly average relative put prices
All EOM has all covariates, as well as all end of month relative put prices

Macroeconomic Variables of Interest

We analyze the relationship between several important macroeconomic series and our relative price measure:

- Real GDP Growth
- Potential GDP
- Non-Residential Fixed Investment
- Residential Investment

Quarterly data interpolated to monthly using cubic spline

Testing Granger Causality

Does variable on
vertical axis Granger Cause variable on horizontal axis (p-values):

	Real GDP	Real Pot. GDP	Real Non-Res. Invest.	Real Res. Invest.
VIX	0.0720	0.0000	0.7506	0.0866
TED	0.0283	0.0000	0.0001	0.8037
Bloom	0.0682	0.5091	0.3056	0.3603
JLN 3M	0.8867	0.0000	0.4333	0.8023
30 EOM	0.0794	0.0000	0.2455	0.1126
30 AVG	0.0693	0.0000	0.8002	0.0557
60 EOM	0.0951	0.0000	0.3613	0.6392
60 AVG	0.0820	0.0000	0.8159	0.0574
90 EOM	0.2097	0.0000	0.4978	0.1296
90 AVG	0.2373	0.0000	0.7181	0.0806

Note: Lags for each covariate were selected using the Akaike information criterion

Macroeconomic series were exception - only one lag was used

Null hypothesis is abscence of Granger Causality

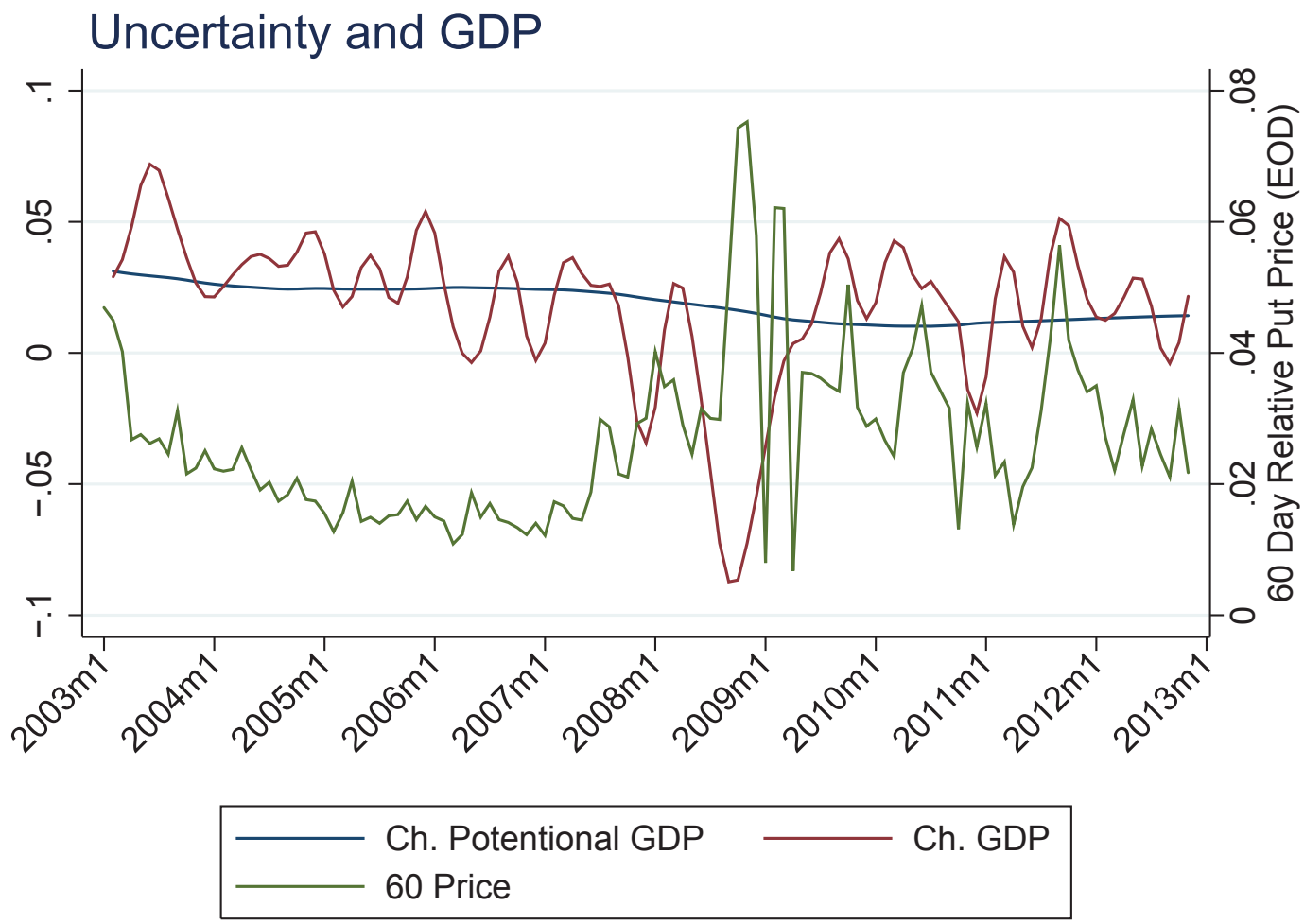
Testing Granger Causality

Does variable on
vertical axis Granger Cause variable on horizontal axis (p-values):

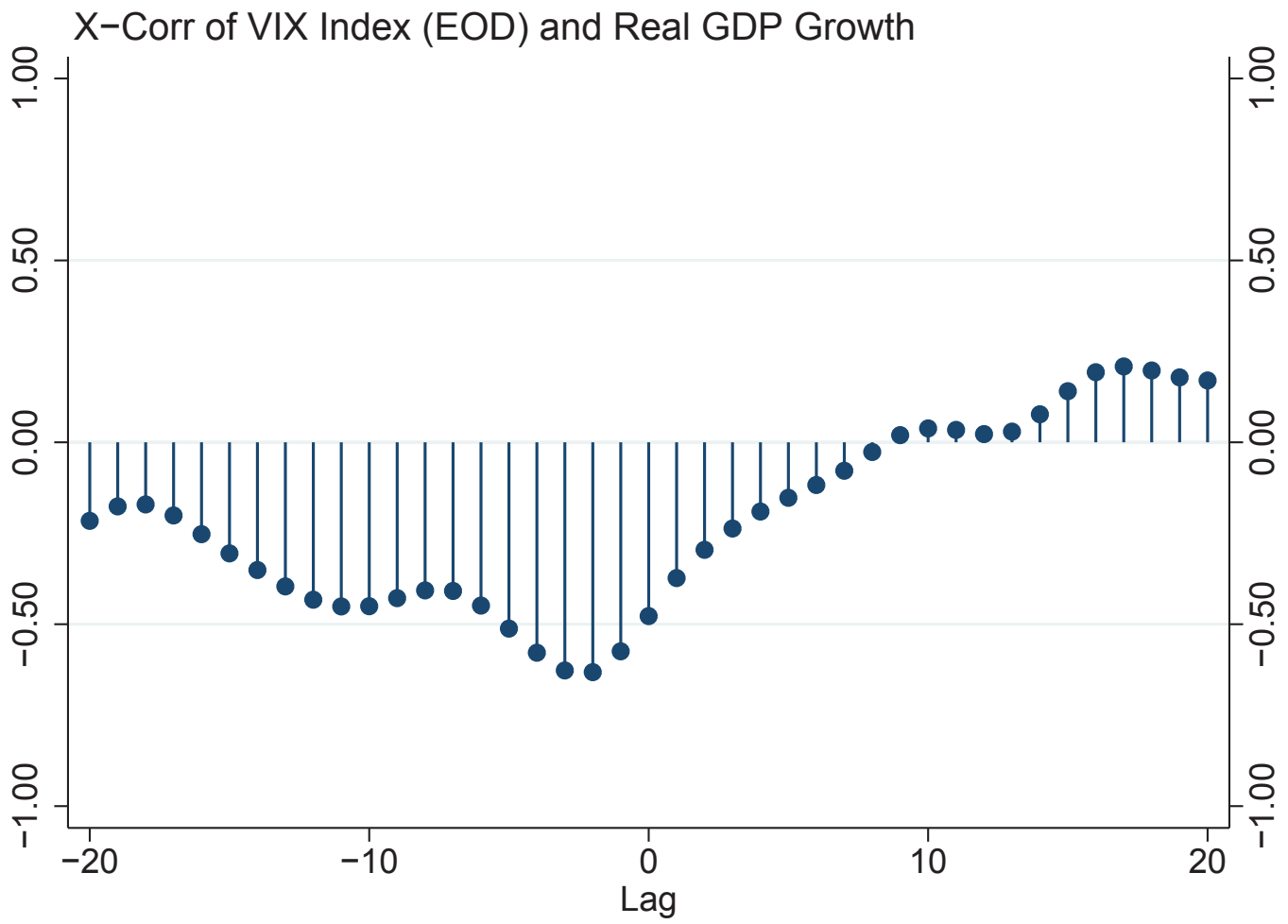
	VIX	TED	Bloom	JLN 3M	30 EOM	30 AVG	60 EOM	60 AVG	90 EOM	90 AVG
Real GDP	0.0000	0.0279	0.0755	0.0000	0.0001	0.0000	0.0006	0.0000	0.0006	0.0002
Real Pot. GDP	0.1458	0.7082	0.0015	0.0651	0.0216	0.1746	0.0024	0.1055	0.0253	0.0781
Real Non-Res. Invest.	0.0217	0.3296	0.6084	0.0440	0.0157	0.0182	0.0094	0.0222	0.0032	0.0136
Real Res. Invest.	0.1169	0.0070	0.8597	0.0031	0.1609	0.0170	0.4560	0.0390	0.1860	0.0524

Null hypothesis is abscence of Granger Causality

Relationship between Relative Put Price and GDP



Cross Correlation



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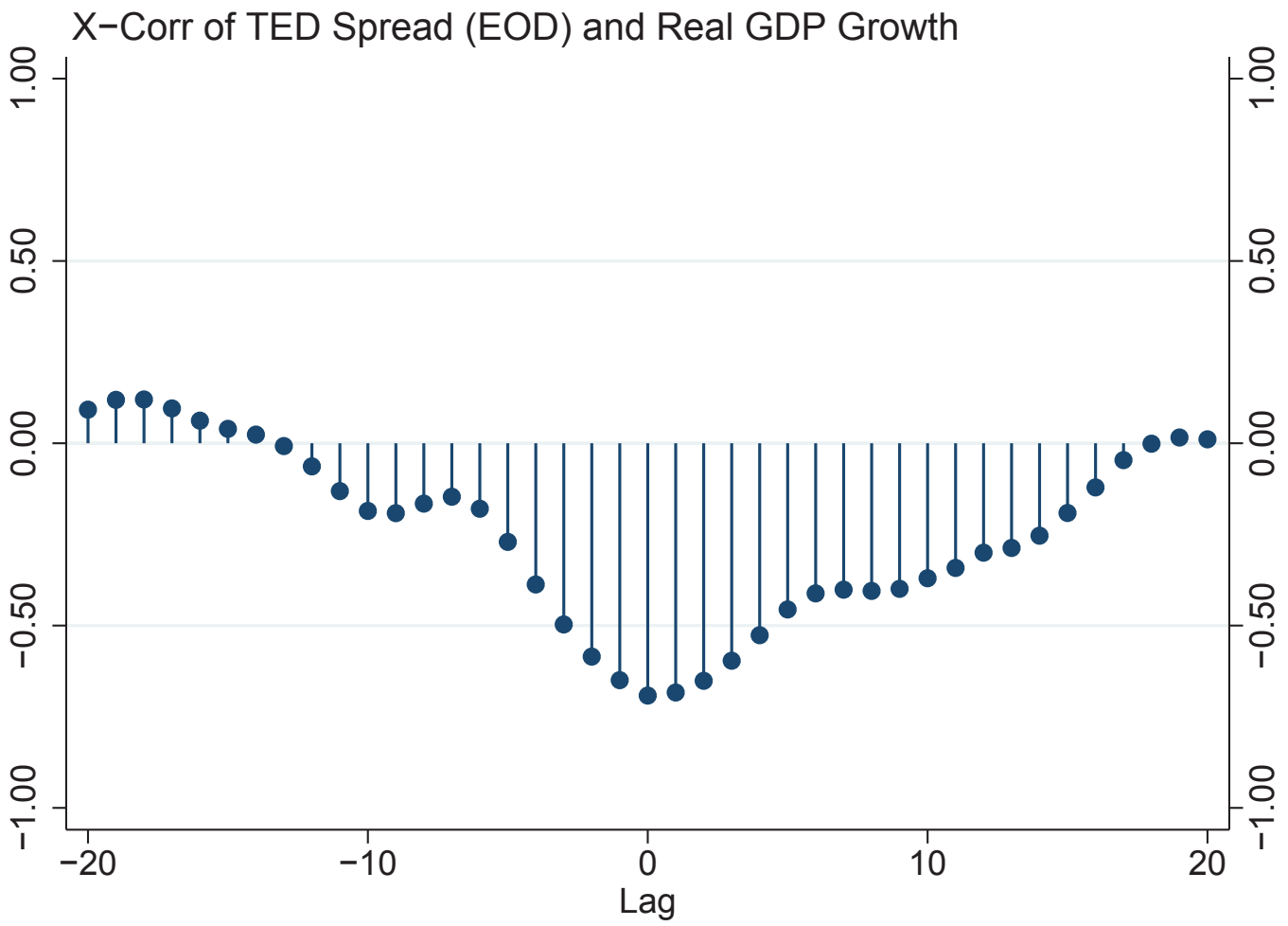

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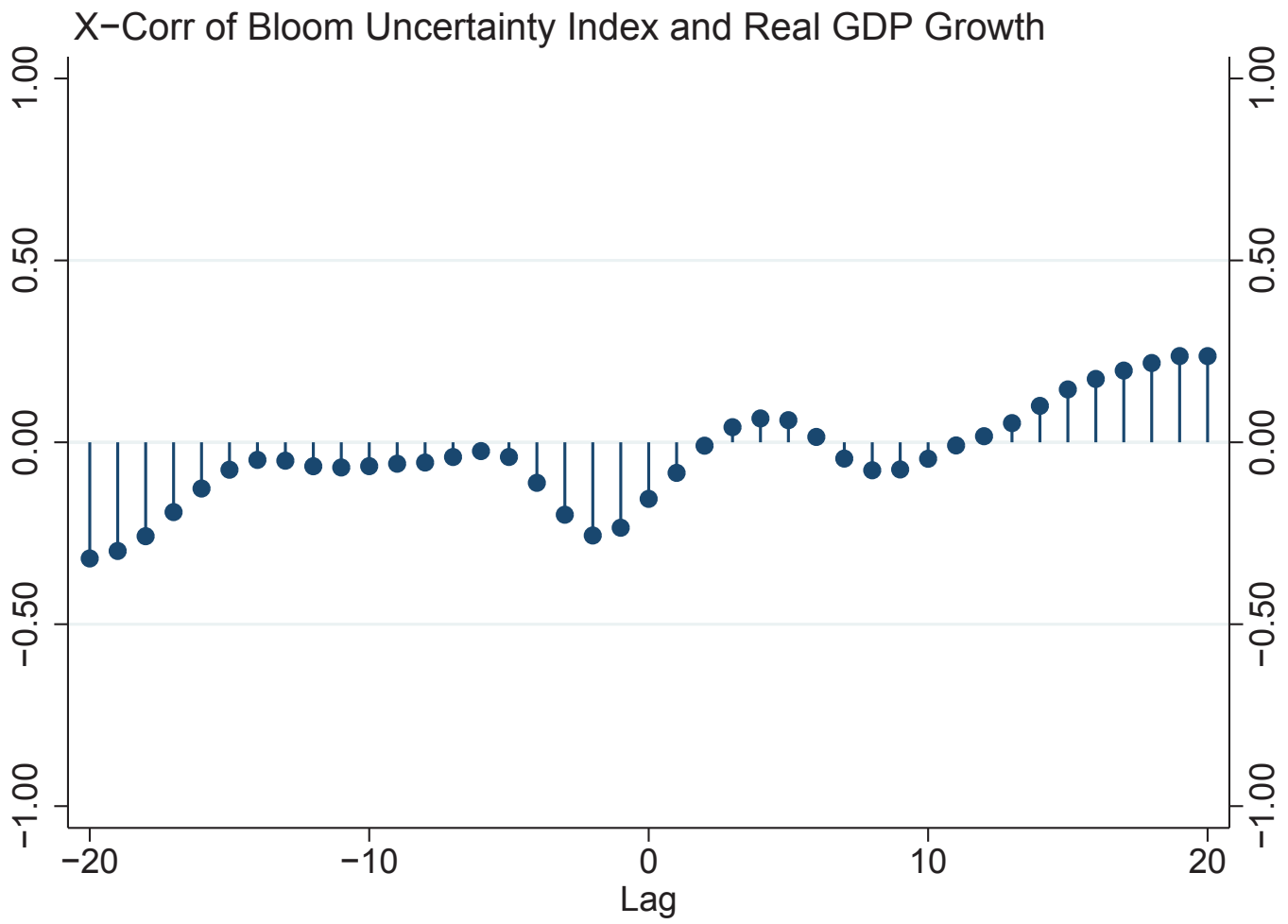

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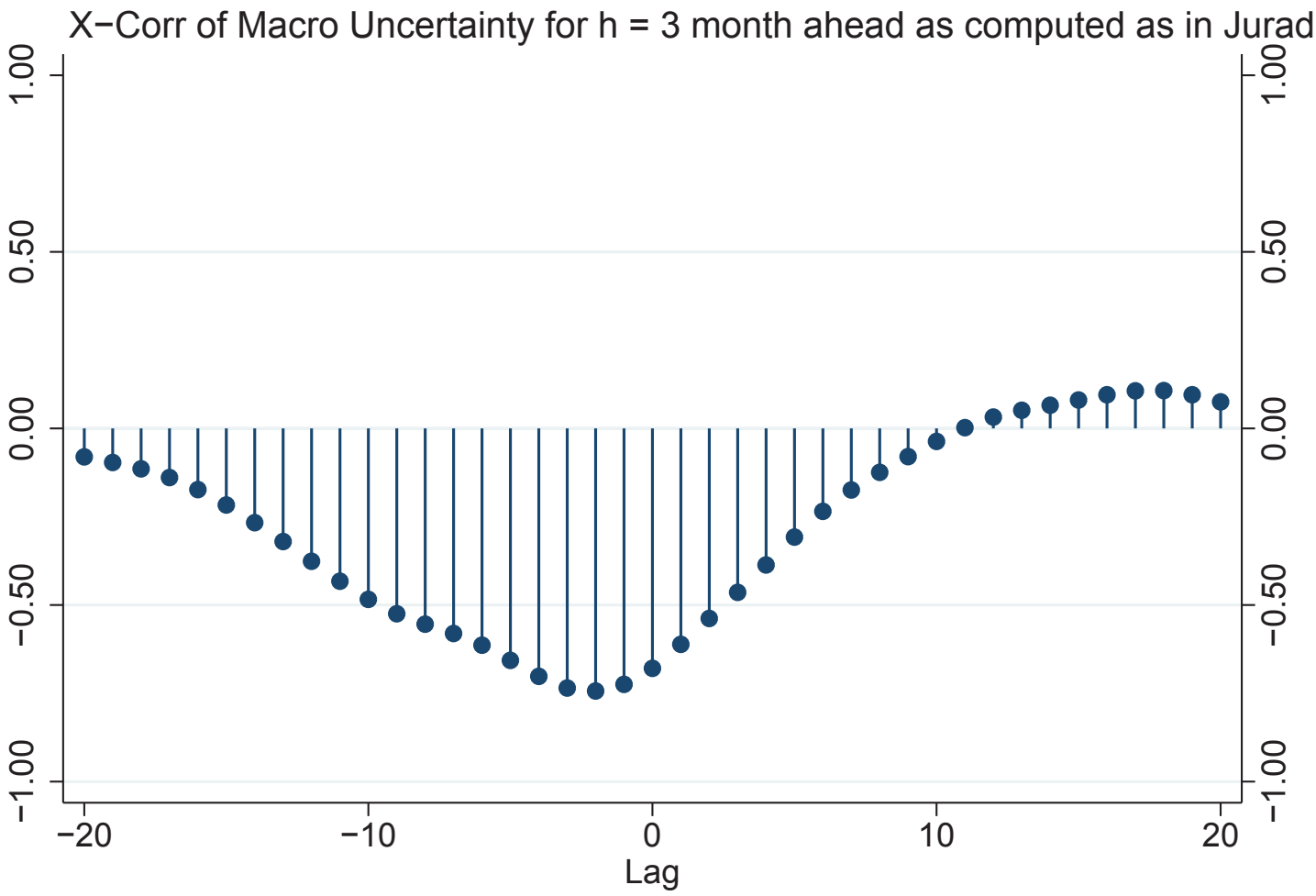
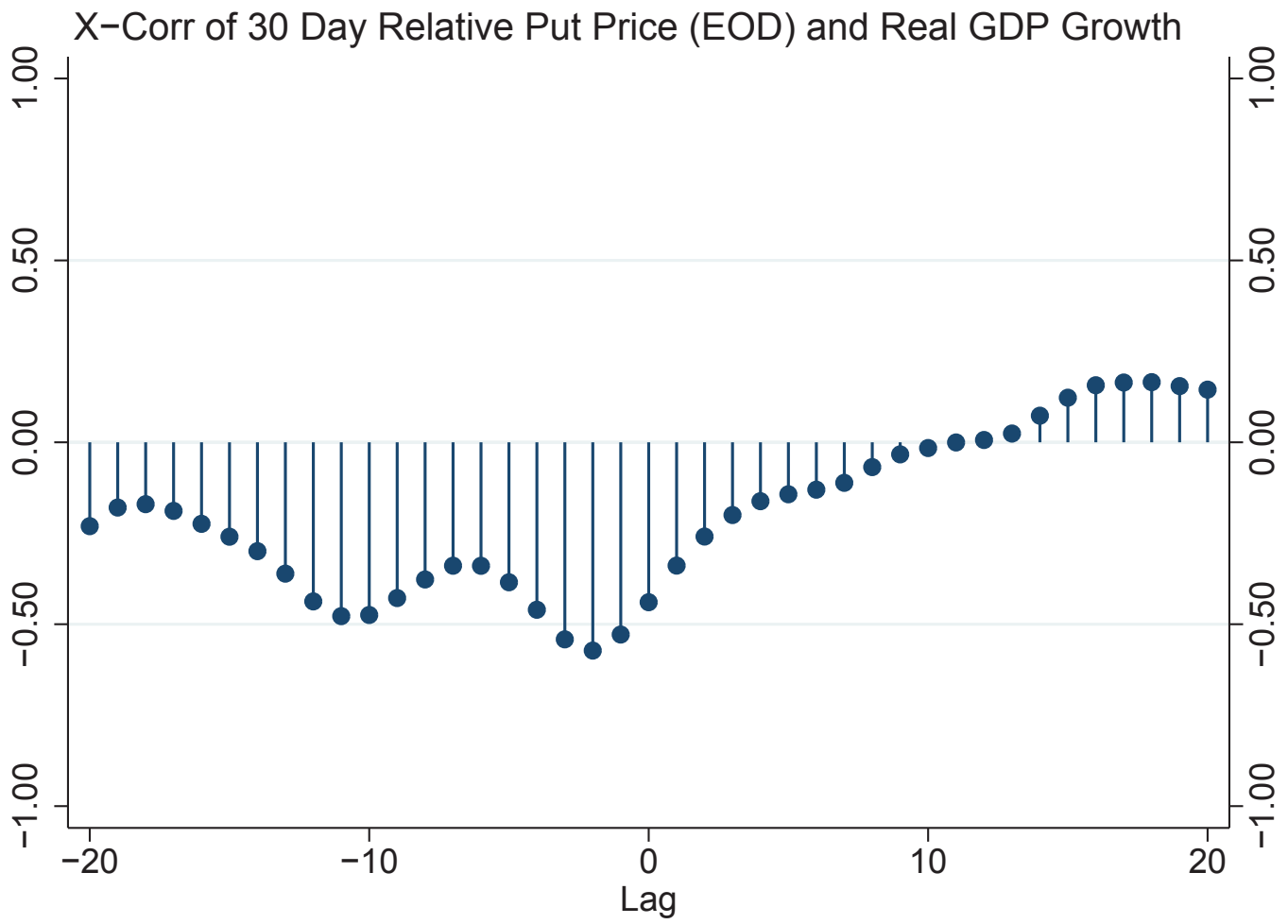


Cross Correlation



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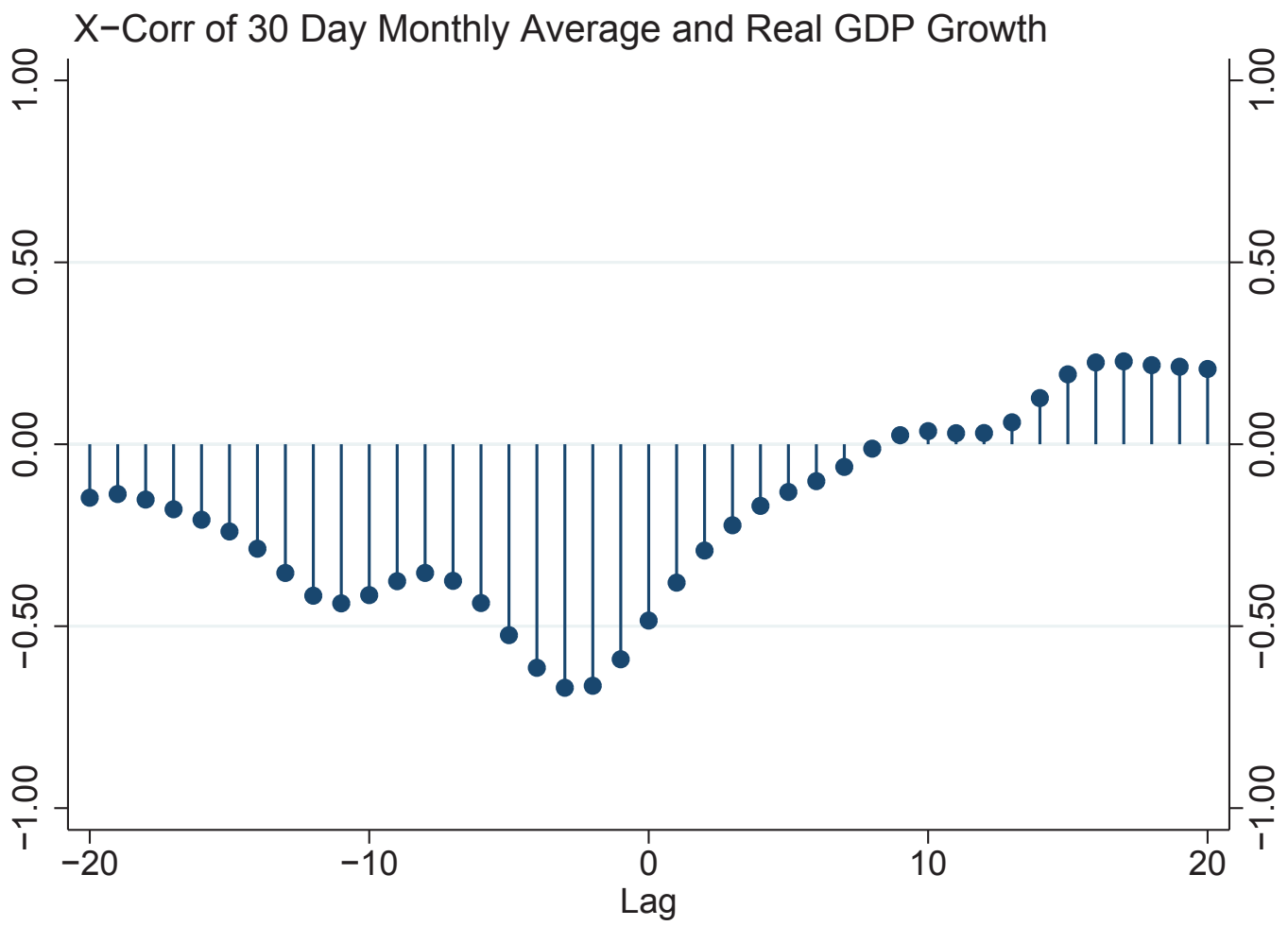

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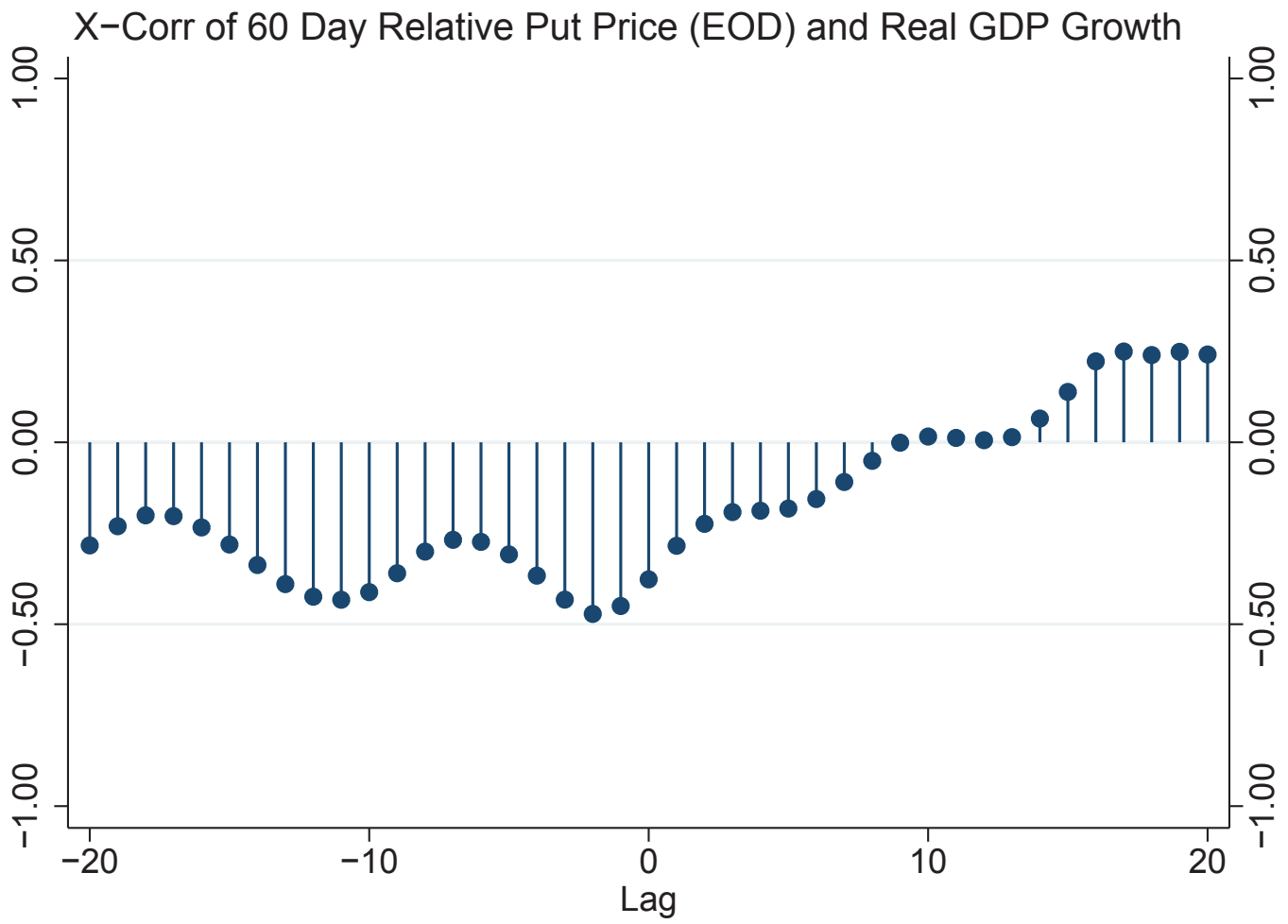

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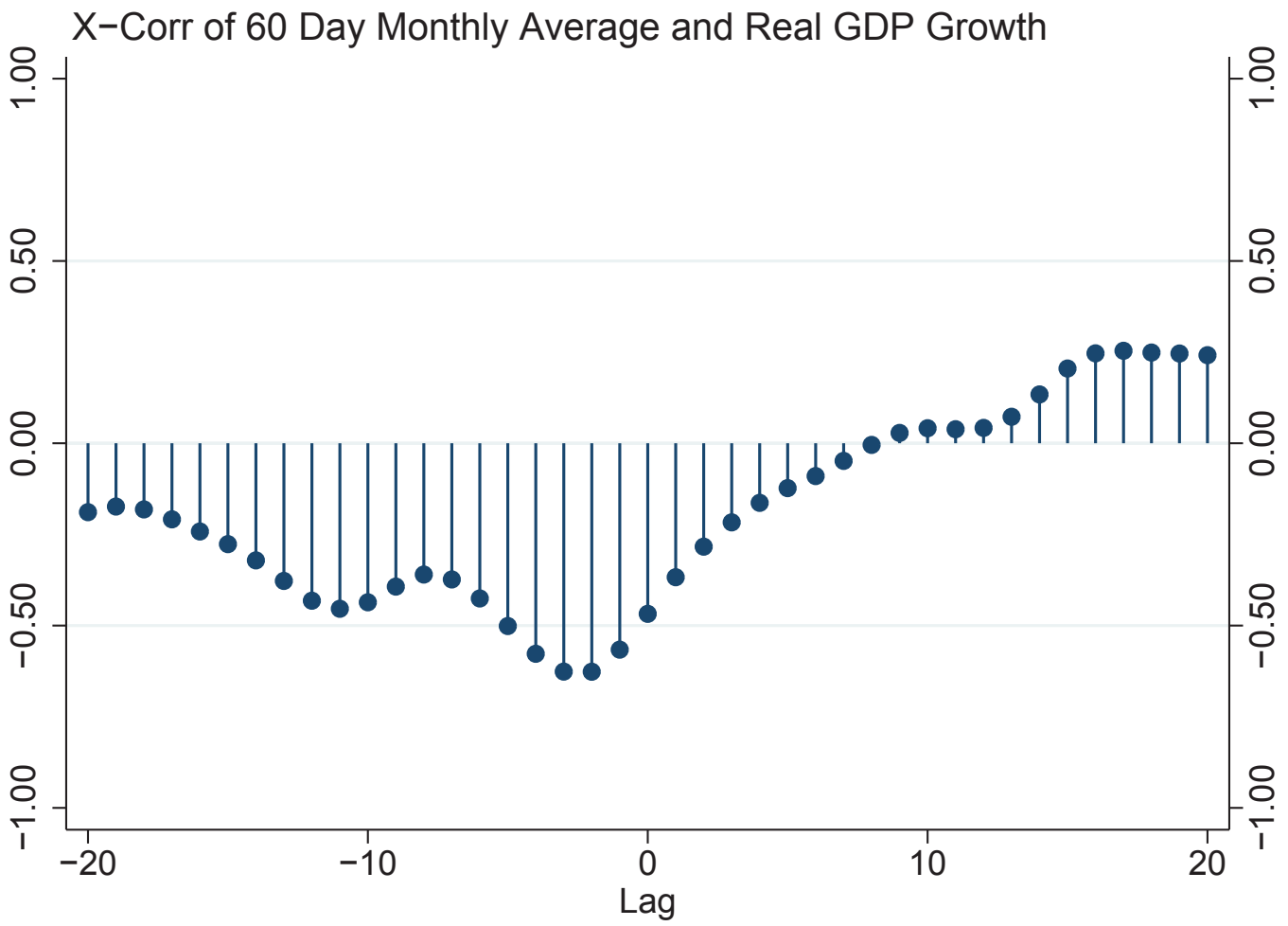

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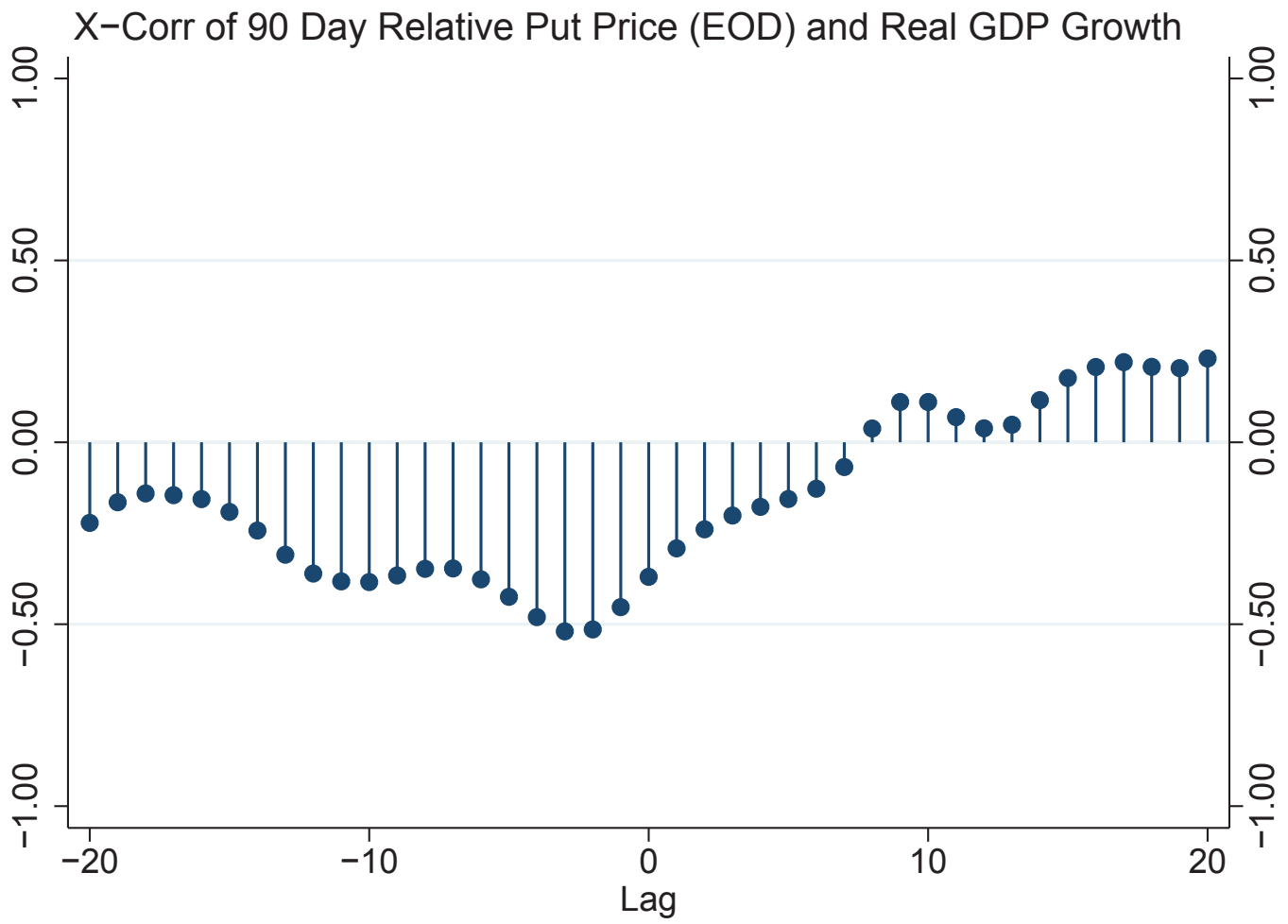

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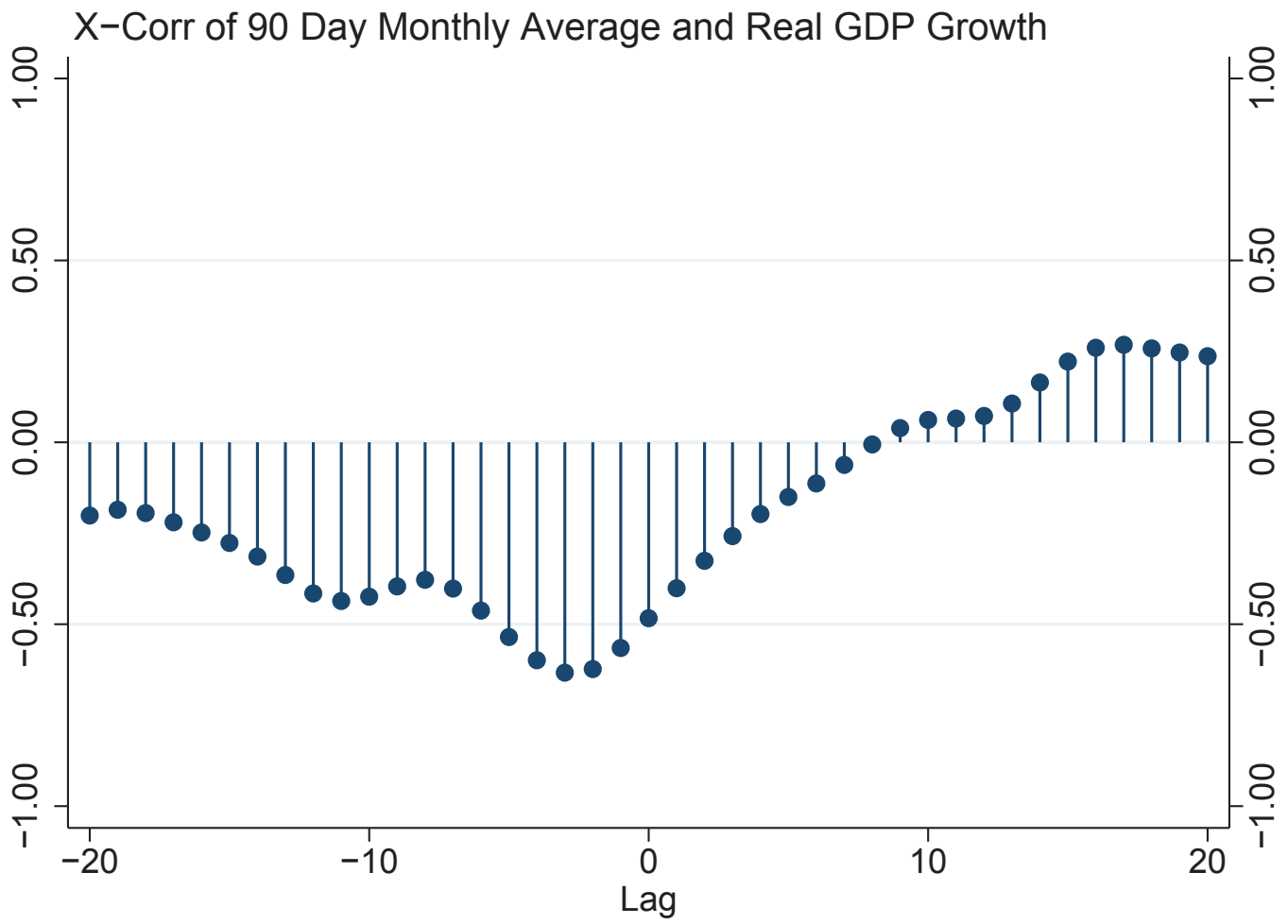


Term Structure

Yield on Treasury Bills with different maturities:

- 3 Month
- 1 Year
- 5 Year
- 10 Year

Testing Granger Causality

Does variable on vertical axis Granger Cause variable on horizontal axis (p-values):

	3 Month	1 Year	5 Year	10 Year
VIX	0.0000	0.0000	0.0135	0.2418
TED	0.0000	0.0000	0.0316	0.0026
Bloom	0.0329	0.0055	0.0025	0.0016
JLN 3M	0.0010	0.0001	0.2410	0.4683
30 EOM	0.0000	0.0001	0.1299	0.3707
30 AVG	0.0003	0.0009	0.0887	0.4145
60 EOM	0.0001	0.0001	0.0031	0.0808
60 AVG	0.0001	0.0001	0.0157	0.2799
90 EOM	0.0005	0.0029	0.1735	0.1257
90 AVG	0.0001	0.0002	0.0307	0.3143

Note: Lags for each covariate were selected using the Akaike information criterion

Null hypothesis is abscence of Granger Causality

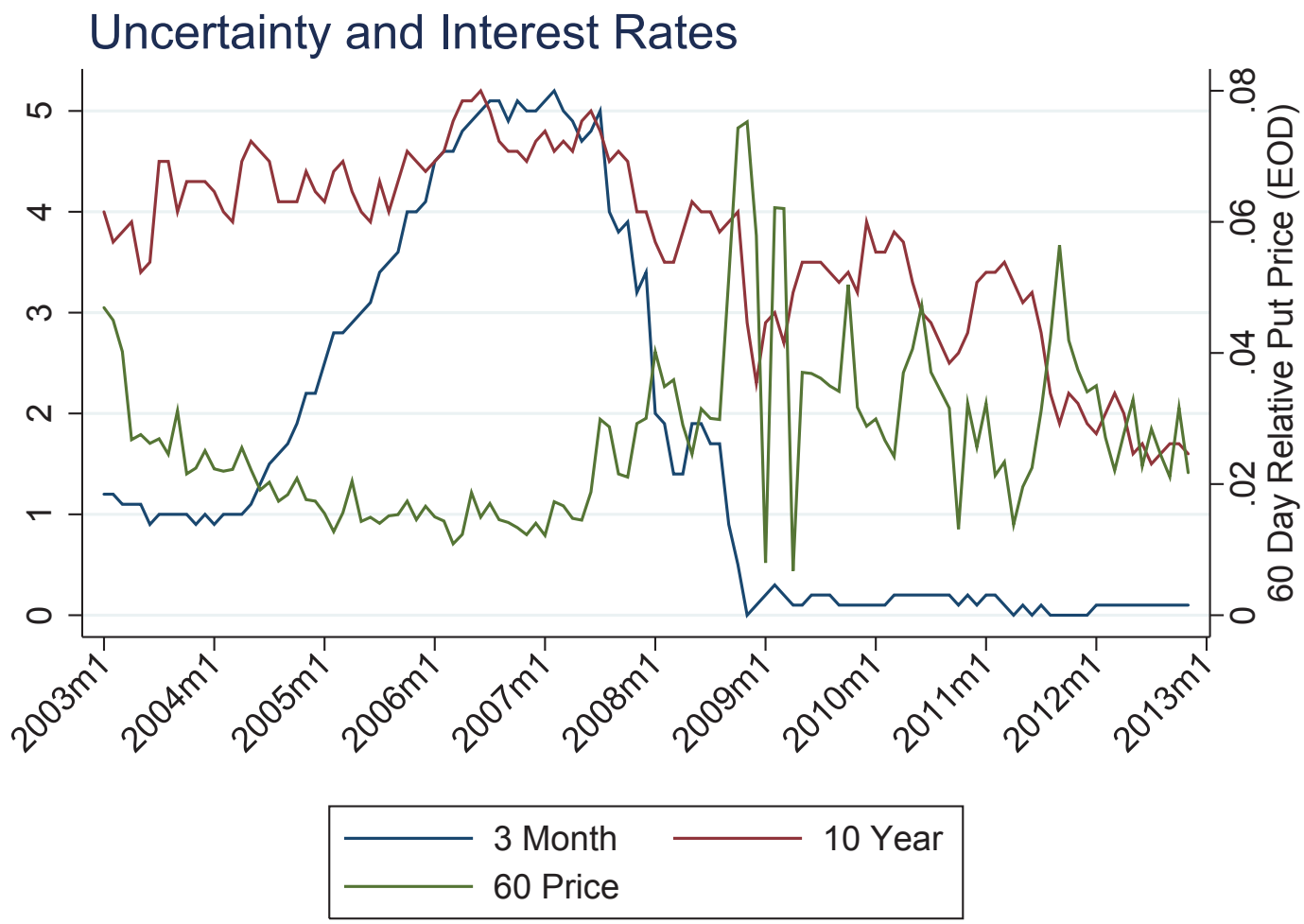
Testing Granger Causality

Does variable on
vertical axis Granger Cause variable on horizontal axis (p-values):

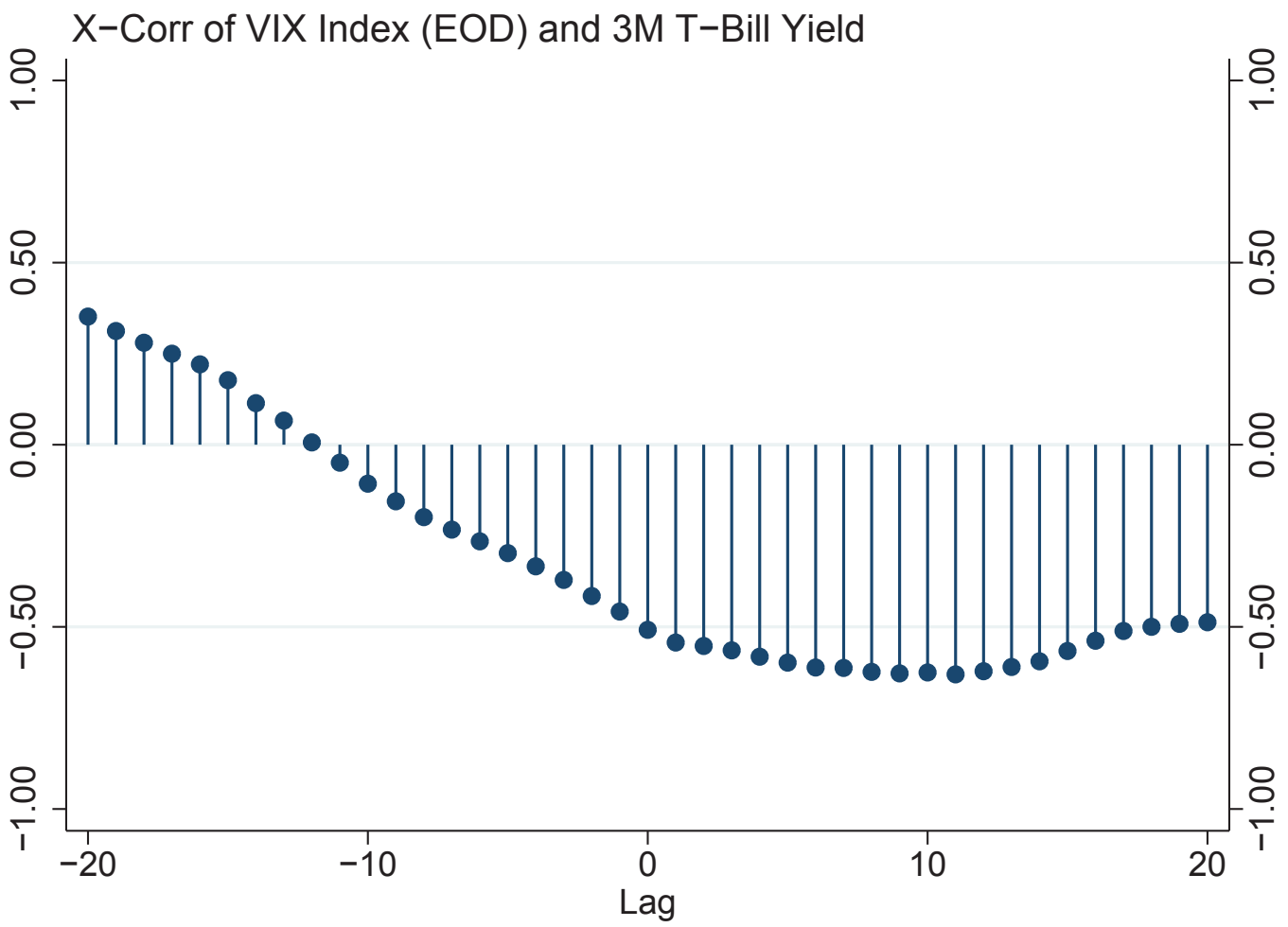
	VIX	TED	Bloom	JLN 3M	30 EOM	30 AVG	60 EOM	60 AVG	90 EOM	90 AVG
3 Month	0.8314	0.0000	0.0002	0.0003	0.8637	0.9926	0.5411	0.8783	0.9577	0.8410
1 Year	0.4819	0.0019	0.0003	0.0083	0.1167	0.6276	0.0336	0.4252	0.1074	0.5917
5 Year	0.9384	0.1403	0.0004	0.0583	0.1599	0.9778	0.0625	0.9485	0.0344	0.5449
10 Year	0.9374	0.0205	0.0002	0.0590	0.3387	0.5820	0.1083	0.9094	0.7042	0.7070

Null hypothesis is abscence of Granger Causality

Relationship between T-Bill Yields and Relative Put Price



Cross Correlation



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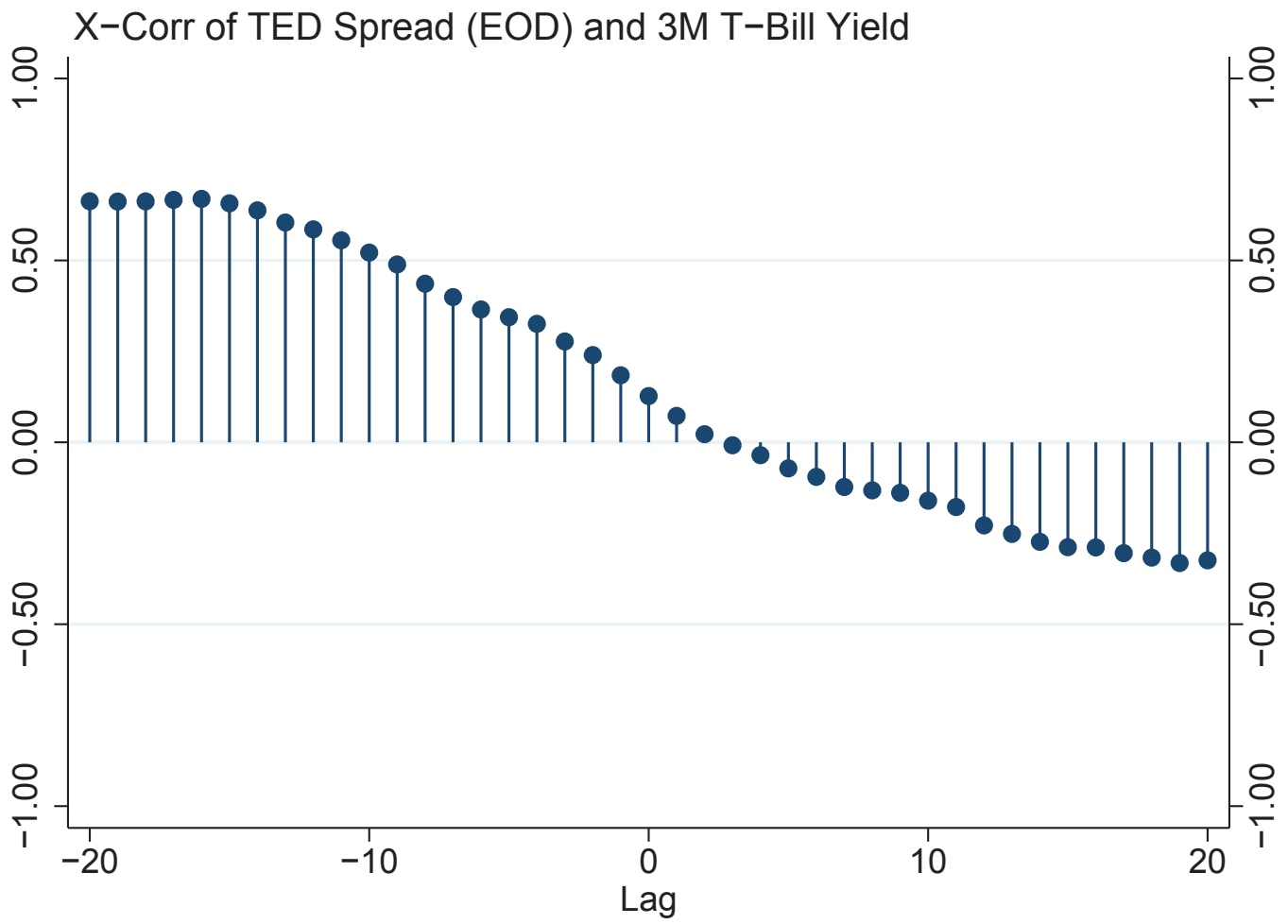

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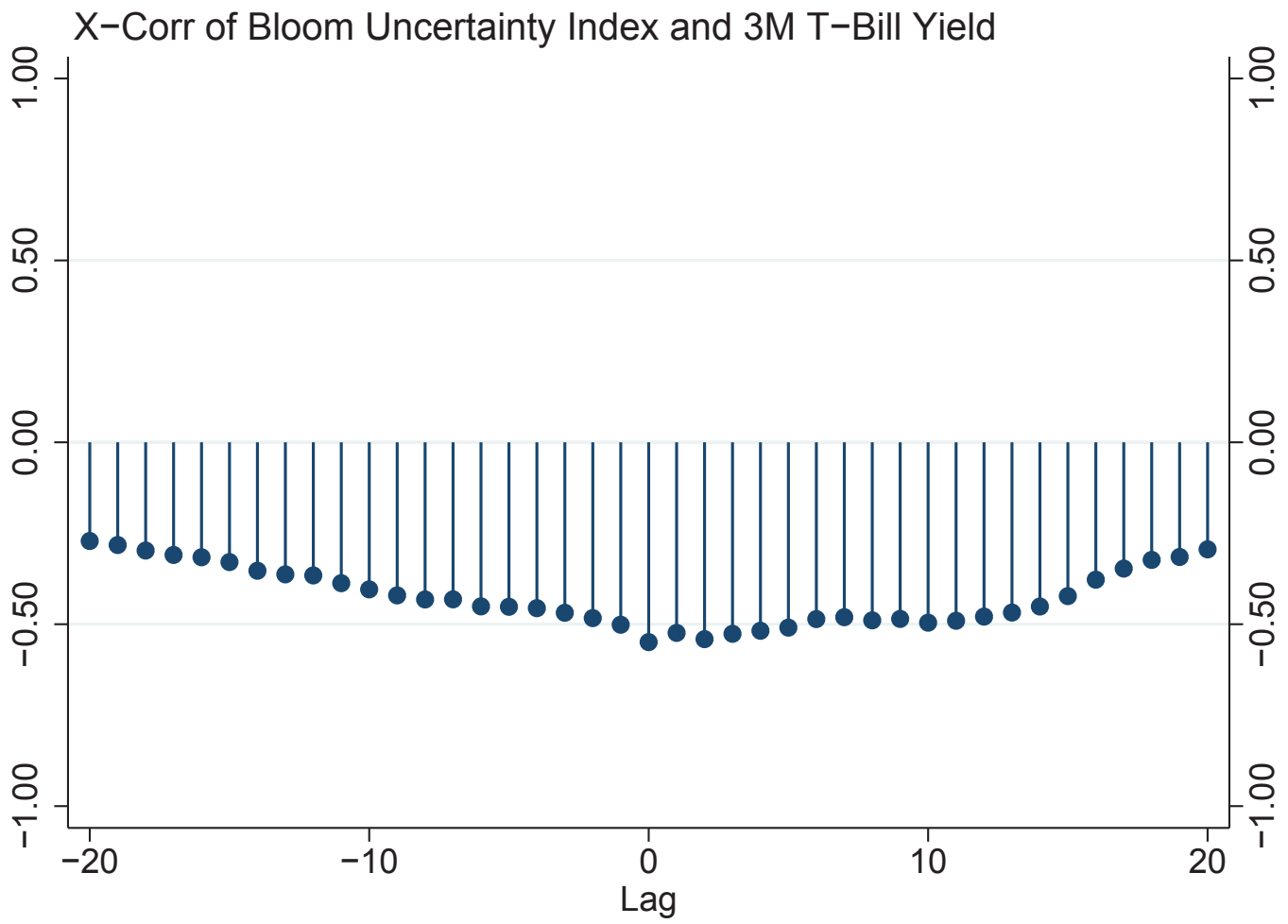

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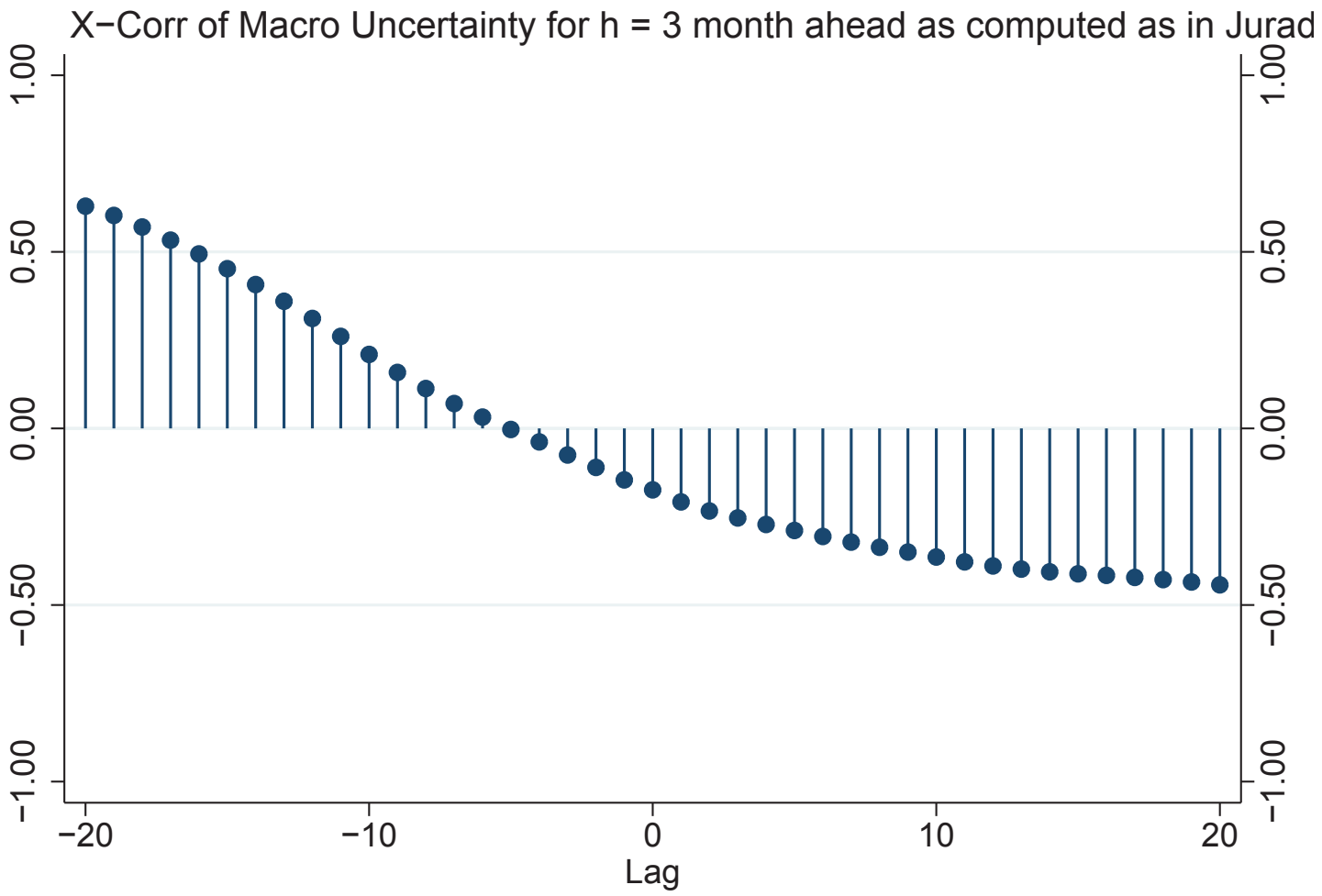

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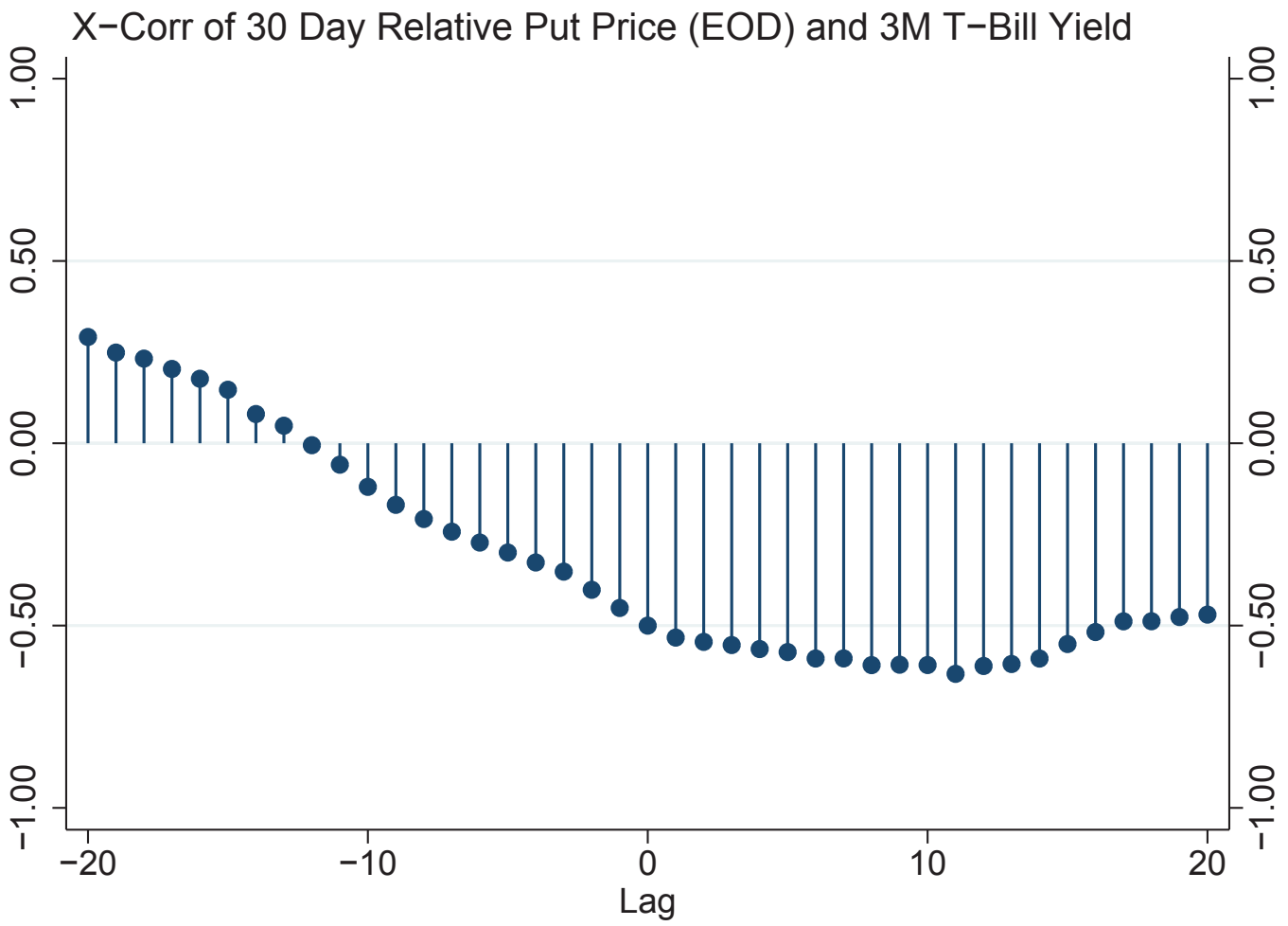

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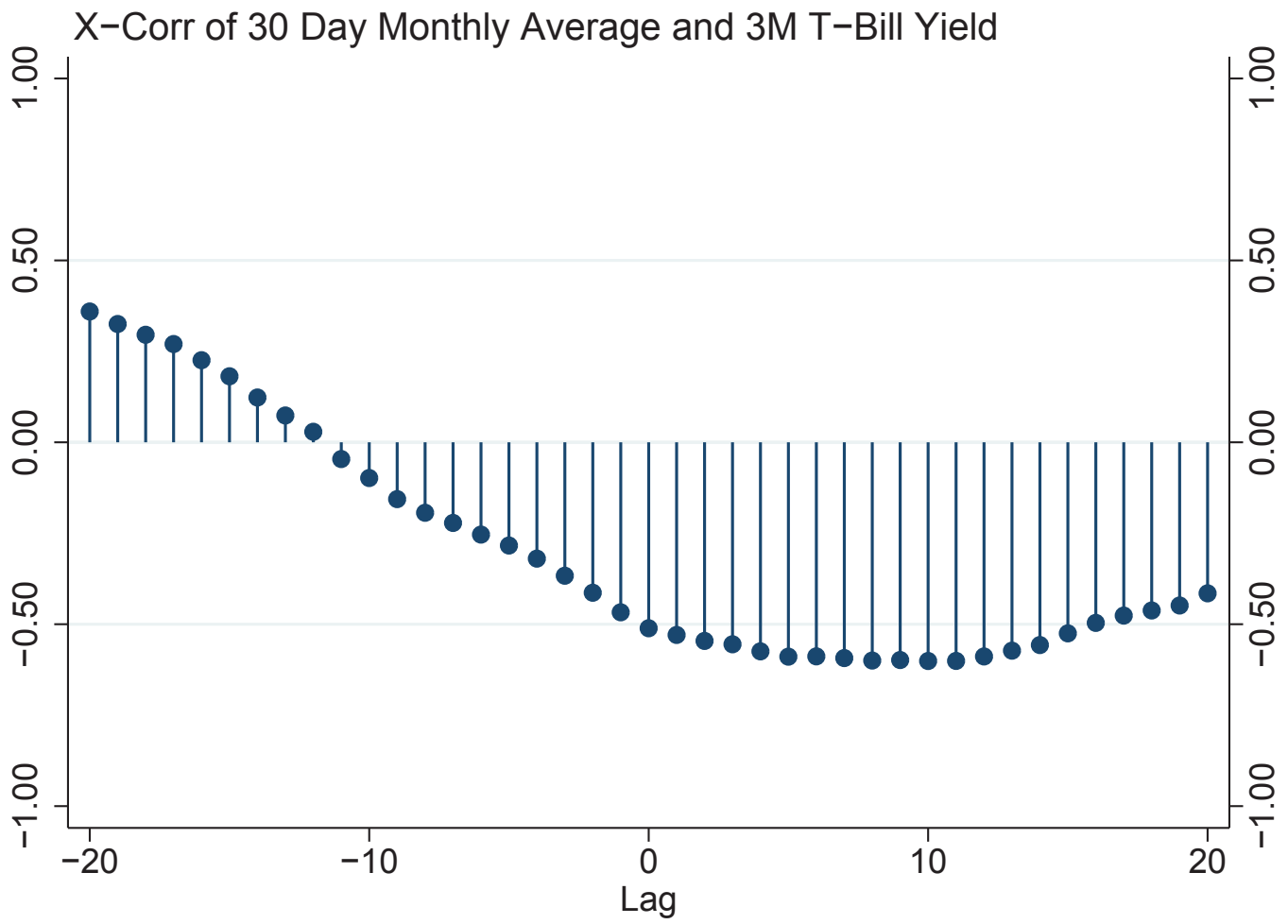

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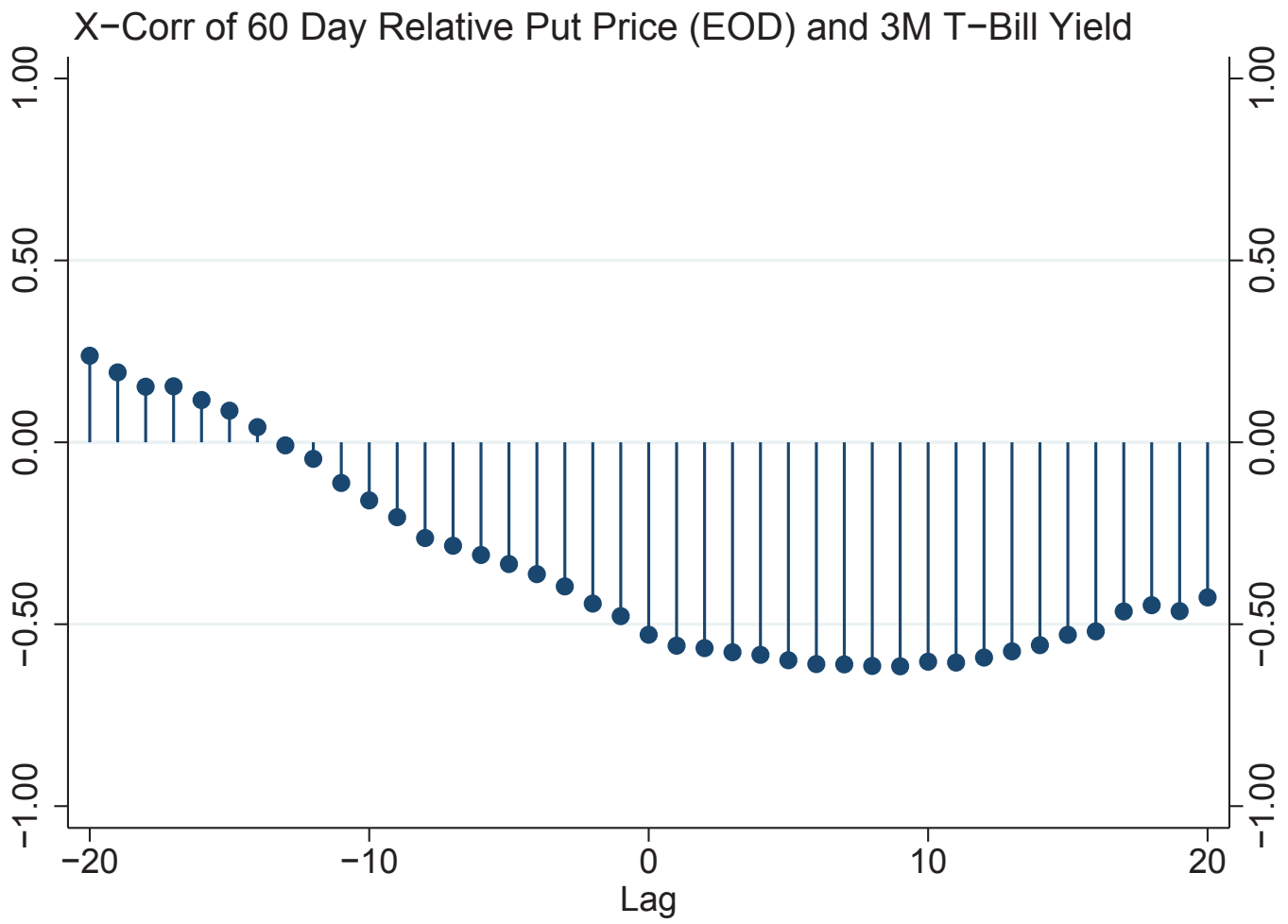

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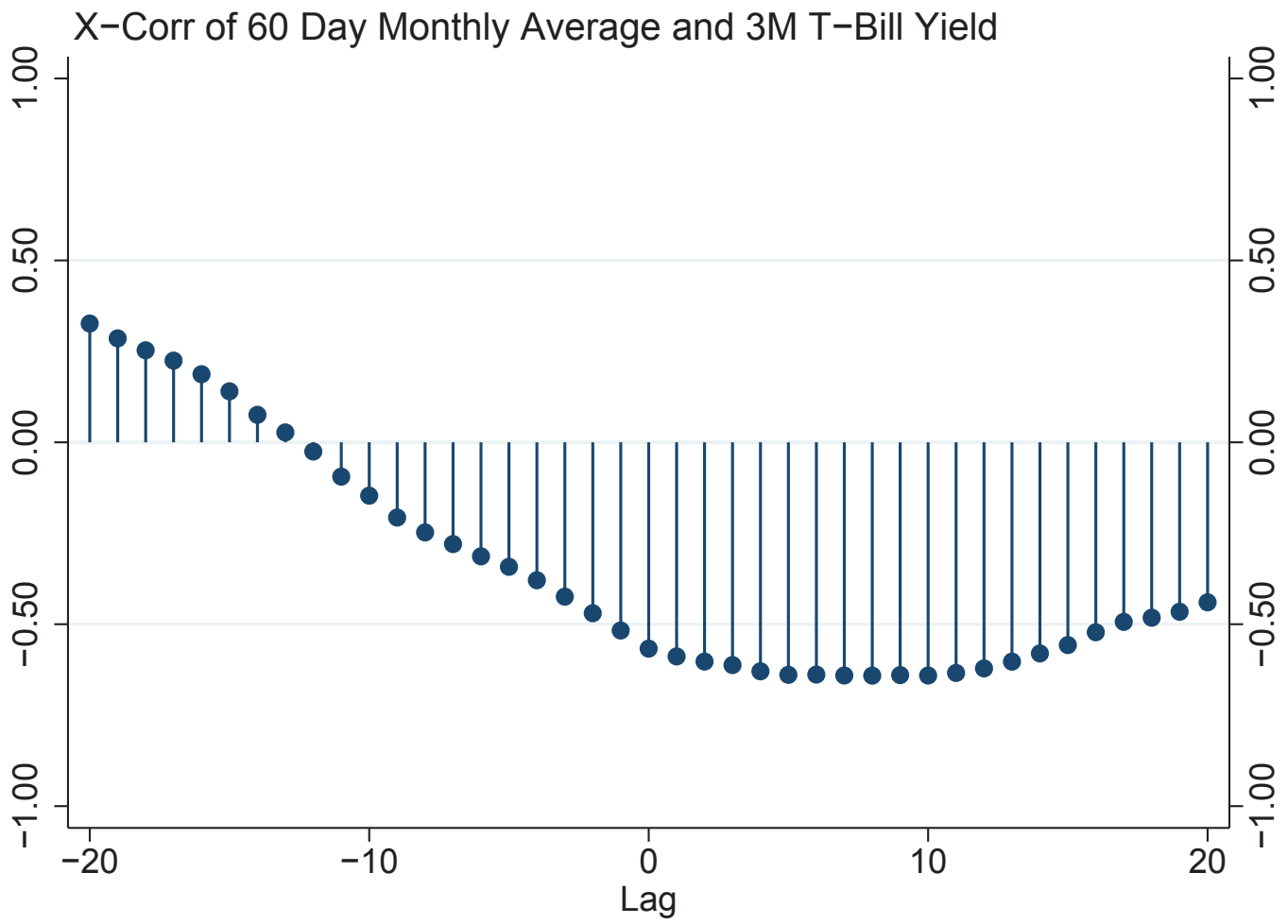

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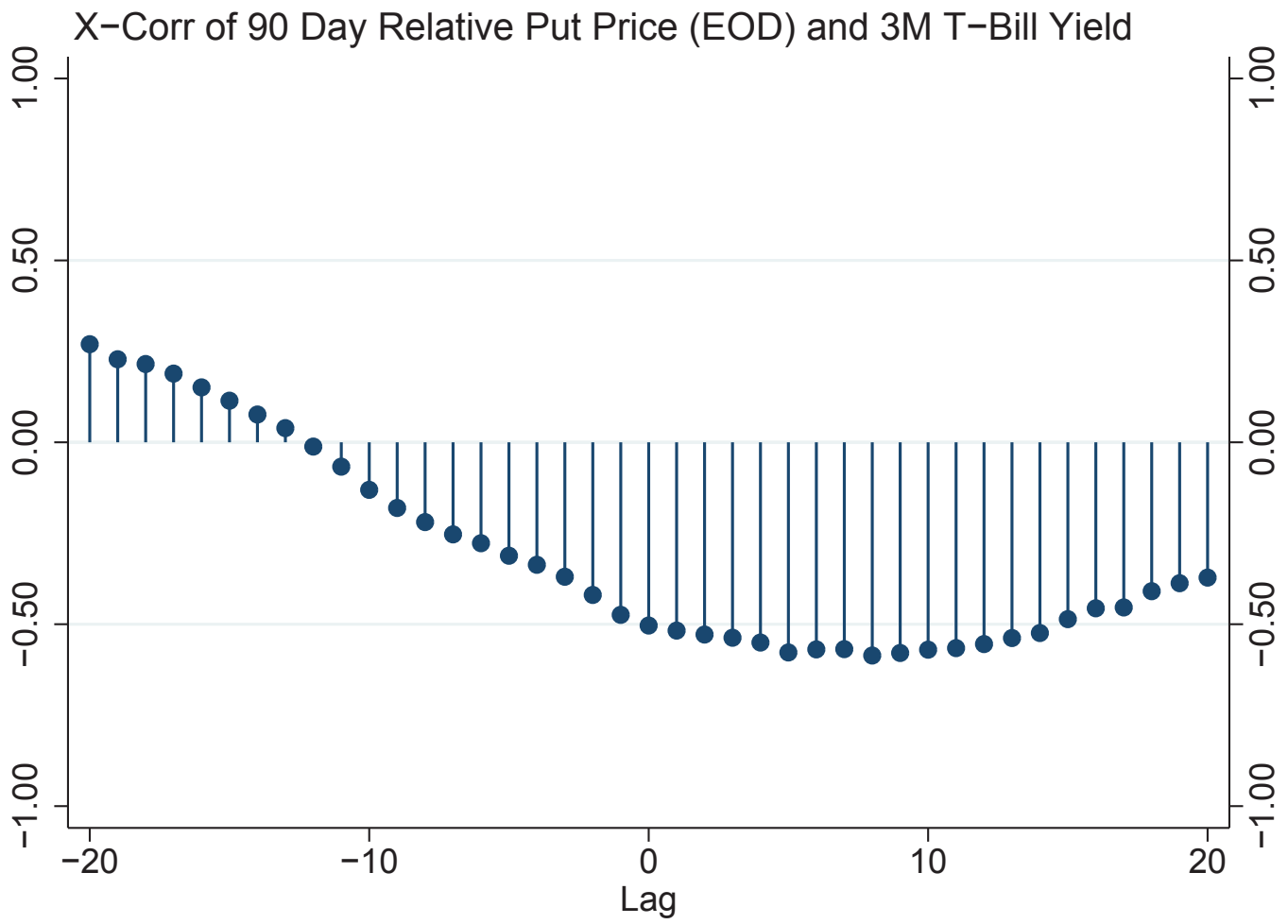

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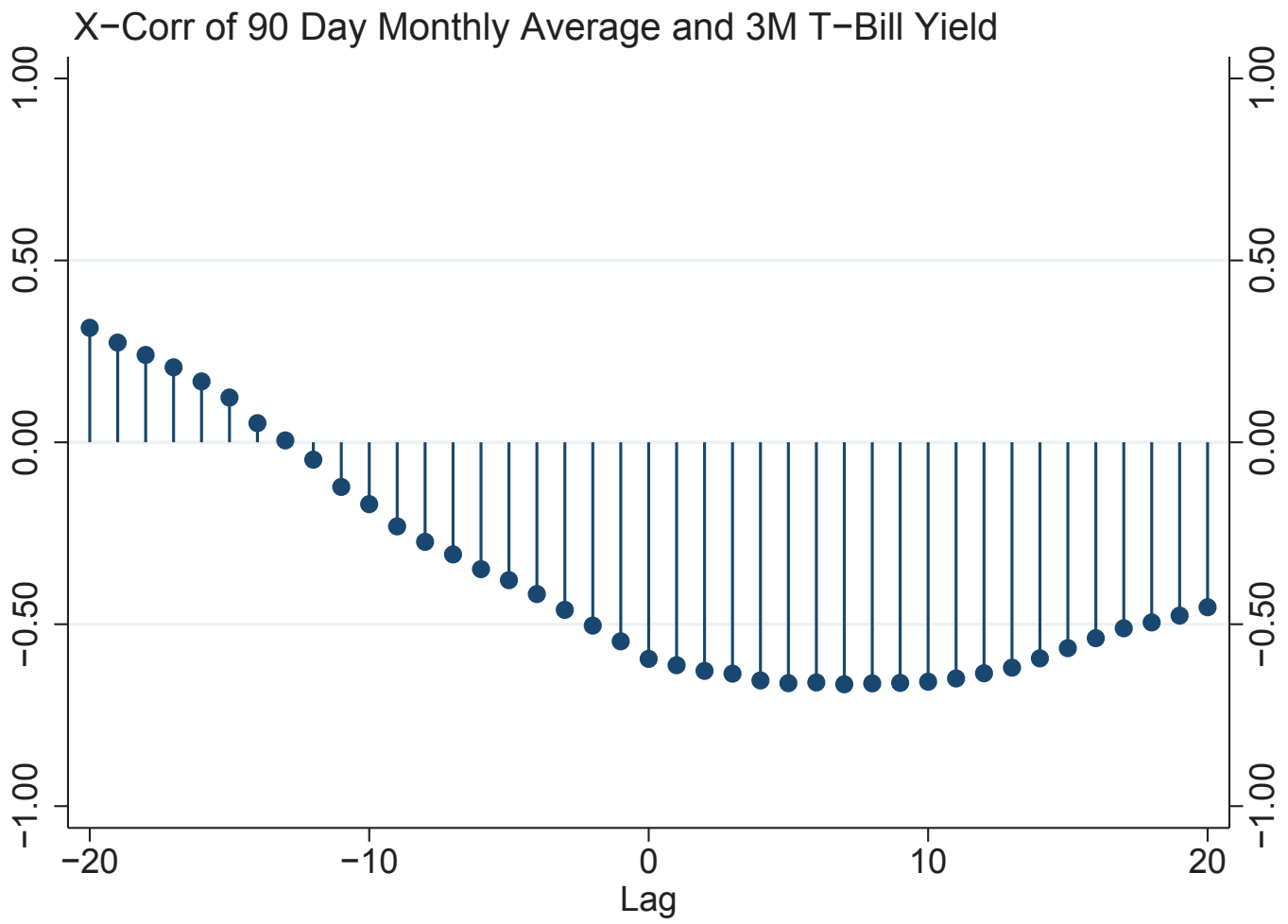


Impulse Response Functions

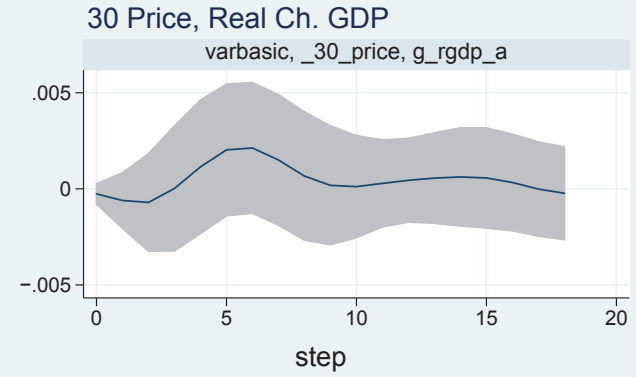
We include all term strcture information in the fitted value for 3-Month T-bill yield with a regression of the following form:

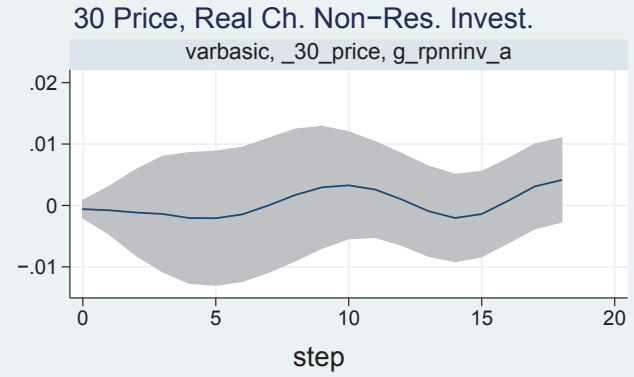
$$3MYield_t = \alpha + \sum_1^a \beta_i 3MYield_{t-i} + \sum_1^b \gamma_i 1YRYield_{t-i} + \sum_1^c \psi_i 5YRYield_{t-i} + \sum_1^d \phi_i 10YRYield_{t-i}$$

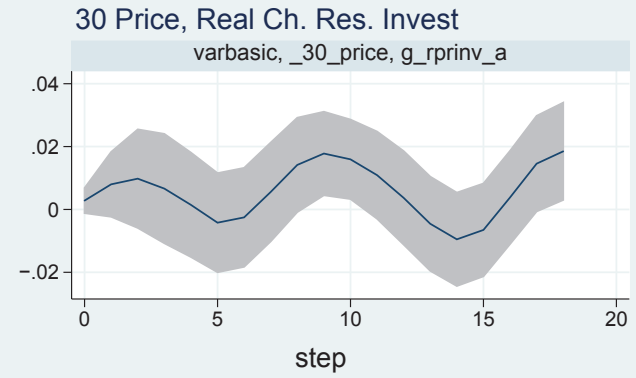
We set $a = b = c = d = 1$, but it is also possible to select the appropriate lags using the AIC.

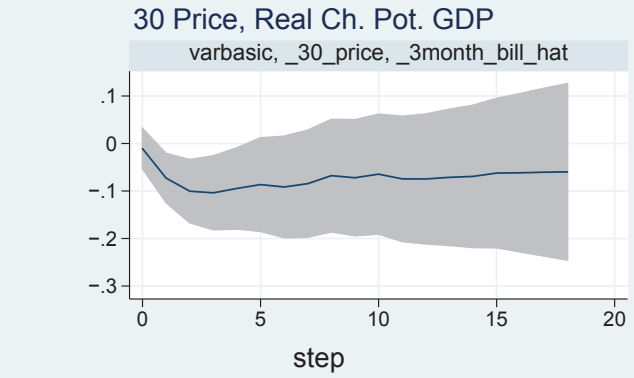
Impulse Response Functions

30 Day Relative Put Price



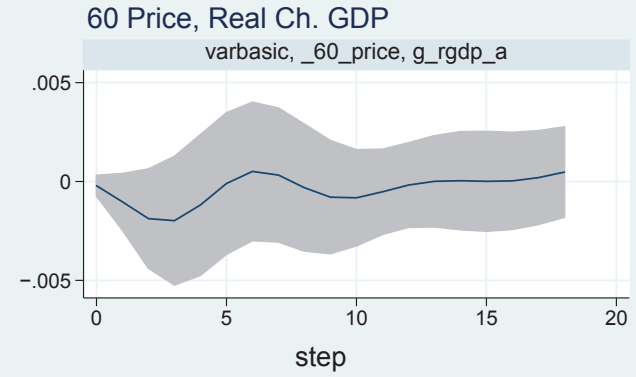


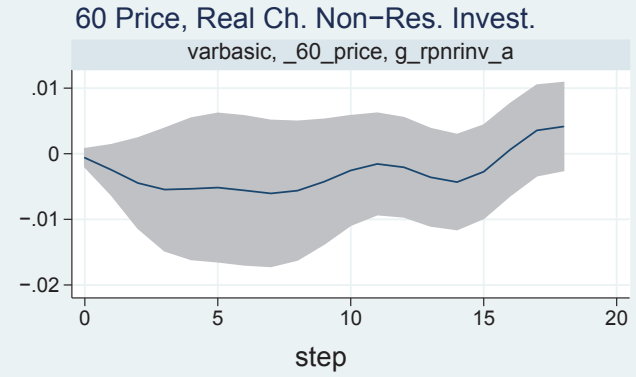


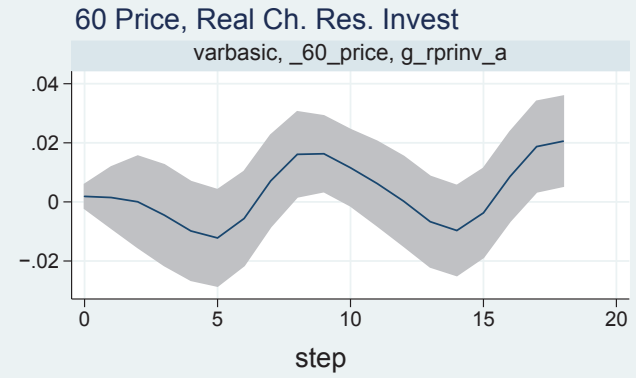


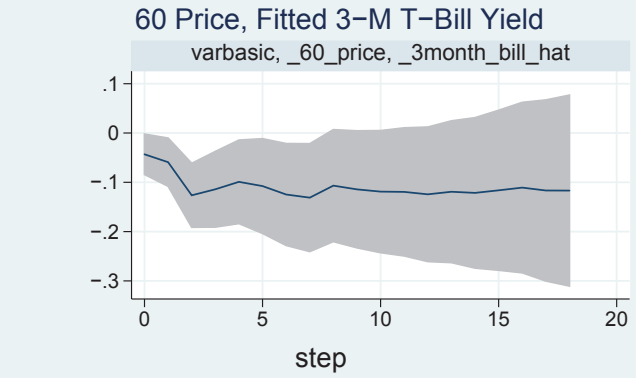
Impulse Response Functions

60 Day Relative Put Price



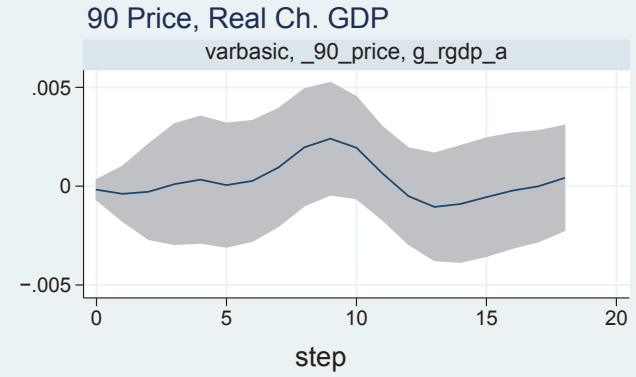


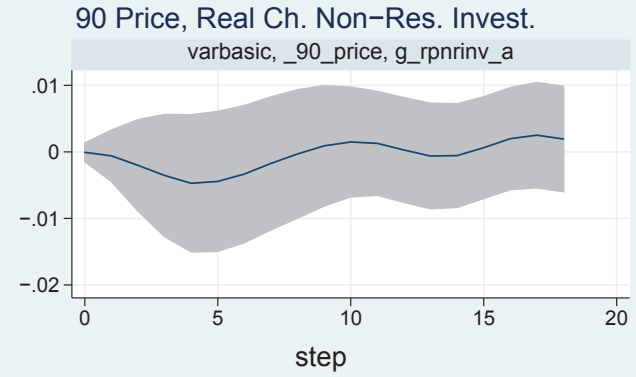


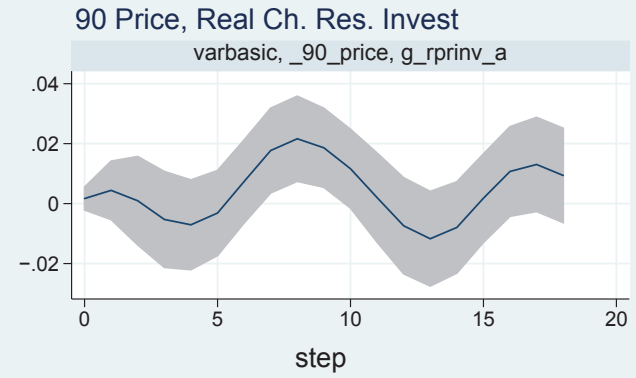


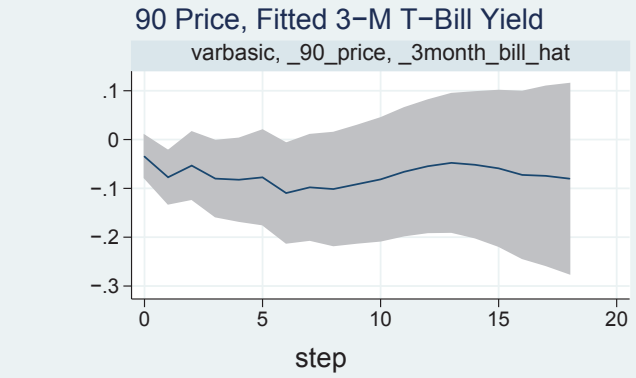
Impulse Response Functions

90 Day Relative Put Price



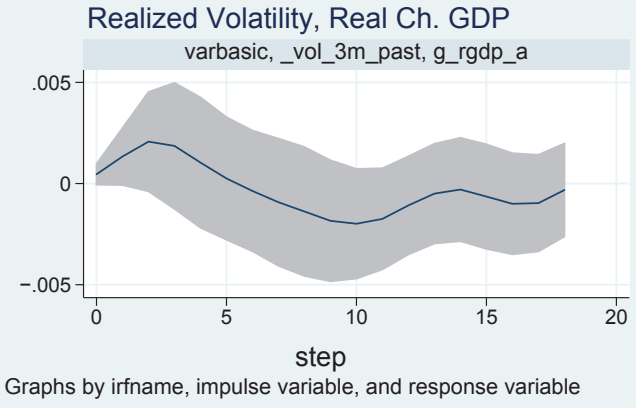


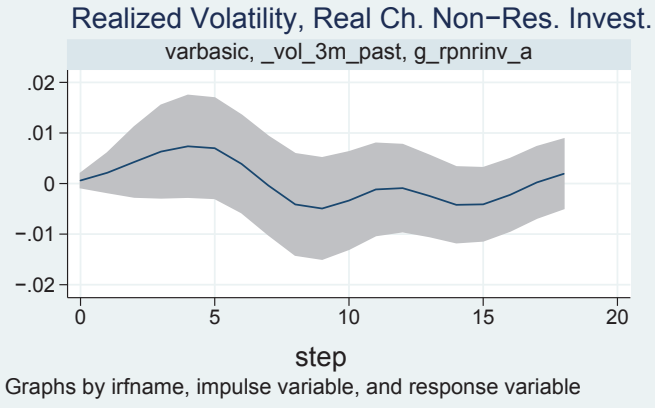


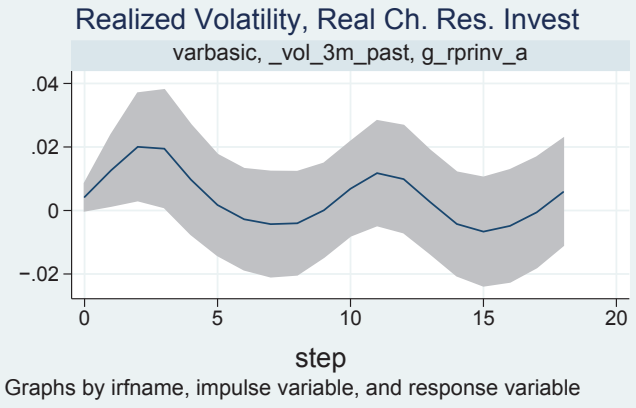


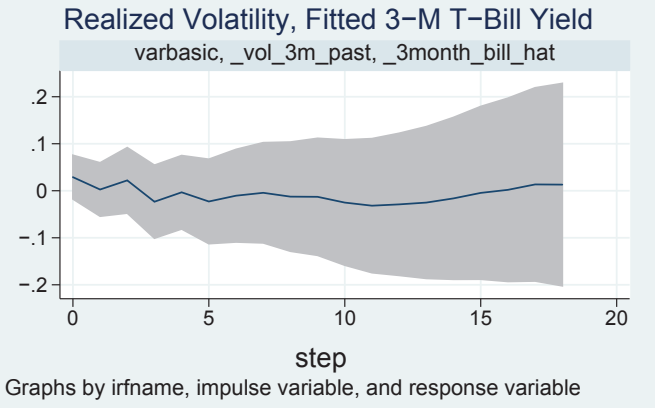
Impulse Response Functions

Realized Volatility (3 Month Historical)





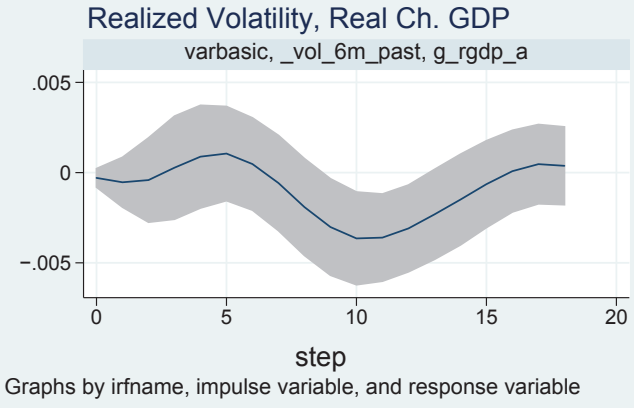


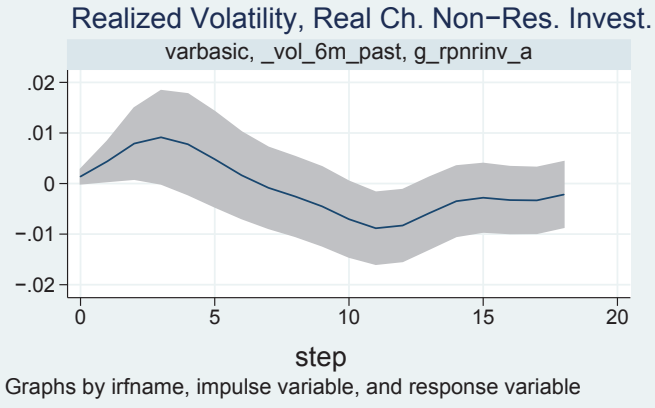


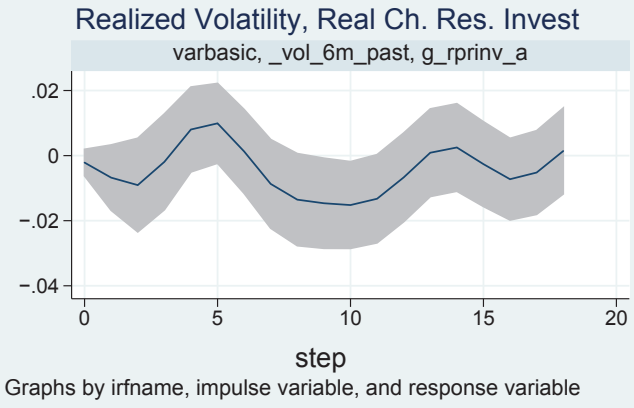
Realized volatility is the standard deviation of S&P 500 returns over the previous 3 months

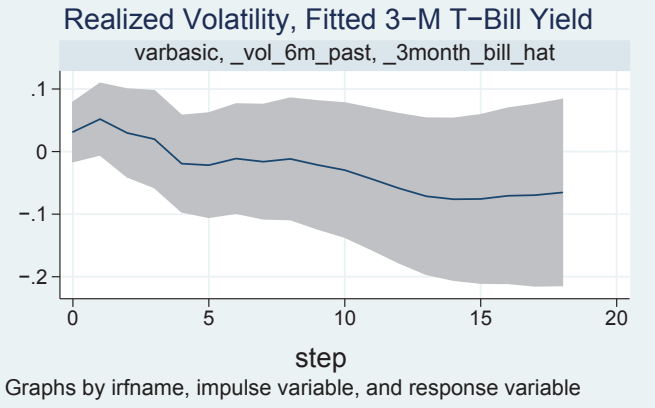
Impulse Response Functions

Realized Volatility (6 Month Historical)





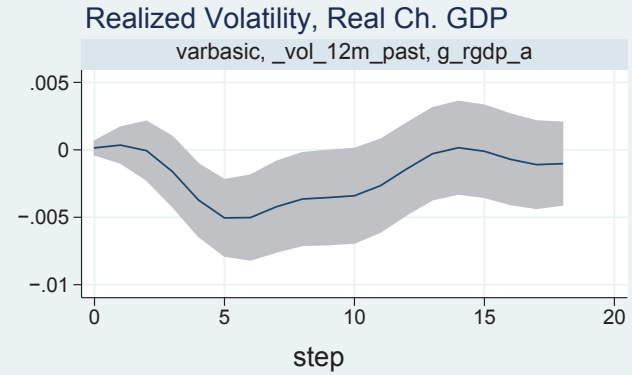


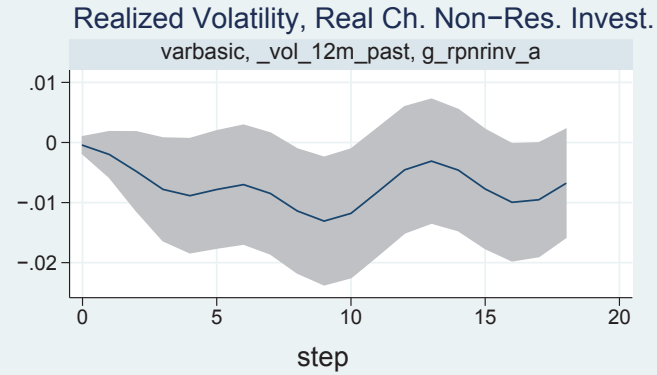


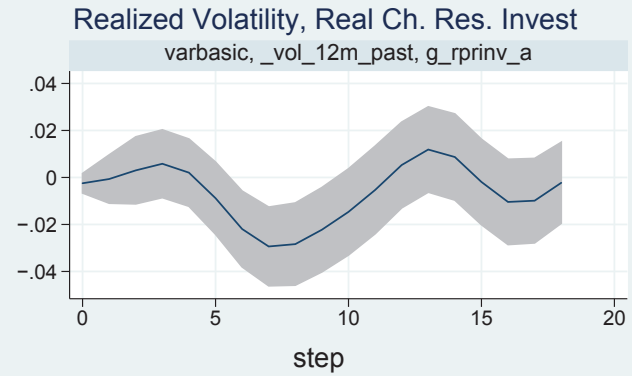
Realized volatility is the standard deviation of S&P 500 returns over the previous 6 months

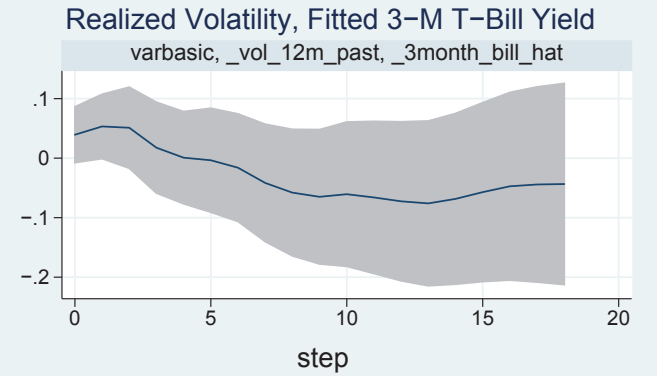
Impulse Response Functions

Realized Volatility (12 Month Historical)









Realized volatility is the standard deviation of S&P 500 returns over the previous 12 months

Summary of Findings

We develop a measure of uncertainty that is:

- Easy to compute
- Superior for forecasting realized volatility
- Useful for forecasting macroeconomic series such as GDP
- Applicable to many areas of future research

Avenues for Future Research

- Use an G/ARCH model to estimate the volatility process
- Test forecasting ability at different frequencies (Daily, Weekly, Monthly, Quarterly)
- Obtain a longer time series with more recessions to ensure the robustness of our uncertainty measure
- Forecast stock volatility for individual companies - especially before earnings announcements or other corporate events
- Use dimension reduction techniques to distill out principal components for forecasting volatility
- Experiment with data filtering techniques, including exponential moving average

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White Paper

Questions