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Is the Intrinsic Value of Macroeconomic News Announcements Related to their Asset Price Impact?*

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Abstract

The literature documents a heterogeneous asset price response to macroeconomic news announcements. We explain this variation with a novel measure of the intrinsic value of an announcement – the announcement's ability to nowcast GDP growth, inflation, and the Federal Funds Target Rate – and decompose it into the announcement's relation to fundamentals, a timeliness premium, and a revision premium. We find that differences in intrinsic value can explain a significant fraction of the variation in the announcements' price impact on Treasury bond yields. The announcements' timeliness and relation to fundamentals are the most important characteristics in explaining this variation.

Keywords: Macroeconomic announcements, price discovery, learning, forecasting, nowcasting
JEL classification: G14, E37, E44, E47, C53, D83

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1. Introduction

An extensive literature has linked macroeconomic news announcements to movements in stock, government bond, and foreign exchange returns.[1] Some of these papers have highlighted the heterogeneous response of asset prices to news: Some announcements have a strong impact on asset prices, but some do not. However, there are no papers that systematically investigate what causes this heterogeneous response. In this paper, we help fill in the void by (i) proposing, estimating and decomposing a novel empirical measure of announcements' intrinsic value, and (ii) relating differences in the U.S. Treasury bond market's responses to differences in our novel measures of announcement characteristics.

First, motivated by economic theory, we define and estimate the intrinsic value of an announcement as its importance in nowcasting the following primitives or fundamentals: the U.S. Gross Domestic Product (GDP), the GDP price deflator, and the Federal Funds Target Rate (FFTR). More precisely, the intrinsic value is the nowcasting weight placed on the macroeconomic announcement at the time of its release.

Next, using the same nowcasting framework, we decompose this intrinsic value into three components that capture the announcement's relation to fundamentals, timing, and revisions. While the previous literature has discussed each of the last two characteristics in isolation, our contribution is to formally define all three announcement characteristics coherently within a single nowcasting framework. Our definition of the announcement's relation to fundamentals is its importance in nowcasting our three primitives independent of the announcement's release time and revisions. We define the announcement's timeliness premium as the change in its nowcasting weight due to its release time. Similarly, we define

[1] Papers that study the government bond market response to macroeconomic announcements include Fleming and Remolona (1997, 1999), Balduzzi et al. (2001), Goldberg and Leonard (2003), Gürkaynak et al. (2005), Beechey and Wright (2009), and Swanson and Williams (2014). Papers that study the foreign exchange market response include Almeida et al. (1998), Andersen et al. (2003), and Ehrmann and Fratzscher (2005). See Neely and Dey (2010) for a review of the literature on foreign exchange response to macroeconomic announcements. Studies of the stock market response include Flannery and Protopapadakis (2002), Ehrmann and Fratzscher (2004), Bernanke and Kuttner (2005), and Bekaert and Engstrom (2010). Boyd et al. (2005), Faust et al. (2007), Bartolini et al. (2008), among others, study multiple asset classes simultaneously.

the announcement's revision premium as the change in its nowcasting weight due to its future revisions.

Finally, we relate an announcement's intrinsic value, timeliness, revision, and relation to fundamentals to the announcement's asset price impact. We find that using GDP as the nowcasting target is more useful in explaining the price impact of announcement surprises than using the GDP deflator or the FFTR. When using GDP as the nowcasting target, our intrinsic value measure explains between 12 and 19 percent of the variation in the heterogeneous response of asset prices to macroeconomic news announcements. When we estimate the importance of the three individual announcement characteristics separately, we find that our novel measures of timeliness and relation to fundamentals are the most important characteristics in explaining the announcement's price impact. Note that our novel measure of intrinsic value explains the heterogeneous response of asset prices to macroeconomic announcements better than other variables discussed in the previous literature, such as the reporting lag of the announcement and the magnitude of its revisions.

Since our focus is on understanding the U.S. Treasury bond market's response to macroeconomic news announcements, we choose nowcasting primitives that are consistent with this literature. In particular, Beechey and Wright (2009) group macroeconomic announcements into three broad categories: news about real output, news about prices, and news about monetary policy.[2] The primitives we choose, namely GDP, GDP price deflator, and the FFTR, are representative of each of these categories. When studying the response of other asset classes to macroeconomic announcements, researchers should consider other primitives: For example, in the case of foreign exchange markets, the primitives should include both domestic and foreign monetary policy rates.

Our paper contributes to the literature by showing that the price response to a particular type of announcement cannot be analyzed in isolation.[3] The effect that announcements

[2]Since nominal Treasury bond prices embody inflation expectations and expected future real interest rates, news about prices, real output, and monetary policy are natural choices of primitives.

[3]Recent studies by Ehrmann and Sondermann (2012) and Lapp and Pearce (2012) further support this view.

have on asset prices crucially depends on the information environment. When studying the link between asset prices and macroeconomic fundamentals, researchers need to account not only for the surprise component of an announcement but also for the announcement's intrinsic value, its relation to fundamentals, its timeliness, and its revisions, all relative to other announcements. For example, researchers who analyze the effect that final GDP announcements have on asset prices are likely to find that they have no impact and may therefore wrongly conclude that there is a disconnect between asset prices and macroeconomic fundamentals. We show that asset prices do not react to final GDP announcements because, even though its relation to fundamentals is high, the timeliness of the GDP final release is poor and, as a result, the price impact of GDP final announcements relative to other announcements is small.

Importantly, our analysis shows that the relationship between the intrinsic value of an announcement and its asset price impact is not perfect. In particular, we find that nonfarm payroll has the biggest impact on U.S. Treasury bond yields, yet it is not the announcement with the biggest intrinsic value. This raises the possibility that there may be an overreaction to certain announcements, such as nonfarm payroll, because of the coordination value of public information beyond its intrinsic value, as in the model of Morris and Shin (2002). Another possibility is that our definition of the intrinsic value of macroeconomic announcements needs to be further refined. For example, one could consider other primitives, like term premia. Furthermore, even though our method allows announcements to vary in their importance over time, one could impose more structure to better estimate this time-variation, as in Bacchetta and van Wincoop (2013) and Goldberg and Grisse (2013), for example. Another extension would be to control for regime switches driven by, for instance, Alan Greenspan's 2004 statement that nonfarm payroll numbers are more informative than the unemployment numbers.[4] We leave these extensions to future research.

[4] Gürkaynak and Wright (2013) show that Greenspan's statement shifted the market's attention to nonfarm payroll and away from the unemployment rate. This may be because investors became convinced that nonfarm payroll is indeed more informative about the state of the economy. Or it may be because investors learned what the Federal Reserve pays attention to it, allowing them to predict future policy actions.

2. Macroeconomic and Financial Data

We collect data on 36 U.S. macroeconomic series, listed in Table 1, covering a broad set of real activity, prices, consumption, and investment variables. For each of these, we have announcement dates and times, (median) market expectations, initial (actual) released values, and final (revised) values. Each announcement $a^n_{p,t}$ is uniquely identified by the index number n of the announcement series in Table 1, by the date and time t of its release, and by its reference period p. Nonfarm payroll released in early February, for example, has January as its reference period. Table 1 also provides the announcement unit used in both the agency reports and the market expectations, the time(s) of the announcements, and the number of observations for each quarterly, monthly or weekly variable.

For a given reference month p, the release of macroeconomic information follows a relatively stable and predictable schedule. Figure 1 shows, for instance, that the University of Michigan (UM) consumer confidence index is almost always released first, and nonfarm payroll is always released on the first Friday of month $p + 1$ at 8:30 am ET. Following Andersen et al. (2003), the variables in Table 1 are presented in the order of their release date within each group (real activity, forward looking, etc.).

Most of our macroeconomic data is from Bloomberg: announcement dates, times, reference periods, market expectations, final revised values and actual released values. The Bloomberg data covers the sample from January 1997 to the present. We augment this with historical data from Money Market Services (MMS). The variables in the MMS dataset, however, start at different times. Many variables go back to the 1980's, but initial jobless claims, consumer confidence, and GDP price deflator start in 1991; core CPI and core PPI start in 1992; and the University of Michigan consumer confidence index, the Chicago PMI, and the Philadelphia Fed manufacturing index are not part of the MMS data. The final (revised) numbers, covering the period from 1990 to 2015 for all variables, were collected in May 2016 from Bloomberg, the various statistical agencies (BLS, BEA, etc.) and the FRED database.

Because we have actual release dates, times, expectations, and values for *all* variables starting only in January 1997, we begin nowcasting in that month and analogously use January 1997 through December 2015 as sample in the event study. This choice is made for consistency between the construction of the announcement characteristics and the asset price impacts we aim to explain. However, since we have actual announcements or final values (or both) for all macroeconomic variables starting in 1990, we utilize the 1990-1996 sample to estimate the transition matrices required in the nowcasting exercise. We also collect data for the Federal Funds Target Rate (FFTR) and its release dates.

Our financial data are from the Federal Reserve Board and consist of daily changes in yields for the constant maturities 6-month, 1-, 2-, and 5-year U.S. Treasury bonds.[5] We focus on the bond market as opposed to the equity or foreign exchange markets because, as shown by the previous literature, e.g., Andersen et al. (2007), the link between Treasury bond price movements and macroeconomic news announcements is theoretically simpler and empirically stronger.

3. Asset Price Response to Macroeconomic Announcements

In this section, we discuss the relationship between an announcement's price impact and what we label as its intrinsic value, timeliness, revisions, and relation to fundamentals within the context of a noisy rational expectations model. We also document the heterogeneous response of Treasury yields to 36 major macroeconomic announcements over the period 1997 through 2015.

3.1. Theoretical Framework

To provide a framework for defining an announcement's price impact, its intrinsic value, and the effect of its underlying characteristics, we briefly discuss a stylized noisy rational

[5]We use daily changes instead of changes from a shorter time window around the announcement time (e.g., 5 minutes) to account for the price drifts ahead of several macroeconomic announcements documented in Kurov et al. (2016). Nevertheless, our conclusions are similar if we relate announcements' characteristics to 5-minute price impacts. Daily data are from the Federal Reserve H.15 Selected Interest Rates (Daily) release.

expectations model of price reactions to public signals, similar to Kim and Verrecchia (1991a) and Kim and Verrecchia (1991b). The details of the model are in the Online Appendix. Every period, the equilibrium price of a traded asset is a function of the representative investor's expectation of the asset's final payoff. When a noisy public signal about this final payoff is received, the investor updates her expectation in a Bayesian manner. As a result, the price change is equal to the surprise component of the signal times a constant. We can label this constant as the *price impact* of the announcement because it is the coefficient one obtains when regressing price changes on the surprise component of the announcement. We can also label this constant as the *intrinsic value* of the announcement because, in the model, it is equal to the weight placed by the investor on the signal when she is updating her belief about the asset's payoff.

In the empirical analysis that follows, we allow the intrinsic value of an announcement to be different from the its price impact. To estimate the intrinsic value of the announcement, we assume that the asset's payoff is related to the state of the economy, as proxied by GDP, GDP price deflator, or the FFTR. We further assume that the investor uses a Kalman filter to nowcast the state of the economy, and we define the intrinsic value of the announcement as the weight the investor puts on the announcement when nowcasting the state of the economy.

Following previous studies, in the next sub-section, we estimate the price impact of the announcement by regressing daily U.S. Treasury bond yield changes on macroeconomic news surprises (e.g., Fleming and Remolona (1997, 1999), Balduzzi et al. (2001), Goldberg and Leonard (2003), Gürkaynak et al. (2005), Beechey and Wright (2009), and Swanson and Williams (2014)). The first main objective of our paper is to relate the intrinsic value of the announcement, the weight the investor puts on the announcement when nowcasting the state of the economy, to the price impact of the announcement.[6]

The model makes several clear and intuitive predictions about the effect of an an-

[6] We are implicitly assuming that the expectations hypothesis holds. For this reason, we focus on short-term bonds (6-month, 1-, 2- and 5-year maturities). In fact, we observe that our measure of intrinsic value, which does not take into account the impact of macroeconomic news announcements on the term premia, explains a higher fraction of the variation in price impact for these shorter maturities than for 10- and 30-year maturity bonds (not tabulated in the paper).

nouncement's characteristic – either its relation to fundamentals, timeliness, or revisions – on its intrinsic value and thus on its price impact (see the Online Appendix for details). A more timely announcement, an announcement that is more highly correlated with the payoff of the risky asset, and an announcement that undergoes smaller revisions, has a higher intrinsic value and therefore has a higher price impact. To ensure consistency with our novel measure of the intrinsic value of the announcement, we define and estimate these characteristics within the nowcasting framework as well. The second main objective of our paper is then to assess which characteristic is most highly related to the price impact of the announcement.

3.2. Price Impact of Announcements

Following the literature, we define the surprise component of a macroeconomic announcement as the difference between its actual realization $a^n_{p,t}$ and its corresponding market expectation $\mu^n_{p,t}$ based on the information available before its release. The realization $a^n_{p,t}$ is the value of the macroeconomic variable n referring to period p, which is released at time t. Market expectations are measured as the median expectation across the set of Bloomberg/MMS forecasts. Also following the literature, the surprises are standardized by dividing each of them by their sample standard deviation in order to make the units of measurement comparable across macroeconomic variables. The standardized news surprise associated with the release of macroeconomic variable n with reference period p at time t is therefore

$$s^n_{p,t} = \frac{a^n_{p,t} - \mu^n_{p,t}}{\sigma^n_s} \tag{1}$$

where σ^n_s is the sample standard deviation of $a^n_{p,t} - \mu^n_{p,t}$ based on all (initial) release times of the respective macroeconomic variable n.

We estimate the impact of a given macroeconomic announcement n on asset prices by estimating the following equation

$$\Delta y_t = \alpha_n + \beta_n s_{p,t}^n + \epsilon_t^n \tag{2}$$

where Δy_t is the daily change in Treasury yields (in basis points) and the intercept α_n is a time-invariant, variable-specific announcement return.[7] Since σ_s^n is constant for any variable n, the standardization in equation (1) does not have an impact on the statistical significance of the response estimates nor on the fit of equation (2).[8]

Table 2 reports the results of equation (2) for each of the 36 macroeconomic variables across the four different Treasury bond maturities for the 1997–2015 sample period. Our measures of each variable's *price impact* are the slope coefficient β_n on the standardized surprise, which represents basis points per standard deviation of surprise, and the corresponding R^2 of the regression.

Consistent with the prior literature, we find large differences in slope coefficients and R^2 across announcements. For instance, while the releases of nonfarm payroll and the Institute for Supply Management (ISM) PMI have large and significant price impacts, the releases of housing starts, durable goods orders, and the PPI have insignificant price impacts. It is this wide heterogeneity in asset price impact that we aim to explain in this paper.[9]

Consistent with the above model and the findings in Fleming and Remolona (1997), Andersen et al. (2003), and Hess (2004), among others, we find that, within a general category of macroeconomic indicators, announcements released earlier tend to have greater impact than those released later. An obvious example is that of GDP, where the advance (first) release has the highest price impact. Similarly, the preliminary announcement of the

[7] For a nice review of the literature on event studies, including its caveats and limitations, please refer to Gürkaynak and Wright (2013).

[8] By using identification through censoring, Rigobon and Sack (2008) estimate the share of the survey-based surprise due to noise. We choose not to follow their procedure because we allow the impact of news to vary with its noise. If we purged the noise from the announcement, we would underestimate the effect of noise on the price impact.

[9] In the Online Appendix, we present results for the sample period excluding the Federal Reserve's zero lower bound, starting in December 2008. Consistent with the findings of Swanson and Williams (2014), the asset price impacts are somewhat stronger prior to the zero lower bound period, in particular for the shorter maturity bonds.

University of Michigan's (UM) consumer confidence index (released around the middle of the reference month) has a bigger effect on asset prices than the final announcement (released just before the end of the reference month).

Other studies highlight the importance of the timeliness of an announcement. Hess and Niessen (2010) show that the price impact of the German *Ifo* business indicator diminished substantially after the creation of the German ZEW business indicator, because the ZEW index is released before the *Ifo* index. Andersson et al. (2008) show that the reason for the small reaction of German bond prices to the aggregate German Consumer Price Index (CPI) announcement lies in the earlier release of CPI data for the individual German states. In a similar spirit, Ehrmann et al. (2011) show that there is no significant market reaction to Euro area macroeconomic announcements because all individual country releases are already known (money supply being the only counter-example since it is only measured at the Euro area level).

However, the results in Table 2 make it clear that timeliness is not the only characteristic that is related to the price impact of an announcement. For instance, even though the unemployment rate and nonfarm payroll are released simultaneously and early, surprises in nonfarm payroll have a much larger price impact than surprises in the unemployment rate (more than 20 percent R^2 versus 2 percent R^2). Similarly, core CPI has a higher price impact than headline CPI. In light of the model above, it may be that nonfarm payroll and core CPI have a bigger price impact because they either undergo smaller revisions after their initial release or because they are more "useful" to investors in forecasting a fundamental variable of interest, such as GDP, GDP deflator or the FFTR. In the following, we define our novel measures of announcement characteristics and we investigate how these characteristics help explain the heterogeneity in price impact of macroeconomic announcements.

4. Measuring and Decomposing the Intrinsic Value of Announcements

In this section we describe the methodology for consistently measuring an announcement's intrinsic value and its components: timeliness, revisions, and relation to fundamentals. We start by setting up a nowcasting framework, which we subsequently use to define these four characteristics.

4.1. Nowcasting GDP Growth, Inflation, and the Federal Funds Target Rate

We propose and estimate a novel empirical measure of an announcement's intrinsic value and its components. We define the intrinsic value of an announcement as its importance in nowcasting three primitives: GDP advance, GDP price deflator advance, and the FFTR.[10] We generate nowcasts based on a dynamic factor model, because this class of models parsimoniously captures the evolution of the high-dimensional vector of macroeconomic announcements. Whenever new information arrives, the Kalman filter provides an estimate (nowcast) of the current state vector, which we then use to forecast the current level of the primitive of interest. Repeating this procedure every time new information arrives, generates a time-series of Kalman gains and regression coefficients, which forms the basis of our measures of intrinsic value, timeliness premium, revision premium, and relation to fundamentals.[11]

Our approach to nowcasting is similar to Evans (2005) and Giannone et al. (2008). We assume that the state vector of the economy, $\Phi_{p,t}$, follows a VAR(1) process, captured at time t by the state equation

$$\Phi_{p,t} = B_t \Phi_{p-1,t} + C_t \nu_{p,t}, \tag{3}$$

where $\nu_{p,t} \sim WN(0, I_{2\times 2})$. Note that there are two time subscripts, p and t. The state of the economy evolves at a monthly frequency, indexed by the reference period p. The subscript t governs how much information is available about the current and the past state vectors, and identifies specific times within the month. This setup naturally maps the ever-evolving information set – with its missing values, revisions, and irregular announcement dates – into our data structure. Because the dataset changes with each data release, the state space

[10] Our primary reason for following the Kalman filter-based nowcasting approach is that its data structure lends itself to traceable counterfactual exercises. Macroeconomic forecasting with mixed-frequency data has received considerable attention in recent years, e.g., Andreou et al. (2010). Nevertheless, the Kalman filter remains the method of choice in terms of accuracy, at the cost of being computationally more demanding than, for instance, mixed data sampling (MIDAS) regressions (Bai et al., 2013).

[11] Section O.2. in the Online Appendix provides extensive details on data management, timing conventions, and the nowcasting procedure.

model is re-estimated at each data release time t.

The corresponding observation equation for a given information set t is

$$A_{p,t} = D_t \Phi_{p,t} + \varepsilon_{p,t}, \tag{4}$$

where $\varepsilon_{p,t} \sim WN(0, V_{p,t})$, and $A_{p,t} = \left[a^1_{p,t}, \ldots, a^N_{p,t}\right]'$ is the monthly vector of N macroeconomic variables containing the values $a^n_{p,t}$ available at time t. The variable $a^n_{p,t}$ contains only values announced on or before time t for the macroeconomic announcement n.

The 36 macroeconomic announcements listed in Table 1 and the FFTR series, which are assumed to jointly capture the state of the U.S. economy, are used in the nowcasting exercise, either in their original reporting units or transformed in order to approximate a linear relationship with the forecasting object. For variables reported in percent or percent changes, the original reporting unit is used, while variables reported in levels are transformed into percent changes. For example, the retail sales series, reported as a percent change, is not transformed, while the new home sales series is transformed from levels to percent change. For indexes, we use the original reporting unit.[12]

We estimate the state space representation given by equations (3) and (4) with the two-step procedure of Giannone et al. (2008).[13] The estimation proceeds in four steps, which we repeat for each announcement release time t. We use an expanding window from January 1990 until time t, starting with the window ending on $t =$ January 1^{st}, 1997.

First, we consolidate variables that are released piece by piece, namely GDP (advance, preliminary, final), GDP price deflator (advance, preliminary, final), and the University of Michigan consumer confidence index (preliminary, final) into one series, respectively. Thus we have $N = 32$ consolidated macroeconomic time series. However, for determining the

[12]More details on the original reporting units and possible transformation of each macroeconomic variable are collected in Section O.3. of the Online Appendix.

[13]Such "partial" models, specifying the target variable separately from the model of the predictors, are widely used in policy institutions (Bańbura et al., 2013). For our sample, this two-step procedure outperformed the one-step procedure in nowcasting GDP in terms of RMSFE. Further, the two-step approach allows us to tailor the second step to the forecasting target, which we exploit when replacing equation (4) for the FFTR by an ordered probit specification.

intrinsic value, we keep track of each observation's original designation (advance, preliminary, or final). Given t, each time-series is standardized to zero mean and unit standard deviation.

Second, we define a five-dimensional state vector based on five principal components $\Phi_{p,t}$ extracted from the balanced part of the sample. Two principal components are based on all announcement series. Three further principal components are based on the subsets of real, nominal, and forward-looking announcement series, respectively. The matrix C_t collects the five eigenvectors, linking the factors $\Phi_{p,t}$ with the announcements $A_{p,t}$.[14]

Third, the Kalman filter is estimated given information available up until time t and the Kalman gains assigned to the announcements at the end of the sample are retrieved. Specifically, to construct the time-series of the intrinsic value of announcement n, only the gains k_t^n at the time of a new release of macroeconomic variable n are used.

Fourth, given the information at time t, we (Kalman-)smooth the latent factors. Then we use these factors to fit a forecasting model for the nowcasting target variables, analogously to equation (4). For the nowcasting targets GDP and the GDP price deflator, a linear model at quarterly frequency is used, whereas for the FFTR an ordered probit specification at monthly frequency is employed. For each forecasting target, indexed by j, we estimate coefficients (marginal effects for the FFTR) $\tilde{D}_t^j$ on the latent factors at each point in time. The absolute value of the product $w(j)_t^n = |\tilde{D}_t^j k_t^n|$ of this coefficient (row) vector with the respective column of the Kalman gain matrix is the *weight* on announcement n at time t for nowcasting the variable j.[15]

When these weights are derived from *actual* data released according to the *actual* release schedule, we refer to them as $w_A(j)_t^n$. In order to estimate the effect of timeliness and revisions, we create counterfactual datasets and apply the same nowcasting procedure

[14] We extract two factors from all announcements because for GDP such a model performs notably better at nowcasting and at forecasting 1-month-ahead GDP than one factor. For GDP deflator and FFTR, the performance is similar across different numbers of factors.

[15] We take absolute values to capture the direction-free impact of an announcement. Because we determine this weight by a two-step procedure, it differs from the weights implicitly assigned to observations within the Kalman filter as in, e.g., Koopman and Harvey (2003) and Bańbura and Rünstler (2011). In contrast, in our paper, the weight combines the gains determined by the Kalman filter with the coefficients from a separate forecasting regression, and captures the empirical relevance of only the most recent announcement release.

on these new datasets. These datasets differ from the original one in terms of release timing, revision status, or both. We modify the respective property of only one macro announcement series n per nowcasting exercise.

To control for release timing, we counterfactually reorder the data. To do so, we identify the earliest announcement for each reference period and set the counterfactual announcement time of the variable of interest to one second before this previously earliest announcement. Applying the nowcasting procedure to these *reordered actual* datasets yields the weight series $w_{RA}(j)_t^n$.

To control for revision status, we counterfactually replace all releases of the variable of interest by the final revised values. By subjecting the original data to both this counterfactual replacement with final values and the counterfactual time reordering, the nowcasting procedure with this counterfactual dataset of *reordered final* announcements yields the weight series $w_{RF}(j)_t^n$.

4.2. Intrinsic Value and its Decomposition

We define the intrinsic value $I(j)_t^n$ of macroeconomic variable n with respect to target variable j (GDP, GDP deflator or FFTR) as the natural logarithm of the nowcasting weight put on macroeconomic variable n at the time t of its announcement, $I(j)_t^n \equiv log\,[w_A(j)_t^n]$. The intrinsic value can therefore be thought of as the importance placed on the announcement when nowcasting the state of the economy.

Columns 1, 5, and 9 of Table 3 report the time-series average of our novel measure of intrinsic value of each macroeconomic variable for the three nowcasting targets. Note that because the weights, $w_A(j)_t^n$, turn out to be between zero and one, the intrinsic value, the logarithm of the weight, is negative. This means that an announcement with a small negative number has large intrinsic value, and an announcement with a large negative number has very little intrinsic value. Based on this metric, Table 3 indicates that forward-looking announcements such as the consumer confidence indices and the PMI indices have large intrinsic values (small negative numbers) when nowcasting GDP and the FFTR. Similarly, price variables such as CPI and PPI appear to have large intrinsic value when nowcasting the GDP price deflator.

We decompose the intrinsic value $I(j)_t^n$ of each macroeconomic variable n for a given target variable j into the announcement's relation to fundamentals $F(j)_t^n$, a timeliness premium $T(j)_t^n$, and a revision premium $R(j)_t^n$:

$$I(j)_t^n \equiv F(j)_t^n + T(j)_t^n + R(j)_t^n, \tag{5}$$

where each component is defined using the nowcasting weights defined in the previous subsection:[16]

$$log\left[w_A(j)_t^n\right] \equiv log\left[w_{RF}(j)_t^n\right] + log\left[\frac{w_A(j)_t^n}{w_{RA}(j)_t^n}\right] + log\left[\frac{w_{RA}(j)_t^n}{w_{RF}(j)_t^n}\right]. \tag{6}$$

Each term in equation (6) reflects one of the announcement characteristics in equation (5):

- The *intrinsic value*, $I(j)_t^n \equiv log\left[w_A(j)_t^n\right]$, is the nowcasting weight placed on the actual macroeconomic announcement at the time of its release.

- The *relation to fundamentals*, $F(j)_t^n \equiv log\left[w_{RF}(j)_t^n\right]$, is the nowcasting weight placed on the macroeconomic announcement independent of its timing and its revisions.

- The *timeliness premium*, $T(j)_t^n = log\left[w_A(j)_t^n\right] - log\left[w_{RA}(j)_t^n\right]$, is the difference between the nowcasting weight placed on the actual macroeconomic announcement at the time of its release and the nowcasting weight placed on the actual announcement when it is reordered to be the first release in each forecasting period.

- The *revision premium*, $R(j)_t^n \equiv log\left[w_{RA}(j)_t^n\right] - log\left[w_{RF}(j)_t^n\right]$, is the difference between the nowcasting weight placed on the actual announcement when it is reordered to be the first release in each forecasting period and the nowcasting weight placed on the announcement when it is reordered and replaced by its final revised value.

[16]Starting with the factorization $w_A(j)_t^n \equiv w_{RF}(j)_t^n \frac{w_A(j)_t^n}{w_{RA}(j)_t^n} \frac{w_{RA}(j)_t^n}{w_{RF}(j)_t^n}$ we obtain equation (6) by taking the natural logarithm of this identity.

We now discuss each component of the intrinsic value in turn, which are presented in Table 3, and compare them with some alternative naïve measures.

4.3. Relation to Fundamentals

In the noisy rational expectations model, market participants put more weight on announcements that are more closely related to fundamentals. The above definition, $F(j)_t^n \equiv log\left[w_{RF}(j)_t^n\right]$, captures this idea since it is the nowcasting weight placed on the announcement that has been replaced with its final revised value (to remove the impact of revisions) and reordered so that it is the first release in each reference cycle (to remove the impact of timing).

The times-series average of this novel measure of relation to fundamentals is reported in columns 2, 6, and 10 of Table 3 for each macroeconomic variable. As for the intrinsic value, an announcement with a small negative number has a large relation to fundamentals, and an announcement with a large negative number has a small relation to fundamentals. Intuitively, GDP announcements are closely related to fundamentals when nowcasting GDP, as well as nonfarm payroll and forward looking indicators. GDP deflator announcements, as well as CPI and PPI announcements, are most closely related to fundamentals when nowcasting the GDP price deflator. A mix of real activity and inflation announcements have a high relation to fundamentals when nowcasting the FFTR.

Alternatively, one could measure the relation to fundamentals by looking at the correlation of each announcement with GDP, the GDP price deflator, and FFTR. These correlations are reported in columns 13-15 of Table 3. Note that the correlations between our novel measures and these alternative measures are 0.7, 0.6 and 0.5, when nowcasting GDP, the GDP price deflator and FFTR, respectively.

4.4. Timeliness Premium

In the noisy rational expectations model, market participants put more weight on announcements that are more timely. The definition of this premium, $T(j)_t^n = log\left[w_A(j)_t^n\right] -$

$log\,[w_{RA}(j)_t^n]$, captures this idea because thereby it is the difference between the actual nowcasting weight and the reordered nowcasting weight. This difference should be negative and small for timely announcements, but large and negative for announcements that are released late and whose re-ordering improves their nowcasting ability.

The time-series average of this novel measure of timeliness is reported in columns 3, 7, and 11 of Table 3. Looking at GDP announcements, our timing premium is higher (smaller negative number) for the timelier variable, GDP advance, than for GDP final. Forward looking variables that are released early, such as the confidence indices, have very high timeliness premia.

The previous literature (e.g., Fleming and Remolona (1997)) uses the reporting lag as a measure of timing discount, which is the difference between the announcement date and the end of the reference period.[17] The time-series average of each variable's reporting lag (measured in days) is shown in column 16 of Table 3. We call reporting lag a timing discount because the larger the number the worse the timing of the announcement. Thus the correlation between our timing premium and reporting lag should be negative. Indeed, we find the correlations to be -0.47, -0.52, and -0.37 when the target variables are GDP, GDP price deflator, and the FFTR, respectively.

One drawback of the announcement's reporting lag as a measure of timeliness is that it is a linear function of time, so an improvement in timeliness of, say, six days is the same for an early and a late announcement. However, we expect a 7-day reporting lag announcement to gain more from moving up its release date six days than a 21-day reporting lag announcement moving up six days. This is because the 7-day reporting lag announcement will now be the first announcement while the 21-day reporting lag will be the 15^{th} announcement, and it is likely that the earlier releases have already conveyed sufficient information. The novel measure we propose explicitly takes into account the position of the announcement when

[17]There is a difference between the end of the reference period and the end of the survey period. For instance, at the Bureau of Labor Statistics, "employment data refer to persons on establishment payrolls who received pay for any part of the pay period that includes the 12^{th} of the month" (http://www.bls.gov/web/cestn1.htm). This means that taking the end of the month as the end of the reference period is not exact, because the surveying stopped much earlier in the month.

computing the nowcasting gain in timeliness. This is the reason why two announcements released at the same time, like the unemployment rate and nonfarm payroll, can have different timeliness premia.

4.5. Revision Premium

In the noisy rational expectations model, market participants put more weight on announcements that undergo smaller revisions. The above definition of this premium, $R(j)_t^n \equiv log\left[w_{RA}(j)_t^n\right] - log\left[w_{RF}(j)_t^n\right]$, captures this idea since it is the difference between the nowcasting weight of the actual announcement minus the weight of its final revised value, both independent of the timing of the announcement (reordered). This number should be negative and small for announcements that are not heavily revised, but large and negative for announcements that are heavily revised and their revisions improve their nowcasting ability.

The times-series average of this novel measure of revisions is reported in columns 4, 8, and 12 of Table 3. Overall, there is significantly less variation in revision premium across announcements compared to the other characteristics. Many numbers are even positive, which indicates that the final revised values do worse in nowcasting the given primitive than the actual releases. This is consistent with the findings in Orphanides (2001) who shows that a Taylor rule with real-time macroeconomic announcements performs better than a Taylor rule with final revised numbers.

The previous literature (e.g., Gilbert (2011)) uses an alternative measure of revision noise, namely the absolute value of the difference between the final revised value and the initial release. This measure captures the magnitude of the revisions that an announcement undergoes.[18] This definition includes both sample and benchmark revisions and assumes that the last available value reflects the "true" situation.[19] In the last column of Table 3,

[18]In order to normalize the unit of measurement across macroeconomic series, we normalize this alternative measure of revision magnitude

$$\frac{\left|a_{p,\infty}^n - a_{p,t}^n\right|}{\sigma_{\left|a_{p,\infty}^n - a_{p,t}^n\right|}}$$

where t is the time of the initial release of $a_{p,t}^n$ and $a_{p,\infty}^n$ is the final revised value.

[19]As a robustness check, we also use the first-available sample revisions for the variables available in the

we report the time-series average of this measure of revision magnitude.

The correlation between our novel measure of revision premium and the alternative revision magnitude (discount) measure is on average -0.10 for the three nowcasting targets (GDP, GDP deflator and FFTR). This occurs because the revision magnitude does not take into account the possibility that the revised (final) number is less useful in nowcasting target variables than the original (first-released) number. This measure only captures the magnitude of the revision but not the relevance of a revision, which our nowcasting measure does capture. For example, the UM consumer confidence index is heavily revised, and hence its preliminary release has a big revision magnitude shown in the last column of Table 3. However, we find that the preliminary release has a revision premium of zero when nowcasting the FFTR, which suggests that the final revised value does no better than the initial released value.

5. Relating the Price Impact to the Announcements' Characteristics

In this section, we relate our novel measure of the announcements' intrinsic value, as well as its components (relation to fundamentals, timeliness premium, and revision premium) to their price impact. We first examine whether our measures affect the impact of announcement surprises on asset prices using the full sample. Then we investigate whether our measures explain the cross-section of price impact. All results are presented for the full sample period, but qualitatively similar results using the period excluding the Federal Reserve's zero lower bound period are presented in the Online Appendix.

5.1. Direct Impact on Asset Returns

To assess the importance of the announcements' characteristics, the event study exercise from Section 3. is repeated with the intrinsic value, relation to fundamentals, timeliness premium, and revision premium added into the regressions. However, rather than estimating the price

Federal Reserve Bank of Philadelphia's Real-Time Data Set and Bloomberg. The results are qualitatively similar.

impact separately for each announcement (as we do in equation (2) and Table 2), we estimate an average price impact $\beta(j)$ across announcements, and only allow this price impact to vary across announcements according to the announcements' characteristics $X(j)_{p,t}$. More precisely, we estimate the following equation separately for each target variable j:

$$\Delta y_t = \beta_0(j) + \beta(j) s_{p,t} + \beta_x(j) s_{p,t} X(j)_{p,t} + \epsilon(j)_t, \tag{7}$$

where Δy_t are the daily changes in U.S. Treasury bond yields in basis points around the macroeconomic releases and $s_{p,t}$ are the surprise components of all the macroeconomic announcements pooled together, defined as in equation (1).[20] The interaction term, $s_{p,t}X(j)_{p,t}$, allows the price impact of the announcement to vary across the announcements' characteristics, which are either the intrinsic value (I), relation to fundamentals (F), timeliness premium (T), revision premium (R), or a vector with all three characteristics.[21]

We standardize and smooth our measure of intrinsic value of the announcement. Specifically, we divide each characteristic by its standard deviation estimated across all announcements and all times. This eases the interpretation of the coefficient estimates. In addition, we smooth the weights by taking a 12-month backward-looking moving average. The assumption is that, in calculating the importance of an announcement, investors take the average importance over the past year.

There is one table of results per nowcasted primitive j: Table 4 for GDP, Table 5 for the GDP price deflator, and Table 6 for the FFTR. Columns 2 to 5 in all three tables show the results with each different characteristic included in the regression in isolation, and column 6 shows all three characteristics competing against each other.

Column 2 shows that, for all nowcasting targets, the intrinsic value of an announcement

[20] We change the sign of the surprise of two announcements, the unemployment rate and initial jobless claims, so that positive surprises are associated with either higher economic activity or higher inflation than expected.

[21] We do not include a main effect for the announcement characteristic because the noisy rational expectations model predicts that the announcement characteristic only affects the price impact, and does not affect the yield change. Consistent with this view, when we include a main effect for the announcement, the main effect is not statistically significant and our results are qualitatively similar.

has an economically and statistically significant effect on the asset price impact of that announcement. The sign of the coefficient is consistent with theory: the bigger the intrinsic value of the announcement is, the bigger is its price impact. For example, a one-standard deviation surprise in an announcement with an average intrinsic value of zero increases the 6-month Treasury yields by about 1 basis point when the nowcasting target is GDP (Table 4, column 2). If we increase the intrinsic value of this announcement by one standard deviation, a surprise on this announcement will increase 6-month bond yields by about 1.2 basis point (1.022+0.216), which is a 20 percent increase in the impact on yields. Repeating this calculation, we see that the increase in price impact due to intrinsic value is about 15 percent across maturities when the nowcasting target is the GDP price deflator or the FFTR.

Columns 3 through 6 suggest that, across forecasting targets, the relation to fundamentals and timeliness premium are the most relevant announcement characteristics; and revision noise is, most of the time, statistically insignificant. Column 6 suggests that increasing the timing of an announcement by one standard deviation increases the impact of the surprise by about 10 to 20 percent, when the nowcasting variable is GDP, while increasing the relation to fundamentals by one standard deviation increases the impact of the surprise by about 20 to 30 percent. The sign of these effects is consistent with the theoretical model summarized in Section 3.1.

The importance of the timeliness premium suggests that financial markets indeed learn in a Bayesian manner. Imprecise, but early, information can be as useful from a nowcasting perspective as precise, but late news.

5.2. Determinants of Average Surprise Impact

In the previous sub-section, we examined whether our novel measures affect the impact of announcement surprises on asset prices using the full sample. We now investigate whether our measures explain the cross-section of price impact and how they compare with the alternative announcement characteristics previously used in the literature, such as reporting lag. In this cross-sectional analysis, we take our estimates of the asset price impact, namely the R^2 from equation (2) and Table 2, and estimate the following equation:

$$R_n^2(j) = \alpha_0(j) + \alpha_x(j)X_n(j) + \epsilon_n(j), \tag{8}$$

where X_n is the time-series average of our announcement characteristics. Table 7 shows the results where X_n is the announcement's intrinsic value for all three nowcasting targets j, namely GDP, GDP price deflator and FFTR. Table 8 shows the results for GDP only, but where X_n is the announcement's relation to fundamentals, timeliness premium, revision premium, as well as the alternative measures of these components used by the previous literature: correlation with GDP, reporting lag, and revision magnitude. We include each of these characteristics separately because our sample is small, with only 36 observations (one estimate of price impact per announcement).

Looking across columns 1 through 3 in Table 7, we find that our intrinsic value measure, when using GDP or FFTR as our nowcasting targets, explains a significant fraction (6 to 18 percent) of the variation in the price impact of announcement surprises, as measured by the R^2.[22] In contrast, using GDP deflator as the nowcasting target is not useful at all. This finding may be an artifact of the sample period we analyze, during which inflation was relatively low and inflation expectations may not have played a big role in nominal U.S. Treasury bond prices.[23] Using GDP as the nowcasting target is also more useful in explaining the variation than using the FFTR. This may not be surprising because the impact of news about the FFTR on nominal U.S. Treasury bonds includes offsetting effects on real and inflation components, as shown by Beechey and Wright (2009).

Columns 2 through 4 of Table 8 further confirm that an announcement's relation to fundamentals and timeliness premium are more important in explaining the asset price impact of macroeconomic news announcements than the revision premium. Timeliness explains from 6 to 14 percent of the variation in asset price impact coefficients, and relation to funda-

[22]We obtain qualitatively similar results if we use the slope coefficients β_n as measure of price impact.

[23]Indeed we find that prior to the "Zero Lower Bound‘" period the GDP Deflator target is much more relevant – similar in magnitude to the FFTR. The Online Appendix reports these results.

mentals explains 8 to 12 percent of the variation in asset price impact coefficients. However, the revision characteristic explains only 0.8 to 4 percent of this variation. Overall, column 1 shows that our novel measure of intrinsic value explains the largest fraction of the variation in price impact when compared to its three components and their alternative measures.

Amongst the alternative measures in columns 5 through 7, correlation with GDP is mostly insignificant but reporting lag is significant and explains a sizeable fraction of the variation in asset price impact. Interestingly, revision magnitude is statistically significant, but the sign is the opposite of what our theoretical model would predict: announcements that undergo larger revisions have a higher price impact. The counter-intuitive sign suggests that one should not consider the magnitude of the revisions in isolation; instead, one should consider both the magnitude of the revision and the relevance of the revision, which our nowcasting framework does.

6. Conclusion

In this paper, we propose and estimate a novel measure of the intrinsic value of macroeconomic announcements. Our definition is based on the announcement's ability to nowcast GDP growth, the GDP price deflator, and the FFTR. We decompose this intrinsic value into three separate announcement characteristics: relation to fundamentals, timeliness, and revisions. We find that timeliness and relation to fundamentals are the most significant characteristics in explaining the variation in the announcements' asset price impact on U.S. Treasury bonds.

Our study offers two additional takeaways for policy makers and future research. First, the price response to a particular type of announcements cannot be analyzed in isolation. The effect that announcements have on asset prices crucially depends on the information environment. Second, our analysis shows that the relationship between the intrinsic value of an announcement and its asset price impact is not perfect. In particular, we find that nonfarm payroll has the biggest impact on U.S. Treasury bonds, yet it is not the announcement with the biggest intrinsic value. This raises the possibility that there may be an overreaction to certain announcements.

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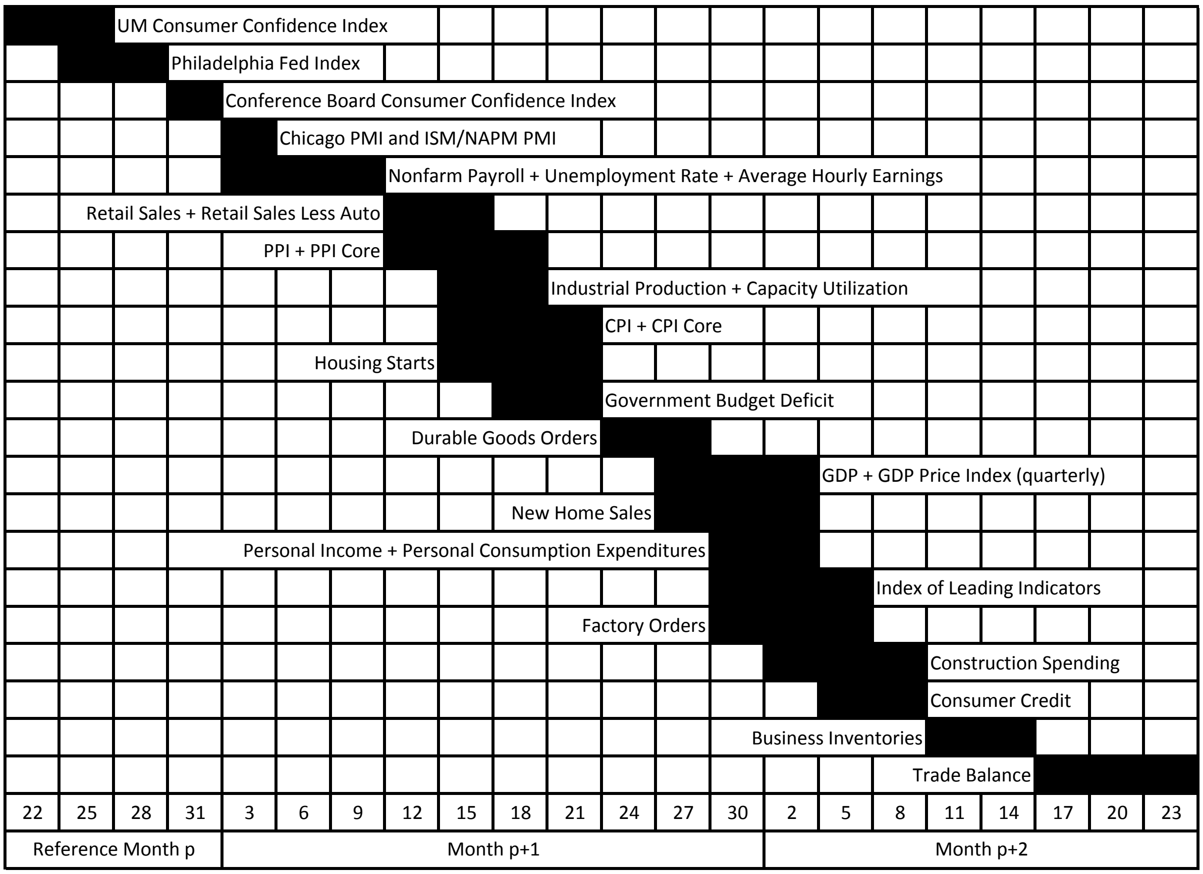

Fig. 1. Macroeconomic announcement calendar. *Note:* This figure shows the usual calendar timing of U.S. macroeconomic announcements across the month. The reference month is labeled as p with most variables released in the subsequent month and some released up to six weeks later. Each GDP series (advance, preliminary, or final) is released on a quarterly basis. Not represented in the figure is the initial jobless claims announcement, which is released weekly on Thursday for the previous week. The University of Michigan releases a final version (not shown) of their consumer confidence index two weeks after their preliminary one.

Table 1
Characteristics of Macroeconomic Announcements.

n	**Announcement**	**Unit**	**Release Time**	**Obs.**
	Quarterly Announcements			
	Real Activity			
1	GDP advance (first estimate)	% change	8:30	76
2	GDP preliminary (second estimate)	% change	8:30	76
3	GDP final (third estimate)	% change	8:30	76
	Prices			
4	GDP price deflator advance	% change	8:30	76
5	GDP price deflator preliminary	% change	8:30	76
6	GDP price deflator final	% change	8:30	76
	Monthly Announcements			
	Real Activity			
7	Unemployment rate	%	8:30	228
8	Nonfarm payroll employment	change	8:30	228
9	Retail sales	% change	8:30	228
10	Retail sales less automobiles	% change	8:30	227
11	Industrial production	% change	9:15	228
12	Capacity utilization	%	9:15	228
13	Personal income	% change	8:30/10:00	228
14	Consumer credit	change	15:00	228
	Consumption			
15	Personal consumption expenditures	% change	8:30	228
16	New home sales	level	10:00	227
	Investment			
17	Durable goods orders	% change	8:30/9:00/10:00	227
18	Construction spending	% change	10:00	227
19	Factory orders	% change	10:00	227
20	Business inventories	% change	8:30/10:00	228
	Government Purchases			
21	Government budget deficit	level	14:00	228
	Net Exports			
22	Trade balance	level	8:30	228
	Prices			
23	Average hourly earnings	% change	8:30	228
24	Producer price index (PPI)	% change	8:30	228
25	Core PPI	% change	8:30	228
26	Consumer price index (CPI)	% change	8:30	228
27	Core CPI	% change	8:30	228
	Forward Looking			
28	U. Michigan (UM) consumer confidence preliminary	index	9:55/10:00	200
29	Philadelphia Fed manufacturing index	index	10:00	227
30	UM consumer confidence final	index	9:55/10:00	200
31	Conference Board (CB) consumer confidence	index	10:00	228
32	(ISM-)Chicago Purchasing Managers Index (PMI)	index	10:00	226
33	ISM Manufacturing PMI	index	9:15/10:00	228
34	Housing starts	level	8:30	226
35	CB leading economic index	% change	8:30/10:00	228
	Weekly Announcements			
36	Initial jobless claims	level	8:30	992

Note: The table displays the 36 U.S. macroeconomic variables analyzed in the paper, along with the announcement unit used in both the agency reports and the market expectations, the time of the announcement release (Eastern Time), and the number of available data releases. The sample covers January 1997 to December 2015. ISM stands for Institute for Supply Management, formerly National Association of Purchasing Management (NAPM).

Table 2
Effect of Macroeconomic Announcement Surprises on U.S. Treasury Yields.

		6-Month Treasury		**1-Year Treasury**		**2-Year Treasury**		**5-Year Treasury**		
n	**Announcement**	Coeff.	R^2	Coeff.	R^2	Coeff.	R^2	Coeff.	R^2	Obs.
1	GDP advance	0.767**	0.054	0.941*	0.049	1.631**	0.068	1.028	0.018	76
2	GDP preliminary	0.298	0.012	-0.039	0.000	0.000	0.000	0.028	0.000	76
3	GDP final	-0.131	0.002	0.227	0.003	0.097	0.000	-0.183	0.001	76
4	GDP price deflator advance	0.221	0.004	0.288	0.005	0.867	0.019	0.867	0.013	76
5	GDP price deflator preliminary	-0.056	0.000	0.405	0.014	0.651	0.016	1.545**	0.061	76
6	GDP price deflator final	0.497	0.022	0.670	0.028	0.082	0.000	-0.342	0.004	76
7	Unemployment rate	-0.775***	0.032	-0.759**	0.020	-1.055**	0.017	-0.344	0.002	228
8	Nonfarm payroll employment	1.845***	0.183	2.734***	0.255	4.218***	0.271	3.687***	0.210	228
9	Retail sales	0.757***	0.068	1.132***	0.097	2.085***	0.125	2.334***	0.113	228
10	Retail sales less automobiles	0.530***	0.033	0.906***	0.062	1.701***	0.083	2.022***	0.084	227
11	Industrial production	-0.015	0.000	0.400	0.006	1.231***	0.041	0.652*	0.012	228
12	Capacity utilization	0.199	0.002	0.757**	0.022	1.606***	0.069	1.082***	0.034	228
13	Personal income	0.025	0.000	-0.109	0.001	-0.182	0.001	-0.110	0.000	228
14	Consumer credit	0.054	0.000	-0.082	0.000	-0.355	0.003	-0.388	0.003	228
15	Personal consumption expenditures	0.287	0.005	0.531*	0.016	0.354	0.004	0.381	0.004	228
16	New home sales	0.353	0.009	0.287	0.005	0.414	0.006	0.787**	0.019	227
17	Durable goods orders	0.335	0.008	0.384	0.008	0.460	0.006	0.633	0.011	227
18	Construction spending	0.266	0.003	0.064	0.000	0.460	0.007	0.321	0.003	227
19	Factory orders	0.163	0.002	0.127	0.001	0.170	0.001	0.313	0.003	227
20	Business inventories	-0.011	0.000	0.048	0.000	0.016	0.000	0.198	0.001	228
21	Government budget deficit	-0.454*	0.015	-0.433*	0.014	-0.581*	0.014	-0.486	0.008	228
22	Trade balance	-0.094	0.001	-0.042	0.000	0.203	0.002	0.707*	0.016	228
23	Average hourly earnings	0.335	0.006	0.714**	0.017	1.260**	0.024	1.840***	0.052	228
24	PPI	0.213	0.004	0.189	0.003	0.248	0.002	0.555	0.009	228
25	Core PPI	0.248	0.006	0.461*	0.015	0.534	0.009	0.994***	0.030	228
26	CPI	0.316	0.004	0.528	0.012	0.697*	0.014	0.543	0.006	228
27	Core CPI	0.480	0.010	0.773**	0.025	1.13***	0.037	0.926**	0.018	228
28	UM consumer confidence preliminary	0.577*	0.016	0.679*	0.018	1.015**	0.024	1.346***	0.038	200
29	Philadelphia Fed index	0.255	0.003	0.769***	0.032	1.575***	0.073	1.784***	0.080	227
30	UM consumer confidence final	-0.080	0.001	-0.011	0.000	0.050	0.000	0.208	0.001	200
31	CB consumer confidence index	0.666***	0.039	0.726***	0.033	0.876**	0.024	1.003**	0.027	228
32	Chicago PMI	0.704***	0.035	1.033***	0.062	1.645***	0.082	1.822***	0.092	226
33	ISM PMI	1.082***	0.052	1.669***	0.131	2.566***	0.174	2.836***	0.164	228
34	Housing starts	0.086	0.000	0.112	0.001	0.152	0.001	0.201	0.001	226
35	CB leading economic index	0.757**	0.022	0.270	0.004	0.075	0.000	0.502	0.007	228
36	Initial jobless claims	-0.558***	0.019	-0 .763***	0.03	-1.152***	0.039	-1.036***	0.027	992

Note: The table reports the results of individual event study regressions of daily bond yield changes on standardized macroeconomic announcement surprises. The sample covers the period from January 1997 to December 2015. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table 3

Nowcasting Characteristics of Macroeconomic Announcements.

		GDP (adv)				GDP Price Deflator (adv)				FFTR				Correlation with			Reporting	Revision
n	**Announcement**	I (1)	F (2)	T (3)	R (4)	I (5)	F (6)	T (7)	R (8)	I (9)	F (10)	T (11)	R (12)	GDP (13)	Def. (14)	FFTR (15)	Lag (16)	Magnitude (17)
	Real Activity																	
1	GDP advance	-3.25	-1.56	-1.42	-0.28	-6.36	-5.29	-1.06	0.00	-5.39	-3.97	-1.42	0.00	1.00	0.00	0.22	29	1.26
2	GDP preliminary	-3.37	-1.84	-1.53	0.00	-6.47	-5.29	-1.18	0.00	-5.50	-3.97	-1.53	0.00	0.96	0.02	0.21	58	1.31
3	GDP final	-3.37	-2.15	-1.54	0.31	-6.49	-5.52	-1.18	0.21	-5.52	-3.98	-1.55	0.01	0.94	0.02	0.14	87	1.30
	Prices																	
4	GDP price deflator advance	-5.52	-3.96	-1.57	0.00	-4.49	-3.94	-1.21	0.66	-6.19	-5.37	-0.85	0.02	0.00	1.00	0.02	29	1.21
5	GDP price deflator preliminary	-5.56	-4.00	-1.61	0.04	-4.50	-3.30	-1.21	0.00	-6.16	-5.38	-0.80	0.03	0.02	0.98	0.01	58	1.24
6	GDP price deflator final	-5.58	-3.89	-1.62	-0.06	-4.51	-3.47	-1.22	0.18	-6.17	-5.33	-0.82	-0.02	0.01	0.97	0.13	87	1.11
	Real Activity																	
7	Unemployment rate	-3.77	-2.03	-1.69	-0.05	-4.79	-4.59	-0.19	0.00	-5.18	-3.97	-1.19	-0.02	0.20	0.25	0.06	5	0.81
8	Nonfarm payroll employment	-3.04	-1.95	-1.14	0.05	-6.19	-5.23	-0.80	-0.17	-5.12	-4.02	-1.15	0.05	0.60	0.11	0.31	5	1.14
9	Retail sales	-3.81	-2.29	-1.67	0.15	-6.47	-5.74	-1.05	0.32	-6.15	-4.46	-1.81	0.12	0.49	0.01	0.19	13	1.26
10	Retail sales less automobiles	-3.56	-2.38	-1.52	0.34	-6.56	-5.76	-1.10	0.30	-5.87	-4.42	-1.69	0.24	0.52	0.27	0.28	13	1.22
11	Industrial production	-3.87	-2.14	-1.75	0.02	-7.07	-5.48	-1.55	-0.05	-6.05	-4.36	-1.82	0.14	0.66	0.07	0.27	16	1.28
12	Capacity utilization	-4.10	-2.07	-1.91	-0.12	-5.96	-5.03	-0.90	-0.04	-5.74	-4.06	-1.61	-0.07	0.30	0.27	0.02	16	1.80
13	Personal income	-4.98	-2.78	-2.21	0.01	-7.69	-6.39	-1.33	0.02	-7.02	-4.86	-2.18	0.02	0.24	0.09	0.01	29	0.81
14	Consumer credit	-4.50	-2.35	-2.17	0.01	-7.11	-5.97	-1.18	0.04	-6.41	-4.40	-2.02	0.01	0.33	0.03	0.00	37	1.23
	Consumption																	
15	Personal consumption expenditures	-4.39	-2.36	-2.02	0.00	-7.18	-5.47	-1.46	-0.25	-6.67	-4.57	-2.16	0.05	0.48	0.16	0.14	29	1.23
16	New home sales	-6.09	-3.77	-2.25	-0.07	-8.54	-6.47	-1.79	-0.29	-8.63	-6.13	-2.43	-0.08	0.11	0.11	0.13	27	1.12
	Investment																	
17	Durable goods orders	-4.56	-2.59	-2.04	0.07	-7.29	-5.78	-1.63	0.11	-6.87	-4.74	-2.18	0.06	0.17	0.15	0.10	26	1.06
18	Construction spending	-4.87	-2.53	-2.20	-0.15	-7.79	-5.84	-1.74	-0.21	-7.08	-4.72	-2.26	-0.10	0.42	0.03	0.15	32	1.24
19	Factory orders	-4.38	-2.55	-2.06	0.22	-7.15	-5.68	-1.64	0.18	-6.60	-4.66	-2.13	0.19	0.35	0.03	0.14	34	1.09
20	Business inventories	-5.54	-2.48	-2.12	-0.93	-7.56	-5.73	-1.32	-0.51	-7.17	-4.39	-1.95	-0.82	0.44	0.33	0.13	44	1.23
	Government Purchases																	
21	Government budget deficit	-6.82	-4.89	-2.02	0.10	-8.05	-7.04	-0.99	-0.03	-8.61	-6.88	-1.88	0.15	0.30	0.17	0.01	15	0.17
	Net Exports																	
22	Trade balance	-7.03	-3.63	-2.43	-0.98	-9.36	-7.16	-1.72	-0.47	-9.29	-5.71	-2.33	-1.25	0.10	0.43	0.03	43	1.13
	Prices																	
23	Average hourly earnings	-5.80	-4.13	-2.01	0.33	-6.10	-4.60	-0.35	-1.15	-7.87	-6.41	-1.67	0.22	0.04	0.21	0.12	5	0.89
24	PPI	-4.29	-3.43	-0.84	-0.02	-3.56	-3.26	-0.29	-0.01	-4.88	-4.66	-0.41	0.20	0.28	0.38	0.15	15	0.98
25	Core PPI	-5.63	-4.34	-1.53	0.24	-4.26	-3.62	-0.75	0.10	-5.80	-6.00	-0.55	0.74	0.11	0.40	0.01	15	0.92
26	CPI	-4.51	-3.31	-1.19	0.00	-3.67	-3.24	-0.52	0.09	-5.01	-4.61	-0.55	0.15	0.34	0.55	0.19	17	1.38
27	Core CPI	-5.69	-3.85	-1.64	-0.20	-4.43	-3.42	-1.08	0.08	-6.33	-5.91	-0.84	0.41	0.03	0.33	0.09	17	1.27
	Forward Looking																	
28	UM consumer confidence preliminary	-1.95	-1.68	-0.27	0.00	-4.87	-4.61	-0.27	0.00	-3.87	-3.63	-0.24	0.00	0.48	0.05	0.21	-17	1.20
29	Philadelphia Fed index	-2.21	-1.81	-0.38	-0.02	-5.09	-4.70	-0.41	0.02	-4.50	-3.99	-0.53	0.02	0.61	0.00	0.55	-12	1.23
30	UM consumer confidence final	-2.71	-1.68	-1.03	0.00	-5.43	-4.60	-0.83	0.00	-4.50	-3.63	-0.86	0.00	0.49	0.04	0.19	-3	0.11
31	CB consumer confidence index	-3.41	-2.13	-1.28	0.00	-4.93	-4.70	-0.21	-0.02	-4.84	-4.05	-0.80	0.01	0.43	0.13	0.11	-3	0.88
32	Chicago PMI	-2.93	-1.93	-0.99	-0.01	-5.81	-4.79	-0.98	-0.04	-5.20	-4.10	-1.15	0.05	0.53	0.13	0.42	-1	1.29
33	ISM PMI	-2.80	-1.79	-1.02	0.00	-5.65	-4.75	-0.98	0.08	-5.14	-3.92	-1.24	0.02	0.61	0.10	0.50	2	1.20
34	Housing starts	-5.12	-3.10	-2.11	0.09	-7.64	-6.13	-1.59	0.08	-7.63	-5.52	-2.29	0.17	0.26	0.05	0.11	18	1.03
35	CB leading economic index	-4.71	-1.89	-2.12	-0.70	-7.29	-5.06	-1.79	-0.44	-7.17	-4.19	-2.20	-0.78	0.18	0.43	0.14	23	0.89
36	Initial jobless claims	-2.45	-2.35	-0.05	-0.05	-5.50	-5.62	0.10	0.02	-4.47	-4.31	-0.06	-0.11	0.38	0.17	0.18	6	1.01

Note: For each macroeconomic variable, the table displays the time-series average of the variable's intrinsic value (I) and its components: the relation to fundamentals (F), the timeliness premium (T), and the revision premium (R). These characteristics are based on nowcasting GDP, the GDP price deflator, or the FFTR, and are computed as described in Section 4. The numbers in columns (1)-(12) are natural logarithms, hence the negative signs. Columns (13)-(17) report alternative measures of the three components, namely the correlation with the nowcasting target, the reporting lag, and the revision magnitude, as defined in Section 4. The data sample is from January 1997 to December 2015.

Table 4
GDP Channel Results.

	6-Month Treasury						1-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	0.379***	1.022***	0.993***	0.575***	0.379***	1.117***	0.539***	1.478***	1.280***	0.851***	0.548***	1.524***
	(0.057)	(0.193)	(0.189)	(0.096)	(0.064)	(0.210)	(0.060)	(0.189)	(0.201)	(0.105)	(0.057)	(0.206)
S × Intrinsic Value		0.216***						0.315***				
		(0.059)						(0.054)				
S × Relation to Fundamentals			0.211***			0.200***			0.255***			0.245***
			(0.053)			(0.051)			(0.065)			(0.054)
S × Timeliness Premium				0.120**		0.0928**				0.191***		0.158***
				(0.050)		(0.044)				(0.055)		(0.056)
S × Revision Premium					-0.003	0.022					0.080	0.110*
					(0.055)	(0.046)					(0.049)	(0.065)
Constant	-0.371***	-0.366***	-0.369***	-0.368***	-0.371***	-0.367***	-0.318***	-0.310***	-0.316***	-0.313***	-0.316***	-0.310***
	(0.050)	(0.045)	(0.038)	(0.044)	(0.040)	(0.051)	(0.050)	(0.048)	(0.059)	(0.061)	(0.050)	(0.049)
R^2	0.009	0.012	0.012	0.010	0.009	0.012	0.015	0.020	0.018	0.017	0.015	0.020

	2-year Treasury						5-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	0.841***	2.249***	1.893***	1.298***	0.863***	2.278***	0.975***	2.296***	1.925***	1.406***	0.998***	2.301***
	(0.065)	(0.243)	(0.233)	(0.131)	(0.084)	(0.269)	(0.101)	(0.230)	(0.275)	(0.159)	(0.098)	(0.256)
S × Intrinsic Value		0.472***						0.443***				
		(0.074)						(0.074)				
S × Relation to Fundamentals			0.361***			0.354***			0.326***			0.322***
			(0.073)			(0.073)			(0.086)			(0.077)
S × Timeliness Premium				0.279***		0.231***				0.264***		0.220***
				(0.064)		(0.080)				(0.079)		(0.071)
S × Revision Premium					0.183***	0.226***					0.196**	0.236***
					(0.067)	(0.069)					(0.090)	(0.084)
Constant	-0.282***	-0.271***	-0.279***	-0.276***	-0.278***	-0.270***	-0.207***	-0.196**	-0.205***	-0.201***	-0.203**	-0.196***
	(0.070)	(0.072)	(0.056)	(0.078)	(0.075)	(0.075)	(0.076)	(0.078)	(0.072)	(0.066)	(0.080)	(0.067)
R^2	0.020	0.026	0.023	0.022	0.021	0.026	0.020	0.025	0.023	0.022	0.021	0.025

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from the nowcasting exercise for GDP. The data sample runs from January 1997 to December 2015, and each regression is based on 7,595 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table 5
GDP Price Deflator Channel Results.

	6-Month Treasury						1-Year Treasury					
Coefficient on	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
S	0.379***	0.907***	1.072***	0.396***	0.375***	1.108***	0.539***	1.439***	1.467***	0.614***	0.537***	1.604***
	(0.052)	(0.231)	(0.221)	(0.058)	(0.048)	(0.189)	(0.051)	(0.260)	(0.202)	(0.089)	(0.052)	(0.221)
S × Intrinsic Value		0.133**						0.226***				
		(0.054)						(0.060)				
S × Relation to Fundamentals			0.160***			0.163***			0.215***			0.225***
			(0.051)			(0.039)			(0.042)			(0.051)
S × Timeliness Premium				0.020		0.033				0.088		0.110*
				(0.043)		(0.050)				(0.063)		(0.059)
S × Revision Premium					-0.034	-0.029					-0.014	0.0014
					(0.042)	(0.046)					(0.060)	(0.058)
Constant	-0.371***	-0.369***	-0.371***	-0.370***	-0.371***	-0.370***	-0.318***	-0.314***	-0.318***	-0.315***	-0.318***	-0.315***
	(0.047)	(0.046)	(0.045)	(0.054)	(0.046)	(0.044)	(0.054)	(0.050)	(0.058)	(0.049)	(0.055)	(0.046)
R^2	0.009	0.010	0.010	0.009	0.009	0.011	0.015	0.018	0.018	0.015	0.015	0.018

	2-year Treasury						5-Year Treasury					
Coefficient on	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
S	0.841***	2.017***	1.902***	0.983***	0.838***	2.138***	0.975***	1.972***	1.724***	1.147***	0.967***	1.986***
	(0.081)	(0.328)	(0.308)	(0.105)	(0.081)	(0.314)	(0.098)	(0.355)	(0.417)	(0.119)	(0.069)	(0.394)
S × Intrinsic Value		0.295***						0.250***				
		(0.080)						(0.081)				
S × Relation to Fundamentals			0.246***			0.263***			0.173*			0.193**
			(0.069)			(0.066)			(0.094)			(0.085)
S × Timeliness Premium				0.166***		0.190***				0.201**		0.215***
				(0.058)		(0.064)				(0.085)		(0.077)
S × Revision Premium					-0.033	-0.009					-0.065	-0.039
					(0.082)	(0.077)					(0.086)	(0.077)
Constant	-0.282***	-0.277***	-0.282***	-0.277***	-0.282***	-0.277***	-0.207***	-0.203**	-0.207**	-0.201**	-0.207***	-0.201***
	(0.075)	(0.063)	(0.072)	(0.068)	(0.062)	(0.080)	(0.063)	(0.081)	(0.086)	(0.086)	(0.072)	(0.077)
R^2	0.020	0.022	0.021	0.020	0.020	0.022	0.020	0.022	0.021	0.021	0.021	0.022

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from the nowcasting exercise for GDP price deflator. The data sample runs from January 1997 to December 2015, and each regression is based on 7,595 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table 6
FFTR Channel Results.

	6-Month Treasury						1-Year Treasury					
Coefficient on	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
S	0.379***	1.026***	1.039***	0.550***	0.378***	1.093***	0.539***	1.494***	1.334***	0.804***	0.540***	1.470***
	(0.061)	(0.220)	(0.269)	(0.103)	(0.063)	(0.295)	(0.066)	(0.241)	(0.215)	(0.113)	(0.0553)	(0.334)
S × Intrinsic Value		0.157***						0.232***				
		(0.051)						(0.053)				
S × Relation to Fundamentals			0.135***			0.117**			0.163***			0.144**
			(0.052)			(0.059)			(0.046)			(0.061)
S × Timeliness Premium				0.123*		0.100*				0.189***		0.163***
				(0.065)		(0.060)				(0.060)		(0.054)
S × Revision Premium					-0.018	0.00726					0.028	0.059
					(0.056)	(0.050)					(0.055)	(0.053)
Constant	-0.371***	-0.368***	-0.370***	-0.369***	-0.371***	-0.368***	-0.318***	-0.313***	-0.316***	-0.315***	-0.317***	-0.313***
	(0.050)	(0.051)	(0.051)	(0.044)	(0.048)	(0.048)	(0.050)	(0.053)	(0.047)	(0.050)	(0.062)	(0.057)
R^2	0.009	0.010	0.010	0.010	0.009	0.010	0.015	0.018	0.016	0.017	0.015	0.018

	2-year Treasury						5-Year Treasury					
Coefficient on	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
S	0.841***	2.151***	1.976***	1.158***	0.845***	2.198***	0.975***	2.127***	1.978***	1.222***	0.980***	2.206***
	(0.060)	(0.311)	(0.345)	(0.128)	(0.080)	(0.385)	(0.080)	(0.321)	(0.378)	(0.108)	(0.094)	(0.370)
S × Intrinsic Value		0.319***						0.280***				
		(0.071)						(0.077)				
S × Relation to Fundamentals			0.233***			0.224***			0.206***			0.211***
			(0.069)			(0.075)			(0.078)			(0.073)
S × Timeliness Premium				0.226***		0.185**				0.177**		0.139
				(0.073)		(0.073)				(0.083)		(0.094)
S × Revision Premium					0.085	0.133					0.115	0.159*
					(0.072)	(0.082)					(0.099)	(0.083)
Constant	-0.282***	-0.276***	-0.280***	-0.279***	-0.281***	-0.275***	-0.207***	-0.202**	-0.205**	-0.205**	-0.205***	-0.201**
	(0.065)	(0.065)	(0.077)	(0.062)	(0.079)	(0.066)	(0.074)	(0.087)	(0.085)	(0.083)	(0.065)	(0.084)
R^2	0.020	0.023	0.021	0.021	0.020	0.023	0.020	0.022	0.021	0.021	0.021	0.022

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from the nowcasting exercise for the Federal Funds Target Rate. The data sample runs from January 1997 to December 2015, and each regression is based on 7,595 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table 7
Price Impact and Intrinsic Value.

6-Month Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.0123**	0.0024	0.0099*
	(0.0060)	(0.0027)	(0.0051)
Constant	0.0570**	0.0281**	0.0602**
	(0.0235)	(0.0124)	(0.0263)
R^2	0.117	0.004	0.067

1-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.0196**	0.0060	0.0163**
	(0.0088)	(0.0040)	(0.0075)
Constant	0.0884**	0.0516***	0.0961**
	(0.0341)	(0.0185)	(0.0384)
R^2	0.139	0.013	0.086

2-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.0266**	0.0064	0.0209**
	(0.0099)	(0.0055)	(0.0086)
Constant	0.1180***	0.0605**	0.1230***
	(0.0383)	(0.0250)	(0.0439)
R^2	0.187	0.011	0.103

5-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.0248**	0.0070	0.0191**
	(0.0094)	(0.0052)	(0.0083)
Constant	0.1120***	0.0625**	0.1150**
	(0.0362)	(0.0244)	(0.0421)
R^2	0.178	0.014	0.094

Note: The table displays results of regressing the estimated R^2 coefficients in equation (2) on the announcement's intrinsic value derived from nowcasting GDP advance, the GDP price deflator advance, and the Federal Funds Target Rate. The sample covers the period from January 1997 to December 2015, and each regression is based on 36 observations. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table 8

Price Impact and Macroeconomic Announcement Characteristics.

6-Month Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0123**	0.0100**	0.0122	0.00453	0.0363*	-0.00626*	0.00383
	(0.0060)	(0.0048)	(0.0073)	(0.0044)	(0.0206)	(0.0036)	(0.0085)
Constant	0.0570**	0.0483**	0.0408**	0.0191***	0.00510	0.0265***	0.0145
	(0.0235)	(0.0188)	(0.0179)	(0.0059)	(0.0043)	(0.0092)	(0.0089)
R^2	0.117	0.089	0.060	0.008	0.083	0.059	0.001

1-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0196**	0.0135*	0.0227**	0.0120**	0.0500	-0.0111**	0.0206**
	(0.0088)	(0.0070)	(0.0111)	(0.0055)	(0.0312)	(0.0054)	(0.0098)
Constant	0.0884**	0.0673**	0.0686**	0.0287***	0.00879	0.0413***	0.00484
	(0.0341)	(0.0276)	(0.0268)	(0.0085)	(0.0065)	(0.0134)	(0.0088)
R^2	0.139	0.076	0.098	0.026	0.074	0.087	0.016

2-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0266**	0.0195**	0.0293**	0.0138*	0.0703*	-0.0168***	0.0427***
	(0.0099)	(0.0080)	(0.0128)	(0.0070)	(0.0376)	(0.0058)	(0.0122)
Constant	0.118***	0.0922***	0.0880***	0.0363***	0.00863	0.0558***	-0.0120
	(0.0383)	(0.0315)	(0.0306)	(0.0099)	(0.0087)	(0.0151)	(0.0112)
R^2	0.187	0.115	0.120	0.025	0.107	0.146	0.052

5-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0248**	0.0162**	0.0302**	0.0159**	0.0547	-0.0168***	0.0388***
	(0.0094)	(0.0077)	(0.0126)	(0.0063)	(0.0361)	(0.0058)	(0.0115)
Constant	0.1120***	0.0824**	0.0894***	0.0362***	0.0142	0.0556***	-0.00797
	(0.0362)	(0.0305)	(0.0297)	(0.0095)	(0.0084)	(0.0144)	(0.0097)
R^2	0.178	0.088	0.139	0.036	0.071	0.162	0.047

Note: The table displays results of regressions of the R^2 from equation (2) in Table 2 on the macroeconomic announcement's intrinsic value and its components (relation to fundamentals, timeliness premium, and revision premium) derived from nowcasting GDP advance. The table also displays the results of similar regressions using alternative measures for the three components, namely correlation with GDP, reporting lag, and revision magnitude. The data sample is from January 1997 to December 2015, and each regression is based on 36 observations. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Online Appendix to:

Is the Intrinsic Value of Macroeconomic News Announcements Related to their Asset Price Impact?

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In this online appendix, we present supplementary material on our analysis of the link between the intrinsic value and the price impact of macroeconomic announcements. First, we present the details of the noisy rational expectations model of the price response to expected public announcements. Second, we provide details on the nowcasting procedure and data management. Third, we present the exact transformations of the macroeconomic variables we use in our tests. Fourth, we present results of our analysis without the Federal Reserve's zero lower bound period.

O.1. A Noisy Rational Expectations Model

In this appendix, we provide the details of the noisy rational expectations model we use to motivate and frame the relationship between an announcement's price impact and its intrinsic value, timeliness, revisions, and relation to fundamentals. For more details on this class of models, we refer the reader to, among many others, Grundy and McNichols (1989), Kim and Verrecchia (1991a,b), Kandel and Pearson (1995), Veronesi (2000), Hautsch and Hess (2007), and Hess and Niessen (2010).

O.1.1. Model Setup

We consider a discrete-time and finite-horizon model where a representative investor trades a claim on future consumption. The terminal payoff of this traded asset is a random variable, which depends on the underlying state of the economy. Every period, the investor updates her belief about the asset's payoff as she receives public (macroeconomic) information and trades accordingly. This setup maps into our empirical analysis by thinking of the traded asset as U.S. Treasury bonds and by viewing the timeline as one specific reference period in actual data, i.e., for a reference period p, the investor receives a sequential set of macroeconomic signals, trades as the information is received, and the final payoff is realized at the end of the calendar of announcements referring to that period.

Before observing any information at time $t = 0$, the investor assumes that the asset's terminal payoff X is normally distributed with mean μ_0 and precision (inverse of variance) ρ_0. At each release time t, the investor observes a noisy signal a_t^n of X, where the subscript n indicates the announcement type (e.g., nonfarm payroll, industrial production).[1] This signal is equal to the asset payoff plus noise, $a_t^n = X + \varepsilon_t^n$, where ε_t^n is normally distributed with zero mean and precision $\rho_{a_t^n}$.

The representative investor maximizes her expected final consumption (wealth W) based on negative exponential utility with constant absolute risk aversion γ:

$$E_t[U(W)] = E_t[-e^{-\gamma DX}], \tag{E-1}$$

where D is the (optimal) amount of the traded asset held in that period. For simplicity, we assume that $\gamma = 1$ and abstract away from private information and heterogeneous prior beliefs. The latter is required to generate trading volume (Kim and Verrecchia, 1991b). Thus prices move without any trading in our model.

[1] In the empirical analysis, announcements have the reference period p as additional subscript. Because the model in this appendix studies the information updating for a specific reference period, we drop the p subscript here.

Because all payoffs and signals are normally distributed and i.i.d., the first-order condition consistent with the above negative exponential utility function is standard, and the investor's demand D_t for the traded asset at time t is a linear function of the asset's price p_t at that time:[2]

$$D_t = \frac{E_t[X] - p_t}{Var_t[X]} \tag{E-2}$$

At each information release t, the rational investor estimates the conditional mean and variance of the asset's payoff based on all available information (current and past signals). Since all signals are public, there is nothing additional to be learned from the price; hence the agent needs to condition only on the signals themselves. Using Bayes' rule, the asset's conditional expected payoff after information release t is

$$E_t[X] \equiv \mu_t = \rho_t^{-1} \left(\rho_0 \mu_0 + \sum_{i=1}^{t} \rho_{a_i^n} a_i^n \right), \tag{E-3}$$

where $\rho_t = \rho_0 + \sum_{i=1}^{t} \rho_{a_i^n}$ is the conditional precision of the investor's posterior at this time. When updating her belief about the state of the economy, the investor places a weight of $\frac{\rho_{a_t^n}}{\rho_t}$ on signal a_t^n.

The negative exponential utility function implies linear demand functions. Imposing the market-clearing condition that demand must equal an exogenous supply of the (normally distributed) traded asset, it is straightforward to show that at each time prices equal the conditional expected payoffs, i.e. that $p_0 = E[X]$ and $p_t = E_t[X]$. Thus the price changes around macroeconomic announcements according to

$$p_t - p_{t-1} = \frac{\rho_{a_t^n}}{\rho_t} \left(a_t^n - \mu_{t-1} \right). \tag{E-4}$$

The price change around the public release of information is therefore equal to a constant times the announcement's surprise.

O.1.2. Intrinsic Value and Price Impact

The previous literature refers to the constant $\frac{\rho_{a_t^n}}{\rho_t}$ in equation (E-4) as the price impact of announcement a_t^n. It is the weight that the representative investor places on that announcement when updating her belief about the state of the economy, which we therefore refer to as the intrinsic value of the announcement. Because prices in this stylized model react only to information, the price impact and the intrinsic value are equal. Empirically, this is not

[2] The investor's coefficient of absolute risk aversion enters the demand function in the denominator, i.e., ceteris paribus, the higher the risk aversion, the lower the demand for the risky asset. Higher risk aversion dampens the equilibrium asset price response.

the case. Whether an announcement matters for forecasting a variable of interest and how it affects asset prices depends on how the market reacts to this underlying information.

O.1.3. Timeliness

To capture the effect of the announcement's timeliness on the intrinsic value, we consider announcements which are released at different times but are equally precise, i.e., they have the same precision $\rho_{a_t^n} \equiv \rho_a$. We can re-write equation (E-4) as

$$p_t - p_{t-1} = \frac{\rho_a}{\rho_0 + t\rho_a}\left(a_t^n - \mu_{t-1}\right). \tag{E-5}$$

Clearly, $\frac{\rho_a}{\rho_0+t\rho_a}$ decreases in t. Therefore an early surprise has a bigger price impact than an equally large surprise later on.

O.1.4. Revisions

To capture the effect of the announcement's revisions on intrinsic value and price impact, we now consider the case of multiple announcements being released at the same time. For simplicity, suppose that M announcements are released simultaneously at time $t = 1$ and that these announcements differ in their precision $\rho_{a_1^n}$, where $n = 1, ..., M$. We therefore have

$$p_1 - p_0 = \frac{\sum_{n=1}^{M} \rho_{a_1^n}\left(a_1^n - \mu_0\right)}{\rho_0 + \sum_{n=1}^{M} \rho_{a_1^n}}. \tag{E-6}$$

The weight on the i^{th} announcement released at time $t = 1$ is therefore $\frac{\rho_{a_1^i}}{\rho_0+\sum_{n=1}^{M}\rho_{a_1^n}}$, which increases in the announcement's precision $\rho_{a_1^i}$. Among announcements released at the same time, the more precise announcement has a bigger price impact.[3]

Importantly, the precision of a noisy announcement combines two components, the announcement's relation to fundamentals and its revisions. Indeed, macroeconomic announcements undergo revisions following their initial release (Croushore, 2011), but even the most carefully revised macroeconomic announcements are imperfect proxies for fundamentals because of measurement error. We can therefore decompose the precision of an announcement into these two components:

$$\rho_{a_t^n} = \rho_{a_t^n}^{\infty} - \left(\rho_{a_t^n}^{\infty} - \rho_{a_t^n}\right), \tag{E-7}$$

where $\rho_{a_t^n}^{\infty}$ is the announcement's relation to fundamentals, i.e., the precision of the fully revised announcement, and $\rho_{a_t^n}^{\infty} - \rho_{a_t^n}$ is the revision noise. We assume that $\rho_{a_t^n}$ increases monotonically in t with each revision, converging to $\rho_{a_t^n}^{\infty} < \infty$ in the limit. By this definition,

[3] No additional intuition is gained from generalizing this to time t, but the equilibrium return is significantly more cumbersome.

the revision noise shrinks to zero over time, whereas the relation to the fundamental is a (finite) constant.

For a set of announcements with the same relation to fundamentals, it follows from equations (E-6) and (E-7) that the announcement weight decreases with revision noise. Ceteris paribus, less revised announcements have a bigger price impact.

O.1.5. Relation to Fundamentals

Per equation (E-7), the relation to fundamentals captures the noise component that never goes away. It is the precision of the final revised value a^n_∞.

For a set of announcements with the same revision noise, it follows from equations (E-6) and (E-7) that the announcement weight increases in $\rho^\infty_{a^n_t}$. Ceteris paribus, announcements with a larger relation to fundamentals have a bigger price impact.

O.2. Methodology

This appendix provides additional details on the definition of our three nowcasting targets, the nowcasting procedure, and the definition of nowcasting weights in actual and counterfactual settings.

O.2.1. Nowcasting Target and Data Management

Mirroring the monthly evolving state of the economy, the data matrix at time t captures the latest known value of each macroeconomic announcement in each reference month. Figure F-1 shows the data structure and its sequential filling.

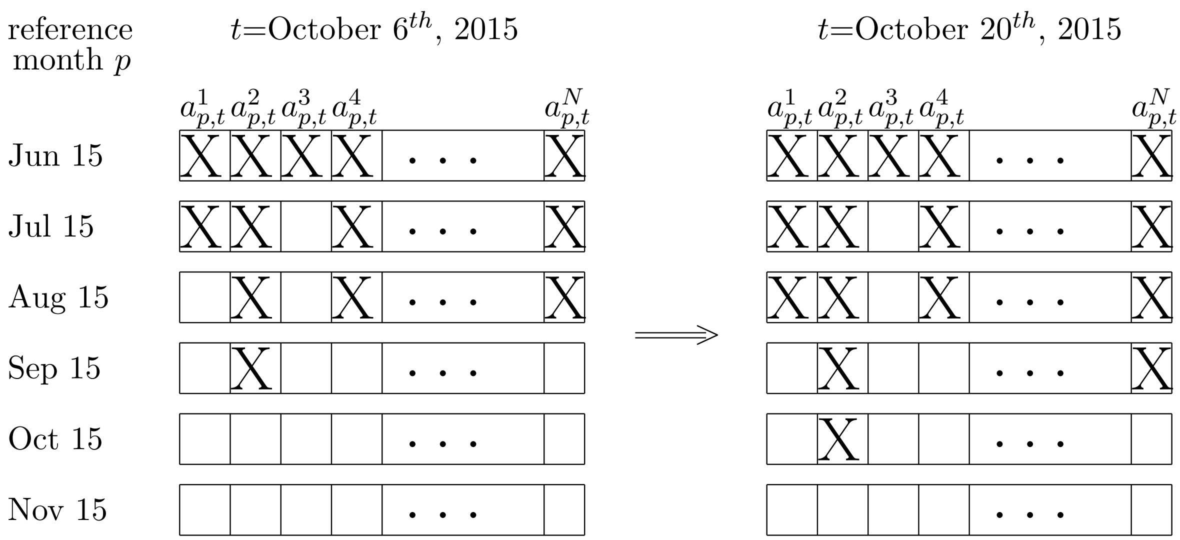

Fig. F-1. Data Structure

We reestimate our model completely each time a new announcement is released. This iterative method requires rebuilding the dataset at every t, because past values might have been revised.

Our raw dataset contains 36 macroeconomic announcement series and the Federal Funds Target Rate (FFTR). For each of these series we record the release times, the initially published values, the reference periods and the latest revised values. We transform these announcements as described in Appendix O.3. to ensure stationarity.

We consolidate variables that are released by installments, namely GDP (advance, preliminary, final), GDP price deflator (advance, preliminary, final), and the University of Michigan (UM) consumer confidence index (preliminary, final) into one series, respectively. That is, we maintain only a single time series of GDP, GDP price deflator, and UM consumer confidence, and replace preliminary values in real time by revised ones as they become available. In terms of Figure F-1 this means that GDP appears as a single column, and that earlier values (in boxes marked with "X") are overwritten by later releases for the same reference period. This reduces the 37 raw announcement series to $N = 32$ consolidated series.

Several of our macroeconomic series refer to periods different from a calendar month. These are variables that are released weekly, quarterly, or irregularly. We convert them to monthly frequency in the following way: The only weekly series in our dataset, initial jobless claims, is measured in headcounts, which we simply add up. If at time t claims are known for only a part of a given reference month, then we scale them up to the full month, assuming the unknown later part of the month will have the same headcounts as its known part, and revise these values as additional weeks become known. We fill quarterly values into all months of the respective quarter and apply mean-invariant smoothing for compounding growth rates to avoid jumps between quarters.

The only irregular series is the FFTR. We specify the monthly FFTR vector to contain the FFTR on the 15^{th} of each month at 23:59:59. We further assume that an FOMC announcement pins down the FFTR until the next scheduled FOMC meeting. We allow any FFTR entry to change again if there is another FOMC meeting before the next 15^{th} of a month. If there are several meetings within a month, then only the FFTR of the last meeting before the 15^{th} of each month at 23:59:59 will remain in the data matrix going forward. All other FFTR rates appear only temporarily, and are eventually overwritten by the value announced at that last meeting. The monthly FFTR change is accordingly the difference between its value on the 15^{th} of the current month and its value on the 15^{th} of the previous month.

Our nowcasting target variables are *GDP advance*, the *GDP price deflator advance*, and the *Federal Funds Target Rate* (FFTR). In the case of quarterly nowcasting targets, i.e. GDP and GDP price deflator, we switch to the next forecasting quarter when their advance estimate is released. In the case of FFTR, we switch on the 15^{th} of any given month to forecasting the next month, in line with our assignment of FFTR announcements to reference periods. This also implies that the change in the FFTR is the difference between its value on the 15^{th} of the current month and its value on the 15^{th} of the previous month.

Our dataset covers the period from January 1990 until December 2015. We base our estimates of the intrinsic value on an expanding window beginning in January 1990. We start the nowcasting exercise with the window ending in January 1997. Our choice of the starting date has two reasons. First, we need initial observations to estimate the system matrices reliably. Second, for some series real-time data is not available for some or all of the years before 1997. When real-time data is not available, in particular for the Chicago Purchasing Manager Index and the Philadelphia Fed Index in the early years, we use instead final values during these years.

O.2.2. State Space Model

As discussed in the main text, we work with the VAR(1) state equation

$$\Phi_{p,t} = B_t \Phi_{p-1,t} + C_t \nu_{p,t}, \tag{E-8}$$

where $\nu_{p,t} \sim WN(0, I_{2\times 2})$. The state of the economy evolves at a monthly frequency, indexed by reference period p. The subscript t governs how much information is available about the current and the past state vectors, and identifies specific times within the month. The announcement series end in different reference periods, which we denote by $\bar{p}_t^n$. At time t the last reference period with the complete set of data available is $\bar{p}_t = min_n(\bar{p}_t^n)$.

We use a 5-dimensional state vector, $\Phi_{p,t}$, consisting of two common factors, one real factor, one nominal factor, and one forward-looking factor. The common factors are based on all $N = 32$ consolidated announcement series. The real factor is based on 19 announcement series: unemployment rate, durable goods orders, housing starts, trade balance, nonfarm payroll, advance retail sales, capacity utilization, industrial production, business inventories, construction spending, factory orders, new home sales, personal consumption, personal income, monthly budget statement, consumer credit, initial jobless claims, GDP, and retail sales less autos. The nominal factor is based on six announcement series: Consumer Price Index, Producer Price Index, CPI ex food and energy, PPI ex food and energy, average hourly earnings, and GDP price deflator. The forward-looking factor is based on nine announcement series: index of leading indicators, consumer confidence index, ISM PMI, Chicago PMI, Philadelphia Fed index, UM consumer confidence, durable goods orders, housing starts, and factory orders.

The corresponding observation equation for a given information set t is

$$A_{p,t} = D_t \Phi_{p,t} + \varepsilon_{p,t}, \tag{E-9}$$

where $\varepsilon_{p,t} \sim WN(0, V_{p,t})$, and $A_{p,t} = \left[a_{p,t}^1, \ldots, a_{p,t}^N\right]'$ is the monthly vector of N macroeconomic variables containing only values announced on or before time t.

O.2.3. Nowcasting Procedure

Because past values are revised, the state space model (E-8) and (E-9) must be re-estimated at each data release. We use the two-step procedure of Giannone et al. (2008), because it permits forecasting the FFTR by an ordered probit specification.[4] The estimation proceeds

[4]Such "partial" models, specifying the target variable separately from the model of the predictors, are widely used in policy institutions (Bańbura et al., 2013). For our sample, this two-step procedure outperformed the one-step procedure in nowcasting GDP in terms of mean squared forecasting error.

in four steps, which we repeat for each announcement release time t. We use an expanding window from January 1990 until time t, starting with the window ending on t = January 1^{st}, 1997.

First, we consolidate variables that are released piece by piece (GDP, GDP price deflator, University of Michigan consumer confidence index) into one series, respectively, as described. For determining the intrinsic value later, we keep track of each observation's original designation (advance, preliminary, or final). Given t, each time series is standardized to zero mean and unit standard deviation.

Second, we define the five-dimensional state vector based on five principal components $\Phi_{p,t}$ extracted from the balanced part of the sample from January 1990 to $\bar{p}_t$. Two principal components are based on all, three further principal components are based on only real, nominal, and forward-looking announcement series, respectively. The matrix C_t collects the five eigenvectors, linking the factors $\Phi_{p,t}$ with the announcements $A_{p,t}$. The diagonal matrix $V_t = diag(v_t^1, v_t^2, \ldots, v_t^N)$ contains the estimate of the idiosyncratic component, that is, the residual variance from projecting separately each $a^n_{\cdot,t}$ series on the factors $\Phi_{\cdot,t}$ by ordinary least squares. We modify V_t to account for observations of $A_{p,t}$ which are missing or which cover only a fraction of the month. Denoting the share of a given reference month covered by information about macroeconomic variable n in reference period p available at time t with $\chi^n_{p,t}$ we define

$$v^n_{p,t} = \begin{cases} v^n_t / \chi^n_{p,t} & \text{if } a^n_{p,t} \text{ missing or incomplete,} \\ v^n_t & \text{otherwise.} \end{cases} \qquad \text{(E-10)}$$

If, for example, the monthly observation $a^n_{p,t}$ is missing, then $v^n_{p,t} = \infty$, or, in the actual implementation, it is set to a very large number. For a weekly series $\chi^n_{p,t}$ is the share of days of month p for which data has already been released by time t. These values are collected in the diagonal matrix $V_{p,t} = diag(v^1_{p,t}, v^2_{p,t}, \ldots, v^N_{p,t})$.

Third, the system matrices B_t and C_t of the VAR in equation (E-8) are estimated by ordinary least squares, the Kalman filter is initialized by the principal component estimates for the first period, and the initial variance is set equal to the unconditional variance of the common factors. For a given information set (indexed by t), the Kalman filter returns a sequence of Kalman gain matrices, $K_{p,t}$. Consider now a specific release time t. Because the matrices B_t, C_t, D_t, and $V_{p,t}$ are constant within the balanced part of the sample, $K_{p,t}$ converges until the last reference period $\bar{p}_t = min_n(\bar{p}^n_t)$ with the complete set of data available within that information set. For $p > \bar{p}_t$ some announcements are missing, reflecting the "ragged edge" problem (Wallis, 1986). In effect, $V_{p,t}$ varies over time, and therefore $K_{p,t}$ fluctuates for $p > \bar{p}_t$. For each forecasting target and each information set t, the Kalman filter produces a Kalman gain matrix $K_{p,t}$ for each reference month p.

$$K_{p,t} = \begin{bmatrix} k_{p,t}^{11} & \dots & k_{p,t}^{N1} \\ \vdots & & \vdots \\ k_{p,t}^{15} & \dots & k_{p,t}^{N5} \end{bmatrix}. \tag{E-11}$$

In a balanced sample, the Kalman gain of interest would obviously be the gain in the very last period. Standard results show that the Kalman gain converges to a constant matrix as p becomes large. In our case, the most recent period with all announcements available is usually two months earlier, and more recent months contain only a subset of the announcements in varying composition. The composition does not follow a strict monthly or quarterly periodicity, because the sequence of announcements changes due to calendar effects specific to each month. It is further complicated by idiosyncratic events such as government shutdowns. The convergence result for Kalman gains does therefore not apply for this most recent period.[5] To construct the time series of the intrinsic value of announcement n, only the gains at the time of a new release of macroeconomic variable n are used, i.e. in period $\bar{p}_t^n$.[6] Therefore we can refer to the column n of $K_{\bar{p}_t^n,t}$ corresponding to this announcement series (sampled in the periods with new releases of n) as k_t^n. Here we keep the release times of the advance, preliminary and final releases of GDP, GDP price deflator, and UM consumer confidence separate in order to assess their impact separately.

Fourth, given the information at time t, we refine the in-sample estimates of the latent factors by Kalman smoothing, which improves the estimates of their past realizations by accounting for subsequently (but not after time t) revealed information. Then we use these smoothed factors $\tilde{\Phi}_{p,t}$ to fit a forecasting model for the nowcasting targets GDP and GDP price deflator,

$$A_{p,t}^j = \tilde{D}_t^j \bar{\Phi}_{p,t} + \varepsilon_{p,t}, \tag{E-12}$$

at quarterly frequency by ordinary least squares, where $\varepsilon_{p,t} \sim WN(0, \tilde{v}_t^j)$. To account for the quarterly frequency, $\bar{\Phi}_{p,t}$ contains the arithmetic average of the estimated monthly factors

[5] Bańbura and Rünstler (2011) impose the ragged edge pattern at the end of the sample of the final data vintage (i.e. of their complete dataset) on the end of each subsample in the recursive estimation. This is justified if the rugged edge pattern does not vary with t. Unfortunately, this is not satisfied in U.S. macroeconomic announcement data, even if the day of the month was held fixed. In fact, several important macroeconomic announcements contribute to time variation in the ragged edge pattern. As a further complication, our approach requires us to reestimate the filter before every release, i.e. multiple times per month, and so the ragged edge varies by construction additionally within each month.

[6] In our setup with unbalanced data, the last converged Kalman gain (from the very last period before some announcements are missing) is an ex-post measure of gain. Instead, we use the Kalman gain in the most recent month for which the respective variable has data. Therefore period for Kalman gain calculation differs between variables. Both Kalman gain vectors would be identical if a given variable was always announced last.

$\tilde{\Phi}_{p,t}$ during the respective quarter. For the discrete nowcasting target FFTR we use the ordered probit model

$$A_{p,t}^{FFTR} = A_i \text{ if } \alpha_{i,t} < A_{p,t}^* \leq \alpha_{i+1,t} \quad \text{(E-13)}$$

$$A_{p,t}^* = \tilde{D}_t \tilde{\Phi}_{p,t} + \varepsilon_{p,t}, \quad \text{(E-14)}$$

following Hamilton and Jordà (2002) at monthly frequency. Here $\alpha_{i,t}$ are the cutoff points which map the latent variable $A_{p,t}^*$ into FFTR steps and $\varepsilon_{p,t} \sim WN(0, \tilde{v}_t^{FFTR})$. To account for the discreteness of the FFTR, we round FFTR changes to 0.25% and define as many ordered probit categories A_i as needed at any given time t.

For each forecasting target, indexed by j, we estimate coefficients $\tilde{D}_t^j$ on the latent factors at each point in time. In the discrete choice model for the FFTR we use the marginal effect instead. The absolute value of the product, $w(j)_t^n = |\tilde{D}_t^j k_t^n|$, of this coefficient (row) vector with the respective column of the Kalman gain matrix is the weight on announcement n at time t for nowcasting the variable j. We take absolute values to capture the direction-free impact of an announcement.

Repeating these four steps recursively at each announcement time t in our sample gives us a sequence of weights.

Based on equations (E-12) to (E-14), one can forecast the factors (or states) out-of-sample for $\tau > t$. The root mean squared forecasting error (RMSFE) of our nowcast of GDP is 1.4 during the period from 1997 to 2015, much lower than that of a random walk forecast of 2.1. The RMSFE for the GDP price deflator is 0.8, which is also lower than that of a random walk forecast with 1.3. For FFTR, the RMSFE is 0.18, which is also better than a random walk with 0.24. Nevertheless, obtaining an optimal nowcast is not a goal of this paper. It is for us just a means to evaluate the impact of announcement characteristics consistently.

We assume that agents with rational expectations care about the best case scenario, i.e., the intrinsic value when the announcement is just released. These are (ex-post) weights on the standardized, transformed macroeconomic variables at announcement time.[7]

Our measure of intrinsic value is the (logarithm of) the weights. Because these weights are derived from actual data released according to the actual release schedule, we refer to them as $w_A(j)_t^n$.

[7] These Kalman gain vectors are, of course, columns of Kalman gain matrices, but are taken from matrices calculated for, in general, different reference periods p – the most recent period p for which the respective variable had data at time t. Note that we are interested in the most recent weight, not in the cumulative weight that the filter assigns to all past realizations of that announcement.

O.2.4. Counterfactual Announcement Times and Revision Status

In order to measure the impact of an announcement while controlling for timing and noise, we create counterfactual datasets. These datasets differ from the original dataset in the release timing, the revision status, or both. We modify the respective property of only one macro announcement series n per nowcasting exercise.

To control for release timing, we counterfactually reorder the data. To do so, we identify the earliest announcement for each reference period and set the counterfactual announcement time of the variable of interest to one second before this previously earliest announcement. The earliest announcements are typically initial jobless claims and UM consumer confidence preliminary. Applying the nowcasting procedure to the reordered dataset yields the weight series $w_{RA}(j)_t^n$.

To control for revision status, we counterfactually replace all releases of the variable of interest by final revision values. In cases where no final value is available, we keep the value of the initial release. Subjecting the original data to both this counterfactual replacement with final values and the counterfactual reordering, and feeding this into the nowcasting procedure yields the weight series $w_{RF}(j)_t^n$.

O.3. Data Preparation

The dataset covers the reference months from January 1990 until December 2015. The real-time series of the Chicago PMI begins with the release for reference period November 1996, and the real-time series of the Philadelphia Fed Index with the release for reference period January 1997. Furthermore, some real-time values up until January 1992 are missing for consumer confidence, initial jobless claims, CPI ex food and energy, PPI ex food and energy, and the GDP deflator (advance, preliminary, final).

The 36 macroeconomic announcements listed in Table 1 in the main paper and the FFTR series, which are assumed here to jointly capture the state of the U.S. economy, are used in the nowcasting exercise, either in their original reporting units or transformed in order to approximate a linear relationship with the forecasting object. For indexes and variables reported in percent or percent changes, the original reporting unit is used, while variables reported in levels are transformed into percent changes. For example, the retail sales series, reported as a percent change, is not transformed, while the new home sales series is transformed from levels to percent change.

We transform the raw data to ensure that all time-series available as of December 31, 2015 are stationary. More precisely, we transform the macroeconomic series, i.e., the dependent variable $A_{p,t}$ in the observation equation (4), in order to approximate a linear relationship with the forecasting object. Table T-1 summarizes the transformations.

We do not modify published data by, for instance, removing or replacing outliers with fitted values. Instead, we treat them as features of the data that our estimates should capture.

Table T-1
Transformations of Macroeconomic Announcements.

n	**Announcement**	**Original Unit**	**Transformation**
	Real Activity		
1	GDP advance	% change	Original
2	GDP preliminary	% change	Original
3	GDP final	% change	Original
	Prices		
4	GDP price deflator advance	% change	Original
5	GDP price deflator preliminary	% change	Original
6	GDP price deflator final	% change	Original
	Real Activity		
7	Unemployment report	%	Original
8	Nonfarm payroll employment	change	Original/ NFP Population
9	Retail sales	% change	Original
10	Retail sales less automobiles	% change	Original
11	Industrial production	% change	Original
12	Capacity utilization	%	Original
13	Personal income	% change	Original
14	Consumer credit	change	% change
	Consumption		
15	Personal consumption expenditures	% change	Original
16	New home sales	level	% change
	Investment		
17	Durable goods orders	% change	Original
18	Construction spending	% change	Original
19	Factory orders	% change	Original
20	Business inventories	% change	Original
	Government Purchases		
21	Government budget deficit	level	% change
	Net Exports		
22	Trade balance	level	% change
	Prices		
23	Average hourly earnings	% change	Original
24	Producer price index	% change	Original
25	Core producer price index	% change	Original
26	Consumer price index	% change	Original
27	Core consumer price index	% change	Original
	Forward Looking		
28	UM consumer confidence preliminary	index	Original
29	Philadelphia Fed index	index	Original
30	UM consumer confidence final	index	Original
31	CB consumer confidence index	index	Original
32	Chicago PMI	index	Original
33	ISM PMI	index	Original
34	Housing starts	level	% change
35	CB leading economic index	% change	Original
36	Initial jobless claims	level	Original/ NFP Population

Note: This table reports, for each of the 36 announcements, the *original unit* used in both original agency reports and Bloomberg expectations, and the *transformation* used in this paper.

O.4. Results Without the Zero Lower Bound Period

In this appendix, we present replications of the paper's main results during the sub-sample prior to the Federal Reserve's zero lower bound period that started in December 2008. Consistent with the findings of Swanson and Williams (2014), the zero lower bound does weaken the findings, especially for the shorter maturities bonds, but our overall conclusions are qualitatively unchanged.

Table T-2

Effect of Macroeconomic Surprises on U.S. Treasury Yields – Prior to Zero Lower Bound.

		6-month Treasury		1-Year Treasury		2-Year Treasury		5-Year Treasury		
n	**Announcement**	Coeff.	R^2	Coeff.	R^2	Coeff.	R^2	Coeff.	R^2	Obs.
1	GDP advanced	2.265**	0.092	2.078*	0.074	1.646	0.053	0.895	0.016	48
2	GDP preliminary	-0.025	0.000	-0.190	0.001	-0.368	0.003	-0.453	0.006	48
3	GDP final	-0.021	0.000	-0.798	0.011	-0.679	0.011	-0.06	0.000	47
4	GDP price deflator advance	0.625	0.006	0.368	0.002	0.270	0.001	-0.138	0.000	48
5	GDP price deflator preliminary	1.468	0.022	1.344	0.021	1.460	0.029	1.150	0.027	48
6	GDP price deflator final	0.701	0.013	0.086	0.000	0.012	0.000	0.010	0.000	47
7	Unemployment report	-1.809**	0.037	-1.391*	0.019	-0.960	0.012	-0.374	0.003	144
8	Nonfarm payroll employment	3.960***	0.243	3.935***	0.207	3.063***	0.169	2.098***	0.125	144
9	Retail sales	2.467***	0.136	2.306***	0.102	1.994***	0.086	1.289***	0.052	144
10	Retail sales less automobiles	1.950***	0.070	2.023***	0.065	1.817***	0.059	1.376***	0.049	143
11	Industrial production	1.573***	0.046	1.665***	0.049	1.302**	0.040	0.885*	0.025	144
12	Capacity utilization	2.091***	0.083	2.178***	0.088	1.981***	0.095	1.536***	0.079	144
13	Personal income	-0.389	0.002	-0.329	0.002	-0.438	0.004	-0.553	0.008	143
14	Consumer credit	-0.301	0.002	-0.703	0.007	-0.717	0.009	-0.893*	0.020	144
15	Personal consumption expenditures	0.705	0.012	0.645	0.009	0.623	0.011	0.704	0.019	143
16	New home sales	0.980**	0.027	1.005**	0.030	1.072**	0.042	1.005***	0.051	143
17	Durable goods orders	0.472	0.004	0.769	0.012	0.790	0.017	0.545	0.013	143
18	Construction spending	0.260	0.002	0.095	0.000	-0.117	0.000	-0.211	0.002	144
19	Factory orders	0.524	0.007	0.848	0.015	.913*	0.021	0.507	0.008	144
20	Business inventories	0.023	0.000	0.271	0.001	0.249	0.001	0.033	0.000	144
21	Government budget deficit	-0.574	0.01	-0.474	0.006	-0.612	0.011	-0.677	0.018	144
22	Trade balance	0.176	0.000	0.610	0.006	0.588	0.007	0.764	0.016	144
23	Average hourly earnings	1.544**	0.028	1.718**	0.030	1.543**	0.033	1.247**	0.033	144
24	Producer price index	-0.014	0.000	-0.143	0.000	0.161	0.001	0.262	0.003	144
25	Core producer price index	0.190	0.001	0.422	0.004	0.586	0.010	0.784**	0.029	144
26	Consumer price index	1.034**	0.03	1.486***	0.05	1.413***	0.048	1.173**	0.044	144
27	Core consumer price index	1.701***	0.074	2.306***	0.110	2.158***	0.103	1.844***	0.098	144
28	UM consumer confidence preliminary	1.310*	0.028	1.134	0.023	1.097*	0.025	0.598	0.011	116
29	Philadelphia Fed index	2.013***	0.081	2.208***	0.090	1.875***	0.073	1.246**	0.038	142
30	UM consumer confidence final	0.327	0.003	0.224	0.001	0.594	0.010	0.543	0.012	115
31	CB consumer confidence index	1.474**	0.040	0.950	0.015	0.723	0.011	0.447	0.006	143
32	Chicago PMI	2.967***	0.162	2.847***	0.152	2.564***	0.146	1.834***	0.085	141
33	ISM PMI	3.275***	0.211	3.356***	0.190	3.031***	0.203	2.497***	0.196	144
34	Housing starts	0.267	0.002	0.286	0.002	0.183	0.001	0.035	0.000	144
35	CB leading economic index	0.055	0.000	0.063	0.000	0.183	0.001	0.535	0.006	143
36	Initial jobless claims	-1.113***	0.026	-1.042***	0.022	-.966***	0.022	-.621***	0.013	624

Note: The table reports the results of individual event study regressions of daily bond yield changes on macroeconomic announcement surprises. The sample covers the period prior to the zero lower bound, from January 1997 to mid-December 2008. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table T-3
GDP Channel Results – Prior to Zero Lower Bound.

	6-Month Treasury						1-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	0.575***	1.431***	1.640***	0.803***	0.575***	1.710***	0.798***	2.052***	2.134***	1.161***	0.811***	2.283***
	(0.108)	(0.310)	(0.269)	(0.160)	(0.081)	(0.321)	(0.098)	(0.293)	(0.295)	(0.187)	(0.088)	(0.333)
S × Intrinsic Value		0.290***						0.425***				
		(0.010)						(0.089)				
S × Relation to Fundamentals			0.364***			0.346***			0.456***			0.426***
			(0.085)			(0.095)			(0.094)			(0.093)
S × Timeliness Premium				0.145		0.077				0.232**		0.143
				(0.090)		(0.069)				(0.096)		(0.010)
S × Revision Premium					-0.001	0.000					0.110	0.109
					(0.078)	(0.074)					(0.084)	(0.082)
Constant	-0.574***	-0.564***	-0.566***	-0.569***	-0.574***	-0.564***	-0.480***	-0.465***	-0.470***	-0.473***	-0.479***	-0.466***
	(0.083)	(0.072)	(0.067)	(0.075)	(0.077)	(0.083)	(0.070)	(0.072)	(0.082)	(0.079)	(0.088)	(0.066)
R^2	0.013	0.017	0.018	0.014	0.013	0.018	0.022	0.029	0.028	0.024	0.022	0.030

	2-year Treasury						5-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	1.155***	2.920***	2.941***	1.658***	1.183***	3.160***	1.165***	2.602***	2.631***	1.569***	1.188***	2.805***
	(0.113)	(0.326)	(0.320)	(0.201)	(0.124)	(0.478)	(0.118)	(0.319)	(0.362)	(0.193)	(0.0973)	(0.345)
S × Intrinsic Value		0.598***						0.487***				
		(0.102)						(0.097)				
S × Relation to Fundamentals			0.610***			0.569***			0.501***			0.469***
			(0.105)			(0.136)			(0.109)			(0.104)
S × Timeliness Premium				0.321***		0.198*				0.258***		0.156
				(0.100)		(0.110)				(0.098)		(0.112)
S × Revision Premium					0.231**	0.230**					0.187*	0.187*
					(0.091)	(0.110)					(0.100)	(0.111)
Constant	-0.351***	-0.330***	-0.338***	-0.341***	-0.351***	-0.332***	-0.279***	-0.262**	-0.268***	-0.271***	-0.278***	-0.263**
	(0.101)	(0.095)	(0.086)	(0.094)	(0.091)	(0.118)	(0.102)	(0.105)	(0.092)	(0.104)	(0.104)	(0.116)
R^2	0.027	0.035	0.034	0.029	0.028	0.036	0.026	0.031	0.030	0.027	0.027	0.031

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from a nowcasting exercise for GDP. The data sample runs from January 1997 to mid-December 2008, and each regression is based on 4623 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table T-4

GDP Price Deflator Channel Results – Prior to Zero Lower Bound.

	6-Month Treasury						1-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	0.575***	1.207***	1.384***	0.710***	0.570***	1.436***	0.798***	1.868***	1.707***	1.087***	0.793***	1.855***
	(0.106)	(0.264)	(0.436)	(0.154)	(0.0904)	(0.426)	(0.0939)	(0.405)	(0.358)	(0.132)	(0.104)	(0.524)
S × Intrinsic Value		0.161**						0.273***				
		(0.069)						(0.100)				
S × Relation to Fundamentals			0.198*			0.184			0.222**			0.194
			(0.118)			(0.112)			(0.089)			(0.127)
S × Timeliness Premium				0.125		0.107				0.269***		0.251***
				(0.085)		(0.066)				(0.077)		(0.083)
S × Revision Premium					-0.122*	-0.113					-0.111	-0.095
					(0.067)	(0.073)					(0.096)	(0.010)
Constant	-0.574***	-0.571***	-0.575***	-0.569***	-0.573***	-0.570***	-0.480***	-0.475***	-0.481***	-0.469***	-0.479***	-0.471***
	(0.072)	(0.069)	(0.073)	(0.074)	(0.074)	(0.055)	(0.068)	(0.075)	(0.092)	(0.080)	(0.076)	(0.086)
R^2	0.013	0.014	0.014	0.014	0.014	0.015	0.022	0.025	0.023	0.025	0.022	0.026

	2-year Treasury						5-Year Treasury					
Coefficient on	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
S	1.155***	2.547***	2.142***	1.590***	1.147***	2.367***	1.165***	2.417***	2.138***	1.564***	1.156***	2.333***
	(0.119)	(0.485)	(0.579)	(0.178)	(0.141)	(0.631)	(0.118)	(0.468)	(0.608)	(0.166)	(0.127)	(0.546)
S × Intrinsic Value		0.355***						0.319**				
		(0.116)						(0.125)				
S × Relation to Fundamentals			0.242			0.197			0.238			0.196
			(0.148)			(0.159)			(0.158)			(0.148)
S × Timeliness Premium				0.405***		0.384***				0.371***		0.348***
				(0.103)		(0.112)				(0.098)		(0.112)
S × Revision Premium					-0.184*	-0.162					-0.229*	-0.208
					(0.109)	(0.122)					(0.135)	(0.153)
Constant	-0.275***	-0.275***	-0.276**	-0.265***	-0.277***	-0.269**	-0.277***	-0.277***	-0.279***	-0.270***	-0.278***	-0.274***
	(0.094)	(0.096)	(0.113)	(0.092)	(0.095)	(0.107)	(0.083)	(0.102)	(0.086)	(0.100)	(0.085)	(0.080)
R^2	0.027	0.030	0.028	0.030	0.028	0.031	0.026	0.028	0.027	0.029	0.027	0.030

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from a nowcasting exercise for GDP price deflator. The data sample runs from January 1997 to mid-December 2008, and each regression is based on 4623 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table T-5

FFTR Channel Results – Prior to Zero Lower Bound.

Coefficient on	6-Month Treasury (1)	(2)	(3)	(4)	(5)	(6)	1-Year Treasury (1)	(2)	(3)	(4)	(5)	(6)
S	0.575***	1.459***	2.281***	0.663***	0.575***	2.289***	0.798***	2.125***	3.032***	0.961***	0.802***	3.034***
	(0.0925)	(0.382)	(0.576)	(0.148)	(0.0947)	(0.495)	(0.111)	(0.344)	(0.524)	(0.137)	(0.103)	(0.578)
S × Intrinsic Value		0.216**						0.324***				
		(0.087)						(0.084)				
S × Relation to Fundamentals			0.338***			0.345***			0.443***			0.438***
			(0.109)			(0.104)			(0.101)			(0.111)
S × Timeliness Premium				0.074		-0.024				0.139		0.0155
				(0.110)		(0.110)				(0.085)		(0.093)
S × Revision Premium					-0.004	-0.002					0.048	0.052
					(0.068)	(0.076)					(0.064)	(0.073)
Constant	-0.574***	-0.566***	-0.564***	-0.572***	-0.574***	-0.564***	-0.480***	-0.469***	-0.467***	-0.476***	-0.480***	-0.467***
	(0.068)	(0.074)	(0.074)	(0.083)	(0.074)	(0.081)	(0.072)	(0.074)	(0.085)	(0.078)	(0.069)	(0.072)
R^2	0.013	0.015	0.017	0.013	0.013	0.017	0.022	0.026	0.028	0.023	0.022	0.028

Coefficient on	2-Year Treasury (1)	(2)	(3)	(4)	(5)	(6)	5-Year Treasury (1)	(2)	(3)	(4)	(5)	(6)
S	1.155***	2.835***	4.041***	1.313***	1.165***	4.067***	1.165***	2.354***	3.327***	1.249***	1.172***	3.357***
	(0.099)	(0.476)	(0.733)	(0.178)	(0.105)	(0.671)	(0.132)	(0.494)	(0.675)	(0.190)	(0.128)	(0.668)
S × Intrinsic Value		0.410***						0.290**				
		(0.114)						(0.117)				
S × Relation to Fundamentals			0.572***			0.581***			0.428***			0.445***
			(0.141)			(0.125)			(0.132)			(0.126)
S × Timeliness Premium				0.134		-0.027				0.071		-0.053
				(0.101)		(0.101)				(0.137)		(0.122)
S × Revision Premium					0.109	0.112					0.078	0.0800
					(0.112)	(0.121)					(0.112)	(0.117)
Constant	-0.351***	-0.337***	-0.334***	-0.348***	-0.352***	-0.336***	-0.279**	-0.268***	-0.266***	-0.277***	-0.279***	-0.267**
	(0.090)	(0.091)	(0.109)	(0.092)	(0.113)	(0.099)	(0.114)	(0.102)	(0.092)	(0.103)	(0.096)	(0.113)
R^2	0.027	0.030	0.032	0.027	0.027	0.033	0.026	0.028	0.029	0.026	0.026	0.029

Note: The table displays results of regressing daily bond yield changes on macro surprises (column 1), on macro surprises and surprises interacted with our announcement characteristics separately (columns 2, 3, 4, and 5), and on macro surprises and surprises interacted with announcement characteristics all at once (column 6). Characteristics are derived from a nowcasting exercise for the Federal Funds Target Rate. The data sample runs from January 1997 to mid-December 2008, and each regression is based on 4623 observations. Bootstrapped standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table T-6
Price Impact and Intrinsic Value – Prior to Zero Lower Bound.

6-Month Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.016**	0.005	0.010**
	(0.006)	(0.004)	(0.005)
Constant	0.075***	0.048**	0.070***
	(0.025)	(0.018)	(0.025)
R^2	0.142	0.018	0.056

1-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.024**	0.013**	0.017**
	(0.009)	(0.006)	(0.006)
Constant	0.109***	0.090***	0.106***
	(0.036)	(0.029)	(0.033)
R^2	0.166	0.060	0.075

2-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.030***	0.017**	0.021***
	(0.011)	(0.008)	(0.007)
Constant	0.140***	0.114***	0.134***
	(0.041)	(0.038)	(0.040)
R^2	0.190	0.067	0.083

5-Year Treasury

	Nowcasting Target		
Coefficient on	GDP (1)	GDP Deflator (2)	FFTR (3)
Intrinsic Value	0.026**	0.017**	0.018**
	(0.011)	(0.008)	(0.007)
Constant	0.124***	0.114***	0.119***
	(0.041)	(0.040)	(0.039)
R^2	0.151	0.077	0.066

Note: The table displays results of regressing the estimated R^2 coefficients in equation (2) on the announcement's intrinsic value derived from nowcasting GDP, the GDP price deflator, and the Federal Funds Target Rate. The sample covers the period from January 1997 to mid-December 2008, and each regression is based on 36 observations. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.

Table T-7

Price Impact and Macroeconomic Announcement Characteristics – Prior to Zero Lower Bound.

6-Month Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.016**	0.016**	0.011	0.006*	0.046*	-0.008*	0.011
	(0.006)	(0.006)	(0.007)	(0.003)	(0.023)	(0.004)	(0.015)
Constant	0.075***	0.072***	0.046**	0.027***	0.0093	0.037***	0.014
	(0.025)	(0.023)	(0.018)	(0.007)	(0.006)	(0.011)	(0.014)
R^2	0.142	0.132	0.044	0.018	0.095	0.079	0.008

1-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0237**	0.0209**	0.0193*	0.0109***	0.0608*	-0.0144**	0.0308*
	(0.00922)	(0.00899)	(0.0107)	(0.00385)	(0.0355)	(0.00659)	(0.0171)
Constant	0.109***	0.0974***	0.0714**	0.0380***	0.0141	0.0549***	0.00238
	(0.0356)	(0.0334)	(0.0262)	(0.00929)	(0.00833)	(0.0149)	(0.0132)
R^2	0.166	0.122	0.068	0.032	0.087	0.119	0.034

2-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0304***	0.0290***	0.0234	0.0110*	0.0802*	-0.0212***	0.0562**
	(0.0109)	(0.0105)	(0.0139)	(0.00577)	(0.0435)	(0.00700)	(0.0213)
Constant	0.140***	0.131***	0.0890***	0.0482***	0.0171	0.0735***	-0.0156
	(0.0412)	(0.0388)	(0.0320)	(0.0112)	(0.0120)	(0.0171)	(0.0182)
R^2	0.190	0.164	0.070	0.023	0.106	0.178	0.079

5-Year Treasury

	Nowcast Measures of				Alternative Measures		
	Intrinsic Value (1)	Relation to Fundamentals (2)	Timeliness Premium (3)	Revision Premium (4)	Correlation with GDP (5)	Reporting Lag (6)	Revision Magnitude (7)
Coefficient	0.0259**	0.0242**	0.0205	0.00959*	0.0606	-0.0215***	0.0562***
	(0.0110)	(0.0103)	(0.0146)	(0.00511)	(0.0420)	(0.00697)	(0.0195)
Constant	0.124***	0.115***	0.0816**	0.0459***	0.0222*	0.0718***	-0.0178
	(0.0407)	(0.0380)	(0.0324)	(0.0106)	(0.0124)	(0.0166)	(0.0162)
R^2	0.151	0.125	0.059	0.019	0.066	0.202	0.087

Note: The table displays results of regressions of the R^2 from equation (2) in Table T-2 on the macroeconomic announcement's intrinsic value and its components (relation to fundamentals, timeliness premium, and revision premium) derived from nowcasting GDP advance. The table also displays the results of similar regressions using alternative measures for the three components, namely correlation with GDP, reporting lag, and revision magnitude. The data sample is from January 1997 to mid-December 2008, and each regression is based on 36 observations. White standard errors are used, and ***, **, and * represent a 1, 5, and 10% level of significance, respectively.