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Information Flow and Expected Inflation: An Empirical Analysis

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Abstract

This paper begins by ranking the absolute value of changes in the 10-year break-even inflation (BEI) calculated using 10-year Treasury notes and 10-year TIPS. Next, a news search is conducted to determine what inflation related information was released on days when the change in the BEI was greatest. The goal of the analysis is not only to see what information is associated with large changes in the BEI, but also to gain insight into the extent to which market participants accept the three competing theories of price determination: the classic monetary theory, the fiscal theory, and a “Keynesian” model that combines central bank setting of interest rates with the Philips curve. I find that there was no mention of the money supply, the demand for money, or the rate of monetary growth on any of the days on which there was a large change in the BEI. Further, I find that there was only one mention of the impact of government debt on a day where the BEI changed substantially. In comparison, there were 53 news items on large change days that either explicitly discussed Federal Reserve policy regarding interest rates or focused on the interaction between Fed policy, economic activity and expected inflation. This suggests that market participants accept the “Keynesian” model of price determination.

Introduction

There have been numerous studies that have examined the impact of policy announcements on expected inflation. Some recent contributions include, Bauer (2014, 2015), Beechey and Wright (2009), and Gurkaynak, Sack, and Swanson (2005). In this study, I turn the analysis on its head and use the approach developed by Cutler, Poterba and Summers (1989) and Cornell (2014). Instead of starting with announcement dates, I use changes in market prices as a measure of the flow of inflation related information. I then go back and examine the news from the days on which the estimated information flow was the greatest to see what inflation related disclosures occurred on those days.

More specifically, I use change in the breakeven expected inflation (BEI) calculated as the difference between the yield to maturity on the 10-year constant maturity Treasury note and the constant maturity 10-year Treasury Inflation Protected Security (TIPS) as a measure of the flow of inflation related information. I choose the 10-year Treasuries because, as discussed further below, there are anomalies associated with the quoted yields on the shorter maturity TIPS. It is important to stress that for my purposes it is not critical that the BEI is an unbiased measure of expected inflation. This is an issue because research by Fleckenstein, Longstaff and Lustig (2014) points to an apparent anomaly in the pricing of the fixed rate securities relative to TIPS. The authors conclude that Treasury bonds are consistently overpriced relative to TIPS. If that is true, even the 10-year BEI will be a biased measure of expected inflation. However, these issues are not problems for the current study. What I require is a variable that captures the flow of information into the market, some of which may be private or involve unobservable sentiment, regarding long-term inflation. That is best captured by observing the price changes for the most actively

traded securities – hence the choice of the 10-year bonds. Even if the level of the BEI is a biased measure of expected inflation, its change should still reflect the flow of inflation-related information with larger absolute changes reflecting greater information flow. It is also for this reason that I choose the Treasury bond market over the inflation swap market. However, for the most part the days on which the changes in the 10-year BEI were the largest were basically the same as those days on which the price movements in the swap market were the greatest. Therefore, the results I report are not sensitive to the variable used to measure the flow of information. It is akin to using different stock indexes to measure changes in the level of equity prices. The choice of index has little impact on the selection of the days with the largest movements.

As a warning at the outset, the aforementioned research by Cutler, Poterba and Summers (1989) and Cornell (2014), which looked at changes in the stock market indexes, pointed to two issues that are relevant here. First, the authors found that even the largest changes in the indexes frequently occurred on days on which there were no disclosures of meaningful, value relevant information. It is possible that the same may be true of the BEI. If so, this complicates the effort to match news with large price changes. Second, the matching process is further complicated by the fact that the financial press feels compelled to offer an explanation for price movements.¹ In the case of equities, for instance, big moves not associated with value relevant information were often attributed to “profit taking” or “investor fears” – vague statements with no valuation relevant content. As a result, news reports have to be analyzed carefully to attempt to distinguish release of value relevant information from ex-post rationalizations of unexplained price movements.

¹ This is less true of the fixed income markets than the equity markets because equity market price movements are generally large and attract more attention from the press.

In addition to providing empirical data on what information is associated with large changes in expected inflation, a related objective of the paper is to provide some insight into the market participants' interpretation of how the price level is determined. Ironically, the question of what determines the price level has become more complicated and controversial in recent years. As Cochrane (2011a) describes there are now at least three competing approaches to price level determination.

The first is the classic monetary theory. As long as there is a reasonably stable demand for money, the Fed can control the price level by exploiting the famous relation $MV = PY$. The problem as Cochrane (2005, 2011a, 2011b, 2011c) has repeatedly stressed is that in the modern economy agents no longer have to hold an inventory of money to make transactions. Thus, there is no reason to believe that the velocity will be stable. In light of this fact, and to further complicate matters, the Fed no longer attempts to target the money supply. Nonetheless, if the monetarist theory is accepted by market participants, large changes in expected inflation should be accompanied by news regarding the supply of or demand for money.

An alternative to the monetarist explanation is the fiscal theory of inflation, developed by Sargent and Wallace (1981), Leeper (1991), Woodford (1994) and Woodford (2004), among others. The fiscal theory is based on the observation that the real value of government debt, including money, should equal the expected present value of future government surpluses as given in a generic form by equation (1).

$$\frac{\text{Nominal Debt}_t}{\text{Price Level}_t} = E_t \sum_{j=0}^{\infty} \frac{\text{Real primary surplus}_{t+j}}{\text{Discount rate}_{t+j}}$$

The implication of equation (1) is that inflation breaks out when people lose faith in the ability of the government to generate future surpluses to pay down the debt. The resulting flight from government debt into goods, services and real assets produces inflation. If this story is correct, then one would expect that large changes in the BEI would be associated with information regarding to ability of the government to repay its outstanding debts by running future surpluses. That suggests looking for stories related to fiscal policy and government debt.

Finally, the third theory of inflation has little to do with money or government debt. According to this interpretation, which I call the “Keynesian” model, the Fed sets interest rates, interest rates affect demand, and demand affects inflation through the Phillips Curve. As Cochrane (2011c) explains, this explanation is hard to reconcile with fundamental microeconomic theory. Nonetheless, if the market participants accept the explanation, then large changes in the BEI should be associated to news regarding and Fed interest rate policy and “aggregate demand.”

While the empirical analysis presented here in no sense constitutes a “test” of the competing theories of inflation, the hope is that the results will provide some suggestive insights. Cataloging the information associated with large changes in BEI makes it possible to compare the implications of the competing theories.

Data and Empirical Results

As noted at the outset, changes in the 10-year BEI are used as an estimate of the importance of the inflation related information impacting the market. I first present results based on this data and then briefly discuss alternative data sets.

The sample for the study is from January 1, 2003 through November 10, 2015. Using data from the Federal Reserve's H.15 release, the 10-year BEI is calculated daily as the difference between the yield on the constant maturity 10-year note and the constant maturity 10-year TIPS. Figure 1 plots both the BEI (in percentage points on the right axis) and the 40-day rolling standard deviation of daily changes in the BEI (in basis points on the left axis). Looking first at the BEI, it bounded between 1.50% and 2.75% for most of the sample period. The exception is a period beginning at the start of October 2008, following the bankruptcy of Lehman at the height of the financial crisis, when it plunges to near zero and remains there until January 2010 when it rises sharply returning to the original range by the end of April. While this period is the most dramatic, the BEI is far from constant. Though it remains within the aforementioned range, it rises and falls repeatedly.

The rolling standard deviation of the daily changes is a mirror image of the BEI. It ranges between 2 and 5 basis points throughout most of the period but jumps to over 11 basis points during the interval following the bankruptcy of Lehman. This suggests that the rate of information flow was higher during the post-Lehman interval.

Choosing what is meant by a "large" change in the BEI is somewhat arbitrary in light of the fact that the standard deviation is not constant. Here I use a cut-off of 10 basis points in absolute value. That cut-off produces 67 large changes out of 3,219 days in the full sampler period, or about 2% of the total sample. The first two columns of Table 1 list the date and the basis point change for all 67 large changes. Of those 67 days, 31 are in the interval between October 1, 2008 and April 30, 2009 – the period during which the BEI spikes downward and then recovers.

The next task was to match the large changes with news regarding inflation. The matching was designed to incorporate any news related to inflation. The search for news stories included the day of and the day after the large change to make sure that any information that arrived between the two price observations is included. Inflation related news was interpreted broadly in order to avoid excluding relevant disclosures. As suggested by the competing theories of price determination, items in the search included, among other things, announcements of price indexes, statements regarding Fed policy and Fed decision making, articles on the impact of “aggregate demand” on inflation, any mention of money supply or demand, and articles relating inflation to government deficits or government debt issuance.²

Once they were collected, the news releases were placed into six buckets. The buckets can overlap in that one disclosure could be placed in more than one bucket. The buckets were selected, in part, to correspond to the types of information the three theories of price level determination suggest would be likely to have an impact on expected inflation. The six buckets are as follows:

1. News regarding Federal Reserve Policy.
2. News regarding economic activity and aggregate “demand.”
3. The release of data related to the CPI.
4. The release of information related to the WPI.
5. Information about the supply of or the demand for money.
6. Information regarding fiscal policy and the level of government debt.

² More complete data on the news releases is available from the author.

The buckets are shown as columns in Table 1. If there was a news item that fits in a given bucket it is recorded in the relevant column for that date. Otherwise, the cell is left blank. Admittedly, judgement is required to sort through the news stories and put the information disclosed into buckets. This is particularly so because information about prices, aggregate demand and Fed policy was often intermingled as discussed further below. It turns out, however, that the results are so dramatic that the basic conclusions do not depend on the manner in which the information is sorted into buckets at the margin.

First, and perhaps most surprisingly, Table 1 shows that there was no mention of the money supply, the demand for money, or the rate of monetary growth on any of the large change dates. Open market operations were discussed on occasion, but only in the context of Fed policy regarding interest rates rather than the money supply *per se*.

Second, there was only one mention of the impact of government debt on large change days— an article describing how the large new issues of government debt were likely to lead to an increase in interest rates in order to absorb the supply. However, the story did not relate the issuance of the new debt to inflation, nor was there any discussion of what the implications of the debt issuance were for long run fiscal stability. Therefore, I see no way to tie the one mention of government debt to the fiscal theory of inflation in any meaningful fashion.

On the other hand, the news releases are highly consistent with the Keynesian model. Whereas there was one news item that could be tied to the monetary and fiscal theories of inflation, there were 53 that fit directly into the Keynesian framework. Excluding the stories that simply reported data the release of price indexes is, virtually every news report related to inflation on days when there were large changes in the BEI

either explicitly discussed Federal Reserve policy regarding interest rates or focused on the interaction between Fed policy, economic activity and expected inflation.

In fact, the news stories regarding Fed policy, economic activity were so intertwined in the fashion predicted by the Keynesian model that one rarely occurs without the other.

For example, on March 18, 2008, Dow Jones Business News reported that,

The Federal Reserve cut a key interest rate by three-quarters of one percentage point on Tuesday. The Fed action takes the federal funds rate target down to 2.25%, the lowest since December 2004. The Fed said the size of the rate cut was enough to promote growth. Cutting rates aggressively to boost the economy is also expected to lift inflation down the line.³

Similarly, on September 16, 2008 the Dow Jones News Service reported that,

The Federal Open Market Committee voted unanimously to keep the target fed funds rate unchanged at 2% for a third-straight meeting. In its statement, the FOMC continued to warn about inflation risks, but also signaled that economic concerns have intensified in the wake of the collapse of Lehman Brothers Holdings Inc.⁴

As one final example, on May 6, 2010, the Dow Jones News Service reported that,

The two sides of the Fed's internal debate could be seen in comments by Federal Reserve Bank of Boston President Eric Rosengren and Federal Reserve Bank of Kansas City President Thomas Hoenig. Speaking Wednesday night in New York, Rosengren said a lack of price pressures and significant excess capacity means accommodative policy remains appropriate. He went further, saying even with rapid growth in the economy, spurred by accommodative monetary policy and stimulative fiscal policy, it is likely to take years before we approach the growth and inflation rates that would really reflect 'tight levels of unemployment.'⁵

³ "MARKET SNAPSHOT: U.S. Stocks Trim Rally in Aftermath of Fed Rate Cut," *Dow Jones Business News*, March 18, 2008.

⁴ "AT A GLANCE: Fed Keeps Rates Unchanged Amid Shaken Wall St," *Dow Jones News Service*, September 16, 2008.

⁵ "FED WATCH: Greek Debacle Doesn't Divert Exit-Strategy Debate," *Dow Jones News Service*, May 6, 2010.

The list goes on and on. The reporters, and the government officials and Wall Street experts they quote in the news releases I reviewed, treat the Keynesian model not as a hypothesis but as a largely proven theory. This raises interesting questions because of the key role of expectations and beliefs in dynamic models of the economy. Of course, it is possible that the financial press accepts the Keynesian model and uses it as a framework to report the news (like reports of profit taking referred to earlier), but sophisticated market participants think differently. That possibility, however, is beyond the scope of the current research. The results reported in Table 1 clearly show that the news that accompanied large changes in expected inflation was of a type consistent with the Keynesian model.

Finally, it is also worth noting that on 26 of the 67 days there was no news that fit into any of the six buckets. This is yet another example of the perplexing difficulty of explaining movements in asset prices even on the basis of ex-post observation of news. As Ross (1995) observes,

It is one thing not to be able to predict what asset returns will be since they will depend on news, and news, by definition, is information that has yet to be revealed. It is another, though, to observe the movement of prices and not know why they moved after the fact. I am particularly troubled that contemporaneous news seems to explain so little of the contemporaneous motion of prices.⁶

The current study underscores his observation.

The impact of using alternative data

The results reported here were limited to data on the 10-year BEI. However, as noted earlier, the choice of day set is not critical in identifying the days on which large

⁶ Ross, Stephen A, 1995, *Neoclassical Finance*, Princeton University Press, Princeton, NJ, p. 64.

changes occurred. Though the ranking of days is affected somewhat, the overall sample of large changes days is highly similar when either 5-year TIPS data or inflation swap data are used to define large changes.

That said, there were anomalies in the 5-year data that render it less reliable. For example, the 5-year BEI turned negative in November 2008 and fell all the way to minus 2.24% by November 28. Then it jumped back to minus 0.32% on the next trading day primarily because the yield on the 5-year TIPS dropped from 4.17% to 2.03%. In comparison, the yield on the 10-year TIPS dropped only 22 basis points from 2.60% to 2.38%. One explanation for this anomalous behavior is that the 5-year TIPS were not very liquid. For that reason, their yields were subject to sharp changes during the crisis – particularly during periods when there appeared to be an increase in demand for highly liquid securities. This translated into anomalous BEI behavior because the fixed rate securities, which were much more liquid, were not subject to the same anomalies. Regardless of the explanation, I concluded that it was better to rely on the 10-year data, which did not evidence any such anomalies and were more liquid than the 5-year securities.

Summary and Conclusions

To summarize, the empirical analysis produced two interesting results. First, and most importantly, the current findings suggest that market participants accept what I have called the Keynesian model of price determination. On days when there were large changes in the BEI, there was not one explicit mention of the supply of or demand for money. Similarly, there was only mention of the role of government debt and the story in which the debt was mentioned was not related to the fiscal theory of inflation. In comparison, there

were 53 stories that focused on the interaction between Federal Reserve policies regarding interest rates and the impact of those policies on economic activity and inflation.

Second, on 26 of the 67 days in which there were large changes in the BEI there was no public release of information related to inflation. This finding is consistent with studies of the equity market by Cutler, Poterba and Summers (1989) and Cornell (2014) who find that a substantial fraction of the largest movements in equity prices could not be tied to the release of value relevant news. It is further evidence of our inability to explain asset price movements, after the fact, on the basis of the public release of information. That inability which remains one of the most vexing issues in financial economics.

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Figure 1: 10-year BEI and 40 day rolling standard deviation of BEI changes

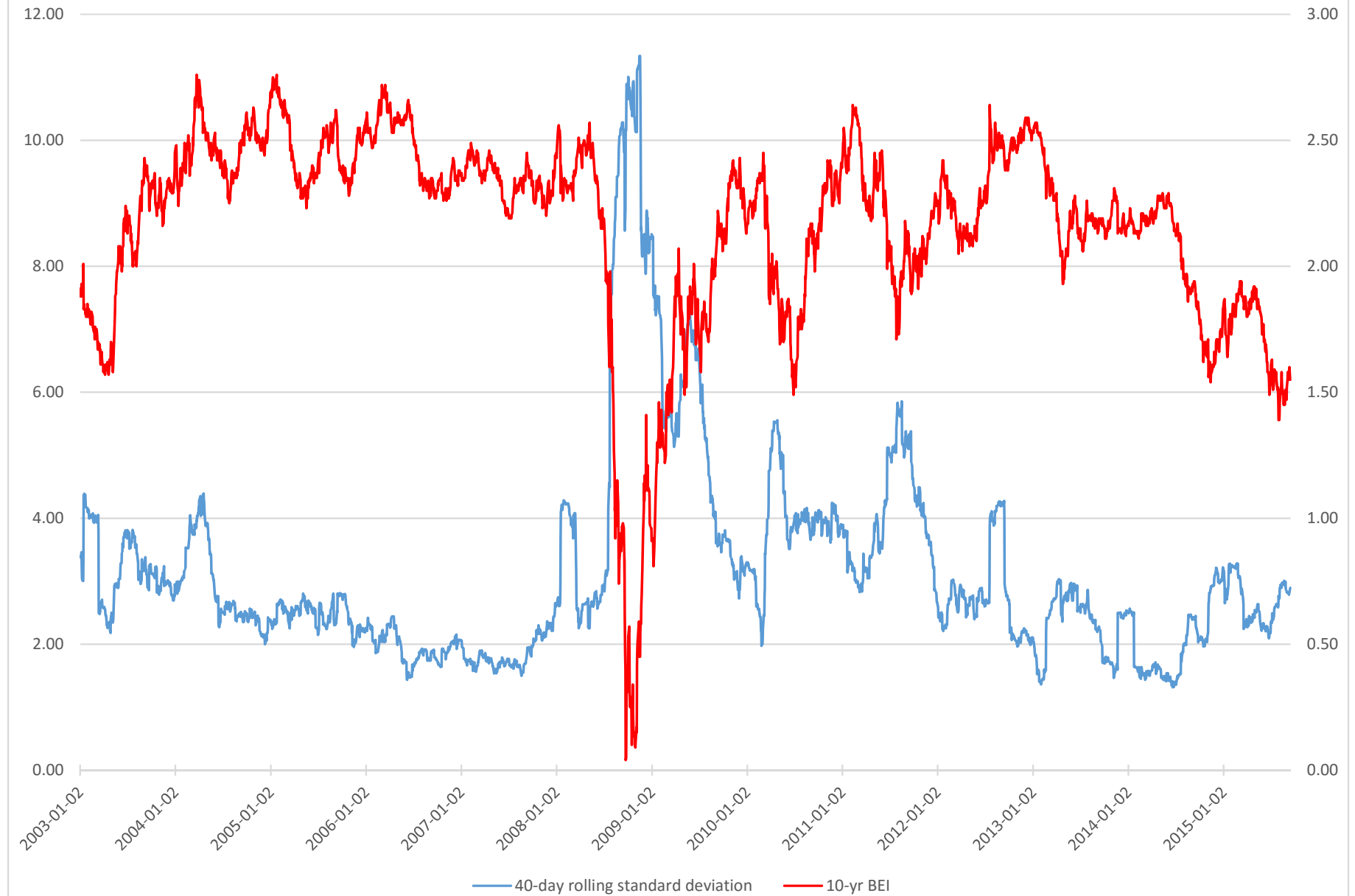


Table 1: News Stories Associated with Large Changes in BEI

<u>Date</u>	<u>BP Change in 10-Yr Breakeven Inflation</u>	<u>Fed Policy News</u>	<u>Economic Actviity and "Demand"</u>	<u>CPI data</u>	<u>Money Supply and/or Demand</u>	<u>WPI data</u>	<u>Fiscal Policy - Government Debt</u>
2003-03-14	-18.00		1				
2003-07-09	10.00						
2004-06-15	-10.00	1	1				
2008-03-17	-14.00						
2008-03-18	11.00	1					
2008-05-02	10.00	1	1				
2008-09-02	-10.00						
2008-09-15	-18.00	1	1				
2008-09-16	-14.00	1	1				
2008-09-19	33.00		1				
2008-09-23	-12.00						
2008-09-24	-11.00	1					
2008-09-29	-17.00		1				
2008-10-06	-18.00	1					
2008-10-08	-15.00	1					
2008-10-10	-13.00						
2008-10-14	11.00						
2008-10-17	14.00	1	1	1			
2008-10-23	-10.00						
2008-10-24	-22.00						
2008-11-18	-22.00					1	
2008-11-19	-21.00	1	1	1			
2008-11-20	-36.00		1				
2008-11-24	19.00		1				
2008-12-03	11.00						
2008-12-05	-13.00	1	1				
2008-12-08	-14.00		1				
2008-12-12	-12.00	1	1				

Table 1: News Stories Associated with Large Changes in BEI

<u>Date</u>	<u>BP Change in 10-Yr Breakeven Inflation</u>	<u>Fed Policy News</u>	<u>Economic Actviity and "Demand"</u>	<u>CPI data</u>	<u>Money Supply and/or Demand</u>	<u>WPI data</u>	<u>Fiscal Policy - Government Debt</u>
2008-12-17	18.00	1					
2008-12-18	-11.00						
2009-01-06	27.00	1	1				1
2009-01-14	-14.00	1					
2009-01-16	10.00			1			
2009-01-29	14.00	1	1				
2009-01-30	10.00						
2009-02-06	12.00						
2009-02-09	18.00	1	1				
2009-02-10	-16.00	1	1				
2009-02-11	-13.00						
2009-02-17	-10.00						
2009-02-24	-10.00	1	1				
2009-03-18	11.00			1			
2009-04-07	-11.00						
2009-04-23	11.00						
2009-05-07	11.00						
2009-05-27	10.00						
2009-06-01	11.00						
2009-06-18	15.00						
2009-07-06	-15.00						
2009-07-07	11.00						
2009-07-14	10.00						
2009-07-15	12.00	1	1				
2009-09-04	11.00		1				
2010-05-06	-12.00						
2010-05-20	-15.00						
2010-05-27	10.00	1	1	1			

Table 1: News Stories Associated with Large Changes in BEI

<u>Date</u>	<u>BP Change in 10-Yr Breakeven Inflation</u>	<u>Fed Policy News</u>	<u>Economic Actviity and "Demand"</u>	<u>CPI data</u>	<u>Money Supply and/or Demand</u>	<u>WPI data</u>	<u>Fiscal Policy - Government Debt</u>
2010-06-04	-11.00						
2011-01-20	-13.00						
2011-05-19	-10.00	1	1				
2011-08-10	10.00	1	1				
2011-08-18	-17.00			1			
2011-09-22	-15.00	1	1				
2011-10-27	10.00						
2011-12-20	10.00	1	1				
2012-09-14	17.00	1					
2013-04-18	-10.00	1					
2014-01-23	-12.00						

Totals

67

27

26

6

0

1

1