Pre-Announcement Risk

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Abstract

I show that the pre-FOMC announcement drift—the tendency of the market to appreciate in the run-up to scheduled FOMC announcements—arises in a model where policy statements are interpreted based on recent news. If the market reaction to a given change in the Fed funds rate depends on announcement time conditions, there are two sources of uncertainty regarding a scheduled Fed announcement: 1) the news contained in the policy statement, and 2) announcement time market exposure. In the model, resolution of uncertainty regarding announcement time market exposure leads to an upward drift prior to the news release. The discrete timing of news events induces a seasonality in expected returns, even though fundamentals change at a constant rate. I provide time-series and cross-sectional evidence consistent with the mechanism.

1 Introduction

Recent work by Lucca and Moench (2015) establishes a striking pattern of upward drift in the aggregate equity market in anticipation of Federal Open Market Committee (FOMC) announcements. This is puzzling because risk premia should be earned when uncertainty is resolved.

In this paper I propose and test a model that can account for this fact. Specifically, I demonstrate that the combination of discrete release of information and time-varying risk exposures gives rise to elevated expected returns before the news announcement is made. The model does not rely on leaked information and investors have, on average, correct expectations about announcement contents.

The key element in the model is a direct link between announcement and pre-announcement information. I argue that investors learn how to interpret a given Fed announcement with news observed

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in the pre-announcement period. A number of recent papers have shown that Fed announcements affect market prices via two distinct channels. In addition to a traditional monetary channel, by which stocks react positively to a surprise cut in rates, these papers establish the existence of an informational channel.\(^1\) This informational channel affects asset prices via expectations of growth rates going forward, or perhaps by directly changing investors’ risk perceptions. In direct contrast to the standard mechanism, a funds rate increase tends to bring about higher market valuations via the informational effect. Because of the time-varying importance of these two channels, the same action by the Fed—say a cut in the funds rate—can have a different impact on asset prices.

I build on this literature and show the announcement type is predictable with information learned in the run-up to the announcement. If recent news has been good, the Fed announcement tends to be interpreted as a reflection of the Fed’s belief of growth rates going forward. In contrast, if recent news has been poor, the Fed announcement tends to be interpreted as a statement about the path of real rates. Put differently, Fed action is interpreted as a traditional monetary policy shock precisely in bad times.

From an asset pricing perspective, this feature of the announcements can give rise to a risk premium earned in the run-up to the announcement. Consider an investor with Epstein-Zin preferences in a two-period setting. The Fed is scheduled to make an announcement in the second period. In the first period, the investor learns the type of announcement to be made, which in turn determines the continuation value of the investor’s value function. As a consequence, innovations to the state variable that govern the announcement type constitute a priced risk in the pre-announcement period. Absent informational leaks, uncertainty about the announcement is resolved when the news release is made. In contrast, uncertainty about announcement time economic conditions declines at an increasing rate in the run-up to the scheduled event, leading to increased valuations as the meeting approaches. In other words, the pre-announcement drift is caused by a reduction in the market risk premium. This explanation does not require any news leakage about the announcement itself during the pre-announcement drift window—but it is vital that there is some uncertainty regarding the action the Fed will take.

I also provide a framework under which the Fed finds it optimal to operate in this manner. The underlying mechanism is the same that makes the investors demand high expected returns prior to the announcement: the Fed actions impact markets via a direct effect, as well as via an informational effect. Recognizing a trade-off between the optimal policy choice with respect to the direct and informational impact, the Fed adopts an announcement strategy under which it conditions its policy objective on the state of the economy.

Let me contrast the proposed explanation with existing literature, notably the account in Cieslak

\(^1\)Examples here include Gurkaynak et al. (2005), Matheson and Stavrev (2014), Boyarchenko et al. (2016), Kroencke et al. (2017), Cieslak and Schrimpf (2018), Jarocinski and Karadi (2018), Nakamura and Steinsson (2018), and Paul (2018).
et al. (2016). These authors establish that the pre-FOMC announcement drift is part of a broader cyclical pattern—expected returns are high on even weeks following the FOMC announcement. They argue these periodic high expected returns stem from a combination of two factors: informal communications from the Fed that tend to be concentrated on even weeks of the FOMC calendar, and a persistent underestimation by market participants of the amount of accommodation the Fed is able to provide. Like Cieslak et al. (2016), the model proposed here attributes the high returns in even weeks of the cycle to a risk premium effect. It does so, however, with investor beliefs that are on average correct. Because Fed announcements are made conditional on the state of economy at announcement time, the times leading up to communications from the Fed are riskier from the investors’ perspective.

Setting aside the reasons behind cyclicality in market returns over the FOMC calendar, the high returns in the last days before Fed announcements are hard to square with leaks or biased expectations. If the drift is caused by leaked information, the realized pre-announcement return should predict with a positive sign the market response to the announcement, which is not true in the data. Likewise, if the drift is caused by a bias in investor expectations, the same bias should be evident in Fed funds futures market, which is also not supported in the data.

To provide empirical support for the model proposed here I build on recent work by Cieslak and Schrimpf (2018) and Jarocinski and Karadi (2018) to classify Fed announcements based on the observed stock-bond covariance immediately following an announcement. These authors show that a traditional monetary policy shock is associated with positive stock-bond return covariance while a shock to expectations about growth rates is associated with a negative stock-bond covariance. Extending their work, I demonstrate that the type of announcement can be predicted using pre-announcement returns: poor market returns in the run-up tend to be followed by an announcement with positive stock-bond covariance. Put differently, the intermeeting market return informs investors’ interpretation of the Fed action. Similarly to Rigobon and Sack (2003) and Cieslak and Vissing-Jorgensen (2017), I find that market returns contain information about Fed announcements. In contrast to these authors, I find it is the type of announcement that can be gleaned from pre-announcement market behavior.

This predictability of announcement type is evident at short horizons: intraday return on the announcement day predicts the announcement type. That is, I find that the way the announcement is interpreted by the market depends on very short-lived signals. Calibrating the model allows me to quantify this statement: the state variable that governs announcement type has an autocorrelation of .8 in the daily data. Underlying this dependence on late-breaking developments could be a tendency of the Fed to react to recent news, a belief on the part of market participants that the Fed behaves this way, or a feedback effect as described in Stein and Sunderam (2018). This isn’t to say that the Fed is never responding to news that happen more than a couple days before scheduled meetings. Rather, substantial news that happen to arrive just before the Fed announcement tends
to have a strong impact on how the surprise component of the announcement is interpreted.

It is evident from transcripts of FOMC meetings that policymakers pay close attention to market and non-market news arriving just before the decision is made. Of the 152 scheduled FOMC meetings from 1994 to 2012, the transcripts of 80 contain mention of macroeconomic news announcements made in the morning of the meeting. Many others contain discussion of stock-, bond-, or Fed futures market behavior during the meeting. I list a number of examples in Appendix D.1. In order to provide more systematic evidence I count phrases such as “this morning” and “this week” in the FOMC transcripts and show that the frequency of these phrases is positively correlated with the strength of the pre-announcement drift.

In addition to the drift in the stock market, the model can rationalize the pre-announcement evidence in other asset classes. Lucca and Moench (2015) find no pre-announcement drift in Treasury prices. This is puzzling because the Fed action directly affects the near end of the yield curve. Karnaukh (2016) and Borisenko and Pozdeev (2017) find substantial predictability in currency returns around FOMC announcements. I show that the drift in FX markets and the apparent lack of drift in fixed income markets is consistent with the account presented here. In the model, the pre-announcement returns correspond to a reduction in the market risk premium. Cross-sectionally, then, the model predicts that a given asset’s exposure to the drift depends on its market beta. This is precisely what I find: accounting for the time-variation in FX and Treasury portfolios’ respective market betas, the pre-announcement returns are consistent with the contemporaneous stock market returns.

The model can also deliver the striking cyclicality of market returns over the FOMC cycle documented by Cieslak et al. (2016). In the model, the Fed optimally adopts a time-varying announcement policy to alleviate an informational asymmetry. However, by doing so, the Fed increases uncertainty prior to its announcements, leading to a pre-announcement drift. The benefits of Fed action—lower expected returns—accrue at a constant rate over time. The costs of Fed action—high required returns pre-announcement—accrue predominantly right before the announcement. As a result, market returns display a strong seasonality over the FOMC calendar. According to the model, should the Fed decide to do less to counter aggregate fluctuations, the pre-announcement drift would be lower, but expected returns in other times would increase.

My results have applications outside the topic of monetary policy transmission. The mechanism I use to account for the pre-FOMC drift predicts a pre-announcement drift in any situation featuring time-varying risk loadings and discrete arrival of news. Indeed, I find evidence of a market-level pre-announcement drift before scheduled Consumer Confidence Index announcements, before BLS employment announcements and before earnings announcements of the largest ten companies in the market. As already reported in Frazzini and Lamont (2007) and Hartzmark and Solomon (2013) there is a pre-announcement drift before scheduled earnings and dividend announcements. Consistent with the model here, I demonstrate that such drift is particularly strong for high CAPM
beta stocks.

In the final section of the paper I discuss alternative explanations of the pre-announcement drift, particularly the hypothesis that attributes these returns to informational leaks from the Fed. I demonstrate that the leaks hypothesis is inconsistent with a key prediction: realized returns in the pre-announcement window should predict the market response to the announcement itself.

2 Model

The model separately studies the two sides of the Fed announcement. Firstly, I will show that investors demand a pre-announcement risk premium because of the dependence of announcement interpretation on aggregate conditions. Secondly, I will show that the Fed finds it constrained optimal to communicate in this manner.

Underlying both parts of the model is the observation that Fed announcements affect financial markets at least via two distinct channels. A number of recent papers have provided theoretical and empirical support to this effect. Broadly speaking, the surprise component of a Fed announcement might represent a change in the expected path of real rates, or it might correspond to news about Fed’s expectation of economic growth going forward. Examples of papers studying the separate channels include Gurkaynak et al. (2005), Matheson and Stavrev (2014), Boyarchenko et al. (2016), Kroencke et al. (2017), Cieslak and Schrimpf (2018), Jarocinski and Karadi (2018), Nakamura and Steinsson (2018), and Paul (2018).

The presence of multiple types of information in a given announcement is evident in short window event studies. On average, stock prices tend to rise in response to a surprise cut in the funds rate, consistent with textbook models of monetary policy transmission. However, looking at the data meeting-by-meeting, stock prices often drop in response to a surprise cut.

The goal of the model is to demonstrate that this newly documented feature of Fed announcements can also rationalize the high pre-announcement expected returns. Two additional conditions have to be met. One, the two types of announcements have to command a different risk premium. Empirically, I will show that shocks to the path of real rates command a high risk premium, and shocks to expected growth command a small risk premium. Two, it has to be the case that Fed communications tend to be about the path of rates—the announcement that commands a higher risk premium—precisely in bad times.

The model specifies Epstein and Zin (1989) recursive preferences. In addition to providing a convenient way to capture the model insight, Epstein-Zin preferences are likely necessary to match the empirical magnitude of the pre-announcement risk premium. For instance, Savor and Wilson (2013) calibrate a version of the Bansal and Yaron (2004) model to match the empirical fact that
market expected returns are higher on days of significant macroeconomic announcements.\footnote{While FOMC announcements are part of their sample, Savor and Wilson (2013) do not separately address the pre-announcement evidence—their paper was likely completed before Lucca and Moench (2015) was first circulated.}

Magnitudes aside, the existence of a pre-announcement risk does not crucially rely on the specific functional form of Epstein-Zin or on the preference for early resolution of uncertainty. Indeed, I show in Appendix B that the model of pre-announcement risk is consistent with CRRA utility, as well as a host of other preference specifications.

A separate question concerns the behavior of the consumption process in the short window during which the pre-announcement risk premium is earned. It is likely the case that contemporaneous consumption cannot adjust in the few days before a given FOMC announcement, let alone during the day of. In recent work, Ai and Bansal (2018) argue that given this short-term rigidity in the consumption process, a sizable macroeconomic announcement premium constitutes evidence against time-separable expected utility preferences. In contrast, I find that a pre-announcement risk premium is consistent with expected utility preferences even if contemporaneous consumption cannot adjust at a high frequency. Investors can change plans for future consumption with the new information, and therefore the announcement is immediately impounded into asset prices. In Appendix C I derive the SDF for expected utility preferences under the assumption that short-term consumption is fixed, and find it consistent with a pre-announcement risk premium.

2.1 Investors’ Problem

Consider the following two period set-up. There is a scheduled Fed announcement to be made at time $t = 2$. The announcement can be either of two types: an announcement about the path of real interest rates, or an announcement about the Fed’s beliefs about long-term economic growth. Both announcements are made by changing the funds rate, and investors interpret the announcement conditional on a state variable $X$, capturing aggregate economic conditions.

At $t = 0$ investors don’t know the type of the announcement, nor do they know the content of the announcement. At $t = 1$ both the Fed and market participants observe the state variable $X$, capturing aggregate economic conditions and governing the announcement type to be made. For now suppose there are only two aggregate states, good ($X = 1$) and bad ($X = 0$).

By observing the evolution of the state variable from $t = 0$ to $t = 1$ investors learn the type of announcement the Fed will make—whether it will be about monetary policy stance, or about long-term growth expectations. In good times the Fed makes an announcement about growth expectations—an $\eta$ shock. In bad times the Fed makes a statement about monetary policy stance—an $\epsilon$ shock. Denote the announcement time change in Fed funds rate, relative to expectations, by...
Figure 1: Resolution of Uncertainty. In the first period, investors learn the type of the announcement to be made. In the second period, the announcement of $\epsilon$ or $\eta$ is made.

$\phi \sim N(0, \sigma_\phi^2)$. The corresponding $\epsilon$ and $\eta$ shocks are backed out according to

$$
\begin{align*}
\eta &= X_t \phi \\
\epsilon &= (1 - X_t) \phi.
\end{align*}
$$

Investors have Epstein-Zin recursive preferences. Let me start by directly specifying the value function in the terminal time $t = 2$, and then work backwards to find the SDF at earlier times. The time $t = 2$ value function depends on the surprise change in the Fed funds rate $\phi$, and the economic conditions $X$.

$$
V_2(X_t, \phi) = C_2 + \lambda_\epsilon (1 - X)\phi + \lambda_\eta X \phi \\
= C_2 + \lambda_\epsilon \epsilon + \lambda_\eta \eta
$$

(2)

Investor value functions at $t = 2$ are more sensitive to news about the path of real rates than they are about long term growth prospects, captured by $\lambda_\epsilon > \lambda_\eta$. The value function at time $t = 1$ depends on the certainty equivalent consumption amount of $t = 2$ value function. I have assumed $\lambda_\epsilon > \lambda_\eta$ and therefore it follows that

$$
\mathcal{I}_1[V_2(X = 1, \phi)] > \mathcal{I}_1[V_2(X = 0, \phi)]
$$

(3)

where $\mathcal{I}_1$ is the certainty equivalent functional defined as

$$
\mathcal{I}_1[V_2(X, \phi)] = E_1 \left[ V_2(X, \phi)^{1-\gamma} \right]^{1/(1-\gamma)}.
$$

(4)

In words, the $t = 2$ value function certainty equivalent at time $t = 1$ is higher in the good state.
If optimal consumption is likewise higher in the up state, or if consumption is equal in both states, the value functions at time $t = 1$ satisfy

$$V_1(X = 1) = \left( (1 - \beta)C_1(X)\beta^{-\frac{1}{\psi}} + \beta I_1[V_2(X = 1, \phi)] \right)^{1-\frac{1}{\psi}} \phi^{-1} > \left( (1 - \beta)C_1(X)^{-\frac{1}{\psi}} + \beta I_1[V_2(X = 0, \phi)] \right)^{1-\frac{1}{\psi}} \phi^{-1} = V_1(X = 0).$$  \hspace{1cm} (5)

Let’s turn to time $t = 0$. The SDF that discounts payoffs of $t = 1$ back to $t = 0$ takes the familiar form

$$M_{0,1} = \beta \left( \frac{C_1(X)}{C_0} \right)^{-\frac{1}{\psi}} \left( \frac{V_1(X)}{I_0[V_1(X)]} \right)^{1-\frac{1}{\psi}} \phi^{-1}.$$  \hspace{1cm} (6)

We have already seen how the $t = 1$ value function $V_1(X)$ depends on the realization of the state variable $X$. Consequently the discount factor depends on the realization of $X$ at least via the continuation value component.

Any asset, then, with a payoff that depends on the state variable $X$ will earn a risk premium in the pre-announcement period. Consider an asset with the log return

$$r_{0,1} = \mu + \sigma_d (X - E_0[X]).$$

To calculate risk premia let’s re-express the log SDF in terms of innovations

$$m_{0,1} - E_0[m_{0,1}] = -\frac{1}{\psi} (c_1(X) - E_0[c_1(X)]) + \left( \frac{1}{\psi} - \gamma \right) (v_1(X) - E_0[v_1(X)]).$$  \hspace{1cm} (7)

Standard calculations, shown in detail in Appendix A.1 result in

$$RP = \frac{1}{\psi} \text{Cov} (c_1(X) - E_0[c_1(X)], \sigma_d (X - E_0[X]))$$

$$+ \left( \gamma - \frac{1}{\psi} \right) \text{Cov} (v_1(X) - E_0[v_1(X)], \sigma_d (X - E_0[X])).$$  \hspace{1cm} (8)

Insofar as either the continuation value $v_1$ or the optimal consumption decision $c_1$ depends on the realization of $X$, this covariance is nonzero. Note that without any uncertainty about the Fed announcement $\phi$ (meaning $\sigma_\phi^2 = 0$), the middle period value functions are equal and there is no pre-announcement drift.

In this section I have worked with Epstein-Zin preferences. Restricting the reciprocal of intertemporal elasticity of substitution to equal the parameter of risk aversion $\left( \frac{1}{\psi} = \gamma \right)$, Epstein-Zin collapses
to CRRA utility. In the case of CRRA, the pre-announcement risk premium is

\[ RP_{\text{CRRA}} = \gamma \text{Cov} (c_1(X) - E_0[c_1(X)], \sigma_d (X - E_0[X])) \]  

which is nonzero if optimal consumption \( c_1 \) is a function of the state variable \( X \). If it is the case that consumption cannot respond to information at such short horizons, a non-zero risk premium still obtains but the derivation of the SDF is more complicated. I detail the calculation of the SDF under CRRA utility and fixed short-term consumption in Appendix C.

### 2.1.1 Timing of Pre-Announcement Returns

Equation (8) demonstrates the mechanism underlying a pre-announcement risk: the SDF before the announcement reflects the risk premium commanded by the announcement itself. I will now impose more structure on the behavior of the state variable \( X \) to demonstrate how compensation for pre-announcement risk accrues in the run-up to the announcement.

Let the pre-announcement period consist of \( N \) time periods, indexed by \( t \). Relabel the pre-announcement time \( t = \tau \). Like above, the relative share of \( \epsilon \) and \( \eta \) shocks at announcement depends on the state variable just before the announcement—meaning at \( t = \tau \). For ease of exposition I will specify the \( t = \tau \) log value function as

\[ v(X_\tau) = \bar{c} + X_\tau. \]

Let the state variable \( X_t \) follow an AR(1) process

\[ X_{t+1} = \bar{X} + \theta (X_t - \bar{X}) + \sigma \xi_{t+1} \]  

where \( \theta < 1 \). Consider an investor holding the market from time \( t \) until \( \tau \)—right before the next scheduled Fed announcement. The market return is given by

\[ r_{t,\tau} = \mu (\tau - t) + \sigma_d \sum_{i=t+1}^{\tau} \xi_i + \zeta_i \]  

where \( \zeta_i \) captures return variation for reasons other than news about the state variable \( X \). Let me assume the risk premium stemming from covariance with optimal consumption is small. Standard calculations (shown in detail in Appendix A.1) reveal that the risk premium commanded by the
exposure of the asset to state variable shocks is given by
\[
RP(t, \tau) = \left( \gamma - \frac{1}{\psi} \right) \text{Cov} \left( v(X_\tau) - E_t[v(X_\tau)], \sigma_d \sum_{i=t+1}^{\tau} \xi_i \right).
\]
\[
= \left( \gamma - \frac{1}{\psi} \right) \text{Cov} \left( X_\tau - E_t[X_\tau], \sigma_d \sum_{i=t+1}^{\tau} \xi_i \right). \tag{13}
\]
What determines the risk premium is the covariance between innovations to the expectation of time \(\tau\) value of \(X\), and the asset return. Because the state variable follows a mean-reverting process, the uncertainty about its \(t = \tau\) value is resolved at an increasing rate when approaching \(\tau\).

To see this explicitly, write \(X_\tau\) as a function of the value at \(t\) and subsequent innovations
\[
X_\tau = \bar{X} \sum_{i=0}^{\tau-t} \theta^i + \theta^{\tau-t} X_t + \sum_{i=0}^{\tau-t} \theta^i \sigma_\xi \xi_{\tau-i}. \tag{14}
\]
The time \(k\) innovation to the expectation of time \(\tau\) value is
\[
E_k [X_\tau] - E_{k-1} [X_\tau] = \theta^{\tau-k} \sigma_\xi \xi_k. \tag{15}
\]
Hence the risk premium commanded by the state variable innovation \(\xi_k\) is given by
\[
RP(k - 1, k) = \left( \gamma - \frac{1}{\psi} \right) \text{Cov} (X_\tau - E_t[X_\tau], \sigma_d \xi_k)
\]
\[
= \left( \gamma - \frac{1}{\psi} \right) \theta^{\tau-k} \sigma_\xi \sigma_d. \tag{16}
\]
Because \(\theta < 1\) expected returns are high just before the announcement. Figure 2 illustrates the expected returns implied by Equation 16. I perform a calibration of the model in Section 3.4.

2.2 The Fed’s Problem

The model of pre-announcement risk relies on the assumption that Fed’s communications are interpreted by the market conditional on the aggregate state of the economy. I will now provide a framework under which this mode of communicating is constrained optimal. The underlying mechanism is the same than in the investors’ problem—Fed actions impact markets via a direct effect, as well as via an informational effect. The direct effect stems from monetary non-neutrality and allows the Fed to smooth target outcome variables. The informational effect stems from the Fed having a more precise signal of underlying economic conditions. Recognizing a trade-off between the direct and informational effect the Fed adopts a conditional announcement strategy.

Suppose the Fed is tasked with setting the funds rate to manage the volatility of two target
variables—real rate and inflation. Denote the two state variables by $Y^N$ and let the natural level of the state variables be given by

$$
Y_1^N = \chi_1 \\
Y_2^N = \chi_2
$$

(17)

where $\sigma(\chi_1) = \sigma(\chi_2) = \sigma_\chi$.

The Fed is mandated to minimize the squared deviation from zero of these two state variables. To do so, the Fed only has one tool at its disposal: setting the Fed Funds rate. Define the stance $F$ of monetary policy as the difference between the funds rate and the natural rate that would prevail under no Fed intervention.

Without loss of generality, suppose the stance $F$ moves the two state variables in opposite directions. After Fed intervention, the resulting values of the state variables are:

$$
Y_1 = Y_1^N + F = \chi_1 + F \\
Y_2 = Y_2^N - F = \chi_2 - F.
$$

(18)
With its mandate in mind, the Fed observes the realization of $\chi$ and picks $F$ to minimize the state variables deviation from the respective unconditional means

$$
\min_F S(\chi) = \min_F (\chi_1 + F)^2 + (\chi_2 - F)^2
$$

resulting in the optimal stance

$$
F = \frac{\chi_2 - \chi_1}{2}.
$$

Because the Fed only has one tool to target the two state variables it typically cannot set the target function to zero. Under the optimal rule, the expected value of the target function is

$$
E[\min_F S(\chi)] = E \left[ (\chi_1 + \frac{\chi_2 - \chi_1}{2})^2 + (\chi_2 - \frac{\chi_2 - \chi_1}{2})^2 \right] = \sigma_\chi^2.
$$

This compares favorably with an average deviation of $2\sigma_\chi^2$ under no Fed intervention.

The Fed’s smoothing activities have a side effect. While the Fed observes the true state with infinite precision, the market participants only have access to a noisy signal. As a consequence, investors try to back out the true state variable whenever the Fed announces $F$. Suppose that the value of state variable $Y_1$ in particular has some instrumental value to the investors, and so their utility is increasing in the signal precision

$$
I(Y,F,\nu) = -\kappa (\chi_1 - B_1(F,\nu))^2
$$

where $B_1$ denotes the investor belief after observing their own signal, as well as the Fed stance $F$. Let the investors’ signal be given by

$$
\nu_1 \sim N(Y_1^N, \sigma_\nu(X_t)).
$$

The $\sigma_\nu(X_t)$ terms emphasize that the precision of the investors’ signal depends on the state variable $X_t$. An equivalent modeling choice would be a time-varying concern about the state variables under a constant signal precision. The underlying motivation is a time-varying relative concern on part of the investors regarding the two state variables in the Fed’s mandate. In Appendix D.2 I show evidence from the Survey of Primary Dealers consistent with the view that Fed decisions have time-varying weights on the two components in the policy mandate.

With the stance $F$ being a function of both state variables it is impossible to exactly back out $\chi$. Instead, a given announcement specifies a line in the $(\chi_1, \chi_2)$ space on which the true value lies. Investors can then pick the point on said line most likely under their prior distribution. As shown
in Appendix A.2, the investor belief on state variable \(Y_1\) after observing \(F\) is given by

\[
B_1(F, \nu) = \frac{\nu_1 + \nu_2}{2} - F. \tag{24}
\]

Recognizing this informational effect, the Fed can tilt its announcement so that investors can better back out \(\chi_1\) precisely when the investor signal is of low precision. Specifically, the Fed can weight the relative importance of the two state variables and make the announcement rule dependent on the state variable \(X_t\) which is observed both by the market and the Fed. Define a weighted announcement \(F_w\) as

\[
F_w(X_t) = (1 - w(X_t))\chi_2 - w(X_t)\chi_1. \tag{25}
\]

The key is that the Fed varies the weight systematically, based on \(X_t\). This allows the Fed to coordinate with the market and convey more information about \(\chi_1\) precisely when the investors’ signal is noisy. Investors, knowing that the Fed follows a conditional announcement have post-announcement beliefs given by

\[
B_1(F_w, w(X_t), \nu) = \left(\nu_1 + \frac{w}{1-w}\nu_2 - \frac{w F_w}{(1-w)^2}\right) / \left(1 + \frac{w^2}{(1-w)^2}\right). \tag{26}
\]

where \(F_w = (1 - w)\chi_2 - w\chi_1\) and the complete derivation of the formula is in Appendix A.2.

As \(w \to 1\) the Fed stance is determined almost entirely by \(\chi_1\) and beliefs converge to the true value \(B_1 \to \chi_1\). Conversely, as \(w \to 0\) the Fed stance is determined almost entirely by \(\chi_2\) and investors beliefs about \(Y_1\) are determined entirely by their own signal \(\nu_1\).

Consequently, the expected error in beliefs about \(Y_1^{N}\) is decreasing in \(w\)

\[
\frac{d}{dw} E \left[ \kappa (\chi_1 - B_1(F_w, w(X_t), \nu))^2 \right] < 0. \tag{27}
\]

On the other hand, we found earlier that \(w = (1 - w) = .5\) represents the optimal weight from the perspective of the Fed’s direct mandate. Indeed, the expected deviation of the state variables from the corresponding unconditional means increases as \(w\) deviates from .5

\[
E [S(\chi)] = E \left[(\chi_1 + (1 - w)\chi_2 - w\chi_1)^2 + (\chi_2 - (1 - w)\chi_2 + w\chi_1)^2\right]
= 2(1 - w)^2\sigma^2_\chi + 2w^2\sigma^2_\chi \geq \sigma^2_\chi. \tag{28}
\]

Therefore, changing \(w\) will have the Fed trading off the two effects. To find the optimal conditional announcement rule the Fed solves for the value of \(w(X_t)\) such that the expanded target function is
minimized in expectation

$$\min_{w(X_t)} 2(1 - w)^2 \sigma^2 + 2w^2 \sigma^2 + E \left[ \kappa (\chi_1 - B_1(f_w, w(X_t), \nu))^2 \right] |X_t\right].$$ \tag{30}

This equation can be solved for the optimal value of $w(X_t)$ given a precision of the signal $\sigma_\nu(X_t)$.

To the extent the volatility of the investors’ prior $\sigma_\nu(X_t)$ changes with the state variable $X_t$, the Fed will find it optimal to adjust the weights with $X_t$. As a result the announcements will be interpreted by the market conditional on $X_t$, as required by the model of pre-announcement risk premium.

3 Empirical Evidence from Pre-FOMC Drift

In this section I demonstrate that market behavior before and at FOMC announcements is consistent with the predictions of the model in Section 2. After briefly summarizing the data I show considerable regularity in the time-series strength of the pre-announcement drift. I then turn to the cross-section to provide direct evidence in support of the model assumptions. I also calibrate a reduced-form expression of the pre-announcement risk premium provided by the model. Finally, I discuss the nature of the information learned in the run-up to the announcements and provide evidence from FOMC transcripts to show that committee members often consider late breaking news when discussing policy options.

3.1 Data

The main data is from the TAQ database. I construct a panel of intraday returns at one minute frequencies for all the stocks in the SP500 at the beginning of the month of a given FOMC announcement. Time-series of SP500 constituent stocks is from WRDS. I use SPDR SP500 Exchange Traded Fund (ticker: SPY) prices to construct minute-by-minute returns of the SP500 index; I use data from GovPX to construct minute-by-minute returns of various maturity Treasuries. For the last two years of the sample I construct 10-year Treasury returns using the iShares 7-10 Year Treasury ETF (ticker: IEF) prices.

Data on intraday Fed Funds Futures contract prices is from the CME Group. I use the Kuttner (2001) methodology (described in Appendix A.3) to construct a daily measure of the expected level of Fed Funds rate. Each minute during the FOMC announcement day, I calculate the surprise component in the Fed Funds rate change assuming the then-current prices prevail at end of day.

All other data sources are standard. The data in this study spans 1994-2017. Many papers studying monetary policy start the sample in 1994 because that is when the Fed started announcing its
decisions at a press conference. Coincidentally, it is also the time when TAQ data becomes available.

There are eight scheduled FOMC meetings per year, resulting in a full sample of 192 meetings. In graphs showing intraday returns I restrict the sample to the 181 meetings where the announcement was made at 2pm or later.

### 3.2 Evidence from the Time Series

As shown in Table 3, there is a considerable amount of time-series predictability in the magnitude of the pre-announcement drift, consistent with the risk-based explanation proposed here. Notably, the drift is stronger in times where there is substantial uncertainty about the announcement, measured by the implied volatility of Fed funds rate post announcement (prior to an announcement futures prices typically impound nonzero probabilities for two outcomes; the volatility is calculated assuming the surprise change follows a binomial distribution.) High levels of risk premia in Fed Funds futures—constructed as a moving average of returns on a zero-cost Fed Funds futures portfolio like in Piazzesi and Swanson (2008)—are positively correlated with the pre-announcement drift. (I describe the construction of Fed Funds risk premia in Appendix A.3.) The pre-announcement drift is also strong during times when there is substantial volatility in market returns: high VIX predicts a strong pre-announcement drift. As an alternate measure of market volatility, I use the daily returns of SP500 constituent stocks to calculate the average squared deviation from the corresponding CAPM beta implied return. I call the square root of this quantity *cross-sectional idiosyncratic volatility* (XS-VOL).

In Table 3 I estimate univariate regressions with realized intraday pre-announcement drift on the left hand side. All the right-hand-side variables are lagged so that they are known prior to the day of the announcement. As the table reveals, the previous day SP500 XS-VOL explains a full 24% of the time-series variance in pre-announcement drift strength. In Figure 5 I illustrate these results with histogram plots, and in Figure 6 I show graphically the evolution of market prices in the pre-announcement window conditional on the level of XS-VOL. Finally, in Figure 7 I plot the moving averages of the pre-announcement drift and XS-VOL to further illustrate the tight time-series relationship between market volatility and drift strength.

### 3.3 Evidence from the Cross Section

I will now provide direct evidence in favor of the key assumption of the model: that the Fed announcement type is predictable.

The empirical strategy is as follows. I first describe the methodology to classify announcement time market reaction to Fed announcements, following existing literature. Having constructed the
announcement type measure, I show that the cross-sectional sensitivity of assets to the two types of announcements differs as a function on the assets’ market and interest rate betas. Recognizing this cross-sectional heterogeneity motivates a predictive regression: I show that the intraday return on market, or the intraday return on interest rate beta sorted long-short portfolio, predicts the realized covariance at announcement time.

3.3.1 Classifying Announcements

I classify Fed announcements following Cieslak and Schrimpf (2018) and Jarocinski and Karadi (2018). These authors gauge the informational content of central bank announcements by calculating the correlation between stocks and various maturity bonds in a short window around the Fed announcement. Noting that a conventional monetary policy shock induces a positive correlation between stock and bond returns, they argue that a negative stock-bond correlation in response to a monetary announcement is evidence of non-monetary information conveyed to the market.

I perform a similar exercise: after each scheduled FOMC announcement I use fifteen minutes of minute-by-minute returns on the SP500 and the then current on-the-run 10y Treasury bond to calculate stock-bond covariance. As shown in Figure 8, this realized covariance exhibits substantial variation, both meeting-to-meeting and over the business cycle.

For example, consider the FOMC announcement of December 16th, 2008. As of market open, Fed Funds futures market implied an expected cut of 89 basis points. The Fed announced a cut of 100 basis points, and the market responded with a 340 basis point rally. During the post-announcement market gains, the prices of safe assets gained as well, a feature consistent with the textbook account of monetary policy announcements.

In contrast, consider the previous meeting on October 29th, 2008. The market rallied a whopping 977 basis points the day before the announcement. At 14:15, the Fed announced a 50 basis point cut in the target rate, which represented a 5 basis point cut relative to the expectations. Typically, such a cut would be associated with an increase in market valuations. In this case, however, the market ended the day down 264 basis points relative to just before the announcement was made. The post-announcement covariance between stock and bond returns was large and negative, indicating that the announcement was interpreted by the market as one about growth expectations. With the Fed cutting more than anticipated the stock market lost value as safe assets gained.

I picture stock and bond returns on these two dates in Figure D1. Both meetings resulted in a surprise cut of rates relative to expectations, but a starkly different market reaction. I interpret the differential response as a reflection of the importance of economic conditions to the interpretation by the market of the Fed’s actions. In December, the market was interpreting the lower-than-expected rates as accommodation provided by the Fed. In contrast, in October, the lower-than-expected
rate was interpreted as bad news about economic fundamentals.

3.3.2 Asset-level Heterogeneity in Response to Announcements

I will now show that characteristic sorted portfolios display differential exposure to Fed announcements, and particularly so during announcements that are classified as shocks to real rates.

Specifically, I show in Table 4 that two characteristics—market beta and interest rate beta—capture heterogeneity in the stock-level response to Fed announcements. This is in line with the results in Bernanke and Kuttner (2005) who find that high beta industries are more sensitive to Fed announcements. As a new result I show that stocks with high market or interest rate betas are particularly sensitive to changes in the funds rate during announcements that are classified as real rate shocks.

I demonstrate this finding by estimating the following triple interaction regression

\[ R^i_t = \gamma_1 \Delta FF_t + \gamma_2 \Delta FF_t \cdot \beta^i_{CAPM} + \gamma_3 \Delta FF_t \cdot \beta^i_{CAPM} \cdot Pos_t + \gamma_4 \Delta FF_t \cdot Pos_t + \gamma_5 \beta^i_{CAPM} \cdot Pos_t + \gamma_6 \beta^i_{CAPM} + \gamma_7 Pos_t + \epsilon_{i,t}. \]  

(I also estimate a version of this equation where \(\beta_{CAPM}\) is replaced by beta with respect to the level factor of interest rates, and a version with both the betas and the respective interaction terms.)

As shown in columns 2 and 3 of Table 4, in both specifications, the triple interaction term emerges as a statistically and economically significant determinant of stock-level response, meaning that high beta and high interest rate beta stocks are particularly sensitive with respect to Fed announcements about short rates. Of course, there could be other characteristics that are equally important in accounting for the cross-sectional response to policy announcements, as documented by Basistha and Kurov (2008), English et al. (2018), and others.

3.3.3 Predicting Announcement Type

The finding in Table 4 motivates the following predictive regression. If the announcement type is indeed predictable, the change in value of a portfolio of stocks that is particularly exposed to a given type of announcement should predict the type. This is precisely what I find. As shown in Table 5, market return in the pre-announcement window predicts the announcement type. Likewise, the return on the interest rate beta sorted long-short portfolio predicts the announcement type. If market return is poor before the announcement, a positive covariance announcement is more likely; ditto if interest rate exposure sorted portfolio return is poor. This conclusion continues to hold controlling for the stock-bond covariance before the announcement. Table 5 provides direct evidence in favor of the main claim in the model: the announcement type is predictable using
information learned in the immediate run-up to the announcement.

Recognizing the two distinct announcement types also provides insight into the announcement time risk premium. As Lucca and Moench (2015) point out, the absence of announcement time risk premium poses a hurdle for any risk-based explanation of the pre-announcement drift. As I show in Figure 9, sorting announcements into five bins based on the realized stock-bond covariance reveals that those with positive covariance—meaning real rate shocks dominated the announcement—see on average a positive return on announcement; those with negative covariance see on average a negative return on announcement. This finding corresponds to the assumption in the model that the two types of announcements command a differential risk premium.

3.4 Calibration of Returns over the FOMC Cycle

The model makes a specific prediction about the shape of aggregate market returns over the FOMC cycle: the pre-announcement risk accrues at an increasing rate before the announcement, as captured by Equation 16, reproduced here

\[
RP(k - 1, k) = \left(\gamma - \frac{1}{\psi}\right) \theta^{r-k} \sigma_{\xi} \sigma_d. 
\]  

(16)

Naturally, there are other sources of risk in the economy that do not follow this pattern. In this section I use observed market returns over the FOMC cycle to calibrate the parameter \(\theta\) that governs the timing of pre-announcement returns.

Instead of calibrating the primitives of the model, I seek to estimate \(\theta\) from a reduced form specification. Specifically, I assume that the pre-announcement returns are earned according to the functional form in Equation 16 and all parameters save for \(\sigma_{\xi}\) are constant. I proxy for \(\sigma_{\xi}\) using the cross-sectional return volatility of the market (XS-VOL), which I showed in Section 3.2 to be a strong determinant of drift strength. I further assume that the risk premia from other sources of risk accrues at a constant rate over the FOMC cycle.

Under these assumptions I can estimate \(\theta\) along with two nuisance parameters: returns from exposure to other shocks (denoted \(\delta\)), and the risk price associated with a unit exposure to shocks to the state variable (denoted \(\lambda\)). I use Generalized Method of Moments to estimate the parameters \((\theta, \lambda, \delta)\) in the following equation

\[
r_{t,t+1} = \lambda \text{XS-VOL}_t \theta^{r-k} + \delta. 
\]  

(32)

I perform the estimation on daily returns starting with eight days before a scheduled FOMC announcement. On the announcement day I only use pre-announcement returns. GMM estimation results, reported in Table 1, result in the estimate of \(\theta = .77\) (statistically significant at the 1%
level) meaning the state variable governing announcement type has very low persistence. The estimate allows me to illustrate the model-implied daily returns in Figure 3. While we only see a statistically significant pre-announcement drift in the two days prior to the FOMC meeting, the model predicts a pre-announcement drift of 9bps three days before, 6 bps four days before, and so on. That we don’t see this pattern past the first couple days in the data is likely due to lower statistical power, which makes it tougher to pick up these lower expected returns farther away from the FOMC meeting.

<table>
<thead>
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<th>Target</th>
<th>Value</th>
<th>S.E.</th>
</tr>
</thead>
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<td>0.23</td>
</tr>
<tr>
<td>(\delta)</td>
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<td>9.83</td>
</tr>
<tr>
<td>(\lambda)</td>
<td>14.98</td>
<td>4.98</td>
</tr>
</tbody>
</table>

Table 1: Calibration of \(\theta\). Heteroskedasticity robust standard errors. I use GMM to estimate Equation 32. Sample daily returns in the 8 trading days leading up to an pre-scheduled FOMC announcement.

In Figure 4 I use the same unconditionally estimated coefficients to show the predicted pre-announcement returns in two subsamples: above and below median in terms of cross-sectional volatility (XS-VOL.) This figure illustrates how Fed activity leads to cyclicality over the FOMC cycle. Because the Fed announcements interpreted conditional on the state variable \(X\), investors demand risk compensation in anticipation of policy changes. At the same time, to the extent the Fed is successful in smoothing volatility in the target variables, the unconditional risk premium demanded by investors is lower. The two effects combined create a seasonality in expected returns, notably the strikingly high returns in the last couple days before the announcement. The overall effect on expected returns, however, is likely much more muted—indeed the average return in the two subsamples is similar. Put differently, just because returns are high pre-FOMC announcements does not imply that Fed’s behavior increases expected returns in the aggregate. Reduction in risk premia at other times may well offset these high returns.

### 3.5 Information Learned Before the Announcement

The model delivers a pre-announcement drift because there is information learned by both the market and the Fed in the run-up to the policy decision that can alter the manner in which the eventual decision is interpreted by market participants. As Figure 3 illustrates, the bulk of this information is learned in the very last days before the announcement. In this section I discuss the nature of this information, and provide corroborating evidence from FOMC meeting transcripts.

A natural source of information pre-announcement—one already suggested by the empirical work above—is that both the Fed and the investors condition their actions on stock market performance. Because the stock market can exhibit great volatility, the announcement time risk loadings can be
uncertain right up until the announcement. Prior work has sought to establish a causal impact of stock returns on Fed actions. Gurkaynak et al. (2005) use a VAR setting to estimate this dependence, while Cieslak and Vissing-Jorgensen (2017) use textual analysis of the Open Market Committee meeting transcripts to argue that the Fed pays close attention to the market.

Another source of information could stem from various macroeconomic news announcements (MNAs). Taken alone, any given macro announcement may not materially impact market prices. Indeed, Law et al. (2017) find only four MNAs that can reliably move markets. Still, the constant flow of information from MNAs can potentially allow investors to update beliefs on the state of the economy at a high frequency. For instance, Beber et al. (2015) construct a real-time measure of macroeconomic performance without relying on any financial market information.

In recent work, Fisher et al. (2016) show that media coverage of macroeconomic announcements, including FOMC statements, increases in anticipation of the scheduled release date. Further, they demonstrate that market returns are higher on FOMC announcement days that saw a large increase in media attention prior to the announcement. Their findings are consistent with the view that investors interpret Fed announcements using information learned in the pre-announcement period.

Finally, adding to the uncertainty regarding the interpretation of a given announcement could be a feedback effect between market expectations of Fed action, and Fed taking into consideration market expectations, as described in Stein and Sunderam (2018). As an application of their model, Stein and Sunderam (2018) provide an example where the market’s belief that Fed action is dependent on incoming macroeconomic data induces, in a self-fulfilling equilibrium, an excess sensitivity of Fed decisions to macroeconomic announcements made before the announcement. In the context of this paper, it is the market interpretation of the announcement that is determined by recent news, potentially constraining the Fed’s decision.

It is evident from the transcripts of the Open Market Committee that policymakers pay close attention to both market and non-market data coming in just before the decision on Fed funds rate is made. In Appendix Table D1 I provide excerpts from FOMC meeting transcripts pertaining to discussion of macroeconomic announcements on the morning of the meeting, and discussion of the market reaction to the MNAs. The table also contains examples of discussion about market expectations of Fed behavior. All in all, as shown in Table D2, the transcripts of 80 of the 152 meetings from 1994 to 2012 contain discussion of MNAs made on the day of the meeting (transcripts are released with a five year lag.)

Let me highlight a couple examples. Many transcripts reveal attention paid to macroeconomic announcements during the morning of the meeting. For instance, consider the meeting of October 28th, 2003. Here, the FOMC discussion makes note of positive economic data in the past weeks, including the durable goods order released that morning.
MR. STOCKTON. In a nutshell, things have been going very well for the U.S. economy in recent weeks. The latest piece of news fitting that pattern was this morning’s release of the September report on new orders and shipments of nondefense capital goods.

CHAIRMAN GREENSPAN. I believe it’s more likely that evidence of an old-fashioned business cycle expansion is beginning to emerge ... when I saw the original Greenbook projection that had inventory liquidation continuing through the rest of the year, I was incredulous. I was even incredulous about it continuing in the third quarter. But clearly that’s what we’re seeing. Indeed, the data on durable goods inventories for manufacturing confirmed that this morning.

Another suggestive example of Fed paying attention to very recent information is provided by the FOMC meeting of March 18th, 2008. Held during the early stages of the Great Recession, this meeting came in the heels of Bear Stearns takeover by JPMorgan Chase.

The day saw a slew of activity even before markets opened. At 8:00am Goldman Sachs announced quarterly earnings (three of Goldman’s 2008 quarterly earnings reports occurred the morning of an FOMC meeting.) While Goldman’s investment banking revenues were down 41% relative to the quarter before, the earnings beat analyst expectations. At 8:17am Lehman Brothers released quarterly earnings. They saw a 57% decrease in net income, which was still good enough to beat expectations. At 8:30am the Census Bureau reported that housing permits in the previous month were given out at the lowest rate since 1991. As shown in Appendix D1 the FOMC meeting transcript reveals close attention being paid to these developments, including queries during the meeting about Fed funds curve, and references to the stock market performance in response to the announcements that morning.

Of course, there is no counterfactual available to prove that any given Fed decision, or the corresponding market reaction would have been different absent late breaking news. Let me give one more example, from the meeting on January 31st, 2001. This two-day meeting occurred after a string of poor macroeconomic news, the latest of which was the Conference Board consumer confidence index released on the first day of the meeting.

CHAIRMAN GREENSPAN. I have been concerned about the possibility that our moving so fast in a month would suggest either a knowledge of facts that nobody else knows or that we are getting scared. Fortunately, I guess, the markets as a result of yesterday’s consumer confidence index have now put something like a 20 percent probability that we’ll move 75 basis points.

MS. MINEHAN. ... after listening to the television a bit this morning and seeing the degree to which there were now expectations in the market of an even bigger move– and not being able to reconcile in my own mind the real risks with a balanced risk statement—I came around to your position.

The meetings I have mentioned here are by no means extraordinary in terms of attention paid to recent events. In order to provide more systematic evidence of attention paid to recent events
I count the use of terms such as “this morning”, “this week”, and “market” in the transcripts of FOMC meetings. The results in Table 6 demonstrate that the frequency of these terms are associated with stronger pre-announcement drift. The right-hand-side variables are calculated as shares of total words in the transcript, and normalized to have standard deviation of one. A one standard deviation increase in the frequency of the term “this morning” is associated with a 12 basis point increase in the pre-announcement drift.

There is also direct evidence from market participants that they interpret Fed announcements conditional on aggregate conditions. In Appendix D.2 I list excerpts from the New York Fed’s Survey of Primary Dealers. The dealer responses reveal a belief that Fed targets either unemployment or inflation in a time-varying manner, depending on economic conditions.

4 Testing Further Implications

I will now turn to exploring the implications of the model to auxiliary puzzles of the pre-FOMC announcement drift: the bi-weekly pattern in aggregate market returns over the FOMC calendar, the pre-announcement drift in FX markets, and the apparent lack of drift in Treasury markets.

4.1 Return Seasonality over FOMC Cycle

In recent work, Cieslak et al. (2016) document that stock returns follow a striking seasonal pattern over the FOMC announcement cycle—even weeks in the FOMC announcement cycle see higher aggregate market returns than odd weeks. They attribute this finding to communications from the Fed: turns out that non-FOMC information emanating from the Fed tends to be concentrated in even weeks. They further argue that market participants have systematically underestimated the accommodation the Fed can provide, leading higher-than-expected returns during times when the Fed communicates.

The model proposed in this paper provides a risk-based account of this return seasonality consistent with investor expectations that are, on average, correct. According to the model, Fed announcements that are made conditional on the state variable $X_t$ benefit investors by providing them with more information during announcements, but also induce more uncertainty right before the announcement. Compared to a fixed policy rule counterfactual, the investors know that Fed announcements are more informative, leading them to require lower expected returns unconditionally. At the same time, right before the announcement investors demand higher expected returns on account of the pre-announcement risk mechanism. As discussed in Section 3.4, this feature leads to a cyclicality in aggregate market returns over the FOMC calendar. Precisely when the underlying state variable exhibits great volatility is when the Fed’s optimal policy weights are volatile, and we
should expect strong cyclicality of returns over the FOMC cycle.

I test this prediction in Table 7. As I reported in the empirical work in Section 3, cross-sectional volatility (XS-VOL) is a good predictor of pre-announcement drift intensity. According to the model, then, times with high XS-VOL should see strong cyclicality of returns. This is precisely what I find. As column (6) in Table 7 demonstrates, the high even week excess returns are entirely concentrated in times when XS-VOL is above its median value. I illustrate this finding graphically in Figure 12. Here I condition FOMC cycles based on the value of XS-VOL at previous announcement time. As the figure makes clear, cyclicality is concentrated in times of high volatility.

4.2 Drift in Fixed Income Prices

Part of the pre-FOMC drift puzzle is the apparent lack of a corresponding drift in fixed income markets, as documented in Lucca and Moench (2015). Because the Fed’s policy action directly affects the near end of the yield curve, one might expect any pre-announcement movements to show up in fixed income markets.

I find the nearly zero unconditional drift in longer maturity bonds in 1994-2017 consistent with the account proposed in this paper. In the model the pre-announcement drift represents an aggregate reduction in the market risk premium. We would therefore expect that a given asset’s pre-announcement drift intensity is proportional to its exposure to the market risk premium.

Campbell et al. (2017) find that the CAPM betas of nominal bonds have changed considerably over time. In the sample period of this paper, 1994-2017, nominal bond betas started at slightly positive values, drifted into negative territory, and exhibited a substantially large negative values during the financial crisis.

In order to account for time-varying betas of long maturity bonds, I calculate a “beta-implied” drift in bond prices in the pre-announcement window. Specifically, I first estimate CAPM betas of 10-year Treasury bonds using daily bond returns in a 30-day rolling window. I then multiply the estimated conditional beta with the observed drift in the SP500 index:

\[
\hat{R}_{t,\text{pre}}^{10y} = \hat{\beta}_{t-1}^{10y} \cdot R_{t,\text{pre}}^{\text{SP500}}
\]

The behavior of this beta-implied drift in 10-year bond returns closely tracks the observed pre-announcement drift in the 10-year bond price. I illustrate this finding in Figure 10. Here I’m plotting the 8-meeting (meaning one calendar year) moving average of drift in the 10-year bond price, and the beta-implied drift.

The calculation implies an upward drift in bond returns during the positive beta periods, and a
downward drift in the negative beta periods. On average the beta-implied drift is close to zero. In the sample period, the observed drift in the 10-year Treasury bond is on average 1.6 bps.

Regressions reported in Table 8 confirm that the conditional beta model does a good job of accounting for drift in Treasury prices. The time-series correlation between the moving average of beta-implied drift and observed Treasury drift is .61.

Like Lucca and Moench (2015), I find no material pre-announcement drift in the Fed Funds futures market. This finding is consistent with the model: I claim that the pre-announcement drift arises because the different types of announcements command a different risk premium and not because the market expectations of Fed action are systematically different as a function of the state variable.

4.3 Drift in FX Markets

The view that pre-announcement drift corresponds to a reduction in aggregate risk premium also helps rationalize the pre-announcement returns in foreign exchange markets. As documented by Mueller et al. (2017), FX rates tend to show excess returns on FOMC days, in part before the announcement is made. Karnaukh (2016) and Babenko et al. (2016) also find predictability in FX returns around Fed announcements.

Following the approach I took with Treasury returns, I again seek to account for the pre-announcement returns by measuring the conditional exposure of currency exchange rates to market returns.

Specifically, I estimate CAPM betas in a rolling 30 day window for the seven major currency exchange rate pairs with the US dollar: AUD, CAD, CHF, EUR, GBP, JPY, and NZD. On each Fed announcement day I multiply the most recent beta estimate with the realized pre-announcement return on the SP500 to find a beta-implied currency pair return. I then regress the realized currency pair returns on the beta-implied return.

As shown in Table 9, the estimated coefficients are all around 1, as predicted by theory. Note that the currency pair returns are calculated from daily end-of-day data, and therefore are contaminated by post-announcement returns. Still, because the right-hand-side uses the pre-announcement return this provides suggestive evidence that reduction in aggregate risk premium is responsible for the drift in currency prices.

4.4 Other Central Bank Announcements; FOMC Announcements before 1994, and Going Forward

Should we expect to find similar pre-announcement drifts before other central bank announcements? According to the model, there are two requirements for a drift to occur. The candidate
announcement needs to have a material impact on asset prices, and the market beta of this surprise announcement needs to exhibit some time variation.

In recent work, Brusa et al. (2017) document that FOMC announcements are unique among central bank communications in their ability to move global asset prices. Other central bank announcements have little impact on international equity markets. What is more, even local stock markets show little excess returns on local central bank announcement days. Based on their findings, the model would predict no pre-announcement drift prior to other central bank news events.


With respect to the drift before FOMC announcements, Lucca and Moench (2015) find a stronger pre-announcement drift starting in 1994 when the Fed started to announce a specific target rate. They find no drift before 1980 when the Fed held more frequent meetings. According to the model, high-frequency meetings would bring along a weaker pre-announcement drift as volatility of surprise changes at each announcement would have to be smaller, keeping constant the target policy path.

The pre-announcement drift has been weak since the first draft of Lucca and Moench (2015) was circulated—Gilbert et al. (2018) find the drift has averaged roughly zero since 2011. I find the recent behavior of market prices in the pre-announcement window consistent with the time-series evidence documented in Section 3.

During the zero lower bound era, there were almost no surprises regarding the Fed Funds rate on announcement days. Even the end of ZLB era has brought along little uncertainty about Fed action going into the meetings. From 2009 to 2017 the standard deviation of surprise Fed Funds rate changes was 0.9 basis points, compared to 4.7 basis points from 1994 to 2008. During the five Fed Funds target increases in 2015 to 2017, the realized surprise changes in the Fed Funds rate were 2, 0, 0, 1, and 0 basis points. That is, in each occasion the market prices before the announcement reflected a high degree of confidence in a rate increase.

The low volatility of recent announcement surprises might reflect the success of Fed in better communicating their plans, though the early stages of rate increase cycles are often the times where Fed action is most predictable. Compounding the low volatility in the Fed Funds rate, the aggregate market volatility has been low in recent years. As shown in Figure 7, market volatility has a strong correlation with the strength of the pre-announcement drift. Should the uncertainty of Fed Funds rate changes return, and should market volatility pick up, the pre-announcement drift should gain in strength. In 2018 market volatility increased relative to the past couple years and the average pre-announcement drift was 15 basis points.
Finally, the two day pre-announcement return since 2011 has been 27 basis points, statistically significant at the 5% level. There were eight meetings from 2011 to 2012 where the announcement was made at 12:30 and perhaps market participants figured that the decision was correspondingly made earlier. Lucca and Moench (2018) report that the pre-announcement drift since 2011 has been present only prior to meetings that are associated with a Chair press conference. This finding is consistent with the view that market participants only expect significant action on part of the Fed at meetings followed by a press conference, as argued in Boguth et al. (2015).

5 Pre-Announcement Drift Elsewhere

So far I have framed the model explicitly in the context of monetary policy. However, the mechanism of pre-announcement drift can potentially be relevant in a host of contexts. The two key elements of the model are a value-relevant news announcement arriving at a previously determined time, and a return sensitivity that predictably depends on some state variable that is observable to investors in real time. In this section I provide evidence of a pre-announcement drift in two additional contexts: announcements of corporate earnings and dividend news, and other macroeconomic announcements.

5.1 Earnings and Dividend Announcements

Existing work such as Frazzini and Lamont (2007), Hartzmark and Solomon (2013), and Hartzmark and Solomon (2017) has documented pre-announcement drifts in anticipation of earnings and dividend announcement dates.

In Table 10 I present evidence of pre-announcement drift before scheduled earnings and dividend announcements. I’m again using the sample of SP500 stocks. For each stock in the SP500 at the beginning of a month I use the IBES database to record the date and time of the scheduled quarterly earnings and dividend announcements.

The pre-announcement return \( t - 1 \) to \( t \) is defined as the last full trading day (meaning 9:30am-4:00pm) without the announcement having taken place. Due to IBES data availability the sample spans 1994-2017 for earnings and 2002-2017 for dividends.

As Table 10 demonstrates, the average return on pre-announcement days is 9 and 7 basis points for earnings and dividends news, respectively. The table also reveals that pre-announcement returns are particularly pronounced for stocks with high market betas.

To make this a tradeable strategy, investors need to be able to predict the date and time of these announcements. To the extent companies can postpone pre-scheduled announcements the results in Table 10 can overstate the return attainable to an investor. Companies almost never announce
during the trading day so there is little risk that the pre-announcement trading strategy could be contaminated by announcement returns.

In Figure 13 I demonstrate a time variation in the stock-level response to EPS news. In this figure I report the beta from a quarterly regression of announcement day stock surprises on corresponding earnings surprises. It appears that stock valuations are more sensitive to earnings announcements in times of poor economic performance. To the extent investors can learn about announcement time economic conditions right up to when the news is released, their estimates of announcement time betas become more precise. It might seem that stock-level announcement risk could be diversified away. While most of the SP500 stocks account for a small share of the total market cap, on any given day an announcing stock can represent a large fraction of the value-relevant news in the market.

### 5.2 Other Macroeconomic Announcements

In Table 11 I document pre-announcement drift before other macroeconomic announcements. I find a drift of 5 basis points in the half hour before pre-scheduled Consumer Confidence Index announcements, and a drift of nearly three basis points before BLS employment announcements (though not statistically significant at the 5% level). I also calculate market returns before days when one of the 10 largest companies in the SP500 has a scheduled earnings announcement. Such days see a market drift of 11 basis points in the three hours before the scheduled announcements. In performing this analysis I pre-screened the announcements to those that have a measurable impact on prices on announcement, as documented in Law et al. (2017).

Why does stock return sensitivity to macroeconomic announcements change over time? Goldberg and Grisse (2013) find significant heterogeneity in Treasury and FX rate exposure to macroeconomic announcements, and associate it with a perceived re-weighting of Taylor rule inputs. Similarly, Law et al. (2017) ascribe the time-varying impact of MNAs to monetary policy following different regimes over time. Boyd et al. (2005) find that news of higher than expected unemployment is good news for stocks in expansions, bad news during contractions. They argue—like I have argued in this paper—that the share of different types of information in such announcements varies over time. It could also be that in bad times there’s more information in macroeconomic announcements, while in good times the surprise component of any given MNA is mostly noise.
6 Discussion, Related Literature

What other theories could account for the pre-FOMC announcement drift, or drifts before other announcements?

6.1 Informational Leaks

It could be that the pre-announcement drift is caused by informational leaks from the Fed. The resolution of uncertainty via a news leak would result in an upwards drift in market prices even if the leaked news are, on average, neutral. As argued in Lucca and Moench (2015), from an institutional viewpoint it seems unlikely that policy decisions have been systematically leaked over the span of twenty plus years. That said, Cieslak et al. (2016) provide a substantial list of leaks from the Fed. In a recent working paper, Finer (2018) finds intriguing evidence on abnormally high taxi cab traffic between the Federal Reserve Bank of New York and commercial bank headquarters around the time of FOMC announcements, though the statistically significant abnormal cab rides tend to happen after the FOMC blackout window, not during the pre-announcement drift period. Most of the leaks documented by Cieslak et al. (2016) likewise happened outside the pre-announcement window. Other work, such as Bernile et al. (2016) and Kurov et al. (2017) find evidence of informed trading in a very tight window (of the order of thirty minutes) before scheduled macroeconomic announcements. Further, Abdi and Wu (2018) find that bond market returns over eight days prior to the announcement have predictive power over the realized funds rate surprise.

Still, I find that key features of the empirical evidence are hard to square with the leaks hypothesis. If the pre-FOMC drift is caused by informational leaks, the realized market return pre-announcement should predict the eventual response to the Fed statement. Equivalently, the direction of the market pre-FOMC should be able to predict the realized surprise change in Fed Funds target rate. I test these two predictions in Table 12. Contrary to the leaks hypothesis, I find that the realized return from market open to Fed announcement is negatively correlated with the market return post-announcement. I illustrate the lack of predictive content in the drift return in Figure 14. Here I split the sample on the realized post-announcement return. The pre-announcement drift looks identical in the two subsamples.

In principle an informational leak could reduce the volatility of the announcement with no change in the expectation of the outcome, resulting in a positive pre-announcement drift without corresponding predictability. However, because the outcome in this setting—the post-announcement Fed funds rate—is almost always binomial random variable, a change in volatility is accompanied by a change in the mean.

The principal ingredient of the model proposed here—high frequency variation in announcement time risk loadings to Fed announcements—suggests a trading strategy to illustrate the difficulty
facing a leak-based explanation. Suppose an investor is on the receiving end of a leak and knows with certainty the end-of-day Fed Funds rate at the beginning of a FOMC announcement day. With the ability to take any position in the market portfolio, what are the returns this illegally informed investor could reap?

The simplest strategy would be to buy the market right before the announcement if the Fed announces a surprise cut in rates, and short the market right before the Fed announces a surprise increase in rates. However, because of the announcement time interpretation of Fed action changes a lot in the time series, this strategy would not reliably earn positive returns. As reported in Table 13, a naive leak-trading strategy that buys the market just before an announced cut, and shorts the market just before an announced raise would only make 10 basis points per meeting, with 90 bps of volatility. Counter-intuitively, in the pre-announcement period the illegally informed investor would have to long the market before a surprise increase announced later in the day, and short the market before a surprise cut.

Now, perhaps uncertainty regarding the Fed announcement is entirely resolved via leaks. The resolution of uncertainty in the pre-announcement period would then give rise to positive returns, on average. In that case we should see no response from the equity market on announcement—which is contradicted by the data. The Fed announcement sees a large jump in trading volumes, and the market return on announcement is on average strongly negatively correlated with the surprise component of the Fed announcement.

It could be that the Fed attempts to manage expectations and “talk down” the market expectations regarding the policy decision. However, such biased expectations should be reflected in Fed Funds futures prices. Like Lucca and Moench (2015), I find no material drift in Fed funds futures prices in the pre-announcement window.

In sum, I find that the dynamics on FOMC days are not consistent with a purely leak-based explanation.

6.2 Theories Other than Informational Leaks, Other Related Work

A number of recent papers address directly the question of drift before FOMC announcements. As already mentioned, Karnaukh (2016) studies the pre-announcement drift in foreign exchange markets. She finds that the dollar appreciates before rate cuts, and depreciates before rate increases, where expectations of are backed out from futures prices, and argues this provides evidence for limited attention and market segmentation. Mueller et al. (2017) also study the FX market. They find that a portfolio in global currencies financed by a short position in the dollar earns high returns on FOMC days, in large part before the announcement. Borisenko and Pozdeev (2017) analyze a number of currencies and central bank announcements. Neuhierl and Weber (2018) find that the
market tends to have drifted up before expansionary announcements. They further find that after such expansionary announcements the market continues to gain in price. Sangrey (2018) estimates compensation for jump risk in prices, including on FOMC announcement days. Both Kroencke et al. (2017) and Brooks et al. (2018) find evidence of a post-announcement drift in returns and fund flows.

Johnson and So (2018) study expected returns around firm scheduled events. They argue that sell orders are more expensive than buy orders in the run-up to announcements, leading to systematic overpricing of stocks that are about to make an announcement. To the extent such mispricing is predictable it should not lead to excess returns earned in the pre-announcement window. Similarly, Bilyi (2018) proposes a model where the pre-FOMC drift arises because of the combination of heterogeneous valuations and short-sale constraints. His model shares some of the time-series and cross-sectional predictions, such as drift being stronger at times with high uncertainty about the announcement, and high beta stocks showing a stronger drift. Like here, Bilyi (2018) finds the empirical evidence inconsistent with a purely leak-based explanation. Bátyi (2018) constructs a learning-based model in which investors rationally concentrate attention on stocks about to make an announcement. In such a model, the presence of other value-relevant announcements can make investors rationally direct attention to FOMC announcements only in the last days prior to the scheduled time and so prices become more informative in the pre-announcement window.

Hu et al. (2018) argue that the pre-FOMC drift represents compensation for uncertainty aversion. Like reported in this paper, they find a pre-announcement drift prior to other MNAs. They further find that implied volatility decreases as the Fed announcement nears in time: half of the reduction in VIX on FOMC announcement days accrues prior to the news release, a result consistent with the model of pre-announcement risk presented here. Fisher et al. (2016) show that media attention to FOMC announcements increases prior to scheduled releases, and the magnitude of this increase predicts with a positive sign the announcement day return. They also find that higher attention to FOMC pre-announcement predicts a larger decrease in the level VIX on announcement.

There are also a number of papers on announcement effects outside the issue of pre-announcement drift. Law et al. (2017) study the market impact of a slew of MNAs, they are specifically interested in estimating the conditional effect of MNAs over the business cycle. They find evidence of systematically different behavior over the business cycle. Goldberg and Grisse (2013) study conditional sensitivities of Treasury and FX rates to macroeconomic announcements. Hördahl et al. (2015) study the effect of MNAs on the Treasury yield curve. They decompose the impact of announcements into a shock to path of expected short rates and changes in risk premia, which work in opposite directions. Kadan and Manela (forthcoming) estimate the value of private information regarding MNAs under various preference parameters. Gilbert (2011) studies the conditional reaction of the market to MNAs as well as subsequent data revisions.

A voluminous literature studies the time-varying impact of Fed announcements. Nakamura and
Steinsson (2018) show that conventional contractionary monetary shocks typically bring along an increase in expected growth rates on account of an informational channel. Quantitatively, they attribute two thirds of the response in real rates to monetary shocks to this effect on investor expectations. Similarly, Jarocinski and Karadi (2018) suggest that monetary policy announcements contain two types of information: news about the short term interest rate, and news about the monetary authority’s view of economic fundamentals. These authors seek to untangle the two channels in order to better estimate the impact of monetary policy decisions on the economy. Cieslak and Schrimpf (2018) decompose the informational content of the four major central bank announcements. In addition to news about real rates and growth they also seek to measure innovations to the risk premium. Gurkaynak et al. (2005) find that a single factor is not sufficient to capture Fed announcement impact on asset prices. They attribute over three quarters of the response in yields to news orthogonal to the change in the Fed funds rate. Further work that measures the importance of informational effects on FOMC announcements includes Paul (2018). Basistha and Kurov (2008) and Kurov (2010) study conditional exposures to Fed announcements, as do Kontonikas et al. (2013) who find that stocks tended to react negatively to surprise cuts in the funds rate during the crisis. Fleming and Piazzesi (2005) find that the response of Treasury rates to FOMC announcements depends on the shape of the term structure at announcement time. Hanson and Stein (2015) study the behavior of long rates in response to monetary announcements.

Finally, a recent literature has sought to explain why CAPM risk premia tends to be earned on announcement days. Andrei et al. (2017) provide a theoretical account: they argue that the econometrician fails to observe the CAPM on most days because betas are mismeasured but on announcement days public information releases ensure more precise beta measurement and the CAPM is more evident. Implicit in their model is the view that betas vary a lot over time. Wachter and Zhu (2017) argue that macroeconomic announcements allow investors to learn about a latent disaster probability, leading to higher market risk premia on announcement days. FOMC announcements are an example of MNAs that see the CAPM hold in the cross section—though the effect stems primarily from the pre-announcement returns.

7 Conclusion

High average returns before FOMC announcements present an apparent puzzle from the perspective of asset pricing. In this paper I show that the pre-announcement drift arises in a model where the market’s response to Fed announcements exhibits substantial time variation. The key element of the model is a tight connection between the announcement time risk loadings and pre-announcement information.

I motivate time variation in market exposure to Fed announcements by appealing to how the market interprets Fed actions depending on the state of the economy. If recent news has been
good, the market interprets a surprise increase in Fed Funds rate as a reflection of optimistic growth expectations on behalf of the Fed. If recent news has been poor, the market interprets a surprise increase in Fed Funds rate as a reflection of higher real rates going forward. I also provide a setting in which the Fed finds it optimal to act in this manner.

From the perspective of asset pricing, this paper spells out a framework under which a scheduled news release can give rise to high expected returns in the run-up to the announcement. From the perspective of monetary policy transmission, this paper underlines the importance economic environment to both the determination and interpretation of monetary policy announcements.
Table 2: Summary Statistics on FOMC Meeting Level. All scheduled FOMC meetings 1994-2017. Returns in percentages; change in implied Fed Funds target in basis points. Returns in the pre-announcement period are calculated from market open to one minute before the announcement. Returns in the post-announcement period are calculated from the announcement to market close at 16:00. Treasury bond returns in the post period are calculated from announcement to 15:00. XS-VOL is the cross-sectional volatility of stocks in the SP500. Change in Fed Funds Futures implied target calculated according to the Kuttner (2001) methodology using intraday data. In here and other results, cross-sectional volatility XS-VOL, VIX, and Fed Funds risk premia, and Fed Funds implied volatility are lagged so that they are known prior to the FOMC announcement day.
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>SP500 Return 9:30-announcement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP500 XS-VOL (t-1)</td>
<td>0.330***</td>
<td>0.289***</td>
</tr>
<tr>
<td></td>
<td>(6.65)</td>
<td>(3.96)</td>
</tr>
<tr>
<td>VIX(t-1)</td>
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<td>0.00493</td>
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<td>(5.39)</td>
<td>(0.84)</td>
</tr>
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<td>Fed Funds Implied Volatility</td>
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<td>(1.61)</td>
<td>(-1.01)</td>
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<td>MA Fed Funds risk premia</td>
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<td>(0.96)</td>
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<td>(-4.65)</td>
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<td>0.166***</td>
<td>(3.95)</td>
</tr>
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<td></td>
<td>0.118**</td>
<td>(3.12)</td>
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<tr>
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<td>-0.429***</td>
<td>(-4.59)</td>
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<td>0.015</td>
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<td></td>
<td>0.074</td>
<td>0.259</td>
</tr>
<tr>
<td>$R^2$</td>
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</tr>
<tr>
<td></td>
<td>0.000</td>
<td>0.244</td>
</tr>
<tr>
<td></td>
<td>0.153</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>0.074</td>
<td>0.259</td>
</tr>
</tbody>
</table>

Table 3: Pre-FOMC Announcement Drift 1994-2017. Left hand side variable is the intraday SP500 returns from market open to FOMC announcement. The first column shows the unconditional average in the sample. All right-hand-side variables are known at the beginning of the day. Implied volatility of announcement is calculated as the volatility of a binomial random variable using probabilities backed out from Fed futures prices. Fed Funds risk premia is the 12-month moving average from holding the next month Fed Funds Futures portfolio, after Piazzesi and Swanson (2008). Heteroskedasticity robust standard errors.
<table>
<thead>
<tr>
<th></th>
<th>Stock Return Announcement-16:00</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Δ FF</code></td>
<td>-6.554** (-3.25)</td>
</tr>
<tr>
<td></td>
<td>-2.919 (-1.83)</td>
</tr>
<tr>
<td></td>
<td>-3.925 (-1.90)</td>
</tr>
<tr>
<td></td>
<td>-2.601 (-1.64)</td>
</tr>
<tr>
<td><code>Δ FF x β_{CAPM} x Pos.</code></td>
<td>-4.046* (-2.22)</td>
</tr>
<tr>
<td></td>
<td>-2.784** (-2.73)</td>
</tr>
<tr>
<td><code>Δ FF x β_{CAPM}</code></td>
<td>-1.042 (-1.55)</td>
</tr>
<tr>
<td></td>
<td>-0.897 (-1.45)</td>
</tr>
<tr>
<td><code>β_{CAPM} x Pos.</code></td>
<td>0.0613 (1.11)</td>
</tr>
<tr>
<td></td>
<td>0.0168 (0.34)</td>
</tr>
<tr>
<td><code>β_{CAPM}</code></td>
<td>-0.00624 (-0.16)</td>
</tr>
<tr>
<td></td>
<td>0.0179 (0.48)</td>
</tr>
<tr>
<td><code>Δ FF x β_{Yield} x Pos.</code></td>
<td>-5.114* (-2.11)</td>
</tr>
<tr>
<td></td>
<td>-4.770* (-2.02)</td>
</tr>
<tr>
<td><code>Δ FF x β_{Yield}</code></td>
<td>-1.236 (-0.78)</td>
</tr>
<tr>
<td></td>
<td>-1.066 (-0.68)</td>
</tr>
<tr>
<td><code>β_{Yield} x Pos.</code></td>
<td>0.0770 (0.73)</td>
</tr>
<tr>
<td></td>
<td>0.0627 (0.59)</td>
</tr>
<tr>
<td><code>β_{Yield}</code></td>
<td>-0.130 (-1.65)</td>
</tr>
<tr>
<td></td>
<td>-0.132 (-1.65)</td>
</tr>
<tr>
<td><code>Δ FF x Pos.</code></td>
<td>0.923 (0.50)</td>
</tr>
<tr>
<td></td>
<td>-2.901 (-1.04)</td>
</tr>
<tr>
<td></td>
<td>1.208 (0.61)</td>
</tr>
<tr>
<td><code>Pos.</code></td>
<td>0.178 (1.96)</td>
</tr>
<tr>
<td></td>
<td>0.187 (1.58)</td>
</tr>
<tr>
<td></td>
<td>0.168 (1.87)</td>
</tr>
<tr>
<td><code>Constant</code></td>
<td>0.0235 (0.34)</td>
</tr>
<tr>
<td></td>
<td>-0.0868 (-1.21)</td>
</tr>
<tr>
<td></td>
<td>-0.0370 (-0.41)</td>
</tr>
<tr>
<td></td>
<td>-0.0646 (-0.93)</td>
</tr>
<tr>
<td><code>Observations</code></td>
<td>78297 78297 78297 78297</td>
</tr>
<tr>
<td><code>R^2</code></td>
<td>0.057 0.084 0.104 0.109</td>
</tr>
</tbody>
</table>

**Table 4: Stock-level Response to Surprise Fed Funds Change on Announcement Days.** Stocks in the SP500 at the beginning of the month of the announcement. Pre-scheduled announcements 1994-2017. `ΔFF` refers to the surprise change in Fed funds rate. `β_{CAPM}` is the CAPM beta of the stock, calculated monthly using daily returns from the previous calendar month. `Pos.` is an indicator variable for announcements with positive realized stock-bond covariance. `β_{Yield}` is the beta of the stock with respect to the level factor of Treasury yields. Standard errors clustered by day. Firm-level fixed effects.
<table>
<thead>
<tr>
<th></th>
<th>Cov(Stocks, Tr 10y) Post FOMC</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SP500 $R_{pre}$</td>
<td>-36.87**</td>
<td>-18.23*</td>
<td>-29.75**</td>
<td>-18.26*</td>
</tr>
<tr>
<td></td>
<td>(-2.92)</td>
<td>(-2.19)</td>
<td>(-2.87)</td>
<td>(-2.10)</td>
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<tr>
<td>L-S $\beta_{Yield}$ $R_{pre}$</td>
<td>-23.05***</td>
<td>-18.30***</td>
<td>-22.30**</td>
<td>-18.66*</td>
</tr>
<tr>
<td></td>
<td>(-4.23)</td>
<td>(-3.50)</td>
<td>(-2.98)</td>
<td>(-2.57)</td>
</tr>
<tr>
<td>Cov(Stocks, Tr 10y) Pre FOMC</td>
<td></td>
<td>2.579</td>
<td>0.179</td>
<td>-0.418</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.01)</td>
<td>(0.06)</td>
<td>(-0.14)</td>
</tr>
<tr>
<td>10y Treasury $R_{pre}$</td>
<td></td>
<td>5.344</td>
<td>9.273</td>
<td>8.429</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.34)</td>
<td>(0.68)</td>
<td>(0.55)</td>
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<td>Constant</td>
<td>10.52</td>
<td>4.802</td>
<td>8.840</td>
<td>10.45</td>
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<tr>
<td></td>
<td>(1.89)</td>
<td>(0.96)</td>
<td>(1.70)</td>
<td>(1.89)</td>
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<td>84</td>
<td>84</td>
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<tr>
<td>$R^2$</td>
<td>0.142</td>
<td>0.218</td>
<td>0.243</td>
<td>0.165</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>0.220</td>
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<td></td>
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<td>0.245</td>
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</table>

**Table 5: Predicting Announcement Time Stock-Bond Covariance.** Pre-scheduled meetings 1994-2017 with expected change in funds rate larger than two basis points in magnitude. L-S $\beta_{Yield}$ $R_{pre}$ refers to the pre-announcement return of a portfolio long high interest rate exposure stocks, short low interest exposure stocks. Heteroskedasticity robust standard errors.
<table>
<thead>
<tr>
<th></th>
<th>SP500 Return 9:30 to Announcement</th>
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<tbody>
<tr>
<td>Count “This Morning”</td>
<td>0.121*</td>
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<tr>
<td></td>
<td>0.0710</td>
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<td></td>
<td>(2.01)</td>
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<td></td>
<td>(1.71)</td>
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<tr>
<td>Count “This Week”</td>
<td>0.128</td>
</tr>
<tr>
<td></td>
<td>0.0959*</td>
</tr>
<tr>
<td></td>
<td>(1.93)</td>
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<td>(2.20)</td>
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<td>Count “Recent”</td>
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<td></td>
<td>-0.00219</td>
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<tr>
<td></td>
<td>(1.02)</td>
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<td></td>
<td>(-0.05)</td>
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<tr>
<td>Count “Market”</td>
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<td>0.163***</td>
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<td>(3.57)</td>
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<td>Count “Volatility”</td>
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<td>0.00638</td>
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<td>(0.19)</td>
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<td>Constant</td>
<td>0.0868</td>
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<td>0.199***</td>
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<td>-0.368*</td>
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<td>0.218***</td>
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<td></td>
<td>-0.458**</td>
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<td></td>
<td>(0.90)</td>
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<td>(3.63)</td>
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<td>(0.93)</td>
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<td>(-2.36)</td>
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<td></td>
<td>152</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td>0.056</td>
</tr>
<tr>
<td></td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>0.118</td>
</tr>
<tr>
<td></td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>0.175</td>
</tr>
</tbody>
</table>

**Table 6: Textual Analysis of FOMC Meeting Transcripts.** Count of phrases spoken at FOMC meetings, normalized by total count of words. Phrases in quotation marks matched allowing for upper- and lowercase letters, and any word endings. Scheduled FOMC announcements 1994-2012. Right hand side variables normalized to unit standard deviation. Heteroskedasticity robust standard errors.
<table>
<thead>
<tr>
<th></th>
<th>Daily Market Excess Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Even Week FOMC Cycle</td>
<td>0.0753*</td>
</tr>
<tr>
<td></td>
<td>(2.52)</td>
</tr>
<tr>
<td></td>
<td>-0.212</td>
</tr>
<tr>
<td></td>
<td>(-1.29)</td>
</tr>
<tr>
<td></td>
<td>0.0753*</td>
</tr>
<tr>
<td></td>
<td>(2.52)</td>
</tr>
<tr>
<td></td>
<td>0.0155</td>
</tr>
<tr>
<td></td>
<td>(0.53)</td>
</tr>
<tr>
<td>SP500 XS-VOL</td>
<td>-0.0362</td>
</tr>
<tr>
<td></td>
<td>(-0.76)</td>
</tr>
<tr>
<td></td>
<td>-0.117</td>
</tr>
<tr>
<td></td>
<td>(-1.67)</td>
</tr>
<tr>
<td>Even Week x XS-VOL</td>
<td>0.153</td>
</tr>
<tr>
<td></td>
<td>(1.62)</td>
</tr>
<tr>
<td>XS-VOL &gt; p50</td>
<td>-0.0250</td>
</tr>
<tr>
<td></td>
<td>(-0.85)</td>
</tr>
<tr>
<td></td>
<td>-0.0880*</td>
</tr>
<tr>
<td></td>
<td>(-2.01)</td>
</tr>
<tr>
<td>Even Week x XS-VOL &gt; p50</td>
<td>0.118*</td>
</tr>
<tr>
<td></td>
<td>(1.99)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0339*</td>
</tr>
<tr>
<td></td>
<td>(2.27)</td>
</tr>
<tr>
<td></td>
<td>-0.00640</td>
</tr>
<tr>
<td></td>
<td>(-0.29)</td>
</tr>
<tr>
<td></td>
<td>0.102</td>
</tr>
<tr>
<td></td>
<td>(1.24)</td>
</tr>
<tr>
<td></td>
<td>0.214</td>
</tr>
<tr>
<td></td>
<td>(1.76)</td>
</tr>
<tr>
<td></td>
<td>0.00631</td>
</tr>
<tr>
<td></td>
<td>(0.29)</td>
</tr>
<tr>
<td></td>
<td>0.0383</td>
</tr>
<tr>
<td></td>
<td>(1.82)</td>
</tr>
<tr>
<td>Observations</td>
<td>6019</td>
</tr>
<tr>
<td></td>
<td>6019</td>
</tr>
<tr>
<td></td>
<td>6019</td>
</tr>
<tr>
<td></td>
<td>6019</td>
</tr>
<tr>
<td></td>
<td>6019</td>
</tr>
<tr>
<td></td>
<td>6019</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>0.002</td>
</tr>
</tbody>
</table>

Table 7: Market Excess Returns over the FOMC Cycle. Daily returns 1994-2017. The second column replicates the finding in Cieslak et al. (2016) that expected returns are high on even weeks of the FOMC cycle. Consistent with the model proposed here, the cyclicality over the FOMC cycle is modulated by the level of XS-VOL. As the last column indicates, the even week returns are particularly high when XS-VOL is above its sample median value. When XS-VOL is above median value the odd week returns are low. Heteroskedasticity robust standard errors.
<table>
<thead>
<tr>
<th></th>
<th>FF Surprise</th>
<th>FF Surprise</th>
<th>10y Tr.</th>
<th>10y Tr.</th>
<th>10y Tr.</th>
<th>10y Tr. MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP500 R_{pre}</td>
<td>0.384</td>
<td>-0.0610</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.63)</td>
<td>(-1.90)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied 10y Tr.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.500***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(4.97)</td>
</tr>
<tr>
<td>Beta-implied 10y Tr. MA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.710***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(5.36)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0526</td>
<td>-0.146</td>
<td>0.00906</td>
<td>0.0221</td>
<td>0.0162</td>
<td>0.0173</td>
</tr>
<tr>
<td></td>
<td>(-0.42)</td>
<td>(-1.06)</td>
<td>(0.54)</td>
<td>(1.23)</td>
<td>(1.02)</td>
<td>(1.24)</td>
</tr>
<tr>
<td>Observations</td>
<td>174</td>
<td>174</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.000</td>
<td>0.015</td>
<td>0.000</td>
<td>0.019</td>
<td>0.115</td>
<td>0.331</td>
</tr>
</tbody>
</table>

Table 8: Pre-announcement Drift in Fed Funds Futures and Treasury Prices. First two columns show the change in Fed Funds Futures implied change in target rate. FF surprise quoted in basis points. Third and fourth column show the drift in Treasury prices. In the fifth column I regress the observed drift in Treasury prices on the “beta-implied” drift. Beta-implied drift is calculated by multiplying 10y Treasury bond CAPM beta with the drift in SP500. Treasury beta is calculated using a 30-day rolling window. The last column regresses an 8-meeting moving average of Treasury price drift on the corresponding 8-meeting moving average of beta-implied drift.
<table>
<thead>
<tr>
<th></th>
<th>$\Delta_{\text{AUD USD}}$</th>
<th>$\Delta_{\text{CAD USD}}$</th>
<th>$\Delta_{\text{CHF USD}}$</th>
<th>$\Delta_{\text{EUR USD}}$</th>
<th>$\Delta_{\text{GBP USD}}$</th>
<th>$\Delta_{\text{JPY USD}}$</th>
<th>$\Delta_{\text{NZD USD}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-implied $\Delta$ AUD/USD</td>
<td>1.108*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.17)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ CAD/USD</td>
<td></td>
<td>1.895***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.87)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ CHF/USD</td>
<td></td>
<td></td>
<td>0.624</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.61)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ EUR/USD</td>
<td></td>
<td></td>
<td></td>
<td>0.969**</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.68)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ GBP/USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.419**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(3.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ JPY/USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.599</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1.73)</td>
<td></td>
</tr>
<tr>
<td>Beta-implied $\Delta$ NZD/USD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.075*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(2.17)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.0410</td>
<td>-0.0508</td>
<td>-0.0697</td>
<td>-0.107**</td>
<td>-0.110**</td>
<td>0.0700</td>
<td>-0.0589</td>
</tr>
<tr>
<td></td>
<td>(-0.69)</td>
<td>(-1.30)</td>
<td>(-1.55)</td>
<td>(-2.94)</td>
<td>(-2.71)</td>
<td>(1.65)</td>
<td>(-1.02)</td>
</tr>
<tr>
<td>Observations</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.024</td>
<td>0.073</td>
<td>0.014</td>
<td>0.036</td>
<td>0.046</td>
<td>0.016</td>
<td>0.024</td>
</tr>
</tbody>
</table>

Table 9: Pre-announcement Drift in Foreign Exchange Markets. Pre-scheduled FOMC announcements 1994-2017. The left-hand-side variable is the announcement day change in the foreign exchange rate over USD. The right hand side is the return on the same foreign exchange rate implied by its market beta and the realized pre-announcement return on the SP500. Foreign exchange rate betas are calculated using a 30-day rolling window. In the regression using EUR/USD exchange rate I replace EUR with ECU (European Currency Unit) exchange rate prior to the introduction of the Euro.
<table>
<thead>
<tr>
<th></th>
<th>Earnings</th>
<th></th>
<th>Dividends</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(t-3) to (t-2)</td>
<td></td>
<td>(t-2) to (t-1)</td>
</tr>
<tr>
<td></td>
<td>0.0115</td>
<td>0.0144</td>
<td></td>
<td>0.0309**</td>
</tr>
<tr>
<td></td>
<td>(0.98)</td>
<td>(0.54)</td>
<td>0.0106</td>
<td>(2.60)</td>
</tr>
<tr>
<td></td>
<td>-0.00306</td>
<td>0.0203</td>
<td>0.0332</td>
<td>0.0203</td>
</tr>
<tr>
<td></td>
<td>(-0.12)</td>
<td>(1.36)</td>
<td>(0.80)</td>
<td>(2.40)</td>
</tr>
<tr>
<td></td>
<td>-0.00189</td>
<td>0.0340*</td>
<td>0.0739***</td>
<td>0.0739***</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(-0.20)</td>
<td>(1.25)</td>
<td>(0.21)</td>
</tr>
<tr>
<td></td>
<td>0.00798</td>
<td>-0.00704</td>
<td>0.0448</td>
<td>0.0448</td>
</tr>
<tr>
<td></td>
<td>(0.21)</td>
<td>(0.20)</td>
<td>(1.25)</td>
<td>(1.25)</td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} )</td>
<td></td>
<td></td>
<td>0.00915**</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.61)</td>
<td></td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} \times \text{ (t-3) to (t-2) } )</td>
<td>0.0144</td>
<td></td>
<td></td>
<td>-0.00934</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.54)</td>
<td></td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} \times \text{ (t-2) to (t-1) } )</td>
<td>0.0106</td>
<td></td>
<td></td>
<td>0.0387</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.41)</td>
<td></td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} \times \text{ (t-1) to t } )</td>
<td>0.0520*</td>
<td></td>
<td></td>
<td>0.0273</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(2.09)</td>
<td></td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} \times \text{ t to (t+1) } )</td>
<td>-0.0348</td>
<td></td>
<td></td>
<td>-0.0691</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(-0.71)</td>
<td></td>
</tr>
<tr>
<td>( \beta_i, \text{CAPM} \times \text{ (t+1) to (t+2) } )</td>
<td>0.0276</td>
<td></td>
<td></td>
<td>-0.0281</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.90)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>2472886</td>
<td>2472886</td>
<td>1670695</td>
<td>1670695</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 10: Pre-Announcement Drift Before Earnings and Dividend Announcements. Earnings and dividend announcement date and time from IBES. Daily returns of SP500 stocks from 1994-2017 (earnings) and 2002-2017 (dividends.) Indicator variables indicate trading days relative to the announcement. Day \( t = 0 \) indicates the last full trading day before the announcement. The pre-announcement returns are concetrated among high CAPM beta stocks. Heteroskedasticity robust standard errors.
<table>
<thead>
<tr>
<th></th>
<th>t=[-180 -1]</th>
<th>t=[-60 -1]</th>
<th>t=[-30 -1]</th>
<th>t=[0 60]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONF</td>
<td>0.0111</td>
<td>0.0523</td>
<td>0.0461</td>
<td>-0.00778</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(1.25)</td>
<td>(1.82)</td>
<td>(-0.24)</td>
</tr>
<tr>
<td>EMP</td>
<td>-0.0155</td>
<td>0.00182</td>
<td>0.0300</td>
<td>0.0906</td>
</tr>
<tr>
<td></td>
<td>(-0.44)</td>
<td>(0.07)</td>
<td>(1.75)</td>
<td>(1.67)</td>
</tr>
<tr>
<td>EPS</td>
<td>0.103**</td>
<td>0.0663*</td>
<td>0.0361*</td>
<td>-0.0263</td>
</tr>
<tr>
<td></td>
<td>(2.70)</td>
<td>(2.40)</td>
<td>(2.02)</td>
<td>(-0.76)</td>
</tr>
<tr>
<td>FOMC</td>
<td>0.116***</td>
<td>0.0472**</td>
<td>0.0478***</td>
<td>0.0266</td>
</tr>
<tr>
<td></td>
<td>(4.24)</td>
<td>(3.05)</td>
<td>(3.86)</td>
<td>(0.46)</td>
</tr>
<tr>
<td>PPI</td>
<td>-0.0185</td>
<td>0.0375</td>
<td>0.0201</td>
<td>-0.0639</td>
</tr>
<tr>
<td></td>
<td>(-0.32)</td>
<td>(1.05)</td>
<td>(0.73)</td>
<td>(-1.07)</td>
</tr>
<tr>
<td>ISM</td>
<td>-0.148***</td>
<td>-0.147***</td>
<td>-0.120***</td>
<td>0.142*</td>
</tr>
<tr>
<td></td>
<td>(-3.72)</td>
<td>(-4.75)</td>
<td>(-4.87)</td>
<td>(2.55)</td>
</tr>
</tbody>
</table>

Table 11: Pre-Announcement Drift Before Other Macroeconomic Announcements. Consumer Board Confidence Index (CONF), BLS employment announcements (EMP), earnings announcements of ten largest companies of the SP500 (EPS), FOMC announcements (FOMC), ISM Manufacturing Index (ISM) and BLS inflation announcements (PPI). Sample from 1997 to 2017.
<table>
<thead>
<tr>
<th></th>
<th>SP500 $R_{\text{post}}$</th>
<th>FF 9:30-Ann.</th>
<th>FF Ann.-Close</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP500 $R_{\text{pre}}$</td>
<td>-0.358* (-2.01)</td>
<td>0.384  (0.78)</td>
<td>1.637*  (2.27)</td>
</tr>
<tr>
<td>$\Delta$ Fed Funds Implied Target $\text{post}$</td>
<td>-0.0538* (-2.60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R_{\text{Market}}^{(t-10)}$ to $\text{(t-1)}$</td>
<td></td>
<td>0.0153 (0.07)</td>
<td></td>
</tr>
<tr>
<td>$R_{\text{Market}}^{(t-10)}$ to $\text{(t-1)}$, if negative</td>
<td></td>
<td>-0.232 (-0.75)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.0748 (1.03)</td>
<td>-0.0526 (-0.42)</td>
<td>-0.146 (-1.16)</td>
</tr>
<tr>
<td>Observations</td>
<td>192</td>
<td>174</td>
<td>184</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.035</td>
<td>0.000</td>
<td>0.035</td>
</tr>
</tbody>
</table>

Table 12: Leaks Hypothesis. Pre-scheduled FOMC Announcements 1994-2017. Under the hypothesis of leaked information, the realized drift in the pre-announcement period should predict with a positive sign the announcement outcome. Heteroskedasticity robust standard errors.
Table 13: Trading on a Hypothetical Fed Leak. Pre-scheduled FOMC Announcements 1994-2017. Percentage returns of a strategy that is long the market if the \textit{ex post} surprise in funds rate is negative; short the market if \textit{ex post} surprise in funds rate is positive. The strategy that uses leaked information to trade on the announcement earns an average of 11 basis points per announcement, with volatility near .9%, underlining the difficulty of predicting market response to a given Fed announcement. In contrast, the strategy that is always long the market before the announcement earns an average of 21 bps with half the volatility. Annualized Sharpe ratios calculated on a strategy that invests in the risk-free rate on days with no pre-scheduled FOMC announcements.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>$E[R]$</th>
<th>$\sigma(R)$</th>
<th>Sharpe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-Short Pre Ann.</td>
<td>-0.022</td>
<td>0.476</td>
<td>-0.129</td>
</tr>
<tr>
<td>Long-Short Post Ann.</td>
<td>0.118</td>
<td>0.870</td>
<td>0.384</td>
</tr>
<tr>
<td>Long-Short Entire Day</td>
<td>0.097</td>
<td>0.934</td>
<td>0.292</td>
</tr>
<tr>
<td>Long Only Pre Ann.</td>
<td>0.213</td>
<td>0.520</td>
<td>1.159</td>
</tr>
<tr>
<td>Long Only Post Ann.</td>
<td>-0.002</td>
<td>1.001</td>
<td>-0.005</td>
</tr>
<tr>
<td>Long Only Entire Day</td>
<td>0.211</td>
<td>1.042</td>
<td>0.572</td>
</tr>
</tbody>
</table>
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References


A Appendix A

A.1 Solving for Risk Premia

In this section I provide more detail on the calculation of risk premia in Section 2. In this appendix I am reusing notation—the greek characters here do not have the same interpretation than before.

Let the SDF be given by

$$m_{t+1} = a - \Lambda \eta_{t+1}$$

and let the asset return be

$$r_{t+1} = \mu + \beta \eta_{t+1} + \beta \xi \xi_{t+1}.$$  

The shocks \( \eta_{t+1} \) and \( \xi_{t+1} \) are normally distributed with zero means, and volatilities \( \sigma_\eta \) and \( \sigma_\xi \). The asset return then has to satisfy the pricing equation:

$$1 = E_t [\exp\{m_{t+1}\} \exp\{r_{t+1}\}]$$

To find the risk premia, let me first take the expectation and solve for \( \mu \):

$$\mu = -a + \Lambda \beta \sigma_\eta^2 - \frac{1}{2} \Lambda^2 \sigma_\eta^2 - \frac{1}{2} \beta^2 \sigma_\eta^2 - \frac{1}{2} \beta^2 \sigma_\xi^2.$$  

Similarly, solve for the risk free rate by finding \( r^f \) in

$$1 = E_t [\exp\{m_{t+1}\} e^{r^f}]$$

$$r^f = -a - \frac{1}{2} \Lambda^2 \sigma_\eta^2.$$  

The continuously compounded risk premium on the asset is then given by:

$$\ln\left(\frac{E[R_t]}{R^f}\right) = \ln(E[R_t]) - \ln(e^{r^f})$$

$$= E[\ln(R_t)] - \frac{1}{2} \sigma^2 (\ln(R_t)) - r^f$$

$$= \mu + \frac{1}{2} \beta^2 \sigma_\eta^2 + \frac{1}{2} \beta^2 \sigma_\xi^2 - r^f$$

$$= -a + \Lambda \beta \sigma_\eta^2 - \frac{1}{2} \Lambda^2 \sigma_\eta^2 - \frac{1}{2} \beta^2 \sigma_\eta^2 - \frac{1}{2} \beta^2 \sigma_\xi^2 + \frac{1}{2} \beta^2 \sigma_\xi^2 + \frac{1}{2} \beta^2 \sigma_\xi^2 + a + \frac{1}{2} \Lambda^2 \sigma_\eta^2$$

$$= \Lambda \beta \sigma_\eta^2.$$  

A.2 Fed’s Problem Calculations

The conditional announcement rule is given by

$$F_w(X_t, \chi) = (1 - w(X_t)) \chi_2 - w(X_t) \chi_1.$$  

(35)
The announcement \( F_w \) defines the following line in \((\chi_1, \chi_2)\) space

\[
\chi_2 = \frac{F_w + w \chi_1}{1 - w}. \tag{36}
\]

Investor beliefs will be given by the point on the line defined by Equation (36) closest to their signal. Denote with lowercase \( x_1 \) and \( x_2 \) the investor posterior. The distance squared from the point \( \nu \) is given by

\[
(x_1 - \nu_1)^2 + (x_2 - \nu_2)^2 = (x_1 - \nu_1)^2 + \left( \frac{F}{1 - w} + \frac{wx_1}{1 - w} - \nu_2 \right)^2. \tag{37}
\]

The derivative with respect to \( x_1 \) is given by

\[
\frac{d}{dx_1} : 2 (x_1 - \nu_1) + \frac{2w}{1 - w} \left( \frac{F}{1 - w} - \nu_2 + \frac{wx_1}{1 - w} \right). \tag{38}
\]

Setting the derivative to zero and solving for \( x_1 \) results in

\[
0 = (x_1 - \nu_1) + \frac{w}{1 - w} \left( \frac{F}{1 - w} - \nu_2 + \frac{wx_1}{1 - w} \right) \tag{39}
\]

\[
x_1 \left( 1 + \frac{w^2}{(1 - w)^2} \right) = \nu_1 + \frac{w}{1 - w} \nu_2 - \frac{wF}{(1 - w)^2} \tag{40}
\]

\[
\Rightarrow x_1 = \left( \nu_1 + \frac{w}{1 - w} \nu_2 - \frac{wF}{(1 - w)^2} \right) / \left( 1 + \frac{w^2}{(1 - w)^2} \right). \tag{41}
\]

Under the unconditional announcement rule \( w = (1 - w) = .5 \) the expression for post-announcement \( x_1 \) collapses to

\[
x_1 = \frac{\nu_1 + \nu_2}{2} - F. \tag{42}
\]

### A.3 Mechanics of Fed Funds Futures Contracts

The Chicago Board of Trade (now CME Group) started trading Fed Funds futures contracts in 1988. Following the literature, I use \( f_{t,d}^{(n)} \) to denote end of day price (quoted as a rate) of the \( n \)-month ahead Fed Funds futures contract in month \( t \), day \( d \). For example, \( f_{m,1}^{(0)} \) refers to the price of the current month \( m \) Fed Futures contract one day into the month.

The futures are cash settled. At maturity, the month \( m \) Fed Funds futures contract pays out 100 minus the average end of day effective Fed Funds rate during the trading days of the month. That is, at maturity the current month contract price has to equal

\[
f_{m,D}^{(0)} = \frac{1}{D} \sum_{t=1}^{D} FF_{m,t}
\]
where $D$ denotes the number of trading days in the month.

**A.3.1 Calculation of Intraday Fed Funds Surprises**

I employ the Kuttner (2001) methodology to calculate daily Fed Funds futures implied surprise changes in the Funds rate. The surprise change in the effective Fed Funds rate on day $d$ is given by:

$$
\Delta FF_{m,d} = \frac{D}{D - d} \left( f^{(0)}_{m,d} - f^{(0)}_{m,d-1} \right)
$$

The only complication to this calculation arises near ends of month. With liquidity moving to next months’ contracts, small amounts of noise in the underlying price can cause severe measurement noise as the denominator $D - d$ becomes small. I again follow Kuttner (2001) and use the change in the next month futures price to calculate the change during the last three trading days of a month.

**A.3.2 Fed Funds Risk Premia**

Piazzesi and Swanson (2008) find considerable risk premia in the Fed Funds futures market. They calculate returns on the zero cost portfolio that enters into a Fed Funds Futures contract at the beginning of month and sells to close the position at the end of the last trading day. Specifically, they calculate:

$$
r_{x}^{(n)}(t) = f_{t,1}^{(n)} - \frac{1}{D} \sum_{j=1}^{D} FF_{t+n,j}
$$

In principle, this calculation should take into account the costs from mandatory margins posted by traders. However, Piazzesi and Swanson (2008) find that the impact of taking into account margin requirements does not have a material effect on the measures of risk premia.
B Appendix B–Alternative Preference Specifications

In the main text I specified that investors have Epstein-Zin preferences. In this section I briefly discuss other preference specifications that can account for a pre-announcement risk premium.

B.1 CRRA

Because Epstein-Zin preferences nest CRRA preferences it is easy to rederive the model results. Under CRRA the reciprocal of the parameter governing intertemporal elasticity of substitution equals the parameter governing risk aversion ($\frac{1}{\psi} = \gamma$).

The pre-announcement risk premium under CRRA follows directly from Equation 8 in the main text, reproduced here

$$RP = \frac{1}{\psi} \text{Cov} (c_1(X) - E_0[c_1(X)], \sigma_d (X - E_0[X])) +
(\gamma - \frac{1}{\psi}) \text{Cov} (v_1(X) - E_0[v_1(X)], \sigma_d (X - E_0[X])).$$

Setting $\gamma = \frac{1}{\psi}$ results in

$$RP = \gamma \text{Cov} (c_1(X) - E_0[c_1(X)], \sigma_d (X - E_0[X])).$$

In contrast to Epstein-Zin preferences, under CRRA it is necessary that optimal consumption $C_1$ is a function of the realization of $X$. Strictly from the perspective of risk premium, CRRA utility is consistent with a pre-announcement risk earned in the run-up to a scheduled announcement. Of course, CRRA preferences have other features that make them hard to reconcile with asset pricing data.

Note that Equation 44 is derived under the assumption that the consumption decision at $t = 1$ is made with all available information, meaning it is made conditional on the realization of $X$. If the consumption process cannot adjust in the pre-announcement period then the marginal utility of consumption cannot serve as the pricing factor—we instead need to price assets directly with the value function. I take up this point in Appendix C.
B.2 Non-Standard Preferences

Preferences other than Epstein-Zin and CRRA are also consistent with a pre-announcement risk premium. Strzalecki (2013) shows that the recursive definition
\[ V_t = u(c_t) + \beta I_t[V_{t+1}] \]  
(45)
can capture an array of non-standard preference specifications with the appropriate specifications of certainty equivalent functional \( I \) and flow utility function \( u \).

Let’s derive the SDF under this preference specification. Define the value function formally as
\[ V_t(W_t, X_t) = \max_{\theta} \left\{ u(c_t(X_t)) + \beta I_t[V_{t+1}(W_{t+1}, X_{t+1})] \right\} \]
\[ \text{s.t.} \quad \theta \cdot p_t \leq \phi \cdot p_t = W_t \]  
(46)
where \( \theta \) contains the portfolio weights of the representative investor over a full slate of Arrow-Debreu assets, \( \phi \) is the endowment of the representative investor, and \( p_t \) is a vector of time \( t \) prices. Asset payouts are in the consumption good. The time \( t \) wealth, \( W_t \), is defined as the market price of the investor’s endowment. Prices are such that investors decide to consume exactly the endowment amount in each period.

At the optimum, any asset with current price \( p^i_t \) and stochastic payout \( X_{t+1} \) next period has to satisfy investor first order conditions. Namely, a small investment of today’s wealth \( W_t \) in the payout \( x_{t+1} \) must leave the value function unchanged
\[ p^i_t \frac{dV_t(W_t, X_t)}{dW_t} = E_t \left[ \frac{dV_t(W_t, X_t)}{dW_{t+1}} X_{t+1} \right] \]  
(47)
\[ \implies p^i_t = E_t \left[ \frac{dV_t(W_t, X_t)}{dW_{t+1}} / \frac{dV_t(W_t, X_t)}{dW_t} X_{t+1} \right] \]  
(48)

Current value function depends on future wealth only via the effect on the continuation value
\[ \frac{dV_t(W_t, X_t)}{dW_{t+1}} = \frac{dV_t(W_t, X_t)}{dV_{t+1}(W_{t+1}, X_{t+1})} \frac{dV_{t+1}(W_{t+1}, X_{t+1})}{dW_{t+1}} = \beta \frac{dI_t[V_{t+1}(W_{t+1}, X_{t+1})]}{dV_{t+1}(W_{t+1}, X_{t+1})} \frac{dV_{t+1}(W_{t+1}, X_{t+1})}{dW_{t+1}}. \]  
(49)

The Envelope condition ensures that the benefit of an incremental increase in current wealth equals the benefit of an incremental purchase the consumption good
\[ \frac{dV_t(W_t, X_t)}{dW_t} = u'(c_t) \]  
(50)
Therefore the SDF under preference relation 45 is given by

\[
M_{t,t+1} = \frac{dV_t(W_t, X_t)}{dW_{t+1}} \frac{dV_t(W_t, X_t)}{dW_t} \\
M_{t,t+1} = \beta \frac{dE_t[V_{t+1}(W_{t+1}, X_{t+1})]}{dV_{t+1}(W_{t+1}, X_{t+1})} \frac{dV_{t+1}(W_{t+1}, X_{t+1})}{dW_{t+1}} \frac{dV_t(W_t, X_t)}{dW_t} \\
= \beta \frac{dE_t[V_{t+1}(W_{t+1}, X_{t+1})]}{dV_{t+1}(W_{t+1}, X_{t+1})} \frac{u'(c_{t+1})}{u'(c_t)}. 
\]

(51)

The condition for a pre-announcement risk premium is simple. The discount factor in Equation 51 needs to have non-zero covariance with innovations to the state variable \(X_t\). This covariance could stem from the consumption component, like in the case of CRRA preferences, or from the continuation value component, like in the Epstein-Zin specification in the main text.
Appendix C–Announcement Risk Premium Under Fixed Consumption

A complication with respect to calculating risk premia in the pre-announcement window arises when the consumption process cannot adjust at a high frequency. In this section I provide a derivation of the SDF in a setting where consumption is fixed in the short run and preferences are CRRA, and show that that the SDF is consistent with a pre-announcement risk premium.

Let me first illustrate a situation under which a pre-announcement risk premium would be inconsistent with CRRA preferences. Suppose consumption can adjust at a high frequency, and that the consumption process is observable to the econometrician. If in that world we observed no contemporaneous consumption response in the pre-announcement drift period, we could conclude that investor preferences are not characterized by time-separable expected utility formulations.

Empirically speaking, we do not in general see an immediate reaction in consumption to any macroeconomic announcements. The failure to observe such consumption response could stem from poor measurement of consumption, from investor preferences, or from non-reversible nature of the consumption process.

If it’s the case that consumption cannot adjust at a high frequency, then the lack of consumption response does not by itself establish that preferences are not time-separable. In recent work, Ai and Bansal (2018) argue that if the representative investor cannot quickly adjust consumption in response to news, a positive macroeconomic announcement risk premium provides direct evidence against time-separable expected utility preferences.

In this section I provide an alternative derivation in the same setting and find that an announcement (or pre-announcement) risk premium is consistent with time-separable preferences, even if consumption is fixed in the short term.

The intuition is precisely the same than in Anderson (2018): a non-optimal consumption decision drives a wedge between the marginal value of wealth and the marginal utility of current consumption. I first show that the pricing equation that employs ratios of marginal utility of consumption no longer obtains if consumption is not determined with contemporaneous information. I then provide a direct calculation of the announcement risk premium under in a two period setting where consumption cannot adjust instantaneously. Finally, I address the proof in Ai and Bansal (2018).
C.1 Pricing Formula if Consumption is Fixed

Like derived in Appendix B, the general form of the asset pricing equation employs the ratio of value function derivatives with respect to wealth

\[ P_t = E_t \left[ \frac{dV_t}{dW_{t+1}} \frac{dV_t}{dW_t} x_{t+1}(s) \right]. \]  

(52)

In words, prices are such that an incremental small investment of today’s wealth in an asset that pays out \( x_{t+1}(s) \) in time \( t + 1 \) wealth leaves the value function unchanged.

Under expected utility, the term \( \frac{dV_t}{dW_{t+1}} \) can be simplified: the continuation value enters today’s value function linearly, with time discount \( \beta \)

\[ \frac{dV_t}{dW_{t+1}} = \frac{dV_t}{dW_{t+1}} \frac{dV_{t+1}}{dW_{t+1}} = \beta \frac{dV_{t+1}}{dW_{t+1}}. \]  

(53)

If current consumption is part of the investors’ optimization problem the Envelope Theorem implies that, at the optimum, the marginal benefit of wealth consumed should be the same than the marginal benefit of wealth invested:

\[ \frac{dV_t}{dW_t} = \frac{dV_t}{dc_t} = u'(c_t) \]  

(54)

Substituting the Envelope condition and Equation 53 into the asset pricing Equation 52 results in the familiar formulation

\[ P_t = E_t \left[ \beta u'(c_{t+1}) \frac{u'(c_t)}{u'(c_t)} x_{t+1}(s) \right]. \]  

(55)

Because the derivation used the Envelope condition, implicit in Equation 55 is that \( c_t \) is decided using time \( t \) information, and \( c_{t+1} \) with \( t + 1 \) information. If the structure of the consumption process is such that the contemporaneous consumption amount is determined at an earlier period, Equation 55 no longer holds. However, we can still find asset prices by directly calculating Equation 52.

C.2 Calculation of Risk Premium under Fixed Consumption

Let me illustrate the direct calculation of asset prices with Equation 52 in a setting where consumption is determined with a lag. Specifically, I will use the two-period model contained in Ai and Bansal (2018). Solving the problem, I find that value-relevant news commands a risk premium right on announcement, even if preferences are time separable and consumption cannot adjust at short horizons.
C.2.1 Model Setup

Three dates, labeled $t = 0^-$, $t = 0^+$, and $t = 1$. Representative investor with a strictly increasing and continuously differentiable utility function $u(c)$. There is no consumption in period $0^-$. In period $0^+$ representative investor consumes $c_0$, where $c_0$ is known already at time $0^-$. Also in period $0^+$, a random variable $s$ is revealed. In period $t = 1$ representative investor consumes $c_1(s)$.

For my purposes, time $0^+$ is interpreted as the pre-announcement period where investors learn announcement type. Period $t = 1$ is some time after the announcement when investor consumption can respond to the information contained in the signal $s$.

![Figure C1: Two Period Model Timeline.](image)

C.2.2 Announcement Risk Premium

Let me calculate the SDF from period $t = 0^-$ to $t = 0^+$. The representative investor problem at time $t = 0^-$ is

$$\max_{\theta} \{u(c_0) + E_-[\beta u(c_1(s))]\} \Rightarrow u(c_0) + \max_{\theta} \{E_-[\beta u(c_1(s))]\}$$

subject to the budget constraint

$$c_1(s) = \theta(s)$$
$$\theta \cdot p \leq \phi \cdot p.$$  

Note because $c_0$ is a constant known at $0^-$ it can be taken out of the maximization problem. $\theta$ denotes the holdings of the $|s|$ Arrow-Debreu securities that pay out at time $t = 1$ and $\phi = [c_1(s_1) \quad c_1(s_2) \quad \ldots \quad c_1(s_N)]'$ is the endowment of the investor. There are only $N$ different outcomes possible in the model so these Arrow-Debreu assets span the state space.

The first order conditions with respect to holdings of each Arrow-Debreu asset with payout at time
\[ t = 1 \text{ yield} \]
\[
\begin{bmatrix}
\pi_1 u'(c_1(s_1)) \\
\pi_2 u'(c_1(s_2)) \\
\vdots
\end{bmatrix} =
\begin{bmatrix}
p_1 \\
p_2 \\
\vdots
\end{bmatrix}
\lambda.
\]

(56)

In typical settings, the first order condition with respect to current consumption yields \( u'(c_0) = \lambda p_0 \), where \( p_0 \) is the price of current period consumption good. Because consumption at \( c_0 \) has been determined before \( 0^- \), this condition does not appear. Let’s solve for \( \lambda \) by normalizing the time \( t = 0^- \) price of terminal period risk-free asset to \( \beta \).

\[
\beta = \beta \sum_{i=1}^{S} \frac{\pi_1 u'(c_1(s_i))}{\lambda} \implies \lambda = E_{-}[u'(c_1(s))]
\]

(57)

The SDF from \( 0^- \) to \( 1 \) is therefore:

\[
m_{1}^{-} = \beta u'(c_1(s)) \]

(58)

What is the SDF from time \( t = 0^+ \) to \( t = 1 \)? The representative investor value functions at \( t = 0^+ \) and \( t = 1 \) are

\[
V_{+} = \beta u(c_1(s)) \\
V_{1} = u(c_1(s)).
\]

Note there are no expectation terms because all uncertainty has been resolved. At both times, there is only one Arrow-Debreu asset with a nonzero payout. Therefore, there is no meaningful optimization the investor can carry out. The wealth in both periods, measured in units of for-sure consumption in the period \( t = 1 \), is the realization of terminal consumption \( c_1(s) \).

The discount factor can be found with the formula derived in Equation 48

\[
m_{1}^{+} = \frac{dV_{+}}{dW_{1}} \bigg/ \frac{dV_{+}}{dW_{+}}.
\]

Calculating the derivatives results in

\[
\frac{dV_{+}}{dW_{1}} = \frac{d\beta u(c_1(s))}{dc_1(s)} = \beta u'(c_1(s)) \\
\frac{dV_{+}}{dW_{+}} = \frac{d\beta u(c_1(s))}{dc_1(s)} = \beta u'(c_1(s)) \\
\implies m_{1}^{+} = \frac{dV_{+}}{dW_{1}} \bigg/ \frac{dV_{+}}{dW_{+}} = 1.
\]

(59)
The discount factor from $0^-$ to $0^+$ is therefore given by

\[ m_+ m_1^1 = m_1 \]
\[ \implies m_+ = m_1^1 / m_1^1 \]
\[ \implies m_+(s) = \beta \frac{u'(c_1(s))}{E_[-[u'(c_1(s))]]} \]

(60)

which is a function of $s$ and collapses to a constant if $c_1(s) = c$, or if $u$ is an affine function. The term $E_[-[u'(c_1(s))]]$ is a result of price normalizing decision and does not affect the conclusion with respect to the timing of risk premium. In typical settings the Envelope condition results in $\frac{dV_t}{dW_t} = u'(c_t)$. Here, however, the setup introduces a mis-timing between the when the consumption amount is determined, and when it is consumed. Therefore, $u'(c_0)$ does not reveal the derivative of the value function in either of the periods, and $u'(c_1)$ enters the calculation via the time $0^+$ value function.

An asset with a payoff $x(s)$ in time $t = 0^+$ wealth earns a risk premium from $0^-$ to $0^+$, even though the representative investor’s consumption does not change until the next period. Specifically, the expected return on the asset with a time $0^+$ payoff $x(s)$ is:

\[ R^+ = \frac{E_[-[x(s)]]}{E_[-[m^+(s)x(s)]]} = \frac{E_[-[x(s)]]}{E_[-[m^+(s)]E_[-[x(s)]] + \text{Cov}(m^+(s), x(s))} \]

(61)

C.3 Comparison with Ai and Bansal (2018)

Let me contrast the result with that in Ai and Bansal (2018). In the paper, time $0^-$ price of a $t = 1$ payout—measured in units of for sure $0^+$ consumption—is calculated using the ratio of marginal utilities:

\[ P^- = E_[-\left[ \beta \frac{u'(c_1(s))}{u'(c_0)} x(s) \right]], \]

(62)

and the time $0^+$ price of a $t = 1$ payout—again measured in units of for sure $0^+$ consumption—is calculated as

\[ P^+ = \beta \frac{u'(c_1(s))}{u'(c_0)} x(s). \]

(63)

The first equation is consistent with my approach, up to the normalizing constant $u'(c_0)$ which is irrelevant for calculating covariances. In the second period, however, I find that the SDF is uniquely 1 as wealth becomes deterministic.

Combined, Equations (62) and (63) imply the time $0^-$ to $0^+$ discount factor is equal to 1, which
corresponds to Theorem 2 point (i) of the paper. To see this, note that

\[
\begin{align*}
P^- &= \mathbb{E}_- \left[ m^+ P^+(s) \right] = \mathbb{E}_- \left[ m^1 x(s) \right] \\
P^+ &= \mathbb{E}_+ \left[ m^1_+ x(s) \right] \\
\implies m^-_+ &= m^1_- / m^1_+ = \beta \frac{u'(c_1(s))}{u'(c_0)} \frac{u'(c_1(s))}{u'(c_0)} = 1.
\end{align*}
\]

Because they find an SDF that is always one there is no risk premium earned on announcement (or, in my context, when the pre-announcement information comes out.)

C.4 Proof in Ai and Bansal (2018)

Let me go through the proof of Theorems 1 and 2 to highlight where my solution differs. The proof of Theorem 1 constructs an announcement period SDF in the form (let me indicate equations in the published paper with the prefix AB)

\[
m^*(s^t_+ | z^-_t) = \frac{\mathcal{D} \mathbb{I} \left[ V_{z^t_+} W_{z^t_+, s^t_+} \right]}{\mathbb{E} \left[ \mathcal{D} \mathbb{I} \left[ V_{z^t_+} W_{z^t_+, s^t_+} \right] | z^-_t \right]}.
\]

As an intermediate step, the authors establish

\[
\mathbb{E} \left[ \mathcal{D} \mathbb{I} \left[ V_{z^t_+} W \right] \left( R_j(z^t_+) - 1 \right) | z^-_t \right] = 0.
\]

The key step where my approach differs relates to the application of Envelope condition on the post-announcement value function. The post-announcement value function is defined in Equation (AB17):

\[
V_{z^t_+}(W) = \max_{C, \xi} \left\{ u(C) + \beta \mathbb{I} \left[ V_{z^t_{-1}} W' \right] | z^t_+ \right\}
\]

\[
C + \sum_{j=0}^{J} \xi_j = W
\]

\[
W' = \sum_{j=0}^{J} \xi_j R_{P,j}(s^t_{-1} | z^t_+), \quad \text{all } s^t_{-1}
\]

where \( W \) is the post-announcement wealth of period \( t \), which depends on the realization of the signal \( s^t_+ \). Aggregate consumption \( \bar{C}_t \) is determined at an earlier period when the realization \( s^t_+ \) is not known.
Right after Equation (AB52), the proof of Theorem 1 states

\[ u'(\bar{C}_t) = \frac{dV_{z_t^+}(W)}{dW}. \]  \hfill (65)

Where \( W \) is the post-announcement wealth, meaning the post-announcement value of the investor endowment. As reflected in Equation (AB18), the post-announcement wealth is a function of the realization of the announcement \( s_t^+ \). In contrast, \( \bar{C}_t \), is a constant known at a prior time—before \( s_t^+ \) is realized.

Equation 65 states that derivative of the post-announcement value function with respect to the post-announcement wealth amount is equal to the marginal utility of \( \bar{C}_t \). The value function derivative in Equation 65 can be known at \( t^- \) only if the value function \( V_{z_t^+}(W) \) is affine in wealth, in which case all risk premia are zero. Because the consumption decision \( \bar{C}_t \) was made at an earlier period it does not reveal the marginal value of wealth in the post-announcement period. Let me show that without Equation 65, the claim (AB53) no longer follows.

Equation (AB53) reads:

\[ \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right](R_j(z_t^+)-1)\right] = 0 \]

Which is equivalent to:

\[ \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]R_j(z_t^+)\right] = \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]\right]. \]  \hfill (66)

Let’s re-derive the left hand side of Equation 66 without the Envelope condition, starting from Equation (AB51). Here \( W' \) refers to the post-announcement wealth of period \( t \).

\[ \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]\frac{d}{dW'}V_{z_t^+}(W')(R_j(z_t^+)-1)\right] = 0 \]

\[ \implies \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]\frac{d}{dW'}V_{z_t^+}(W')R_j(z_t^+)\right] = \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]\frac{d}{dW'}V_{z_t^+}(W')\right] \]

\[ \implies \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]R_j(z_t^+)\right] \mathbb{E}\left[ \frac{d}{dW'}V_{z_t^+}(W')\right] + \text{Cov}\left( \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]R_j(z_t^+), \frac{d}{dW'}V_{z_t^+}(W')\right) \]

\[ \implies \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]R_j(z_t^+)\right] = \]

\[ = \mathbb{E}\left[ \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]\frac{d}{dW'}V_{z_t^+}(W')\right] - \text{Cov}\left( \mathcal{D}\mathcal{I}\left[V_{z_t^+}(W')\right]R_j(z_t^+), \frac{d}{dW'}V_{z_t^+}(W')\right) \]  \hfill (67)

where both \( W' \) and \( R_j(z_t^+) \) are functions of the signal \( s_t^+ \) and therefore the covariance term is not
Since the first version of the appendix I have come to know that Equation (AB18) should read:

$$W' = (W - \sum_{j=1}^{J} \zeta_j) R_0 + \sum_{j=1}^{J} \zeta_j R_{A,j}(s_t^+ | z^-)$$

where $R_0$ is the risk-free return, and $\zeta_j$ are portfolio holdings of various assets, including the claims on future endowment amounts. The statement I made in the previous version about this equation does not hold.
Appendix D

D.1 Excerpts from FOMC Transcripts

In the below table I show discussion of macroeconomic news releases made in the morning of the FOMC meeting, as well as discussion pertaining to the market reaction to the MNAs and market expectations of Fed action. Of the 152 scheduled meetings from 1994 to 2012, 80 contain discussion of MNAs made during the same day.

<table>
<thead>
<tr>
<th>FOMC Date</th>
<th>MNAs</th>
<th>Discussion Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>02/04/1994</td>
<td>Employment Report</td>
<td>MR. PRELL. Earlier this morning I had a brief discussion with a senior official at the Bureau of Labor Statistics. The civilian unemployment rate for January was reported at 6.7 percent under the new survey. ... The Labor Department believes that weather had a serious effect on the payroll increases, particularly in construction. ... MR. BOEHNE. How are financial markets interpreting that? MS. LOVETT. Initially, the market moved up by almost a point at the long end—at the 30-year mark—as the headline news on the nonfarm number came across the wire. There has been some backing away from that. The market is still up; it was up about 3/8 to 1/2 when we came in here. It may be that market participants are trying to read through some of the underlying data in terms of hours and so forth. So, it’s lost some of its initial gain, but it is still up. CHAIRMAN GREENSPAN. Let me just go get the latest report. [Secretary’s note: Chairman Greenspan left the meeting very briefly at this point.] MR. KOHN. The other interesting aspect was that bill rates went down 3 or 4 basis points and the funds rate, which had opened at 3-1/8 to 3-3/16, went down to 3 to 3-1/16 and remained there. So in some sense at least the certainty of firming today was taken out by the employment numbers. Now, maybe as the bond market and everyone else reassesses them, the adjustment will be reversed. CHAIRMAN GREENSPAN. The long end is now down 3/32. MR. LINDSEY. They got to the last page of the release! ... MR. LINDSEY. I notice that the hours were way up, from 125.2 to 126.3. Is that the basis of your higher GDP forecast? MR. PRELL. Well, that’s the key element in my judgment that would probably raise the forecast. But these numbers are all being affected by weather; evidently, we’re going to have to sort through the data to get a more refined assessment.</td>
</tr>
</tbody>
</table>
CHAIRMAN GREENSPAN. After talking to my colleagues on the Board of Governors, I think there is a sentiment on the part of the Board to raise the discount rate 50 basis points in line with what a number of the Reserve Banks are requesting. I think implicit in that, in the view of the Board, is to request this Committee to allow all of the increase to pass through. Also, I might add, implicit in that general policy view is our adoption of symmetric instructions to the Desk. The more I think about that as a potential sort of policy package, the less I like all of the other alternatives. I started off at either no change and asymmetry or 50 basis points with symmetry on the grounds that 25 basis points struck me as risking the other shoe dropping syndrome. **But I must say, the more I listened to this group and your comments on the elements involved and such things as the housing starts figures this morning**—incidentally, Mike, the adjusted permits if we add back the nonpermit issuing areas are down only .8, not 1.7.

MR. PRELL. I just got these numbers at the break and I think the picture in the adjusted permits and the single-family starts is really one of rough stability in the past three months. CHAIRMAN GREENSPAN. **In other words, if we had a very weak residential construction area or a weak motor vehicles area, I would say we might want to pause and do nothing. But I think the evidence is increasingly convincing that we probably need to do 50 basis points.** I must admit that I was going to start out more even-handed—on the one hand, on the other hand, if you will—but I convinced myself to steer away from that. [Laughter] So with those apologies, I open up the discussion.
MR. PRELL. Mr. Chairman, I might bring to the Committee’s attention a late-breaking piece of news here this morning. The Conference Board released its survey for September. The headline is that consumer confidence registered its third consecutive monthly loss in September, declining 2 points. In June the index had registered 92.5 but it is now at 88.4. The punch line in this release is that "the current level of consumer confidence has been associated in the almost 30-year history of the survey with a reasonably lively economy." So it’s consistent with the notion that consumer sales have slipped a bit but are not far below the higher levels that we reached earlier this year.

...

MR. MCTEER. Mike, this is a follow-up to Bob Parry’s earlier question to Joan. In Part II of the Greenbook, Section III-1, there is a sentence that says: "The press release announcing the August policy moves was widely interpreted as indicating that subsequent action was on hold, at least for a few months, and longer-term rates initially fell somewhat." Is that saying that you think the rates fell because of the "on hold" phrase as opposed to the action itself?

MR. PRELL. Well, this is open to varying interpretations! [Laughter] Certainly, as we perceived it, that announcement has been an element in the sense that it gave traders a period of safety in which they didn’t have to worry that every bit of incoming economic data would necessarily carry with it the risk of a tightening action. So, they probably were a little more relaxed about the near-term outlook.

...

CHAIRMAN GREENSPAN. I think bond dealers would prefer that (1) the Fed never did anything, (2) that no one released any statistics, and (3) that everything was trading incrementally. Under those conditions they would feel comfortable. Any further questions?
Initial Jobless Claims, Leading Indicators

MR. PRELL. Thank you, Mr. Chairman. I will be very brief. **Initial claims for the week of July 1 were published this morning and were unchanged at 369,000.** You will recall that two weeks ago they showed a spike up to 396,000; they came off last week and were unchanged in the latest week. Insured unemployment was up to 2.7 million. That has been trending up recently, so the rise wasn’t particularly surprising in light of the initial claims. **The leading economic indicators were down 0.2 percent in May, as we and most other people had anticipated.** The change in the prior month stood at minus 0.6 percent; there was a revision from minus 0.5 percent to minus 0.4 percent, I believe, in the preceding month. For what it’s worth, we were speculating that **the measure of the probability of recession that we presented in the Greenbook would be about 54 percent and, with the revision to the earlier month—this is a very sensitive measure—it is now at 48 percent.** [Laughter]

The Johnson Redbook came out yesterday afternoon—up 1.4 percent for June—and you have the auto sales figures before you. As I indicated yesterday, they were up slightly in June to 14.9 million units for light vehicles, which is in line with the Greenbook forecast.

MR. MOSKOW. Peter, I was on the "morning call" this morning and one of the subject was the fed funds futures rate. **My recollection from this morning was that the fed funds futures rate is now indicating a 60 or 65 percent probability of a 25 basis point cut in the fed funds rate this month.** I was just wondering how that ties in with what you were saying here this morning.

MR. FISHER. I think we heard the same thing from the same sources at different times this morning. Looking through the pricing of the contract and the different time horizons one has to adjust for, there is a 60ish percent probability, if you read it literally, of a move early in the month—meaning now. **And there is an implied probability closer to 100 percent of a 25 basis point easing by the end of the month.** Without going too far into the gymnastics of it, that’s how one interprets 14 basis points on a contract that settles near the end of the month, given the different probabilities and different time horizons.
MR. FISHER. The shutdown of the Commerce Department has resulted in the postponement of today’s scheduled statistical releases, and the fiscal battle remains unresolved. So, having no hot news to report, I want simply to underscore a few key points about the Greenbook forecast as it stands. Being naturally argumentative, I’m going to focus particularly on some differences we have with notions that have been expressed frequently around this table recently and that may have a direct bearing on your policy decision today.

...  

MR. MELZER. Peter, you mentioned that the bond market was selling off further this morning. What is it doing now?

MR. FISHER. The long bond is at 6.22 percent, I think, so it is backing up a bit. The middle of the maturity range is also backing up.

MR. KOHN. There was more news on the budget and, as I understand it, more pessimism about the prospects for an agreement.

CHAIRMAN GREENSPAN. How many 32nds was that down?

MR. KOHN. It was down about 1/2 point.

MR. FISHER. Yes, 1/2 point. In yield, the long bond traded up to 6.22 percent early overnight in Tokyo, came down to 6.18 percent, and was back up to the 6.22 - 6.24 percent range in the last hour.

CHAIRMAN GREENSPAN. (Consulting a pocket electronic market monitor) The truth is the markets are down 10/32. The cash market for the long bond is at 6.22 percent.

VICE CHAIRMAN MCDONOUGH. You are our official source on the matter of long-term bond rates! [Laughter]

CHAIRMAN GREENSPAN. With all the technology we have in this room, I can’t have a little old gadget?

MR. BLINDER. It’s in the transcript that you made that remark! [Laughter]
MR. PRELL. Mr. Chairman, Karen Johnson is going to lead off our remarks, but let me just mention to the Committee that we released industrial production data this morning—I trust a few minutes ago. We failed to put a copy of the release in front of you, so let me just tell you about it. There were some small net revisions to the data for August and September that left September IP down 0.1 percent instead of the 0.3 percent decline that was published previously. And the October increase in industrial production was 0.7 percent. In manufacturing we had a 0.1 percent increase in September, also an upward revision, and 0.6 percent in October. I think these numbers are significantly above market expectations, so perhaps those of you with electronic gadgets can see whether there has been any market reaction.

CHAIRMAN GREENSPAN. I just looked and the tape is delayed.

MR. PRELL. I’m not sure whether that’s good news or not.

VICE CHAIRMAN MCDONOUGH. The reaction is delayed?

CHAIRMAN GREENSPAN. This gadget is very slow. [Laughter] Let’s turn now to Karen Johnson.
MR. PRELL. Chart 1 summarizes our forecast. But, before I get into the numbers here, I should take note of some late-breaking news. First was the upside surprise in the BEA’s advance estimate of fourth-quarter GDP, published on Friday. The 5.8 percent real output increase exceeded our guess by about a half point. However, we decided not to redo the forecast and to go with the Greenbook numbers for this presentation. This wasn’t simply for the sake of convenience. To be sure, BEA knew more about the fine detail of the fourth-quarter data than we did, but the key differences between their estimate and ours related mainly to assumptions about missing numbers. And we were reasonably content to stick with ours for the time being.

...

MR. PRELL. I might just say, in terms of signs of strong demand, that we have received a preliminary reading on January auto sales. And they seem to have come in at almost 18 million units—17.9 million—for light vehicles, which is well above the rate we are anticipating for the first quarter. So that in combination with the construction data this morning means that we’ve had two pieces of much stronger spending data than we had built into the Greenbook forecast.

MR. STOCKTON. This morning’s reading from the purchasing managers’ survey for January on prices paid—the red line—suggests that upward pressures have continued early this year.

MR. FISHER. The drama came last Friday with the release of the GDP and ECI data. Prior to that date, there really had been two contending camps in the market. One saw the inversion of the yield curve as a temporary phenomenon, expecting the curve to steepen again once this Committee began to tighten over the course of the first quarter. They were thus taking short positions in the long end. A different camp expected the inversion of the yield curve to continue. They expected it to flatten when this Committee began its widely expected tightening. They anticipated a reduction in Treasury supply at the long end but an increasing agency and corporate supply in the short end. And it was also their sense that a late cycle firming by the central bank should slow activity and foster a rally in the bond market. Thus, they took long positions in the long end of the bond market. Last Friday, the initial reaction seemed to favor the first camp as the yield curve backed up, and some in that camp seem to have been tempted to double up their positions. But then the yield curve began to go down rather quickly again, and they were caught scrambling to cover their shorts, which caused a fair bit of see-sawing in the yield curve all day on Friday.
MR. SLIFMAN. The lower left panel shows the Michigan survey’s index of consumer sentiment. And, as you can see on the table we distributed at the lunch break, the Conference Board’s expectations index, which was released this morning, also fell sharply in January.

CHAIRMAN GREENSPAN. ... In that context, moving by 50 basis points today, as a number of you have suggested, strikes me as the right move along with retaining the balance of risks statement to the downside. I have been concerned about the possibility that our moving so fast in a month would suggest either a knowledge of facts that nobody else knows or that we are getting scared. Fortunately, I guess, the markets as a result of yesterday’s consumer confidence index have now put something like a 20 percent probability that we’ll move 75 basis points.

MS. MINEHAN. ... In thinking about the press statement, I had reflected on whether a balanced risk statement would work to solve the problem that President McDonough mentioned regarding the possibility that the size of the cumulative easing moves over a month’s time might feed into the pessimistic psychology about the economic outlook. I wondered whether a balanced risks statement might help calm things. But after listening to the television a bit this morning and seeing the degree to which there were now expectations in the market of an even bigger move– and not being able to reconcile in my own mind the real risks with a balanced risk statement–I came around to your position. So, I’m wholeheartedly in agreement with your recommendation.
MR. STOCKTON. In a nutshell, things have been going very well for the U.S. economy in recent weeks. The data have been coming in almost uniformly stronger than we had expected six weeks ago. The latest piece of news fitting that pattern was this morning’s release of the September report on new orders and shipments of nondefense capital goods. New orders outside of aircraft were up nearly 4 percent last month, after having been about flat in August. Shipments of nondefense capital goods excluding aircraft were up 2.5 percent in September, more than reversing the decline in August. The figures are a bit stronger than we had expected and would probably lead us to add about 1 percentage point to the projected growth of equipment spending in both the third and the fourth quarters, bringing the increases to 13 percent and 12 percent, respectively.

MR. KOHN. ... But with the rise in profits and equity prices and persistent increases in sales, business responses could return to normal more quickly and fully than is assumed in the forecast, allowing much more of the natural resiliency of the economy to show through to even stronger spending. The upward revision to August orders data we saw this morning and the further gain in September I think underline this upside risk.

MR. GRAMLICH. I had been a little worried about the timing because of the pattern of retail sales; growth was very strong in July and August and weakened quite a bit in September. First, the numbers could be revised. Second, the new orders statistics that we got this morning and the strength in housing seem to belie any September weakness, so there may be no particular problem in that pattern.

CHAIRMAN GREENSPAN. If it turns out that the economy, after going through this recent surge, simmers down very dramatically and indeed exhibits weakness, then from a policy point of view we’re obviously well positioned at this stage. I think a weakening in economic activity is unlikely. I believe it’s more likely that evidence of an old-fashioned business cycle expansion is beginning to emerge. The pieces are falling into place.

... There is no question that in July and August firms were liquidating inventories, and the data we have for September confirm that the liquidation continued through the end of the quarter. My recollection is that, when I saw the original Greenbook projection that had inventory liquidation continuing through the rest of the year, I was incredulous. I was even incredulous about it continuing in the third quarter. But clearly that’s what we’re seeing. Indeed, the data on durable goods inventories for manufacturing confirmed that this morning.
MR. STOCKTON. Thank you, Mr. Chairman. After countless meetings and much effort to assemble the Greenbook over the past few weeks, I must admit that it was disappointing to come to work last Thursday to find that our forecast had a half-life shorter than a jar of mayonnaise in the Mojave Desert. [Laughter] As you know, the BEA reported that their advance estimate of the growth in real GDP in the first quarter was 4.2 percent at an annual rate—a full percentage point less than the forecast that we had published only the day before. We spent the last few days poring over the details of that release in order to assess its implications for understanding where the economy has been and where it might be going. That task was made somewhat simpler by the fact that so much of our error was concentrated in inventory investment. Indeed, our projected increase in final sales for the first quarter of 4 percent at an annual rate was only slightly above the BEA’s estimate of a 4 percent increase, with small differences spread out over several categories of spending. And after incorporating yesterday’s data on construction outlays, the BEA would likely raise its estimate of the growth of final sales close to our April forecast.

MR. STOCKTON. This morning, trade data for October were released. The trade deficit came in at $55.5 billion, up $4.5 billion from September and noticeably larger than both we and the markets had anticipated. The increase in the deficit primarily reflected a surge in merchandise imports; exports increased only modestly. These data will no doubt lead us to revise down our projection for real net exports in the current quarter, although we obviously have not had time to digest fully the implications for the outlook.

CHAIRMAN GREENSPAN. Dave, you put down finger-crossing as a serious econometric technique. I want to communicate that in my experience the t-value is quite high. [Laughter]

MR. STOCKTON. A slightly tighter economy has added to a growing list of worries that would make any compulsive hand-wringer proud. That list would also contain higher oil prices, larger increases in non-oil import prices, a steep rise in commodity prices, a reemergence of price pressures from intermediate materials, some deterioration in near-term inflation expectations, and a disappointingly large increase in core PCE [personal consumption expenditures] prices in January. To our relief, this morning’s PPI for February did not add to this list. The increase in core finished goods—at 0.1 percent—and the increase in core intermediate materials—at 0.5 percent—were right in line with the Greenbook projection.
MR. POOLE. By the way, were the unit labor costs released this morning?

DAVID WILCOX. They should have been released by 8:30, I think.

MR. POOLE. Maybe we'll see what happened there during the break.

My argument is that we have very generalized inflation pressure across regions of the world and across commodity and service sectors. The pressure is not isolated. Could you comment on that observation?

CHAIRMAN BERNANKE. Thank you. I see it’s 11:00, and I’m told that coffee is ready outside. Why don’t we take a fifteen-minute break. Thank you. [Coffee break]

CHAIRMAN BERNANKE. David Wilcox has a couple of comments on the productivity data from this morning.

MR. WILCOX. Thank you, Mr. Chairman. Just very briefly, these data came in, in most respects, pretty close to our expectation. I would note that the productivity figures for the second quarter are built on the output data that were incorporated in last week’s advance GDP number. We expect nonfarm business productivity in the second quarter to be revised up. Based on information available today, it would be revised up 0.8 percentage point, to 1.9 percent. Probably because of some fluctuations in hours, the productivity number in Q1 is 0.3 percentage point stronger than we had expected. In Q2, it’s 0.3 percentage point weaker. On balance, the profile there looks much as we had expected. Compensation per hour is 0.5 percentage point stronger in Q1 than we had projected and right on our Greenbook projection in Q2.

CHAIRMAN BERNANKE. Thank you. Let’s turn now to Governor Warsh.

MR. WARSH. Thank you, Mr. Chairman. The Treasury markets have convinced themselves in recent days and weeks of the prospects of lower growth, lower rates, and some degree of comfort with inflation, and they seem to have lurched to that on a somewhat accelerated basis in the past several weeks. But with some degree of humility, I’ll say I’m not quite as convinced as they are. I suspect that they may lose some of their conviction if some of the data that we’ve all talked about this morning around this table come to pass. So we need to be keen in looking at inflation expectations, at the shape of the curve, and at the prices of some of these Treasury securities to evaluate the market reaction to what we do.
MR. KOS. Thank you, Mr. Chairman. Among market participants, September has a reputation for being difficult on portfolios, for sudden bursts of volatility that lead to risk aversion and wider spreads, and for sometimes spectacular blowups in the speculative community. The ERM crisis in 1992, Long-Term Capital Management in 1998, and the aftermath of the terrorist attacks in 2001 are three of the more notable examples. Until Monday, this year looked different. Spreads were and they continue to be narrow. Volatility has generally been low, with the notable exception of energy. Yields are benign, and equity prices, if anything, have been rising in recent weeks. The massive loss disclosed on Monday by a large hedge fund has had remarkably, almost suspiciously, little spillover effects thus far.

GDP

CHAIRMAN BERNANKE. Good morning, everyone. Let’s start with asking Dave Stockton to report on this morning’s data.

MR. STOCKTON. So, Mr. Chairman, this was sort of done on the fly. Unlike the BEA, I won’t be able to go back and revise these remarks. [Laughter] Total GDP this morning came in at 3 percent. That was 0.9 percentage point stronger than we had forecast in the Greenbook. There were really two sources of our miss in the fourth quarter. Of that miss, 0.5 was the net export component, which Karen will speak about in a second, and 0.4 was nonfarm inventory investment. So perhaps Karen will give the quick story on the net export side, and then I’ll complete the report

MR. REINHART. ... The last exhibit gives the latest version of table 1, which circulated Monday. It trims the wording of alternative B to be a little more upbeat about firmer economic growth in section 2, which feels right this morning.
MR. DUDLEY. The tone in financial markets has improved a bit in recent days. Nevertheless, we still appear to be in an environment in which the dominant theme is risk aversion. This can be seen in a matrix that measures the correlation among the price movements in the major asset classes (see exhibit 16). In times when markets are calm and untroubled, the correlation coefficients are generally low. As you can see in the exhibit, which examines these correlations since the August 7 FOMC meeting, the correlation coefficients have been very high recently.

MR. LOCKHART. So I believe our decision today boils down to whether we cut .25 percentage point or .5 percentage point, obviously in combination with careful wording of the statement that conveys a rationale focused on economic fundamentals while signaling some recognition that the problems in the capital markets have the potential to deliver a credit shock to the broad economy. I consider it appropriate to adjust the federal funds rate to the now-weaker economic outlook, and I support a 50 basis point move with the rationale that at least 25 basis points of that represents recognition of a lower equilibrium rate and the remainder is a preemptive, preventive measure designed to renew confidence, facilitate conditions that resolve uncertainty, and shorten the necessary adjustment timeline in a deleveraging financial sector. It is a fair question whether the process of information revelation—that is, removing uncertainty—will be accelerated by an aggressive rate cut. My view is that this action, along with other liquidity actions, removes the psychological barrier—that being the concern that the Fed might fail to ensure enough up-front liquidity and might be pursuing an inadvertently tight policy, compounding problems by putting undue stress on the real economy. I think a distinction can be drawn between trying to influence the psychology around dangerous financial sector circumstances and bailing out the markets, and care should be taken to reflect this in the minutes.

CHAIRMAN BERNANKE. On inflation, I think the slowing that we are likely to see will probably remove some of the upside risk that we have been concerned about. I don’t know how these housing developments will affect owners’ equivalent rent. We saw some perverse effects last time. They are still possible. A very small piece of information is that the PPI numbers yesterday actually had some favorable news in them in terms of both intermediate goods and medical costs. So the near term still looks to be fairly good. But I don’t dismiss inflation risks by any means, and we know that policy changes can work through expectations as well as through resource pressure, and so I consider that to be a serious concern.
MR. STOCKTON. ... We had two other important pieces of information this morning. One was the ADP survey of private payroll employment growth. Their estimate for the gain in private payrolls in October is 106,000. That is above the 50,000 that we implicitly had built into our forecast. Again, this has significant information content in terms of its predictive content for payrolls; they have improved their methodology over the past couple of years as they have gotten into this. While I don’t think we would move our estimate all the way to their 106,000, we would certainly raise it from the 50,000 that we have—probably to 75,000 or 80,000, at least, for an estimate of payroll employment growth in October. The other piece of data that came out this morning was the employment cost index. It is showing hourly compensation for private-sector workers up at an annual rate of 3.1 percent in the third quarter. That is considerably below our estimate of 3.8 percent through the third quarter and leaves the twelve-month change in that measure of hourly compensation flat at 3.1 percent. So that basically is showing no signs of any acceleration whatsoever.

MR. EVANS. Thank you, Mr. Chairman. I find myself in agreement with so many things that have been said already, no matter how the conflict may appear. This is a close call. I think it’s a tough decision. I have, frankly, gone back and forth in thinking about the nuances here. It is the case that the data have been better than I expected at the time of our September meeting. The ADP report this morning sort of continues that. It didn’t have to work out that way, but 106,000 is a pretty strong number. I’m still trying to figure out exactly how to project that to payroll employment. The bad news that we have seen in terms of surveys has hardly been surprising, given our views and what we would have expected in September.

One view is that 50 basis points in September was seen as enough, and we would be judging our future actions on the basis of deterioration in our forecast—data that come in worse than that or some information about risks that are hard to quantify but we thought would be important. I haven’t seen the impetus for that. So that’s one view. Then the other view is the risk-management perspective. Maybe many people, President Yellen included, thought that more than 50 was required but only 50 in September was really achievable without startling markets.
MR. STOCKTON. This morning’s data on housing starts also suggest little end in sight to the ongoing recession in housing. Single-family starts fell more than 6.5 percent, to 707,000 units, in February, and permits dropped a similar amount. Both figures were very close to our expectations. Multifamily starts moved up to 360,000 units, but that figure follows some low figures late last year, and we wouldn’t attach much signal to that reading.

VICE CHAIRMAN GEITHNER. Mr. Chairman, it is kind of awkward to ask this in the midst of a meeting, but I think it is important. I think there was a pretty big change this morning at least in risk perceptions today across a bunch of markets. Can you tell what the fed funds curve has done this morning?

MR. DUDLEY. I think that the April fed funds futures contract earlier this morning was priced at 1.99, and it was up by 4 basis points. I don’t know if it moved subsequently.

MR. MADIGAN. Vice Chairman, it has moved up somewhat further at least as of maybe an hour ago. It looked as though, at least for this meeting, the odds were roughly evenly balanced between 75 and 100, in terms of what was priced in.

MR. DUDLEY. Stocks are up about 2 percent. Both Lehman’s and Goldman’s earnings showed declines, but they were less significant than expected. So share prices for both of them have rallied a lot. Lehman’s stock was up 19 percent when I last looked—I don’t know where it is today. So a lot of reversals occurred yesterday in terms of the investment banks.

VICE CHAIRMAN GEITHNER. Financial credit default swaps this morning are much, much narrower.

MR. EVANS. Thank you, Mr. Chairman. I support your recommendation. I came in here thinking that I preferred 50 basis points, but I also recognize that I expected that we would have to go beyond that after this meeting. So I fully support 75 and the language that you discussed.

MR. FISHER. I think 75 basis points, Mr. Chairman, is way too much. My thought is that it encourages the financial markets. They’re not going to be satisfied. I said this last time. It’s Jabba the Hutt. They will keep asking for more and more. We have to quit feeding them. I’m in a pizza mode, by the way, in this conversation. I do have a suggestion, however.

MR. MISHKIN. You mean Pizza the Hutt, not Jabba the Hutt. [Laughter]
MR. DUDLEY. Just to give you a snapshot of what has happened since Sunday evening, stocks are down worldwide—4 percent plus everywhere. Yesterday, the U.S. stock market was down about 4 percent, and SP futures indicate a lower opening today. There was significant upward pressure in that market—overnight LIBOR rates today were 6.44 percent—and that pressure in Europe is leaking over into our market. Yesterday the federal funds rate opened at 3 to 3.5 percent. Despite our doing a $20 billion repo at our normal 9:30 a.m. time, the upward pressure on the funds rate yesterday continued. It rose to as high as 6 percent in the late morning, and that is why we came in with a second operation of $50 billion around noon yesterday.

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MR. STOCKTON. In response to your request for some economy in our remarks this morning, I’m going to set aside my prepared remarks and just hit some of the highlights here. We did receive a great deal of macroeconomic data since we closed the Greenbook last Wednesday. We didn’t seem to get any of it right, but it all netted out to just about nothing. [Laughter] ...

Now, on the inflation side, this morning’s CPI report for August actually came in a little better than we were expecting. The CPI in August fell 0.1 percent. We had been expecting an increase of 0.1 percent.

MR. MADIGAN. Relative to the Bluebook version, the language of alternative B has been revised in three material ways. First, B2 now notes that strains in financial markets have intensified. Second, the clause some indicators of inflation expectations have been elevated has been dropped from B3 in view of the recent declines in inflation compensation and survey measures of inflation expectations. Finally, the first sentence of B4 has been revised to suggest that the Committee now sees the significant risks to growth and inflation as roughly balanced. Given market participants’ expectation that the funds rate could trade soft to the target for a time in light of recent developments, gauging exactly what is built into markets for the outcome of today’s meeting is difficult. But earlier this morning, market prices appeared to incorporate high odds of at least a 25 basis point easing today or possibly more. Thus markets might well see a decision to keep the funds rate constant and to make no appreciable change to the language of the statement as signaling less concern about financial developments than they anticipated.
MR. STOCKTON. You should have at your place a table and charts of the single-family home sales for December that were released this morning. As you can see, total sales were 342,000. That was weaker than we had expected. We had been thinking around 360,000. But with the upward revisions to October and November, actually the quarterly average was just about exactly what we had been anticipating. That said, stepping back from this one release and thinking about the configuration of the home sales and production data that we have seen, I think that both in trajectory and in overall tenor we are looking at a weaker housing market than we had thought and that the most recent data probably give some reflection of Governor Duke’s fears and President Lacker’s hopes that there may be more downside risk than upside risk to our housing forecast. [Laughter]
MR. LOCKHART. Thank you, Mr. Chairman. Yesterday’s equity market selloff certainly gives pause, but I don’t think it obsoletes the views that I prepared as long ago as Sunday afternoon, the diagnosis that pertains to the context of policy. I wanted to start by saying that President Bullard in an earlier meeting posed a good question when he asked if there was ever a time in the past 25 years when uncertainty did not seem higher than at other times, and he got quite a laugh when he asked about that. I do think the context of this meeting really does present a lot more uncertainty than whatever the Committee could consider normal. ... I think the Tealbook nicely captures the central forecasting challenge of the moment, which is determining the forces responsible for what it calls the greater-than-expected restraint on the expansion. ... We’re one month into the third quarter, a quarter that the Tealbook projects GDP growth at 3 percent, with little indication in the data of that level of growth. We really don’t know how the European debt situation is going to play out in coming weeks. We don’t know beyond yesterday’s developments and this morning’s, if we’re tracking them without BlackBerrys, how the market will sort out the implications of the downgrade. We don’t know whether the projection of inflation settling out will come true, and we don’t really know whether there are underlying forces at work, forces captured in the Tealbook’s phrases persistent spending weakness and supply-side corrosion and damage, that portend a longer and deeper problem of sluggish growth. The outlook, of course, always involves a lot of uncertainty, but it certainly feels to me that the combination of uncertainties at this juncture is unusual. And, at least going into this past weekend, it inclined me, obviously excluding extreme financial instability, to emphasize an agnostic view regarding the outlook. So I am holding to the base-case outlook that I submitted in my last forecast in June of stronger economic growth and subsiding inflation in the second half, but with less conviction. The BEA’s NIPA revisions somewhat changed the narrative in my thinking. The revisions, along with the negative tone of the incoming data, make it harder to sustain my previous forecast. When I submitted my projections in June, I was thinking of restraints on economic growth primarily in terms of commodity shocks and the economic fallout from the earthquake and tsunami disaster in Japan. I think now the list has to be expanded to the uncertainties associated with the ongoing government debt messes here and in Europe. Friday’s employment report somewhat took the edge off of accumulating doubts, but at this point, I’m reluctant to entirely dismiss the possibility of an outright contraction, which is also a change in my thinking since June.
MR. WILCOX. Thank you, Mr. Chairman. I’ll be referring to the first exhibit in the package called Forecast Summary. **A long time ago, when I was sitting at the breakfast table this morning [laughter], I was reminded once again of the value of a supportive home environment.** One of my daughters attempted to bolster my confidence by helpfully observing, Just keep in mind, Dad, that they’re much more likely to remember you today for whether you’re wearing a good tie and whether you’ve got any good jokes to tell. At least Mom has picked out a good tie for you. [Laughter]

Let me proceed in reverse order, beginning with the GDP release. Part of the upside surprise in final sales was in federal purchases—a source of strength that we think, for obvious reasons, has no staying power. **More fundamentally, however, Thursday’s report showed a much lower level of disposable personal income in the third quarter than we had expected in the Tealbook.** While we think some of that downside surprise might be transitory, we’re estimating that perhaps half of it might persist, a factor that caused us to temper the extent to which we extrapolated forward the recent strength in consumption spending.

MR. TARULO The only other thing I’d note is that the **JOLTS report released this morning shows job openings down significantly from the March level and below consensus estimates.** Even putting aside Charlie Evans’s concerns about whether the job openings number may overstate the real number of openings, we’ve actually seen a decline now.

CHAIRMAN BERNANKE ... With respect to the language—Steve, today has been pretty calm, I think, in Europe. Is that correct?

MR. KAMIN. Yes. The sovereign spreads for Italy and Spain, having fallen yesterday, have fallen again today, at least as of this morning. The Greek government looks as though it’s on the cusp of putting together its coalition government. **So it does seem as though the markets are calm for now.**

CHAIRMAN BERNANKE. I think I would therefore, along with a number of you, **strike the bracketed paragraph at the end of the statement.** This is something that we might consider doing, for example, in conjunction with other central banks should the situation arise that stresses intensify.

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**Table D1: Excerpts from FOMC Transcripts.** Discussion pertaining to recent Macroeconomic News Announcements (MNAs) and the market reaction thereto.
<table>
<thead>
<tr>
<th>Year</th>
<th>Meeting #1</th>
<th>Meeting #2</th>
<th>Meeting #3</th>
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<th>Meeting #6</th>
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<td>Employment Report</td>
<td>Trade Balance</td>
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<td>Housing Starts and Permits</td>
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Table D2: Macroeconomic News Releases Made in the Morning of FOMC Meeting. List restricted to announcements that are mentioned in the transcripts of the FOMC meeting.
D.2 Evidence from Survey of Primary Dealers

The following excerpts are from the New York Fed’s Survey of Primary Dealers, available online at https://www.newyorkfed.org/markets/primarydealer_survey_questions.html.

The Surveys demonstrate that market participants view the Fed policy targeting either unemployment or inflation in a time-varying manner, depending on aggregate economic conditions.

August 2018
Some dealers indicated that they assumed the target federal funds rate or range would be more sensitive to deviations in inflation than to deviations in the unemployment rate. Additionally, several dealers cited various reasons they expect a low sensitivity to changes in the unemployment rate.

July 2017
In explaining their responses, several dealers noted that they assumed a larger response in the level of the target federal funds rate or range to a 50 basis point shock to core PCE inflation than to a 50 basis point shock to the unemployment rate.

September 2016
Some dealers expected that the Committee would continue to characterize economic activity as expanding at a “moderate rate.” With regard to labor market conditions, some dealers suggested that the Committee would reference continued improvement in the labor market while several others expected that the Committee would note that the pace of job gains had moderated.

July 2015
Some dealers expected the July FOMC statement to note a moderate expansion in economic growth. Some also indicated that the statement would reflect an upgrade to the current assessment of the labor market. Several dealers anticipated that the statement would note that the weaker-than-expected economic growth in the first quarter of 2015 was largely transitory, while several other dealers expected the statement to reflect a modest upgrade to the Committee’s characterization of domestic housing market activity. Several dealers expected there to be no material changes to the July FOMC statement.

July 2014
Many dealers expected the July FOMC statement to acknowledge an improvement in economic conditions. Some dealers noted improvements in the labor market and several dealers emphasized the pickup in second quarter economic growth as well as inflation moving closer to mandate consistent levels. Several dealers expected no substantial changes.

July 2013
Some dealers expected no material changes to the July FOMC statement. Of those that did expect
changes, several dealers each noted their expectation that the Committee would more explicitly focus on recent low inflation as well as highlight weaker growth data over the intermeeting period. Several dealers discussed the possibility that the FOMC would provide either additional details regarding the expected pace of asset purchases, similar to those provided in Chairman Bernanke’s June 19th press conference, or language that would highlight the data dependency of asset purchases. Several dealers also thought that it was possible that the Committee may decide to strengthen or reinforce the current forward rate guidance.

Some dealers stated that an earlier expected start to reducing the pace of asset purchases has led to increased expectations for a higher path of policy rates, as market participants perceived a link between the Federal Reserve’s asset purchase and federal funds rate policies. Several dealers also noted changes in the perception of the FOMC’s view of the appropriate policy rate path and the Committee’s more optimistic economic projections as shifting short rates higher. In explaining their response to ‘Other/technical factors’, some dealers cited the unwind of leveraged positions and carry-related trades as contributing to the increase in short rates.

**September 2012**

A few dealers expected that the forecasts in the summary of economic conditions could be upgraded in some fashion, with a couple of dealers indicating that it could note improvement in the labor market. In contrast, a few dealers expected that the summary would be downgraded, and some dealers expected it would be little changed.

Most dealers expected some sort of easing to be announced in the September FOMC statement. Most dealers expected that the forward guidance on the path of the federal funds rate would be extended into 2015. Several dealers specified that the guidance to be extended to “mid-2015” and a couple of dealers expected that the forward guidance could be extended past mid-2015. Some dealers noted that the announcement of an asset purchase program was possible, with a few dealers noting the possibility of open-ended purchases.

**August 2011**

Many dealers expected that the August statement would contain a downgrade to the characterization of economic conditions, and a few expected the statement to contain reference to the benchmark revisions to GDP and its impact on the outlook for economic growth. A couple of dealers expected that the statement would reference the moderation in headline inflation. The announcement of additional policy action to lengthen the duration of the SOMA portfolio was expected by a couple of dealers, as was some indication of the Committee’s willingness to ease policy. Some dealers did not expect any substantial changes to the statement.

**D.3 Stock and Bond Returns on FOMC Announcement Days**
Figure D1: Intraday Stock and Bond Returns on Two Consecutive FOMC Announcements. On October 29th, 2008: expected cut 45 bps, realized cut 50 bps, post-announcement stock-bond covariance negative. On December 12th, 2008: expected cut 90 bps, realized cut 100 bps, post-announcement stock-bond covariance positive.