Forecaster Heterogeneity, Surprises and Financial Markets

Marcello Pericoli and Giovanni Veronese

Bank of Italy

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1 Motivation

2 What this paper does

3 Methodology

4 Theory
   - asymmetric information
   - heterogenous beliefs

5 Estimation

6 Results

7 Conclusions
**Outline**

1. **Motivation**
2. **What this paper does**
3. **Methodology**
4. **Theory**
   - asymmetric information
   - heterogenous beliefs
5. **Estimation**
6. **Results**
7. **Conclusions**
Motivation

Intro: macroeconomic news

Macroeconomic news matter: more so, at high frequency

Note: absolute % change in the benchmark 10y US Treasury price
Motivation

The appeal of “news”

- Scheduled macroeconomic news as observable “shocks” impacting financial markets
- Dissemination of *public* information
- Amenable to event-type analysis
- Why and how asset prices respond: provides insights in the “validity” of assumptions in our theoretical models as well as policy relevant information (e.g. $\pi_{exp}$ anchoring)
Motivation
Characterizing the response to macro news

Several lines of research:

1. differences across indicators:
   - e.g. why news in Non Farm Payrolls *matter more* than retail sales? (Gilbert, Scotti, Strasser and Vega, 2015)

2. time variation:
   - e.g. has the 10y Treasury price response to news changed with ZLB (Swanson, Williams, AER 2014)

3. state dependence in response:
   - e.g. macro conditions as well as uncertainty matter for price response (Goldberg and Grisse, 2013),
   - e.g. macro disagreement (*our paper*)
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What this paper does

Objective

- Analyze:
  - the impact of **US macroeconomic surprises** and
  - forecaster heterogeneity → disagreement
  - on USD/EUR and US and German long-term interest rates

- Document **disagreement among forecasters** regarding macroeconomic releases

- Show how **it matters to explain the daily and intra-day movements** in these asset prices

- Attempt to interpret the results
What this paper does
Main results

- Unveil **new source of state dependence** in the response of asset prices
- Estimated impact on long-term yield and FX rates is *significantly stronger* during periods of **low disagreement**
- Result is **robust** to the frequency chosen for the returns data ...
- ... as well as time variation and the radical **changes in the macro environment** over the sample (1999-2014)
What this paper does
How to interpret the results

Several approaches serve as a guide to interpret the results:

- Heterogeneous/asymmetric information $\rightarrow$ No
- Heterogeneity in beliefs $\rightarrow$ Yes?
- Microstructure models: $\rightarrow$ ? (no data, someone else may do it)
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Macroeconomic surprises from Bloomberg

Ahead of every key macroeconomic announcement $i$, $i=1,\ldots,I$

- forecasters post their expectation: $F_{t,i,n}$, $n=1,\ldots,N$
- Bloomberg computes the “median forecast”: $\bar{F}_{t,i} = median(F_{t,i,\cdot})$
- ... and the corresponding Surprise: $\bar{S}_{t,i} = R_{i,t} - \bar{F}_{t,i}$
  (where $R_{t,i}$ is the actual data release)

For comparability across different macro indicators, define standardized surprises:

$$S_{t,i} = \frac{R_{i,t} - \bar{F}_{t,i}}{\sigma_{\bar{S}_i}} = \frac{\bar{S}_{t,i}}{\sigma_{\bar{S}_i}}$$

where $\sigma_{\bar{S}_i}$ is sample standard deviation of the $i^{th}$ surprise
**Methodology**

Information on forecaster heterogeneity

**Exploit** *analysts’ full distribution of expectations* for each macro release

**Identical surprise, but different distribution of expectations**: does this matter for the asset price response?
Forecaster heterogeneity: disagreement

- Forecasters can differ markedly in their expectation
- Consider as a proxy of dispersion, disagreement:
  \[ \text{Disag}_{t, i} = \sqrt{\sum_{n=1}^{N} \frac{(F_{t,i,n} - \overline{F}_{t,i})^2}{N}} \]
- Heterogeneity can be measured and tracked over time

Can use mean or median to measure central tendency: results are not much different
### Table 1 – Main US scheduled macroeconomic releases

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Source</th>
<th>Release Time</th>
<th>$\sigma_R$</th>
<th>Delay</th>
<th>N</th>
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<tr>
<td>Nonfarm Payrolls</td>
<td>M BLS</td>
<td>8:30</td>
<td>191.5</td>
<td>5</td>
<td>70</td>
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<tr>
<td>ISM/NAPM</td>
<td>M ISM</td>
<td>10:00</td>
<td>5.9</td>
<td>2</td>
<td>64</td>
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<tr>
<td>Retail sales ex. autos</td>
<td>M USCB</td>
<td>8:30</td>
<td>0.7</td>
<td>13</td>
<td>72</td>
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<tr>
<td>GDP (advance)</td>
<td>Q BEA</td>
<td>8:30</td>
<td>2.1</td>
<td>29</td>
<td>63</td>
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<tr>
<td>Core durable orders</td>
<td>M USCB</td>
<td>08:30</td>
<td>1.7</td>
<td>26</td>
<td>64</td>
</tr>
<tr>
<td>Consumer confidence</td>
<td>M UnMich</td>
<td>10:00</td>
<td>11.2</td>
<td>-3</td>
<td>59</td>
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<td>Initial jobless claims</td>
<td>W DLS</td>
<td>8:30</td>
<td>75.6</td>
<td>6</td>
<td>36</td>
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<tr>
<td>Capacity utilization</td>
<td>M Fed</td>
<td>9:15</td>
<td>3.2</td>
<td>16</td>
<td>58</td>
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<tr>
<td>Trade balance</td>
<td>M USCB</td>
<td>8:30</td>
<td>11.4</td>
<td>44</td>
<td>63</td>
</tr>
<tr>
<td>Leading Indicator</td>
<td>M CB</td>
<td>10:00</td>
<td>0.4</td>
<td>22</td>
<td>50</td>
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<tr>
<td>CPI Core</td>
<td>M BLS</td>
<td>8:30</td>
<td>0.1</td>
<td>17</td>
<td>67</td>
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<tr>
<td>Unemployment rate</td>
<td>M BLS</td>
<td>8:30</td>
<td>1.8</td>
<td>5</td>
<td>68</td>
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</table>

### Table 2 – Surprises and disagreement: descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>$\sigma_S / \sigma_R$</th>
<th>$\mu_{\text{Disag}} / \sigma_R$</th>
<th>$\text{Out}$</th>
<th>$R^2_{\text{Disagr}}$</th>
<th>$t_{S-\text{lag}}$</th>
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<tr>
<td>Nonfarm Payrolls</td>
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<td>0.17</td>
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<td>ISM/NAPM</td>
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<td>Retail sales ex. autos</td>
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<td>0.34</td>
<td>0.16</td>
<td>0.45</td>
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<td>GDP (advance)</td>
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<td>0.21</td>
<td>0.04</td>
<td>0.40</td>
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<td>Core durable orders</td>
<td>0.97</td>
<td>0.40</td>
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<td>0.27</td>
<td>5.11</td>
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<td>Consumer confidence</td>
<td>0.34</td>
<td>0.13</td>
<td>0.32</td>
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<td>5.62</td>
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<tr>
<td>Initial jobless claims</td>
<td>0.26</td>
<td>0.11</td>
<td>0.28</td>
<td>0.49</td>
<td>11.84</td>
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<td>Capacity utilization</td>
<td>0.11</td>
<td>0.07</td>
<td>0.11</td>
<td>0.30</td>
<td>2.52</td>
</tr>
<tr>
<td>Trade balance</td>
<td>0.30</td>
<td>0.11</td>
<td>0.31</td>
<td>0.12</td>
<td>3.35</td>
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<tr>
<td>Leading Indicators</td>
<td>0.42</td>
<td>0.33</td>
<td>0.04</td>
<td>0.08</td>
<td>-0.86</td>
</tr>
<tr>
<td>CPI Core</td>
<td>0.97</td>
<td>0.53</td>
<td>0.08</td>
<td>0.21</td>
<td>3.34</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.09</td>
<td>0.04</td>
<td>0.19</td>
<td>0.24</td>
<td>5.41</td>
</tr>
</tbody>
</table>

$\sigma_S / \sigma_R$: ratio of st.dev. of surprises and actual releases; $\mu_{\text{Disag}} / \sigma_R$ ratio of average cross-sectional dispersion to the original series st.dev.; $\text{Out}$: fraction of times the release falls outside the range of forecasters’ expectations; $R^2_{\text{Disagr}}$ and $t_{S-\text{lag}}$ are the $R^2$ and the t-statistics of $\gamma$ of the regression of cross-sectional dispersion on its lag and the abs value of most recent surprise.
Methodology

disagreement and uncertainty: a preliminary view

Run Granger causality tests of disagreement series \((i = 1, \ldots, I)\) on past magnitude of the surprise as well as disagreement lags:

\[
Disag_{t,i} = \alpha + \beta Disag_{t-1,i} + \gamma |S_{t-1,i}| + u_t
\]

Disagreement indeed persistent, but past errors (just one proxy of uncertainty) amplify the heterogeneity as well.

How often the actual NFP falls outside support of *forecasts distribution*?
Heterogeneity of agents: accepted and recognized as a source of trade but, there may be different sources of heterogeneity:

- differences in endowments
- differences in information
  - processing: differential interpretation (Kandel Pearson, 1995)
- differences in prior beliefs (Buraschi and Whelan 2010, Ottaviani and Sørensen 2014)
- difference in preferences
Methodology

Relevance of these explanations? not a new question

Patton and Timmermann (2010) analyze analysts’ disagreement from Consensus Forecasts on GDP and $\pi$

To what extent agents disagree, does disagreement change over time?

What is the source of disagreement?

- differences in models or priors
- differences in information
- how does disagreement depend on the state of the economy

Trick: *term structure of disagreement*
In a *stationary world* differences among agents information signals should matter most at short forecast horizons, less so at long horizons

- At short horizon signals matter more
- At long horizons: mean reversion, heterogeneity in priors or models is more important

They find that *heterogeneity in priors* is important (in short as well as in long run) in driving disagreement
In models with private and public information, the announcement changes traders’ beliefs,

- inducing trade and price change, which reflect:
  - *average change in traders’ beliefs*: *surprise*
  - “relative quality” of the information in the announcement

- relative quality: increasing in the *precision* of the public signal and decreasing in the precision of preannouncement information

“A greater preannouncement information implies that the price reacts less to the surprise in the announcement” (Kim and Verrecchia, 1991)

**If disagreement** is interpreted as a measure of the quality of “preannouncement” information we would expect:

- *less disagreement* to be associated with *smaller price change*
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The learning framework is the following.

- Let the price, $p$, depend on a fundamental, say $X$, $p = \nu E(X)$.
- Agents have a prior on $X$ which is $X \sim N(\mu_F, \rho_F^{-1})$ where $\rho_F$ is the precision of the agents’ prior – e.g. the dispersion of beliefs of analysts.
- Signal on this variable comes as $A = X + \varepsilon$ where $\varepsilon \sim N(0, \rho_{\varepsilon}^{-1})$ and $A \sim N(\mu_F, (\rho_{\varepsilon} + \rho_F)^{-1})$.
- The impact of a surprise $A$ on prices is

$$[(P|A) - E(P)] = \mu_F + (A - \mu_F) \frac{\rho_{\varepsilon}}{\rho_{\varepsilon} + \rho_F}.$$
Adding and subtracting $A - \mu_F$ from the right side yields

$$[(P|A) - E(P)] = (A - \mu_F) - (A - \mu_F) \frac{\rho_F}{\rho_F + \rho_F} - \mu_F \frac{\rho_F}{\rho_F + \rho_F}.$$

- pure surprise
- surprise/beliefs interaction
- pure beliefs
Adding and subtracting $A - \mu_F$ from the right side yields

$$[(P|A) - E(P)] = (A - \mu_F) - (A - \mu_F) \frac{\rho_F}{\rho \varepsilon + \rho_F} - \mu_F \frac{\rho_F}{\rho \varepsilon + \rho_F}.$$

This equation can be tested econometrically by defining $(A - \mu_F)$ as the surprise and $\frac{1}{\rho \varepsilon / \rho F + 1} = (D / \rho F + 1)^{-1}$ where $D \equiv \rho \varepsilon$ is the inverse of the beliefs’ dispersion; thus the model is specified by

$$\Delta \rho_t = \alpha + \beta \cdot (A - \mu_F)_t + \gamma \cdot (A - \mu_F)_t \cdot D_t + \delta \cdot D_t + u_t$$

where by construction $\beta > 0$ and $\gamma, \delta < 0$. 
Theory: asymmetric information
How uncertainty is a determinant of sensitivity to news

Theory
- Kim and Verrecchia (1991)
- Kondor (2012)

Empirical findings
- Hautsch and Hesse (2008):
  - analyze Non-Farm payrolls surprise effect on 10y US Treasury
  - take disagreement on NFP as a proxy for “pre-announcement” uncertainty
  - estimate GARCH-type model for NFP, and assume that announcement precision, $n$, is proxied by the innovation variance
- Swanson and Williams (2014):
  - time variation of the bond yield sensitivity to news is well explained by uncertainty on short term evolution of Fed rates
What if instead of using an heterogenous information model framework, we consider model with *heterogenous prior* beliefs?

- Disagreement surveyed by Bloomberg reflects genuine agents’ heterogeneity.
- Heterogeneous agents: may have their own uncertainty, but we don’t observe it directly (unlike in surveys like the SPF).
Theory: heterogeneous beliefs
a stylized model borrowed from Ottaviani and Sørensen (2014)

Key predictions

- Competitive equilibrium price underreacts to public information
- Underreaction is more pronounced when prior beliefs are more heterogeneous
- also, in a dynamic setting, can explain the holy trinity: underreaction, momentum and price reversal

Features:

- Belief aggregation interacts with information aggregation
- wealth effects matter: depart from CARA utility assumptions (Grossman 1976)
- price does not react one to one with information
Theory: heterogeneous beliefs

assumptions

- 2 states of the world: $E$ (Expansion), $R$ (Recession)
- Assets: 2 Arrow-Debreu securities, pay 1 or 0 depending on state (each asset supply = 1)
- $p$ asset paying in $E$ state, $1 - p$ asset paying in $R$ state
- Continuum of traders, $i \in [0, 1]$
- Trader $i$ has a subjective prior $q_i = \text{Prob}_i(E)$
- Endowments: each trader starts off with $w_{i0}$ of each asset
- Initial distribution of assets: linked to agents prior beliefs, i.e.
- $G(q) \to [0, 1]$: share of assets in hands of agents with prior $q_i < q$, continuous and strictly increasing
- example: $G(q) = \frac{q^\gamma}{q^\gamma + (1-q)^\gamma}$, $\gamma \in (0, 1)$ is a measure of concentration of beliefs
Theory: heterogenous beliefs

Timing and setup

- 2 periods: in period 1 endowments are “homogenous” across states
- observe a public signal, \( \ell \), with likelihood ratio \( L \in (0, \infty) \)
- trading occurs after the public signal

A few hypotheses:

- HP1: traders cannot hold less than 0 of any asset
- HP2: traders are risk neutral
- HP3: concordant beliefs, i.e. traders update in the same manner” their beliefs

Heterogenous priors but common likelihood
Each agent $i$ updates beliefs according to Bayes rule:

$$\frac{P^i(E|\ell)}{P^i(R|\ell)} = \frac{P^i(\ell|E)}{P^i(\ell|R)} \times \frac{P^i(E)}{P^i(R)} = L \times \frac{q_i}{(1 - q_i)}$$

Posterior odds ratio = Likelihood ratio $\times$ Prior odds ratio

$$\frac{\pi_i}{(1 - \pi_i)} = L \times \frac{q_i}{(1 - q_i)}$$
Theory: heterogenous beliefs

An example

- What happens to the distribution, $G(q|\ell)$?
- \[ \text{Prob} (\pi_i \leq \bar{\pi}) = \text{Prob} \left( \frac{q_iL}{1-q_i} + q_iL \leq \bar{\pi} \right) = G \left( \frac{\bar{\pi}}{1-\bar{\pi}L} \right) \]

Posterior densities

![Graph showing prior and posterior densities](image)

| $\gamma$ | $\mu_G$ | $\mu_{G|\ell}$ | $\sigma_G$ | $\sigma_{G|\ell}$ |
|----------|---------|----------------|-----------|-----------------|
| 0.5      | 0.5     | 0.68           | 0.38      | 0.35            |
| 3        | 0.5     | 0.84           | 0.14      | 0.08            |
Theory: heterogeneous beliefs

Equilibrium condition

Market clearing requires that net trades are equal to zero:

\[
\frac{1}{p} \int_{p}^{1} w_i dG_i = \frac{1}{p} \quad \text{demand for } E
\]

\[
p = 1 - G \left( \frac{p}{L(1-p) + p} \right)
\]

- Aggregate demand for asset \( E \): \( 1/p \) times the cumulated wealth of agents with posterior beliefs (i.e. \( \pi_i \)) above \( p \)
  (but \( G(\pi) \) can be related to \( G(q) \), change of variable)
- Property: equilibrium price, unique solution, and \( p(L) \) strictly increasing in \( L \)
Theory: heterogenous beliefs
Marginal trader and equilibrium price

Underreaction and role of disagreement in “one line”

In the toy model with $G(q)$ shown earlier the price elasticity to “information” is mapped easily: for a given likelihood ratio (say $L = 6$) varying $\gamma$ leads to a different price response: more concentrated ($\uparrow \gamma$) more response

| $\gamma$ | $\mu_G$ | $\mu_{G|\ell}$ | $\sigma_G$ | $\sigma_{G|\ell}$ | Price | Marginal trader |
|---------|---------|----------------|-----------|-----------------|-------|-----------------|
| 0.5     | 0.5     | 0.68           | 0.38      | 0.35            | 0.645 | 0.232           |
| 3       | 0.5     | 0.84           | 0.14      | 0.08            | 0.793 | 0.390           |
| 10      | 0.5     | 0.86           | 0.04      | 0.02            | 0.836 | 0.459           |

As $\uparrow \gamma$ the price reaction approaches the posterior mean, while the marginal trader prior approaches 1/2: the effect of heterogeneity vanishes (no underreaction)
Wealth effects matter

- Higher $L$ increases price $p$ since:
  - optimistic traders (i.e. $q_i > \frac{p}{p+(1-p)L}$) can buy less units of asset $E$
  - pessimistic traders (i.e. $q_i < \frac{p}{p+(1-p)L}$) can buy more units of asset $E$

- To equilibrate the market the price must change to move agents from pessimistic to optimistic side

- The marginal trader is someone with more pessimistic prior belief

- Hence, although $p$ rises with $L$, it rises more slowly than the posterior belief

- The mechanism works through the link between heterogeneity and wealth distribution: e.g. more optimistic traders attract more resources and take larger positions in asset $E$. 
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Start from basic “event study” regression with surprises:

\[ \Delta y_t = \alpha + \sum_j \beta_j \cdot S_{t,j} + u_t \]

Add non linear effect which depends on forecaster disagreement, here we consider 2 regime dummies:

\[ \Delta y_t = \alpha + \sum_j \gamma_j \cdot S_{t,j} \cdot I_{t,L,j} + \sum_j \delta_j \cdot S_{t,j} \cdot (1 - I_{t,L,j}) + u_t \]

where

\[ I_t^L = \begin{cases} 
1, & \text{if } \text{cdf}(\text{Disag}_t) < \text{Upper} \\
0, & \text{otherwise} 
\end{cases} \]

- \( \Delta y_t \): returns (FX and 10y bonds)
- \( S_t \): Surprise series, Upper=percentile (66th)
- \( I_{t,L,i} \): disagreement regime, specific to each variable
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## Results
### US Treasury

<table>
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<th>Baseline</th>
<th>2 disagreement regimes</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>low disagr.</td>
<td>high disagr.</td>
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<tr>
<td><strong>10-year US Treasury yield</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Non Farm Payrolls</td>
<td>4.23</td>
<td>(5.03)</td>
<td>6.31</td>
<td>(7.29)</td>
</tr>
<tr>
<td>ISM Manufacturing</td>
<td>2.65</td>
<td>(4.78)</td>
<td>3.54</td>
<td>(5.58)</td>
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<tr>
<td>Retail sales ex.autos</td>
<td>2.58</td>
<td>(4.72)</td>
<td>2.94</td>
<td>(4.22)</td>
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<tr>
<td>GDP (advance)</td>
<td>1.85</td>
<td>(1.94)</td>
<td>2.98</td>
<td>(2.20)</td>
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<td>Core durable goods orders</td>
<td>1.60</td>
<td>(3.12)</td>
<td>0.92</td>
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<td>Consumer confidence</td>
<td>1.52</td>
<td>(3.02)</td>
<td>1.80</td>
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<td>Initial claims</td>
<td>-1.48</td>
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<td>Capacity utilization</td>
<td>0.73</td>
<td>(1.28)</td>
<td>1.59</td>
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<td>Trade balance</td>
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<td>CB leading indicator</td>
<td>0.77</td>
<td>(1.64)</td>
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<td>(-0.07)</td>
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<td>CPI Core</td>
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<td>(0.86)</td>
<td>0.59</td>
<td>(1.09)</td>
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<tr>
<td>Unemployment rate</td>
<td>-0.25</td>
<td>(-0.43)</td>
<td>-0.26</td>
<td>(-0.34)</td>
</tr>
<tr>
<td># Observations</td>
<td>1,626</td>
<td></td>
<td>1,626</td>
<td></td>
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<tr>
<td>$H_0$: $\delta_j = \gamma_j$, $\forall j$, p-value</td>
<td></td>
<td>0.08</td>
<td></td>
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<tr>
<td>$R^2$</td>
<td>0.098</td>
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<td>0.113</td>
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T-stats in parenthesis
## Results

### German Bund

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<th>Indicator</th>
<th>Baseline</th>
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<tr>
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</tr>
<tr>
<td>Retail sales ex.autos</td>
<td>1.40</td>
<td>(3.24)</td>
</tr>
<tr>
<td>GDP (advance)</td>
<td>0.96</td>
<td>(1.32)</td>
</tr>
<tr>
<td>Core durable goods orders</td>
<td>0.12</td>
<td>(0.33)</td>
</tr>
<tr>
<td>Consumer confidence</td>
<td>0.70</td>
<td>(1.86)</td>
</tr>
<tr>
<td>Initial claims</td>
<td>-0.95</td>
<td>(-4.84)</td>
</tr>
<tr>
<td>Capacity utilization</td>
<td>0.58</td>
<td>(1.47)</td>
</tr>
<tr>
<td>Trade balance</td>
<td>-0.11</td>
<td>(-0.31)</td>
</tr>
<tr>
<td>CB leading indicator</td>
<td>0.10</td>
<td>(0.33)</td>
</tr>
<tr>
<td>CPI Core</td>
<td>0.84</td>
<td>(1.88)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>-0.11</td>
<td>(-0.25)</td>
</tr>
</tbody>
</table>

| # Observations                     | 1,572    | 1,572                  |
| $H_0$: $\delta_j = \gamma_j, \forall j$, p-value | 0.20     | 0.061                  |
| $R^2$                              | 0.051    | 0.061                  |

t-stats in parenthesis
## Results

### USD/EUR exchange rate

<table>
<thead>
<tr>
<th>Metric</th>
<th>Baseline</th>
<th>Low Disagreement</th>
<th>High Disagreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Farm Payrolls</td>
<td>-0.30</td>
<td>-0.43</td>
<td>-0.18</td>
</tr>
<tr>
<td>ISM Manufacturing</td>
<td>-0.15</td>
<td>-0.10</td>
<td>-0.22</td>
</tr>
<tr>
<td>Retail sales ex.autos</td>
<td>-0.07</td>
<td>-0.14</td>
<td>0.00</td>
</tr>
<tr>
<td>GDP (advance)</td>
<td>-0.25</td>
<td>-0.12</td>
<td>-0.41</td>
</tr>
<tr>
<td>Core durable goods orders</td>
<td>-0.03</td>
<td>-0.04</td>
<td>-0.03</td>
</tr>
<tr>
<td>Consumer confidence</td>
<td>-0.03</td>
<td>-0.11</td>
<td>0.07</td>
</tr>
<tr>
<td>Initial claims</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.02</td>
</tr>
<tr>
<td>Capacity utilization</td>
<td>-0.03</td>
<td>-0.01</td>
<td>-0.04</td>
</tr>
<tr>
<td>Trade balance</td>
<td>-0.08</td>
<td>-0.13</td>
<td>-0.04</td>
</tr>
<tr>
<td>CB leading indicator</td>
<td>-0.01</td>
<td>-0.20</td>
<td>0.06</td>
</tr>
<tr>
<td>CPI Core</td>
<td>-0.01</td>
<td>-0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.09</td>
<td>0.10</td>
<td>0.09</td>
</tr>
</tbody>
</table>

|  # Observations                     | 1,628    | 1,628            |
|  $H_0$: $\delta_j = \gamma_j$, $\forall j$, p-value | 0.02     |
|  $R^2$                              | 0.0268   | 0.048            |

T-stats in parenthesis
NFP has the largest impact on **US long-term yields** followed by the ISM index, retail sales, the advance GDP rate of growth, and consumer confidence. Initial jobless claims and trade balance show a significant impact on long-term yields.

The impact of NFP, ISM, retail sales and initial claims is also large on **German 10-year yields**.

The **USD/EUR exchange rate** shows large sensitivity to surprises upon the release of NFP, ISM, and GDP growth.
Results
Two-disagreement regimes

With low/high disagreement US and German 10-year yields show a larger/smaller sensitivity to surprises; thus, in general we obtain:

\[ |\hat{\gamma}| > |\hat{\beta}| > |\hat{\delta}| \]

This suggests that:

- disagreement among forecasters is not to be interpreted simply as “prior” uncertainty as, for example, in Hautsch and Hess (2007)
- In contrast, heterogeneous beliefs model seems more consistent with our finding
- But what are the drivers of disagreement, how does it relate to other measures of macroeconomic uncertainty?
Results

disagreement or uncertainty?

An empirical matter, the jury is still out

- But disagreement matters per se: there may well be disagreement risk premium (Carlin, et al. 2014)
How to relate series specific disagreement to ...

- Disagreement relating to *overall macroeconomic conditions*?
- other measures: of macro uncertainty and investors risk aversion

Our **disagreement common factor** comoves, albeit partially, with the VIX:

![Graph showing the comovement between disagreement and VIX](image-url)

Disagreement: first common factor (lhs)
VIX (rhs)
Results

Robustness checks

- Investigate whether the asymmetric reaction to surprises found with daily returns data is
  - found also with high frequency (5min data) of returns: $\rightarrow$ Yes
  - due to some dimension of time variation (global financial crisis, QE): $\rightarrow$ Yes/No
- Investigate on an aggregate measure of disagreement, and use it in place of the individual specific disagreement: results are robust to this extension
**Finding** of a greater concentration of beliefs associated with greater response to macroeconomic surprises appears **even stronger**

\[ (\beta = \text{average}, \delta = \text{high disagreement response}, \gamma = \text{low disagreement response}) \]
Robustness to sample period /1

\[ \Delta y_t = \alpha + \sum_{\tau} D_{\tau} \phi_{L,\tau} \sum_j \gamma_j \cdot S_{t,j} \cdot I_{t,j}^L + \sum_{\tau} D_{\tau} \phi_{H,\tau} \sum_j \delta_j \cdot S_{t,j} \cdot (1 - I_{t,j}^L) + u_t \] (1)

Time-varying sensitivity of markets to surprises

<table>
<thead>
<tr>
<th></th>
<th>10-year US yield</th>
<th>10-year German yield</th>
<th>USD/EUR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>tran. crisis QE</td>
<td>tran. crisis QE</td>
<td>tran. crisis QE</td>
</tr>
<tr>
<td>( \phi_{L,\tau_i} )</td>
<td>1 0.88*** 0.92***</td>
<td>1 0.88*** 1.17***</td>
<td>1 0.77*** 0.16</td>
</tr>
<tr>
<td>( \phi_{H,\tau_i} )</td>
<td>1 0.98*** 0.65*</td>
<td>1 1.24*** -1.06*</td>
<td>1 1.19*** 0.36</td>
</tr>
</tbody>
</table>
10-year US Treasury yields
- Impact decreases during the QE period.
- Not much difference between the tranquil and QE period in a low-disag. regime; the impact is weaker during QE with high disagreement.
- The sensitivity is larger with high disag. than with low disag. in the crisis period; the order is inverted during the QE period.

10-year German yields
- Pronounced time variation, especially during the QE period.
- Opposite sign across the two disag. regimes (portfolio shift of investors from the US to the German bond market when disag. is high?)

USD/EUR exchange rate.
- No reaction during the QE period; reaction during the crisis (the order goes from low to high disag.)
- Indirect evaluation of the scapegoat theory of exchange rates (Bacchetta and Van Wincoop, 2013)
Outline

1. Motivation
2. What this paper does
3. Methodology
4. Theory
   - asymmetric information
   - heterogenous beliefs
5. Estimation
6. Results
7. Conclusions
Conclusions

- We analyze the impact of surprises on FX and long-term interest rates in the US and in Germany from 1999 to 2014.
- Exploit the full panel dimension of survey of economists forecasts on US scheduled macroeconomic releases.
- Unveil a new source of state dependence: **forecaster heterogeneity**.
- During low-disagreement regimes **surprises** impact more strongly asset prices.
- Interpret this result as more in line with a model with heterogenous prior beliefs rather than a standard ones with private/public signals.
Conclusions and further research

- This asymmetric reaction according to the extent of disagreement is a novel result.
- Disagreement reflects both series specific factors as well as common “macro driver”
- This disagreement can be linked to investors risk aversion as well as to uncertainty.
- More research is ongoing in this direction.
Thanks