

# Conditional Macroeconomic Survey Forecasts: Disagreement, Revisions and Errors

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# Motivation

- We analyze the relationship between expert's macroeconomic forecasts and their expectations about external conditions (e.g., future oil prices and exchange rates)
- Few papers have analyzed this relationship so far
  - ▶ Fioramanti *et al.* (2016); Engelke *et al.* (2019); Fortin *et al.* (2020); Czudaj (2021)
  - ▶ small samples
  - ▶ (mostly) focus on GDP growth
  - ▶ focus on prediction errors
- Using a large sample from the ECB's Survey of Professional Forecasters, we investigate the role of ex-ante conditioning variables for predictions of various macroeconomic outcomes

# Research Questions

We consider the following forecast dimensions:

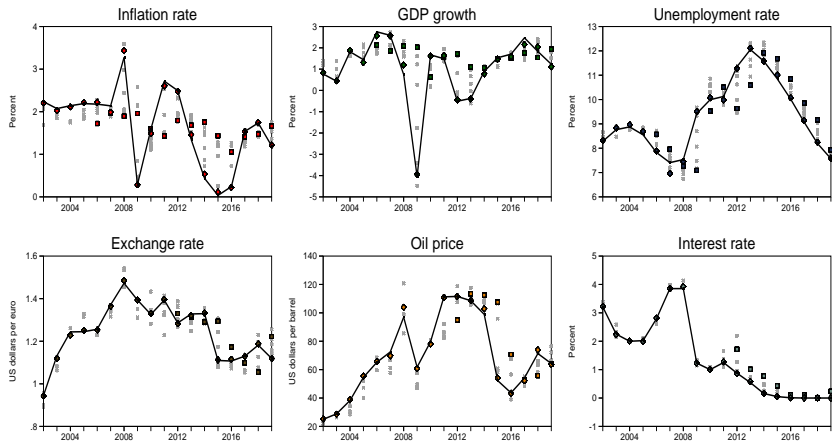
- **Heterogeneity:** Can disagreement of macro forecasts be explained by heterogeneity in conditioning variables?
- **Forecast revisions:** Are macro forecasts updated in accordance with forecast revisions in expectations about external conditions?
- **Forecast errors:** To what extent are inaccurate macro forecasts related to misconceptions about the future state of the world?

# Survey of Professional Forecasters (SPF)

- 72 quarterly survey waves for period 2002Q1-2019Q4
- 101 financial and research institutions ( $\approx 50$  per wave)
- Predictions for the current and the next calendar year  
→ Forecast horizon:  $h \in \{1, 2, \dots, 8\}$  quarters
- Macro variables** ( $y$ ):
  - Inflation (HICP, *infl*)
  - Real GDP growth (*gdp*)
  - Unemployment rate (*une*)
- Assumptions** ( $x$ ):
  - “Please report selected information underlying your forecasts.”
  - Oil price in US-Dollars (*oil*)
  - EUR/USD exchange rate (*usd*)
  - ECB’s main refinancing rate (*ir*)
  - Annual growth in compensation per employee (wage growth; *lab*)

# Survey of Professional Forecasters (SPF)

## Realizations and Consensus Forecasts



*Notes:* Solid black lines depict the real-time realizations of the respective variable. Squares ( $\square$ ) represent the average across the 8-step-ahead predictions, while diamonds ( $\diamond$ ) indicate the average over the 1-step-ahead predictions. Crosses ( $\times$ ) depict  $h$ -step-ahead consensus predictions for intermediate forecast horizons. The horizontal axis depicts the target period, i.e., the year that is being forecasted. The sample period is 2002Q1–2019Q4.



# Forecast Disagreement

- Measured as the standard deviation of the point predictions:

$$s_{z,t,h} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (\hat{z}_{i,t,h} - \bar{\hat{z}}_{t,h})^2} \quad \text{for } z \in \{x, y\}$$

- Stylized facts:

- Disagreement increases with the forecast horizon
- Wage growth assumptions are a notable exception

- Empirical model:

$$s_{y,t,h} = \alpha + \sum_x \beta_x s_{x,t,h} + \lambda_t + \lambda_h + \nu_{y,t,h},$$

where  $\lambda_t$  and  $\lambda_h$  represent target year- and horizon-fixed effects

# Forecast Disagreement

Example: Inflation

	<i>Dependent variable: <math>S_{infl,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$S_{oil,t,h}$	0.021*** (0.002)			0.015*** (0.002)	0.011*** (0.002)		0.017*** (0.002)	0.012*** (0.003)
$S_{usd,t,h}$		2.363*** (0.263)		0.732* (0.415)	-0.365 (0.397)		0.783** (0.335)	-0.368 (0.459)
$S_{ir,t,h}$			0.488*** (0.067)	0.051 (0.112)	-0.088 (0.119)		-0.043 (0.088)	-0.112 (0.116)
$S_{lab,t,h}$						0.170** (0.084)	0.014 (0.023)	-0.054 (0.035)
Constant	0.093*** (0.010)	0.098*** (0.012)	0.132*** (0.015)	0.089*** (0.011)	0.198*** (0.030)	0.122*** (0.030)	0.078*** (0.012)	0.214*** (0.028)
No. of obs.	107	107	107	107	107	120	97	97
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.667	0.608	0.365	0.679	0.796	0.071	0.713	0.799

# Forecast Revisions

➤ Defined as

$$\Delta \hat{z}_{i,t,h} = \hat{z}_{i,t,h} - \hat{z}_{i,t,h+1} \quad \text{for } z \in \{x, y\}$$

➤ Stylized facts:

- ▶ SPF participants update their macro forecasts in approx. 77% of cases
- ▶ Oil price and exchange rate assumptions are updated almost always
- ▶ Interest rate and wage growth assumptions are updated less frequently

➤ We estimate

$$\Delta \hat{y}_{i,t,h} = \alpha + \sum_x \beta_x \Delta \hat{x}_{i,t,h} + \lambda_i + \lambda_t + \lambda_h + \nu_{y,i,t,h}$$

where  $\lambda_i$  is an institutional-fixed effect



# Forecast Revisions

Example: Inflation

	Dependent variable: $\Delta \widehat{\text{infl}}_{i,t,h}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \widehat{\text{oil}}_{i,t,h}$	0.016*** (0.001)			0.016*** (0.001)	0.013*** (0.001)		0.016*** (0.001)	0.014*** (0.001)
$\Delta \widehat{\text{usd}}_{i,t,h}$		0.392*** (0.116)		-0.219** (0.098)	-0.170* (0.097)		-0.216** (0.109)	-0.117 (0.104)
$\Delta \widehat{\text{ir}}_{i,t,h}$			0.301*** (0.026)	0.151*** (0.028)	0.177*** (0.029)		0.108*** (0.034)	0.136*** (0.037)
$\Delta \widehat{\text{lab}}_{i,t,h}$						0.140*** (0.024)	0.063*** (0.021)	0.045** (0.019)
Constant	-0.005 (0.004)	0.009* (0.005)	0.018*** (0.005)	0.002 (0.005)	-0.209*** (0.081)	-0.007 (0.007)	-0.007 (0.006)	-0.061*** (0.022)
No. of obs.	3,213	3,207	3,569	2,894	2,894	2,554	1,674	1,674
$N$	87	86	88	84	84	67	65	65
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.271	0.006	0.048	0.277	0.390	0.030	0.306	0.420

# Forecast Errors and Assumption Errors

➤ The  $h$ -step-ahead prediction error is defined as

$$e_{z,i,t,h} = \hat{z}_{i,t,h} - z_t \quad \text{for } z \in \{x, y\},$$

where  $y_t$  is based on first-release data

➤ Stylized facts:

- ▶ Mean error: Forecasters generally overpredict all variables
- ▶ Underprediction of inflation and exchange rates at short horizons
- ▶ RMSE: Smaller errors with decreasing forecast horizon

➤ Empirical model:

$$e_{y,i,t,h} = \alpha + \sum_x \beta_x e_{x,i,t,h} + \lambda_i + \lambda_t + \lambda_h + \nu_{y,i,t,h}$$

# Forecast Errors

Example: Inflation

	<i>Dependent variable: <math>e_{infl,i,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$e_{oil,i,t,h}$	0.027*** (0.001)			0.030*** (0.001)	0.023*** (0.001)		0.028*** (0.001)	0.023*** (0.001)
$e_{usd,i,t,h}$		1.875*** (0.221)		-1.123*** (0.162)	-0.490*** (0.099)		-0.979*** (0.198)	-0.460*** (0.123)
$e_{ir,i,t,h}$			0.189*** (0.062)	0.020 (0.043)	0.043 (0.028)		-0.144*** (0.046)	-0.018 (0.034)
$e_{lab,i,t,h}$						0.573*** (0.035)	0.219*** (0.021)	0.115*** (0.018)
Constant	0.023*** (0.009)	0.043*** (0.012)	0.027** (0.012)	0.017** (0.008)	0.317*** (0.033)	-0.007 (0.017)	0.028*** (0.010)	-0.156*** (0.029)
No. of obs.	4,797	4,848	5,228	4,472	4,472	3,670	2,571	2,571
$N$	89	89	89	89	89	80	80	80
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.521	0.065	0.008	0.543	0.765	0.246	0.587	0.773

# Summary

- Assumptions contain valuable information that can help understand how experts form their macroeconomic expectations
- The importance of assumptions varies across macro indicators:
  - ▶ Oil price assumptions → inflation forecasts
  - ▶ Interest rate assumptions → GDP growth and unemployment rate forecasts
  - ▶ Smaller role of exchange rate and wage growth assumptions
- For each macro variable, the RMSE could be reduced by up to 40-50% by reducing assumption errors
- Implication: Survey operators should elicit assumptions along with the macro forecasts

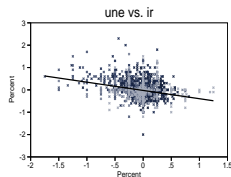
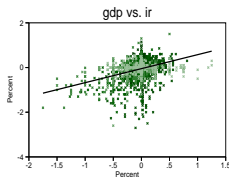
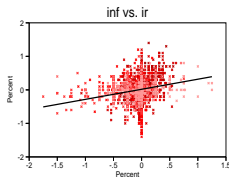
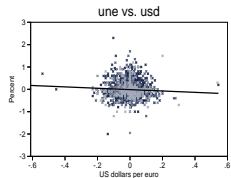
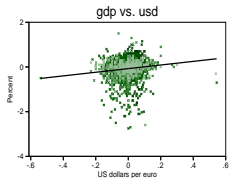
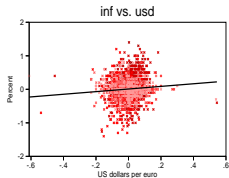
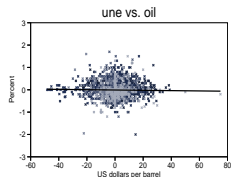
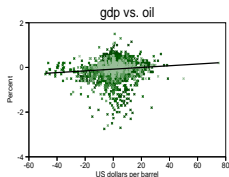
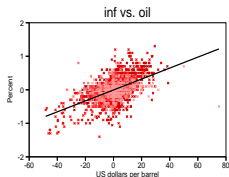
# Thank you for your attention!

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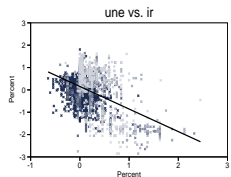
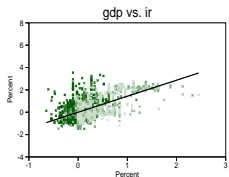
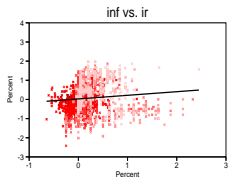
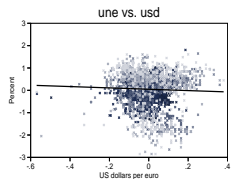
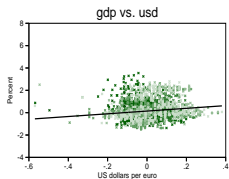
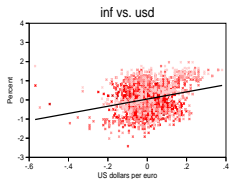
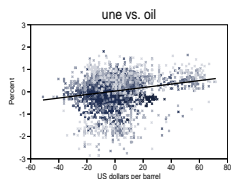
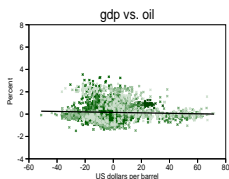
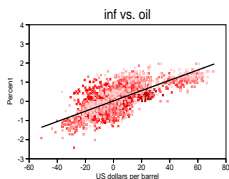


# Appendix

# Forecast Errors and Assumption Revisions



# Forecast Errors and Assumption Errors





# Sample Size

Variable	Forecast horizon $h$								$\sum_h$	FP	PR
	8	7	6	5	4	3	2	1			
Inflation rate	597	603	613	656	928	913	860	941	6111	6691	9
GDP growth	598	604	616	660	929	917	864	945	6133	6691	9
Unemployment rate	580	584	596	639	900	883	832	905	5919	6691	8
Oil price	339	395	380	404	827	843	784	846	4818	5438	8
Exchange rate	347	394	382	414	833	833	802	871	4876	5438	8
Interest rate	384	421	417	455	915	896	849	926	5263	5438	9
Wage growth	449	434	456	464	476	455	475	481	3690	6228	5

*Notes:* For each variable, this table reports the number of predictions per forecast horizon and the total number of predictions across all horizons. The sample period is 2002Q1–2019Q4. Predictions for the next calendar year are included from 2004Q3 onwards based on the availability of wage growth assumptions. For the other assumptions, next year predictions have been elicited since 2010Q2. The column ‘FP’ shows the number of observations that could have been elicited if full participation, i.e., if in each survey wave all active participants would have reported predictions for all variables and horizons. The column ‘PR’ presents the corresponding participation rate.

# Forecast Disagreement

Example: GDP growth

	<i>Dependent variable: <math>s_{gdp,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$s_{oil,t,h}$	0.019*** (0.003)			0.007 (0.006)	0.006 (0.004)		0.008 (0.007)	0.006 (0.005)
$s_{usd,t,h}$		2.318*** (0.318)		0.313 (0.755)	-0.161 (0.731)		0.491 (0.830)	-0.167 (0.769)
$s_{ir,t,h}$			0.673*** (0.091)	0.465*** (0.091)	0.397*** (0.103)		0.329*** (0.100)	0.414*** (0.098)
$s_{lab,t,h}$						0.358*** (0.118)	0.168* (0.093)	-0.017 (0.074)
Constant	0.132*** (0.016)	0.130*** (0.015)	0.144*** (0.012)	0.124*** (0.015)	0.111** (0.042)	0.076* (0.043)	0.052* (0.031)	0.115*** (0.041)
No. of obs.	107	107	107	107	107	120	97	97
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.321	0.338	0.401	0.428	0.664	0.198	0.476	0.659

# Forecast Disagreement

Example: Unemployment

	<i>Dependent variable: <math>s_{une,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$s_{oil,t,h}$	0.029*** (0.004)			0.010** (0.004)	-0.002 (0.004)		0.011* (0.006)	-0.002 (0.005)
$s_{usd,t,h}$		3.520*** (0.408)		2.266*** (0.836)	1.212 (0.926)		2.284*** (0.859)	1.221 (0.989)
$s_{ir,t,h}$			0.719*** (0.141)	0.075 (0.121)	0.226* (0.118)		0.056 (0.128)	0.234* (0.134)
$s_{lab,t,h}$						0.188 (0.121)	-0.035 (0.078)	0.031 (0.079)
Constant	0.113*** (0.021)	0.108*** (0.018)	0.159*** (0.027)	0.102*** (0.019)	0.231*** (0.059)	0.166*** (0.050)	0.113** (0.046)	0.218*** (0.066)
No. of obs.	107	107	107	107	107	120	97	97
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.556	0.609	0.358	0.618	0.756	0.044	0.608	0.745

# Share of Attentive Forecasters

$h$	Macro updating			Assumption updating			
	Inflation	GDP growth	Unemployment	Oil price	Exchange rate	Interest rate	Wage growth
1	69.9%	84.2%	68.2%	100.0%	100.0%	45.0%	59.1%
2	82.2%	79.3%	71.0%	100.0%	100.0%	60.0%	59.3%
3	83.9%	83.7%	77.0%	100.0%	100.0%	64.2%	60.1%
4	84.8%	85.4%	78.9%	97.3%	94.8%	48.5%	65.1%
5	74.5%	80.8%	75.8%	83.7%	79.7%	48.7%	61.2%
6	68.1%	71.7%	74.6%	83.2%	77.9%	60.3%	56.0%
7	72.1%	71.7%	76.7%	80.2%	78.6%	58.8%	58.4%
All	77.1%	80.2%	74.3%	94.8%	93.5%	55.5%	60.0%

Notes: For each macro variable/assumption, this table displays the share of attentive SPF participants across all  $h$ -step-ahead predictions, i.e., the fraction of cases with  $\Delta \hat{z}_{i,t,h} \neq 0$ . In the last row, we report the corresponding statistics based on a pooled sample across all horizons. The sample period is 2002Q1–2019Q4.

# Forecast Revisions

Example: GDP growth

	Dependent variable: $\widehat{\Delta gdp}_{i,t,h}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\widehat{\Delta oil}_{i,t,h}$	0.004*** (0.001)			-0.000 (0.001)	0.004*** (0.001)		0.000 (0.001)	0.004*** (0.001)
$\widehat{\Delta usd}_{i,t,h}$		0.812*** (0.149)		0.436*** (0.145)	0.658*** (0.146)		0.420** (0.185)	0.500*** (0.182)
$\widehat{\Delta ir}_{i,t,h}$			0.627*** (0.035)	0.594*** (0.045)	0.451*** (0.040)		0.547*** (0.056)	0.438*** (0.051)
$\widehat{\Delta lab}_{i,t,h}$						0.107*** (0.030)	0.009 (0.036)	-0.010 (0.040)
Constant	-0.077*** (0.007)	-0.074*** (0.007)	-0.051*** (0.006)	-0.053*** (0.007)	-0.589*** (0.104)	-0.094*** (0.012)	-0.043*** (0.009)	-0.191* (0.108)
No. of obs.	3,222	3,219	3,590	2,903	2,903	2,563	1,679	1,679
$N$	87	86	88	84	84	67	65	65
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.008	0.015	0.121	0.112	0.365	0.009	0.110	0.362

# Forecast Revisions

## Example: Unemployment

	Dependent variable: $\Delta \widehat{une}_{i,t,h}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \widehat{oil}_{i,t,h}$	-0.001 (0.001)			0.002** (0.001)	-0.000 (0.001)		0.001 (0.001)	-0.001 (0.001)
$\Delta \widehat{usd}_{i,t,h}$		-0.306*** (0.109)		-0.156 (0.112)	-0.241** (0.105)		-0.167 (0.134)	-0.231* (0.121)
$\Delta \widehat{ir}_{i,t,h}$			-0.370*** (0.032)	-0.389*** (0.038)	-0.288*** (0.034)		-0.404*** (0.048)	-0.312*** (0.043)
$\Delta \widehat{lab}_{i,t,h}$						-0.058*** (0.020)	0.012 (0.020)	0.020 (0.020)
Constant	-0.010 (0.006)	-0.013** (0.006)	-0.025*** (0.006)	-0.025*** (0.006)	-0.166 (0.138)	0.002 (0.008)	-0.034*** (0.008)	0.014 (0.057)
No. of obs.	3,091	3,075	3,439	2,789	2,789	2,528	1,663	1,663
$N$	84	83	86	83	83	66	64	64
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.000	0.004	0.069	0.075	0.284	0.005	0.090	0.300

# Forecast Accuracy

<i>h</i>	Macro errors						Assumption errors							
	Inflation		GDP growth		Unemployment		Oil price		Exchange rate		Interest rate		Wage growth	
	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE	ME	RMSE
1	-0.002	0.123	-0.001	0.203	0.011	0.195	0.447	2.541	-0.001	0.011	0.008	0.037	0.063	0.547
2	0.019	0.200	-0.003	0.422	0.035	0.263	1.258	7.639	-0.003	0.033	0.035	0.099	0.013	0.538
3	-0.066	0.287	0.064	0.518	0.048	0.327	-1.643	6.831	-0.007	0.053	0.037	0.115	0.001	0.634
4	-0.107	0.518	0.197	0.822	0.056	0.467	-5.451	10.881	-0.010	0.072	0.033	0.188	0.020	0.602
5	0.059	0.861	0.331	1.226	0.008	0.718	2.419	20.455	0.012	0.080	0.105	0.245	0.077	0.645
6	0.144	0.980	0.477	1.605	0.001	0.931	5.712	24.884	0.003	0.122	0.244	0.480	0.075	0.694
7	0.141	0.951	0.560	1.715	-0.028	1.046	6.365	23.787	0.016	0.117	0.379	0.591	0.097	0.686
8	0.156	0.947	0.575	1.768	-0.048	1.128	7.605	24.858	0.022	0.116	0.348	0.505	0.094	0.651
All	0.026	0.643	0.234	1.090	0.016	0.663	0.770	14.591	0.001	0.073	0.103	0.283	0.055	0.625

*Notes:* For each macro variable/assumption, this table displays the mean error (ME) and root mean squared error (RMSE) across all *h*-step-ahead predictions. In the last row, we report the corresponding statistics based on a sample that includes all horizons. The sample period is 2002Q1–2019Q4.

# Forecast Errors

Example: GDP growth

	<i>Dependent variable: <math>e_{gdp,i,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$e_{oil,i,t,h}$	-0.002*** (0.001)			-0.008*** (0.001)	-0.003*** (0.001)		-0.009*** (0.001)	-0.003*** (0.001)
$e_{usd,i,t,h}$		1.221*** (0.229)		0.952*** (0.200)	0.726*** (0.137)		1.065*** (0.237)	0.686*** (0.162)
$e_{ir,i,t,h}$			1.433*** (0.049)	1.444*** (0.052)	1.030*** (0.047)		1.323*** (0.062)	0.983*** (0.058)
$e_{lab,i,t,h}$						0.727*** (0.074)	0.201*** (0.030)	0.034 (0.023)
Constant	0.156*** (0.016)	0.144*** (0.015)	-0.001 (0.012)	0.008 (0.012)	0.317*** (0.059)	0.256*** (0.032)	-0.012 (0.017)	0.583*** (0.078)
No. of obs.	4,805	4,861	5,248	4,478	4,478	3,679	2,576	2,576
$N$	89	89	89	89	89	80	80	80
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.002	0.018	0.319	0.349	0.663	0.126	0.383	0.676



# Forecast Errors

## Example: Unemployment

	<i>Dependent variable: <math>e_{une,i,t,h}</math></i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$e_{oil,i,t,h}$	0.008*** (0.001)			0.012*** (0.001)	0.006*** (0.001)		0.013*** (0.001)	0.006*** (0.001)
$e_{usd,i,t,h}$		-0.300 (0.223)		-0.797*** (0.201)	-0.670*** (0.145)		-0.718*** (0.236)	-0.533*** (0.167)
$e_{ir,i,t,h}$			-1.009*** (0.059)	-1.070*** (0.055)	-0.847*** (0.046)		-1.072*** (0.062)	-0.898*** (0.059)
$e_{lab,i,t,h}$						-0.323*** (0.036)	-0.097*** (0.025)	-0.020 (0.021)
Constant	0.032** (0.014)	0.049*** (0.014)	0.152*** (0.010)	0.141*** (0.010)	0.433*** (0.059)	0.008 (0.019)	0.159*** (0.013)	0.169*** (0.050)
No. of obs.	4,630	4,678	5,058	4,324	4,324	3,632	2,547	2,547
$N$	89	89	89	89	89	79	79	79
Institutional FE	no	no	no	no	yes	no	no	yes
Time FE	no	no	no	no	yes	no	no	yes
Horizon FE	no	no	no	no	yes	no	no	yes
$R^2$	0.039	0.001	0.213	0.306	0.608	0.075	0.345	0.633

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