

Demand for Information, Macroeconomic Uncertainty and the Response of U.S. Securities to News.¹

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Full working paper version available at :
<https://bit.ly/2ygGoP9>

1. The opinions expressed here are our own, and do not reflect the views of the Board of Governors or its staff.

Roadmap

Introduction

Measuring Information Demand

Treasury Price Reactions to News

Interpretation

Additional Tests

Final Thoughts

News and Securities Prices

1. **Why do sometimes news (e.g., macro-economic announcements, earnings announcements etc.) have a big impact on asset prices and other times they do not ?**
 - Important to understand the origin of volatility in securities markets (e.g., news significantly contribute to volatility in stock markets; Boudoukh, Felman, Kogan and Richardson (2018)).

News and Securities Prices

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2. **News= information and information move investors beliefs about asset cash flows.**

News and Securities Prices

- 1. Why do sometimes news (e.g., macro-economic announcements, earnings announcements etc.) have a big impact on asset prices and other times they do not ?**
 - Important to understand the origin of volatility in securities markets (e.g., news significantly contribute to volatility in stock markets; Boudoukh, Felman, Kogan and Richardson (2018)).
- 2. News= information and information move investors beliefs about asset cash flows.**
- 3. Standard Bayesian learning models predict that the magnitude of asset price responses to news is :**
 - 3.1** Positively affected by investors' prior uncertainty (news move prices more if cash flows, before the news, are more uncertain).
 - 3.2** Negatively affected by the noise in news (news move prices more if their informational content is more accurate).

Uncertainty and Information Demand

- **Implication :**
 1. One can forecast securities price reactions to news if one can measure investors' uncertainty ahead of news.
 2. Often difficult (e.g., investors' perceived uncertainty is not easily measured).
- **Idea : Measure directly effort in information collection by investors.**
 1. If more uncertainty about fundamentals, investors should search for more information to reduce uncertainty ("demand more information").
 2. More information demand ahead of news should be associated ("predict") with greater price reactions to news

Our Laboratory

- **News** : **Macro-economic announcements** (Non Farm Payroll-NFP).
- **Asset Class** : **Treasuries**. Why ?
 1. Treasury prices are sensitive to macro-economic news
 2. Large literature on the effects of macro-economic news on treasury prices (Balduzzi, Elton, and Green, 2001; Andersen, Bollerslev, Diebold, and Vega, 2003; Hautsch and Hess, 2007; Swanson and Williams, 2014).
 3. Significant time variations in the sensitivity of treasury prices to macro-news; not well understood (Swanson and Williams (2014), Goldberg and Grisse (2013)).
- **Measure of demand for information** :
 1. **Click data** : Number of clicks on internet links (> 40,000) directing to news about nonfarm payroll announcements in the **4 hours preceding an announcement** from 2011 to 2016 (66 announcements).

Main Findings

- **Well known** : Positive surprises in NFP news announcements → Drop in treasury prices.
- **New** :
 1. **The sensitivity of treasury prices to NFP news announcements is much stronger when investors demand more information shortly before the announcement.**
 2. This effect does not vanish when we control for media coverage about forthcoming nonfarm payroll announcements (**news consumption \neq news supply**).
 3. It does not vanish when we control for many other known determinants of the sensitivity of treasury prices to macro-economic announcements.
 4. Consistent with the idea that elevated information demand ahead of news is due to elevated perceived uncertainty.

Rest of the talk

1. Our data for measuring information demand.
2. Information demand ahead of Non Farm Payroll (NFP) news announcements is strongly associated with stronger treasury price reactions to surprises in NFP news announcements.
3. A theory that explains this finding.
4. Additional evidence in favor of the theory.
5. Conclusions

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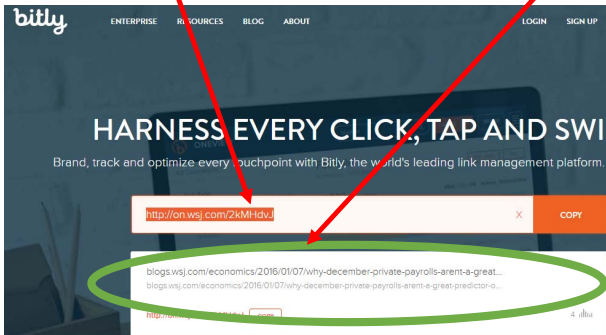
Additional Tests

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Data : Bitly Shortened Links

- We use data provided by “Bitly” (<https://bitly.com/>)
- Bitly provides short-URL-links (SURLs).

Shortened Bitly Link Original Address

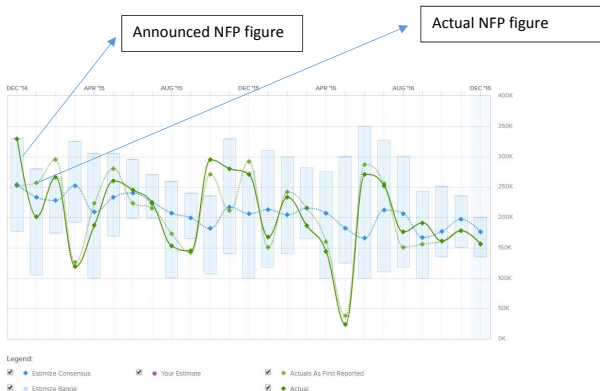


Bitly Shortened Links

- **Advantages for users :**
 1. Easier to share by e.mails, text messages, tweets, and on micro-blogging sites constraining users in the number of characters that they can use.
 2. SURLs' creators can track readership statistics ⇒ Bitly is used by journalists and news agencies for tracking the popularity of their articles.
- **Our (big) data : 70 million links with 10 billions clicks.**
 1. **January 2011 to June 2016 :** All Bitly SURLs pointing to articles provided by 59 major online news providers (e.g., Bloomberg, WSJ, FT etc.).
 2. **The data contains :** A click on a Bitly link with additional specific information : Original URL, Login name of the link creator, time stamp of when the article was shared, clickers' geographical location, access mode (direct, tweeter, Facebook etc.)

Non-Farm Payroll Figures

- We focus on demand for information about Non Farm Payroll in the U.S. ahead of the release of this figure by the BoL every month.
- An estimate of this figure for month $t - 1$ is released at 8 :30 a.m. on the first Friday of the next month.



Non Farm Payroll (NFP) Clicks

JOHN JONES, A NEWS CORP COMPANY
DIA 20750.78 ▲0.42% ▲ S&P 500 2706.57 ▲0.05% ▲ Nasdaq 7741.02 ▲0.95% ▼ US 10-YR ▲F
THE WALL STREET JOURNAL.
The copy is for your personal, non-commercial use only. To order presentation-ready copies for distribution to your colleagues, visit www.wsj.com.
<http://www.wsj.com/archive/FR13000072286300440211545793040244758912>

DJFXTRADER

Nonfarm Payrolls May Show a Big Surprise

By Vincent Cignarella
October 4, 2012



If you are fixating on whether Friday's U.S. nonfarm-payrolls report will show that jobs rose in September by the consensus forecast of 118,000, you might be focusing on the wrong number.

The real action, at least for short-term traders with an eye for opportunistic investing, could lie in the revisions to prior months. And if history and its uncanny record of upward adjustments to August numbers is any guide, such traders might want to be ready to buy the dollar versus the yen.

Eventually, the noise of a difficult global investing environment—marked by euro-zone uncertainty, geopolitical risks and unprecedented central-bank activity—will push both September data and the August revisions into the background. But for a little while we could have something to play with.



<https://on.wsj.com/2OCpDAu>



Click 1

(time, IP,
Mode of access,
Location)

Click 2

(...)

Click 3

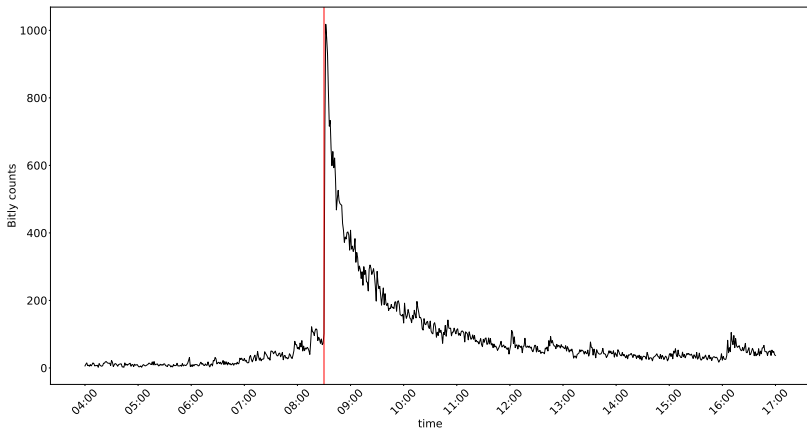
(...)

Etc.

NFP Clicks

- **We select all clicks on links pointing to headline news containing the word “payroll” on announcement days around NFP announcements (from 4 :00 a.m. to 5 :00 p.m.).**
- → 43,648 clicks (“NFP clicks”) : 4,685 clicks before and 38,963 after.
- **Proxy for information demand about NFP before NFP announcement $n \in \{1, \dots, 66\}$:**
 1. *BitlyCounts* : Number of NFP clicks in the 2 hours preceding the announcement.
 2. *HighBitly* : A dummy variable equal to 1 when this number is higher than its median value.

Intraday Bitly Counts Around Nonfarm Payroll Announcements



Nonfarm payroll clicks : News sources

- Bloomberg is an important source of news : For our tests, we just use counts based on Bloomberg (not important).

News Source	URL	Number of Clicks	Percent of Total Number of Clicks	Cumulative Percent
-------------	-----	------------------	-----------------------------------	--------------------

Panel A: Prior to nonfarm payroll release, from 6:25 am to 8:25 am

Bloomberg	www.bloomberg.com	3,438	73	73
Marketwatch	www.marketwatch.com	340	7	80
Wall Street Journal	www.wsj.com	277	6	86
Financial Times	www.ft.com	221	5	91
USA Today	www.usatoday.com	173	4	95
CNBC	www.cnbc.com	153	3	98

Panel B: During and after nonfarm payroll release, from 8:26 am to 10:26 am

Bloomberg	www.bloomberg.com	26,235	67	67
CNBC	www.cnbc.com	5,769	15	82
Reuters	www.reuters.com	1,860	5	87
Marketwatch	www.marketwatch.com	1,265	3	90
Wall Street Journal	www.wsj.com	1,173	3	93
USA Today	www.usatoday.com	772	2	95

Nonfarm payroll clicks : Originators

Bitly User Type	Number of Clicks	Percent of Total Number of Clicks	Cummulative Percent
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Panel A: Prior to nonfarm payroll release, from 6:25 am to 8:25 am

Official Bloomberg Users	2,508	54	54
Seven Individual Users	1,349	29	83
Official WSJ Users	201	4	87
Official USA Today Users	173	4	91
Official Marketwatch Users	148	3	94
Official CNBC Users	74	2	96
Official FT Users	57	1	97
Official Reuters Users	8	0.2	96.2

Panel B: During and after nonfarm payroll release, from 8:26 am to 10:26 am

Official Bloomberg Users	18,228	47	47
Seven Individual Users	10,485	27	74
Official CNBC Users	3,914	10	84
Official Reuters Users	1,528	4	88
Official WSJ Users	1,031	3	94
Official USA Today Users	669	2	96
Official NPR Users	635	2	97
Official Marketwatch Users	257	1	98

How do people access to news?

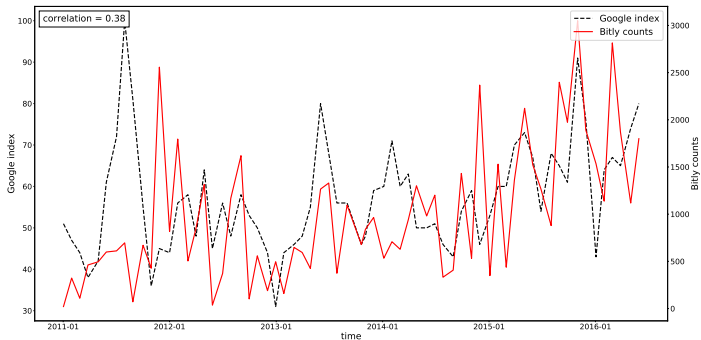
Table 4: How are Bitly Links Accessed

How are links accessed	Number of Clicks	Percent of Total Number of Clicks	Cummulative Percent
Panel A: Prior to nonfarm payroll release, from 6:25 am to 8:25 am			
Twitter	2,338	50	50
Directly	1,928	41	91
Facebook	261	6	97
Google	29	1	98
Financial Times	16	0.3	98.3
Stock Twits	16	0.3	98.6
Market Early Bird	11	0.2	98.8
Panel B: During and after nonfarm payroll release, from 8:26 am to 10:26 am			
Twitter	17,690	45	45
Directly	16,046	41	86
Facebook	3,819	10	96
Google	508	1	97
Daily FX	88	0.2	97.2
Hoot Suite	56	0.1	97.3
Market Early Bird	42	0.1	97.4

Other Measures of Information Demand

- The literature has used **Google searches (measured by Google trend)** about a specific item (e.g., a stock ticker) as a measure of attention to this item (e.g., a stock name); see Da, Engelberg, and Gao (2011)).
- **Google trend = low frequency measure of attention** (highest available frequency is weekly) and it is more likely to capture retail investors' demand for information (see Da, Engelberg, and Gao (2011)).
- The correlation between weekly Bitly clicks on news related to nonfarm payroll and the Google trend index for the topic "nonfarm payroll" is 0.64 and drops to 0.38 in weeks in which nonfarm payroll announcements take place \Rightarrow Do not capture the same attention/demand (maybe not the same users).

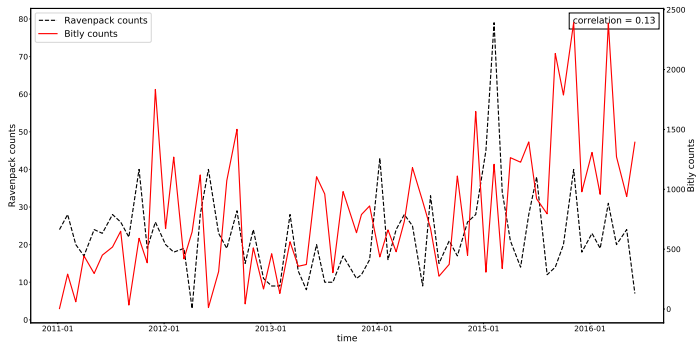
Google Trend vs. Bitly Clicks



Demand or Supply of Information ?

- Media coverage (information supply) can also influence investors' attention (see Peress (2008)).
- To control for media coverage of nonfarm payroll announcements, we use data from **RavenPack's story dataset**.
- **Supply = "RavenPack News Count" = daily Nber of news headlines covered by Ravenpack containing the word "payroll"**.
- The correlation between daily Nber of NFP Bitly clicks and RavenPack News Count is 0.67 and drops to 0.13 on days in which nonfarm payroll announcements take place.

Demand or Supply of Information ?



Roadmap

Introduction

Measuring Information Demand

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Interpretation

Additional Tests

Final Thoughts

Benchmark 1/2

- **To measure the response of treasury prices to nonfarm payroll announcements, we estimate :**

$$TenMinuteReturn_t = \alpha + \beta_S \times Surprise_t + \epsilon_t, \quad (1)$$

where

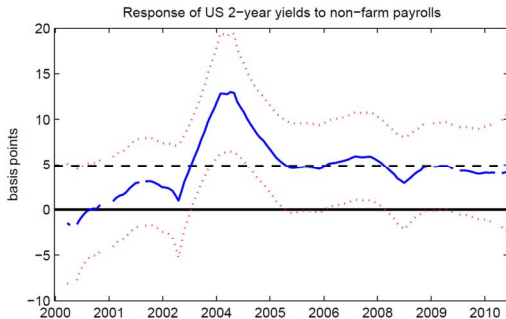
1. $TenMinuteReturn_t$ is the difference in the (log) price of the front-month futures on a U.S. treasury note (of 2, 5 or 10 years maturity) over a 10 minutes window around the announcement time (8 : 25 to 8 : 35 a.m.)
2. $Surprise_t$ is the difference between the actual release of the non-farm payroll figure on day t and the median forecast of this figure submitted to Bloomberg by professional forecasters (standardized by its standard deviation).

Benchmark 2/2

	(1) Jan. 2004 - Jun. 2016	(2) Jan. 2011 - Jun. 2016	(3) Jan. 2011 - Jun. 2016 (exclud. SW ZLB period)
Response of the Two-Year U.S. Treasury Note Futures			
Nonfarm Payroll Surprise	-11.00*** (0.904)	-6.613*** (0.964)	-8.020*** (1.183)
Constant	-0.786 (0.745)	0.255 (0.660)	0.0705 (0.833)
Number of Observations	150	66	49
Adjusted R-squared	0.500	0.424	0.494
Response of the Five-Year U.S. Treasury Note Futures			
Nonfarm Payroll Surprise	-29.81*** (2.135)	-28.17*** (3.220)	-30.92*** (4.013)
Constant	-1.651 (1.759)	0.759 (2.203)	0.216 (2.826)
Number of Observations	150	66	49
Adjusted R-squared	0.568	0.545	0.558
Response of the Ten-Year U.S. Treasury Note Futures			
Nonfarm Payroll Surprise	-41.58*** (2.938)	-43.93*** (4.728)	-44.93*** (5.854)
Constant	-3.629 (2.421)	-0.449 (3.234)	-0.990 (4.123)
Number of Observations	150	66	49
Adjusted R-squared	0.575	0.574	0.556

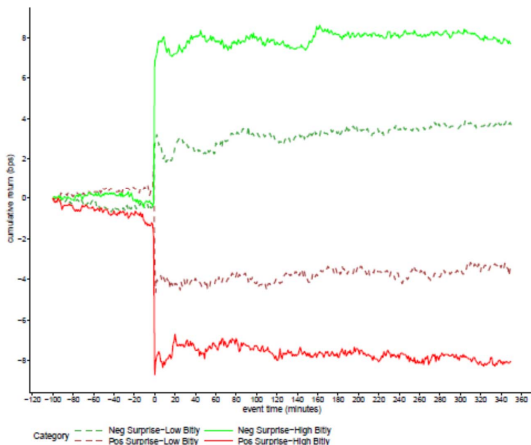
Time-Variations in News Impact

FIGURE – Goldberg and Grisse (2015), NBER Working Paper



Information Demand and Price Reactions to News

Figure 5: Intra Day Bitly Counts on Nonfarm Payroll Days



Determinants of the sensitivity of treasury prices to nonfarm payroll announcements

- **We then consider various possible determinants of the sensitivity of treasury prices to nonfarm payroll announcements in addition to information demand :**

$$r_t = \alpha + \beta_S Surprise_t + \beta_{SX} Surprise_t \times X_t + \beta_X X_t + \epsilon_t \quad (2)$$

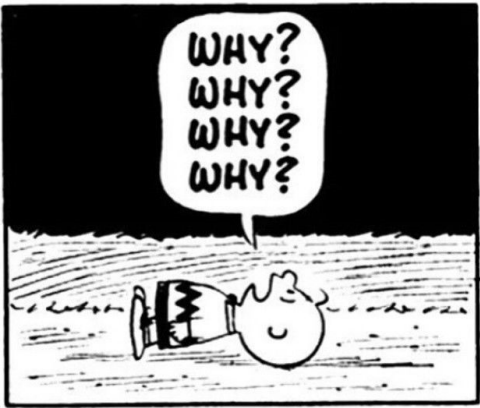
where X_t is a vector of additional control variables grouped in 5 categories :

1. Monetary Policy
 2. Risk
 3. Quality of public signals
 4. Trading Environment
 5. Information demand and supply
- **I present results only for two years treasury notes. Results for other maturities are qualitatively similar.**

The Role of Information Demand

	(1)	(2)	(3)	(4)	(5)	(6)
NFP Surprise	-3.401 (6.328)	-8.281** (3.814)	-9.970*** (2.763)	-9.985 (9.312)	-0.956 (1.955)	-2.817 (13.40)
Monetary Policy Variables						
NFP Surprise x FFR Level		-0.362 (15.61)				-9.528 (20.49)
NFP Surprise x Swanson-Williams Period		5.727* (2.941)				4.052 (4.822)
NFP Surprise x Market-implied Uncertainty		-0.0387 (0.0694)				-0.0812 (0.114)
NFP Surprise x News-based Uncertainty		-0.0115 (0.0177)				-0.000145 (0.0233)
Risk						
NFP Surprise x VIX Index		0.0997 (0.220)				-0.383 (0.373)
Information Environment						
NFP Surprise x Past Revision Noise			0.0704 (0.0616)			0.00710 (0.0826)
NFP Surprise x Past Forecast Errors			-2.370 (3.040)			-3.105 (4.003)
NFP Surprise x Past Forecast Dispersion			23.53 (15.64)			15.17 (26.77)
Trading Volume and Volatility						
NFP Surprise x Past Trading Volume				4.749 (6.702)		8.833 (10.23)
NFP Surprise x Past Realized Volatility				-23.64 (20.07)		-6.211 (26.08)
Information Demand and Supply						
NFP Surprise x High Bitly Count					-5.335*** (1.872)	-4.125* (2.433)
NFP Surprise x High Media Coverage Count					-3.508* (1.969)	-2.765 (3.008)
NFP Surprise x High Google Index					-1.196 (1.894)	-2.102 (2.543)
Constant	-0.0656	0.271	-0.0266	-4.800	1.170	0.516

Why?



Roadmap

Introduction

Measuring Information Demand

Treasury Price Reactions to News

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Additional Tests

Final Thoughts

Framework

- Consider a risky asset with payoff :

$$F = \mu + \alpha \underbrace{A_r}_{\text{Macro-economic fundamental}}, \quad (3)$$

where A_r has a normal distribution with mean 0 and precision τ_{A_r} (**fundamental uncertainty**).

- The payoff of the asset is realized at date 3. α can be viewed as the importance of A_r for monetary policy in the case of treasury markets.
- At date 0, risk averse investors** can acquire a signal $s_i = A_r + \eta_i$ about A_r with precision τ_{η_i} . A signal with precision τ_{η_i} costs $c(\tau_{\eta_i})$. Higher precision requires collecting more information ($c'(\tau_{\eta_i}) > 0$).
- Demand for information** : Average precision of all signals :

$\bar{\tau}_\eta$

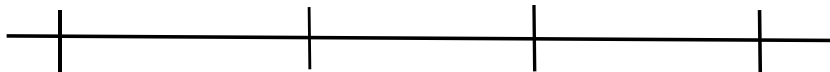
Timeline

Time 0: Information acquisition

Time 1: Trading ahead of news

Time 2: News arrives

Time 3: Uncertainty is resolved



1- Investors collect information about the macroeconomic fundamental and obtain a signal $\mathbf{s}_i = \mathbf{A}_r + \boldsymbol{\eta}_i$ with precision τ_i .

2-Demand for information is realized

1- Investors trade on their signals (submit demand $d(\mathbf{s}_i, p_1)$).

2-Price (p_1) is set and equal the expected payoff conditional on aggregate demand:

$$p_1 = E(F | D(p_1))$$

1- **News arrives** about the fundamental (A_r):

$$NFP = \underbrace{A_r}_{\text{Fundamental}} + \underbrace{\varepsilon}_{\text{Noise}}$$

2-Price is updated (p_2):

$$p_2 = E(F | D(p_1), NFP)$$

1. Uncertainty on the macroeconomic fundamental (A_r) is resolved

2. Asset Payoff (F) is realized.

Equilibrium Prices

- **Price at date 2 (holding information demand constant) :**

$$p_2 = p_1 + \beta \underbrace{(NFP - E(NFP | p_1))}_{\text{Surprise}}, \quad (4)$$

with

$$|\beta| = \frac{|\alpha| \tau_\epsilon}{\tau_\epsilon + \tau_1}. \quad (5)$$

- $\rightarrow \beta$ **measures the sensitivity of the price reaction to the surprise in the macro-economic announcement.** It
 1. Increases in the precision of the announcement (τ_ϵ).
 2. Decreases in the precision of the information available to the market **before** the announcement (“**prior precision** :” τ_1).

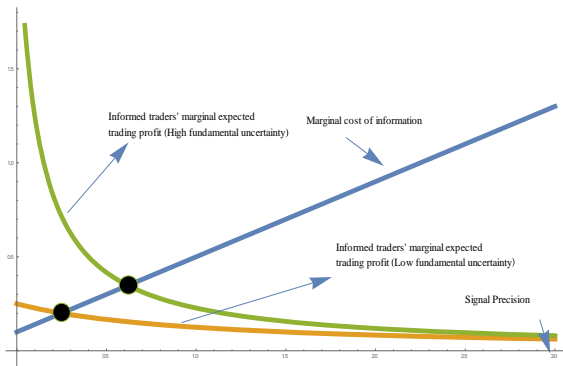
Prior Precision about fundamental (τ_1) = Ex-ante precision (τ_{A_r}) + Information demand ($\bar{\tau}_\eta$)

Causality vs. Correlation

- The model predicts that an increase in information demand before the announcement should reduce the sensitivity of treasury prices to the announcement.
 1. This is the opposite of what we find empirically.
 2. **But information demand is endogenous....**
 3. Thus, it might co-vary with other variables affecting the price reaction coefficient, β (in particular fundamental uncertainty).
- \Rightarrow **We must account for the endogeneity of information demand to understand the data. Economics is important for interpreting correlations....**

Equilibrium Demand for Information

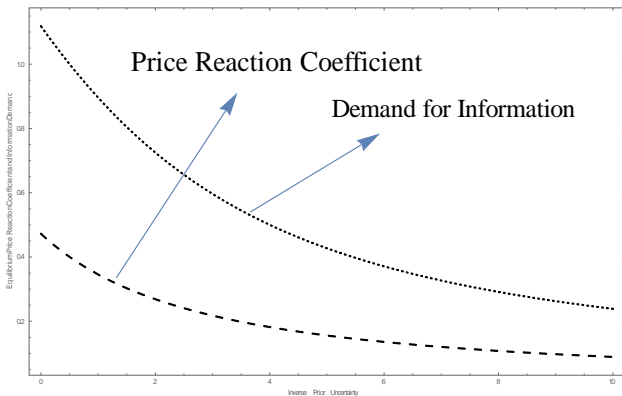
- Investors choose the precision of their signals (level of effort in collecting information ahead of news) to maximize their expected profit (marginal profit = marginal cost).



Summary

- **An increase in uncertainty about the macro-economic fundamental :**
 1. **Directly** raises the sensitivity of bond prices to macroeconomic news announcements ($\beta \uparrow$ when τ_{A_r} decreases)
 2. Raises demand for information ($\bar{\tau}_\eta \uparrow$ when $\tau_{A_r} \downarrow$, which **indirectly** reduced the sensitivity of bond prices to macro-announcements.
- **The second effect dampens the first but never offsets it completely** \Rightarrow Positive correlation between information demand and price reaction to macro-news, as we find empirically for nonfarm payroll announcements.

Uncertainty, Price Reaction and Information Demand



Roadmap

Introduction

Measuring Information Demand

Treasury Price Reactions to News

Interpretation

Additional Tests

Final Thoughts

Determinants of Information Demand

- Is information demand positively correlated with uncertainty on macro-economic fundamentals?

Dependent Variable= Daily #NFP clicks/40-days moving average daily #NFP clicks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NFP Announcement Day Dummy	25.22*** (0.778)	25.24*** (0.779)	16.03*** (1.767)	25.19*** (0.807)	20.49*** (1.112)	22.81*** (0.588)	13.38*** (1.825)
Monetary Policy Variables							
FFR Level		-1.782 (2.285)					-1.071 (2.280)
Swanson-Williams Period		0.0583 (0.0002)					0.129 (0.0009)
Market-implied Policy Uncertainty		0.0302** (0.0118)					0.0308** (0.0127)
News-based Policy Uncertainty		0.00166 (0.00227)					0.00242 (0.00240)
Risk							
VIX Index		0.00264 (0.0288)					-0.0470 (0.0432)
Information Environment							
Revision Noise			0.0682 (0.0458)				0.0310 (0.0462)
Forecast Error			13.80*** (1.856)				12.93*** (1.849)
Forecast Dispersion			2.001 (1.910)				3.708 (2.544)
Trading Volume and Volatility							
Abnormal Trading Volume				0.424 (0.341)			0.448 (0.334)
Abnormal Realized Volatility				-0.347 (1.206)			-1.349 (1.185)
Information Demand and Supply							
Media Coverage Count					0.243*** (0.0411)		0.211*** (0.0413)
Weekly Google Index						0.146 (0.119)	
Constant	-1.134 (1.109)	0.457 (0.527)	0.185 (0.345)	0.419 (1.096)	0.377** (0.167)	0.310* (0.169)	-0.509 (1.403)
Number of Observations	1,417	1,417	1,417	1,417	1,417	1,381	1,417

Additional Prediction

- **The model implies that :**
 1. The price impact of trades before the public announcement (λ) is stronger when the demand of information is stronger.
 2. The price impact of trades before the public announcement is stronger when macro-economic uncertainty is higher, holding information demand constant.
 3. \Rightarrow Endogenous information demand reinforces the effect of macro-uncertainty on the price impact of trades ahead of macro news.
- We test this prediction by estimating :

$$\begin{aligned} \text{OneMinuteReturn}_{\tau t} = & \alpha + \beta_S \text{Surprise}_t + \\ & I_B(\lambda_B \text{OrderFlow}_{\tau t} + \kappa_B \text{HighBitlyCount}_t \times \text{OrderFlow}_t) + \\ & I_A(\lambda_A \text{OrderFlow}_{\tau t} + \kappa_A \text{HighBitlyCount}_t \times \text{OrderFlow}_t) + \epsilon_t, \end{aligned} \quad (6)$$

Price Impact and Information Demand

Table 14: Order Flow Impact

	(1)	(2)	(3)	(4)	(5)	(6)
	Two-Year		Five-Year		Ten-Year	
Nonfarm Payroll Surprise	-5.715*** (0.103)	-5.708*** (0.103)	-22.82*** (0.290)	-22.76*** (0.298)	-27.56*** (0.466)	-27.47*** (0.465)
Order Flow x Two Hours Before	0.104*** (0.0124)	0.0797*** (0.0139)	0.515*** (0.0421)	0.573*** (0.0639)	0.698*** (0.0407)	0.630*** (0.0565)
Order Flow x Two Hours Before x High Bitly Count		0.122*** (0.0308)		-0.104 (0.0849)		0.141* (0.0812)
Order Flow x Two Hours After	0.203*** (0.00605)	0.185*** (0.00851)	0.999*** (0.0186)	0.888*** (0.0269)	1.071*** (0.0144)	0.942*** (0.0198)
Order Flow x Two Hours After x High Bitly Count		0.0362*** (0.0120)		0.206*** (0.0362)		0.247*** (0.0262)
Constant	0.00225 (0.00449)	0.00236 (0.00449)	0.00342 (0.0128)	0.00292 (0.0128)	0.000976 (0.0187)	0.000715 (0.0187)
Number of Observations	15,840	15,840	15,840	15,840	15,840	15,840
Adjusted R-squared	0.237	0.238	0.424	0.425	0.496	0.499

Roadmap

Introduction

Measuring Information Demand

Treasury Price Reactions to News

Interpretation

Additional Tests

Final Thoughts

Final Thoughts

- **Data on news consumption by investors (e.g., search for news on bloomberg terminals, Bitly clicks etc.) offer opportunities to measure information demand in securities markets.**
 1. **Important from an academic viewpoint** because information demand plays a central role in cornerstone theories of price formation in securities markets (e.g., Grossman and Stiglitz (1980)).
- **Important from a practical and regulatory viewpoint :**
 1. **Example :** Does algorithmic trading reduce fundamental information production ?
 2. **Example :** Forecasting future volatility with information demand (information demand is high when fundamental uncertainty is high).

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