Aggregated Macroeconomic News and Price Discovery

JUSTINAS BRAZYS

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Geaggregeerde macro-economisch nieuws en de prijsbevinding

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Preface

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Justinas Brazys
Vilnius, 2015

Contents

Chapter 1

Introduction and outline

1.1 Introduction

"Wall Street stocks closed at record highs, the dollar was at a five-year peak and shorter-dated Treasury bonds were yielding the most since April 2011 after a robust US jobs report prompted some in the markets to bring forward expectations of when the Federal Reserve might begin raising interest rates."

Financial Times, December 5, 2014

Is there a link between asset prices and economic fundamentals? The example from the Financial Times illustrates a strong connection between economic fundamentals and prices of stocks, government bonds and currencies. All markets are exposed to macroeconomic conditions both domestically and internationally.

The link between asset prices and economic fundamentals is also prescribed by theoretical models. For example the flexible price monetary model of exchange rates assumes that only a few variables - money supply, real income and short-term interest rates - drive exchange rates. The variables in the model are specified as the difference between domestic and foreign quantities. Meese and Rogoff (1983) empirically investigate several monetary models, but find no evidence of the implied link between the economic fundamentals prescribed by the models and exchange rates in the medium term. Such models, however, exclude the role of expectations. If markets are efficient and investors form their expectations rationally, then only unexpected changes (news) in economic fundamentals drive asset prices.

Rational expectations present-value asset pricing models assume that the current asset price is equal to the discounted sum of current and expected future fundamentals. Such models suggest that asset returns should be highly correlated to news about fundamentals (e.g. Engel and West, 2005). This is indeed what Andersen et al. (2007) find in very small windows around macroeconomic news announcements. Such event studies are considered the main success stories connecting asset prices to economic fundamentals in the very short term. The reason to use short windows is to avoid contaminating the returns with other types of events (including other macroeconomic news announcements) unrelated to the analyzed economic news. Not surprisingly, the studies trying to relate lower frequency returns (e.g. daily, monthly) to economic news find a much weaker link between fundamentals and asset prices (e.g. Kuttner, 2001 and Vrugt, 2009).

These findings in the literature suggest that to establish a link between news about economic fundamentals and asset prices in the medium term, the contamination of returns should be minimized. To illustrate the level of possible contamination: Bloomberg provides real time details on almost two thousand macroeconomic figures worldwide, of which 137 are U.S. macroeconomic data. Therefore including news about *many* economic fundamentals rather than just a few could provide evidence of the link between assets and economic fundamentals in the medium term.

This thesis aims to provide evidence of a medium-term relation between asset prices and economic fundamentals by using novel methods to aggregate economic news. Aggregating economic data poses several challenges. First, aggregation should reflect the implication of the data for the state of the economy. For example, higher than expected unemployment is bad news for the economy while faster than expected gross domestic product growth is good news. Second, aggregation should reflect the meaning of the data to an asset. For example Boyd, Hu, and Jagannathan (2005) show that higher than expected unemployment is good news for stocks in expansions and bad news during recessions. Aggregation without adjusting for (the sign of) the meaning to the economy or the asset may lead to a meaningless result. The traditional way is to measure the news value of a macroeconomic announcement as the difference between the expected and the announced figure. This thesis proposes aggregation of such survey-based news that incorporates the aforementioned two points. However, survey-based measures assume that expectations of survey participants and the market are the same. Therefore, how do we measure how the market interprets the news? Kuttner (2001) proposes a market-based measure of the news value of FOMC statements using FED funds futures. The price of the futures before an announcement is considered to include all available information, while the price after the announcement is considered to have included the announced information. Following this example, the thesis proposes estimating news importance for the total returns using aggregated returns in small windows around macroeconomic news.

Processing individual news announcements is a relatively easy task for an investor compared to processing a stream of nearly two thousand different macroeconomic figures worldwide. Do market participants incorporate aggregate macroeconomic news into asset prices as fast as individual news? According to the limited attention hypothesis investors may not be able to fully process new information at all times. Aggregation of economic news requires information processing resources. Thus at times when such resources are scarce, aggregated news could be impounded into asset prices with a delay. Aggregate economic news provides means to test if the markets are efficient with regard to aggregate economic information.

1.2 Outline

The next three chapters investigate four aspects of a possible explanation for the apparent disconnect between fundamentals and asset prices in the medium term. First, a broad range of economic fundamentals might be driving asset prices. Instead of using a single fundamental to explain asset prices, a wide range of economic fundamentals is aggregated into a single measure of news. Second, it is important not only to consider surprises in economic announcements, but also to link them to the market reaction. Aggregating price reactions over multiple announcements and longer time periods is important to find a strong relation between fundamentals and prices. Third, the relationship between economic fundamentals and asset prices may be changing over time. For example, for equities good economic news is bad during economic expansions but good during recessions (McQueen and Roley, 1993, Boyd et al., 2005, Andersen et al., 2007). Finally, several studies find single announcements are incorporated into asset prices within minutes (Andersen et al., 2003). However the overall economic situation conveyed by a wide range of economic news might not be incorporated immediately and fully due to limited investor attention (Peng and Xiong, 2006).

The second chapter introduces a novel method to estimate the importance of economic news. Instead of using the indirect measure of economic surprises, the method aggregates price moves in a short window around economic news. Applying this novel method to U.S. treasuries reveals that aggregated economic news can explain on average 20% of the total daily variation in bond returns. On days with announcements on the FOMC target rate, the employment report and the preliminary GDP, the explanatory power increases to 55%, 46%, and 36%, respectively. The importance of news varies over time. In the period with low bond market volatility in 2004 the explanatory power of economic news increases to 51%. News is more important when the VIX is low or investor sentiment is negative. Also, news that is contrary to the direction of FED target rate changes is more important.

The third chapter introduces a method to divide aggregated economic news into sentimental and fundamental depending on the market reaction. Low-yield currencies predominantly react to macroeconomic news consistent with predictions from Taylor-rule models: Good U.S. news is good for the U.S. Dollar. But high-yield currencies also regularly react in the opposite (sentimental) way. Based on these opposite reactions a novel sentimental news index is constructed. Periods of negative surprises in news announcements combined with a sentimental response of high-yield currencies lead to currency carry losses. In periods where the sentimental responses dominate, the sentimental news index explains 27% (26%) of the variation in monthly carry (S&P500) returns. Hence the sentimental news index is a breakthrough in linking fundamentals to risky asset classes in the medium term.

The fourth chapter uses aggregated news indices to predict returns of international bond markets. Not all news is incorporated immediately and fully into government bond prices. Global news predicts local bond returns up to a week in the future. The predictability originates from economic news in Europe and Japan. While U.S. news alone accounts for up to 71% of the contemporaneous *explanatory* power of news for international bond returns, Europe and Japan account for up to 63% of the *predictive* power. This result can be attributed to the combination of the anchoring bias in economist consensus forecasts (Campbell and Sharpe, 2009) and limited attention of market participants. On the one hand economist consensus forecasts do not include all information because changes in aggregated news indices are predictable. On the other hand the predictability of European and Japanese news for international bond markets originates from days with important U.S. news announcements. This is evidence of the limited attention bias of market participants.

Finally, Chapter 5 summarizes and discusses the contributions of preceding chapters, and outlines possible future directions of research.

Chapter 2

How important is economic news for bond markets?

Joint work with Dr. M.P.E. Martens

2.1 Introduction

To what extent can price changes in financial markets be attributed to the arrival of new information? Understanding what drives asset prices is of key importance in financial economics. We expect asset prices react to macroeconomic news announcements or the outcome of FOMC meetings implying that investors update prices in response to new information. Yet many studies[1] find it very hard to establish any link between economic fundamentals and asset prices. The strongest exception is provided by event studies linking the returns in the minutes following the announcement to the surprise in this announcement.[2] Balduzzi, Elton, and Green (2001), for example, find that the surprise component of the announcement explains up to 68% of the bond price variation in a small window around the announcement. These studies, however, say nothing on how much of the *total* return variation can be attributed to (news on) fundamentals, or whether the initial price reaction reflects a permanent change in the price or just a transitory one. To address this issue, some studies investigate news effects on daily returns (e.g. Bernanke and Kuttner, 2005, Vrugt, 2009 and Beber and Brandt, 2009). However, announcements are found to be much less important at the daily frequency. Macroeconomic news can explain only up to 8% of daily bond return variation (Hardouvelis, 1988, McQueen and Roley, 1993, Altavilla, Giannone, and Modugno, 2014).

[1] A famous early example for currencies is Meese and Rogoff (1983) where authors are unable to relate exchange rate moves to macroeconomic fundamentals.

[2] For example, Andersen et al. (2003) investigates currencies, Faust et al. (2007) currencies and interest rates, Balduzzi et al. (2001) and Fleming and Remolona (2001) bonds, Andersen et al. (2007) the joint reaction of T-bills, equities and exchange rates, Elder et al. (2013) energy commodities, Green (2004) government bonds, Elder et al. (2012) metals, Evans (2011) Treasury note, currency and equity futures, and Hussain (2010) international equity indices.

We propose a novel methodology to study the relation between economic news and 10-year U.S. Treasury returns. Rather than using indirect information from surprises in macroeconomic announcements we make use of the return reaction in the 20 minutes around an announcement. We regress the daily returns on these 20-minute returns following the news. There are several advantages to our approach. First, the regression R^2 gives a direct indication how much of the variation in daily returns can be attributed to news announcements. Second, we can analyze the importance of specific announcements for bond markets in terms of permanent price changes. Our novel method shows that several announcements are much more important than previously thought, whereas some news that comes out strong in surprise regressions turns out to be less important. Third, we directly measure news from the market reaction as opposed to using survey-based surprise measures. This is crucial as we confirm earlier findings that regressing daily returns on surprises hardly gives any significant results (average R^2 is only 3.3%). Fourth, we do not need surveys to compute surprises allowing us to take into account more announcements and use a longer sample. For example we can include the FOMC minutes in our analysis. Finally, we can easily aggregate over multiple announcements to provide a measure of how much of the bond returns can be attributed to news in general. A disadvantage of our approach is that other events on the same day provide noise on measuring the importance of news announcements. In that sense we provide a lower bound on the importance of news. Nevertheless we already find a much stronger relation between bond prices and news than other studies. Another disadvantage of our approach is that if two announcements always occur at the same time we cannot tell which of the two announcements is most important. Here also analyzing intraday reactions to the surprises of the respective news announcements can provide a solution.

Macroeconomic news accounts for a large part of total return variation. Based on 57 announcements we find that 20% in the variation of daily bond returns[3] can be attributed to news announcements. This is a much higher figure than previously found in the literature. For example Evans and Lyons (2008) infer from the results of Andersen et al. (2003) that not more than 2% of the total price variation is caused by news announcements. In fact, for the 55 U.S. macroeconomic announcements we have surprise data our novel methodology

[3] Announcements occur on 76% of all trading days. Considering only announcement days announcements explain 24% of the bond return variation.

indicates news explains 20% of the variation[4] in daily returns, whereas replacing the 20-minute returns by weighted (with hindsight) surprises suggests only 6% of the daily variation in bond returns is explained by news. This is in line with the aforementioned existing studies, showing that at most 8% of total daily bond return variation can be explained by the surprises.

Zooming in on individual announcements we find that the top five most important announcements from 1996 to 2013 are FOMC target rate announcements (explains 55% of the variation in daily bond returns on 130 FOMC announcement days), Employment report (46%), GDP Advance[5] (36%) and GDP Preliminary (36%), and Efficiency of Industrial Workers report (24%). In contrast, based on regressing daily bond returns on surprises the top five consists of Nonfarm Payrolls (21%)[6], ISM manufacturing (13%), Chicago PMI (11%), ISM non-manufacturing (11%) and Retail Sales (15%). We find FOMC target rate announcements to be very important, whereas surprises suggest it is not. Also GDP advance and preliminary are much more important than what we would conclude from surprise regressions. Hence both FOMC target rate and GDP advance/preliminary announcements have a substantial and lasting impact on bond prices, whereas manufacturing surveys and retail sales announcements are not as important as previously thought.

The importance of news for bond prices varies over time. First, using 1-year rolling windows we find the explanatory power is the lowest at 5% for the period ending in December 2000 and the highest at 51% for the period ending in December 2004. Second, news is more important when VIX or sentiment changes contradict the business cycle direction. This happens for example during recessions when the Baker and Wurgler (2007) sentiment-changes index is positive or during expansions when VIX is high. Third, we find that news that is contrary to the direction of FED rate changes is more important. For example news with a negative effect on yields is more important when the FED is hiking.

[4] Estimates based on 57 and 55 announcements explain the same fraction of return variation, because the announcements without surprise data (FOMC minutes and Beige Book) are not important for bond returns.

[5] Since Q1 2003 the GDP personal consumption advance and preliminary are released at the same time as the general GDP advance and GDP preliminary, respectively. For this shorter period the explained variation in bond returns rises to 53% and 59%, respectively.

[6] One advantage of the surprise regressions is that it shows which of multiple announcement surprises at the same time drives bond returns. Payroll surprises are much more important (21%) than unemployment surprises (1%). Both announcements are part of the employment report.

2.2 Data

2.2.1 Macroeconomic data

We use an extensive set of U.S. macroeconomic news data. We use real-time data on 57 U.S. macroeconomic announcements, collected from Bloomberg which is a widely used data source by market participants. The data set includes announcement date, time, and for most of the announcements the consensus forecast[7] (median) and actual values of macroeconomic figures. Bloomberg screens display consensus and actual figures as they appear thus providing a point of reference for traders who react to news. Vrugt (2009) verifies that Bloomberg consensus forecast data is efficient and unbiased. Announcements are included based on the history of the data (at least 40 observations) and availability up to the present.

We have Treasury futures tick data for the Chicago Mercantile Exchange open outcry trading hours (8:20-15:00 EST).[8] Thus we limit our sample of the economic news to the ones announced during these hours. This limitation excludes some U.S. announcements such as ADP Employment that is announced 8:15 EST. In our sample 76 percent of the trading days include at least one announcement. Our sample starts October 30, 1996 and ends March 28, 2013, amounting to 4223 trading days.

Table 2.1 provides a brief description of the U.S. economic data used in this chapter. We show starting dates, number of observations, and announcement times of the announcements. Announcement data start October 30, 1996 (when Bloomberg starts reporting such data including time stamps) and cover the period until March 28, 2013. For more than half (31) of the announcements the data start in 1996 or 1997. About half of the announcements (29) are made at 8:30. For all announcements we report both the number of announcement instances and the number of the instances we have Bloomberg survey data. The table also indicates the announcements that often occur at the same time. For

[7] MMS is a popular source of macroeconomic forecast data in the studies covering the period before 2003. However in September 2003 Informa acquired MMS and discontinued the survey. The resulting sharp increase of replies to Bloomberg surveys implies market participants regarded it as the new source of market consensus. Brenner, Pasquariello, and Subrahmanyam (2009) notes that joining several sources of survey data is not viable because of potentially different survey methodologies (e.g. the MMS survey is closed on the last Friday the week before the announcement, while Bloomberg's last chance to give a reply is 3 days before the announcement). In addition, the number of announcement types provided by MMS is limited. The importance of the consensus forecast is not crucial for the novel methodology. Bloomberg provides announcement times starting in October 1996, even if there is no consensus forecast. Thus Bloomberg is our preferred data source.

[8] From June 2003 onwards also overnight trading takes place. Hence for future research but for a shorter period it is possible to look at the impact of announcements outside the CME trading hours.

example Nonfarm Payrolls and Unemployment are always announced together. Some announcements, such as Beige Book, do not have consensus forecasts. Hence only the announcement frequency statistics are reported. Note that the novel methodology used in this chapter allows us to investigate the importance of announcements that have no forecasts, i.e. FOMC minutes or Beige Book. For future research the new methodology allows to evaluate the importance of other events, such as speeches or press conferences of government officials.

The surprise part of the announcement is calculated as the difference between actual and consensus values. In order to compare the market impact across the announcements we standardize the surprises with the full sample standard deviation following Balduzzi et al. (2001). Hence standardized news for announcement k at time t is

$$S_{k,t} = \frac{A_{k,t} - E_{k,t}}{\hat{\sigma}_k}, \tag{2.1}$$

where $E_{k,t}$ is the expected and $A_{k,t}$ the announced figure of announcement k at time t, and $\hat{\sigma}_k$ is the full sample standard deviation of surprises $A_{k,t} - E_{k,t}$.

2.2.2 Treasury bond futures data

We use intraday data for 10-year Treasury bond futures from Tickdata.com. Throughout the chapter we use 1-minute log returns providing 400 1-minute returns every trading day on the Chicago Mercantile Exchange, from 8:20 to 15:00 Eastern Standard Time (similar to Evans, 2011). The 1-minute prices used in the return calculations are determined as the price at which the last trade before the beginning of the minute was executed. The futures contract is rolled to the next contract when the daily day-session tick volume of the back-month contract exceeds the daily tick volume of the front-month. Tick volume is the number of price changes, which indicates the trade activity of a contract. We also use total (including overnight return from 15:00 to 8:20 Eastern Standard Time) close-to-close daily futures returns in our analysis. The close is defined as close of open outcry trading (15:00 Eastern Standard Time). Thus daily returns are computed from the 15:00 of the previous trading day until 15:00 of the current day. All returns used in this chapter are in basis points.

Table 2.1. Summary of the U.S. Macroeconomic Announcement Data

	Announcement	Start Date[1]	Ann. Obs.[2]	Surprise Obs.[3]	Time[4]
	Consumption				
1	Existing Home Sales	02/25/2005	98	97	10:00
2	New Home Sales	10/30/1996	197	197	10:00
3	PCE	02/03/1997	194	193	8:30
4	Pending Home Sales	05/02/2005	96	95	10:00
	FOMC				
5	Beige Book	03/08/2000	104	-	14:00
6	FOMC Rate	05/20/1997	134	128	14:15
7	FOMC Minutes	06/27/2002	84	-	14:00
	Forward Looking				
8	Dallas Manufacturing Activity	01/26/2009	51	50	10:30
9	Richmond Manufacturing	10/25/2005	90	89	10:00
10	Empire State Manufacturing	11/15/2002	125	125	8:30
11	NAHB Index	04/15/2003	120	120	13:00/10:00
12	Philadelphia Fed Survey	11/21/1996	196	192	10:00
13	CB Consumer Confidence	02/25/1997	194	193	10:00
14	Chicago PMI	11/27/1996	197	194	10:00/9:45
15	ISM Manufacturing[a]	11/01/1996	197	196	10:00
16	ISM Prices Paid[a]	07/03/2000	153	153	10:00
17	Building Permits[c]	08/16/2002	128	128	8:30
18	Housing Starts[c]	03/17/1998	181	181	8:30
19	Leading Indicators	12/30/1996	193	191	10:00
20	Michigan Consumer Sentiment Preliminary	05/14/1999	166	166	9:45-10:00
21	Michigan Consumer Sentiment Final	05/28/1999	167	167	9:45-10:00
22	IBD/TIPP Economic Optimism	07/11/2006	81	73	10:00
23	ISM Non-Manufacturing	12/03/1998	172	170	10:00
	GDP				
24	GDP Advance[d]	04/30/1997	64	64	8:30
25	GDP Preliminary[e]	11/27/1996	65	64	8:30
26	GDP Final[f]	03/26/1997	64	64	8:30

Table 2.1. Continued

	Announcement	Start Date[1]	Ann. Obs.[2]	Surprise Obs.[3]	Time[4]
27	GDP Personal Consumption Advance[d]	01/30/2003	41	40	8:30
28	GDP Personal Consumption Preliminary[e]	02/28/2003	41	40	8:30
29	GDP Personal Consumption Final[f]	03/27/2003	41	41	8:30
	Government Purchases				
30	Nominal account	03/12/1998	61	61	8:30
31	Treasury Budget	11/22/1996	197	195	14:00
	Investment				
32	Durable Goods Orders[n]	11/26/1997	185	185	8:30
33	Durable Goods Orders ex transportation[n]	12/28/2001	136	136	8:30
34	Construction Spending[a]	08/01/2003	116	116	10:00
35	Factory Orders	11/01/1996	197	197	10:00
36	Wholesale Inventories/wholesale trade	11/08/1996	197	195	10:00
37	Business Inventories	07/16/1997	189	188	10:00/8:30
	Net Exports				
38	Net Long-term TIC Flows	10/18/2004	102	97	9:00
39	Trade Balance	12/19/1996	196	196	8:30
	Prices				
40	Import Prices	08/13/1998	172	172	8:30
41	PPI[g]	12/12/1997	184	183	8:30
42	PPI Core[g]	12/11/1996	196	195	8:30
43	CPI[h]	12/12/1996	196	196	8:30
44	CPI Core[h]	01/14/1997	195	194	8:30
45	Cost Civilian Workers[d]	01/28/1997	64	64	8:30
46	Unit Labor Costs[b]	06/08/1999	111	109	8:30
47	Case Shiller House Price	12/26/2006	76	70	9:00
	Real Activity				
48	Nonfarm Payroll Employment[j]	01/10/1997	195	193	8:30
49	Unemployment[j]	01/10/1997	195	192	8:30
50	Retail Sales[k]	12/12/1996	194	194	8:30
51	Retail Sales Less Autos[k]	04/11/1997	191	189	8:30

Table 2.1. Continued

	Announcement	Start Date[1]	Ann. Obs.[2]	Surprise Obs.[3]	Time[4]
52	Capacity Utilization[m]	01/17/1997	195	193	9:15
53	Industrial Production[m]	11/15/1996	197	196	9:15
54	Personal Income	10/31/1996	198	197	8:30
55	Nonfarm Productivity[b]	08/12/1997	124	121	8:30
	Real Activity (Weekly)				
56	Initial Jobless Claims[i]	01/04/1997	824	815	8:30
57	Continuing Jobless Claims[i]	07/25/2002	558	513	8:30

The table gives starting dates (mm/dd/yyyy) and number of observations for the data that is collected from Bloomberg. Following Andersen et al. (2003) we group the U.S. announcements into eight categories: GDP, four components of GDP (consumption, investment, government purchases, and net exports), real activity, prices, and forward-looking. Superscripts [a,…,n] indicate the announcements that occur together more than half of the time.
Abbreviations: PCE - personal consumption expenditures, NAHB - National Association of Home Builders, CB - Conference Board, PMI - Purchasing Managers Index, ISM - Institute of Supply Management (former NAPM - National Association of Purchasing Managers), GDP - gross domestic product, PPI - producer price index, CPI - consumer price index, TIC – treasury international capital.
[1] Starting date when the first intraday stamp is available; [2] Number of observations when the timestamps are available; [3] Number of announcement observations with forecast available for surprise calculation; [4] Time of the day of the announcement (eastern standard time). Timestamps for some announcements change over time, in those cases we give a range or a list of times.

2.3 Methodology

In this section we introduce a novel methodology to measure the importance of macroeconomic news that does not rely upon the economic forecast data.

There are two streams in the literature that use returns at different frequencies. Many studies use high frequency intraday returns around macroeconomic news (see for example Andersen et al., 2003 and Faust et al., 2007). Hardouvelis (1988), one of the first proponents of this approach, argues it is necessary to use short windows around macroeconomic news to avoid contamination with noise that is unrelated to the news analyzed. The second approach uses daily returns (e.g. Kuttner, 2001 and Vrugt, 2009) with the argument that if the news is important the effect of the news reaction remains at the end of the day. In both cases news is deemed important if a strong and significant relation is found between the surprises in news announcements and returns. Studies using high frequency returns around the announcement find strong results. But the relation is much weaker when daily returns are used. The explanation is that the daily returns are contaminated with non-news information. But this also suggests that the importance of news is short-lived and only leads to transitory effects on prices.

We propose a new methodology which completely alters the view on the importance of news for daily returns. Our proposed methodology uses the market reaction around news announcements as a proxy of new information. This is superior to using surprises as the relationship between information and returns could be non-linear (e.g. Andersen et al., 2003), time-varying (e.g. Brazys and Martens, 2014), or the forecasts used to calculate the surprises may not be a good proxy of the consensus of all market participants. In Section 2.4 we show the new method leads to much stronger results for daily returns.

2.3.1 News impact

To provide evidence that economic fundamentals are relevant for asset prices a large and active event study literature has developed.[9] The basic tool in this literature is the following univariate regression

$$R_{k,t} = \alpha_k + \beta_k S_{k,t} + \varepsilon_t, \tag{2.2}$$

where $R_{k,t}$ is the change in the asset price in a small window following the announcement k at time t, and $S_{k,t}$ is the standardized surprise of the announcement at time t, see equation (2.1). The coefficient β_k measures the impact of the announcement k on the asset return. In this chapter $R_{k,t}$ is a log return starting 5 minutes before and ending 15 minute after the announcement (consistent with Faust et al., 2007). This 20-minute interval is selected to account for the full reaction to the announcement. The window starts 5 minutes before the time recorded by Bloomberg to account for possible discrepancies between official and Bloomberg recorded times. We also use the total (close-to-close) daily return ($R_{total_k,t}$) in equation (2.2) to show that the relation between macroeconomic surprises and daily returns is weaker.

[9] The literature studies impact of macroeconomic announcements on different asset classes. For example, Andersen et al. (2003) investigates currencies, Faust et al. (2007) currencies and interest rates, Balduzzi et al., (2001) bonds, Andersen et al. (2007) the joint reaction of T-bills, equities and exchange rates, Kilian and Vega (2011) energy commodities, and Elder et al. (2012) metals.

2.3.2 The relation between the initial price reaction and the total daily return

We use a novel approach to investigate the relationship between the return around macroeconomic news and the total return of the day. For each announcement k we regress the total announcement day return, $R_{total_{k},t}$, on the return from 5 minutes before to 15 minutes[10] after the announcement, $R_{k,t}$:

$$R_{total_{k},t} = \alpha_k + \beta_k R_{k,t} + \varepsilon_t. \tag{2.3}$$

We see several advantages to this approach. First, the regression R-squared gives a direct indication how much of the variation in daily returns can be attributed to news announcements. Second, we can analyze the importance of specific announcements for bond markets. Third, we directly measure the market reaction as opposed to using the indirect measure of news surprises. Fourth, we do not need surveys to compute surprises allowing us to take into account more announcements and use a longer sample. A disadvantage of our approach is that other events on the same day provide noise on measuring the importance of news announcements. In that sense we provide a lower bound on the importance of news.

The β_k coefficients tell us something about the persistence of the price reaction immediately following the news. First, $\beta_k = 0$ implies that the immediate reaction to the news has no lasting effect. Second, $\beta_k = 1$ indicates the return earned at the time of the announcement is on average equal to the return at the end of the day. Third, $0 < \beta_k < 1$ means the market on average overreacts to the news and part of the initial reaction is reversed. Fourth, $\beta_k > 1$ means after the initial reaction the price drifts in the same direction. Finally, $\beta_k < 0$ means that the initial price move is more than offset by returns in the remaining part of the day.

The R^2 of the regression in equation (2.3) indicates how much of the daily variance in bond returns can be attributed to economic news.

[10] Balduzzi, Elton, and Green (2001) finds that none of the announcements is significant after 15 minutes. We start the window 5 minutes before announcement to account for the possibility that the timestamp of the news is inaccurate.

Our methodology follows the argument of the literature studying the impact of macroeconomic news on daily returns (e.g. Kuttner, 2001 and Vrugt, 2009). The studies argue that if the news is important the effect of the news remains at the end of the day. We argue that the news is important if the initial reaction to the announcement remains at the end of the day. Furthermore, the news is more important if it accounts for a significant part of the daily return variation.

We have to be careful with the interpretation of the results from equation (2.3), because the intraday return, $R_{k,t}$, is part of the total day return, $R_{total_k,t}$.Theoretically $\beta_k = 1$ in a random process where news plays no role. In such a random world and with constant volatility, regressing the total daily return on the intraday return leads to a R^2 equal to the proportion of time the intraday interval represents relative to the total trading day. For the purpose of correct inference we establish statistical properties of β_k and R^2 of the regression in equation (2.3) by simulation in Section 2.3.3.2.

2.3.3 Correct inference

How much of the total daily return is explained by intraday returns if the news-related returns are as (un-) important as other returns? We first derive the outcome analytically under the assumption of constant volatility and normality of returns. Then we describe the bootstrap procedure to account for non-normal returns and time-varying volatility.

The methodology is intuitive. If we assume all returns contribute equally to the total return, then the contribution of any intraday interval would be equal to the ratio of this interval time to the total time. However, the contribution of some intraday returns is larger because of higher volatility during particular times of the day (e.g. opening and closing times of the trading). To evaluate whether the return around a macroeconomic announcement contributes significantly more to the total return, we compare the contribution of the announcement return to similar returns with no announcement. A significantly larger contribution indicates announcement is important. In this subsection we first derive the properties when returns are normally distributed. We then use a bootstrap to account for the stylized facts of the data.

2.3.3.1 Normally distributed returns

Assume the bond price evolves as a Brownian motion process with no drift and constant volatility σ^2. The total daily return R_{total_k} is the sum of independent and identically distributed[11] intraday log returns r_i

$$R_{total_k} = \sum_{i=1}^{N} r_i\,, \qquad r_i\ i.i.d.\ N(0,\sigma^2).$$

A part of this total return is $R_k = \sum_{j\in\{i_1,\dots,i_M\}} r_j$, where $\{i_1,\dots,i_M\} \subset \{1,\dots,N\}$ and M is a number of intraday returns $(M \le N)$. We estimate the regression (3) for total daily returns on the return of part of that day. The total day return, R_{total_k}, can be rewritten as

$$R_{total_k} = \sum_{i=1}^{N} r_i = \sum_{j\in\{i_1,\dots,i_M\}} r_j + \sum_{j\notin\{i_1,\dots,i_M\}} r_j = R_k + \sum_{j\notin\{i_1,\dots,i_M\}} r_j.$$

Then the β of the regression in equation (2.3) is

$$\beta = \frac{cov(R_{total_k}, R_k)}{var(R_{k,})} = \frac{cov(R_k + \sum_{j\notin\{i_1,\dots,i_M\}} r_j\,, R_k)}{var(R_k)} = 1 + \frac{cov(\sum_{j\notin\{i_1,\dots,i_M\}} r_j\,, R_k)}{var(R_k)},$$

and the regression R^2 is

$$R^2 = \frac{var(\beta R_k)}{var(R_{total_k})} = \beta^2 \frac{M\,\sigma^2}{N\,\sigma^2} = \beta^2 \frac{M}{N}.$$

Hence, in the case that announcement and non-announcement returns are independent and identically distributed, theoretically $\beta = 1$ and R^2 is the fraction of total time the return R_k accounts for.

[11]For simplicity we do not use subscript t, and assume daily returns are identically distributed.

However, if announcement and non-announcement returns are related, i.e. $cov(\sum_{j\notin\{i_1,\dots,i_M\}} r_j, R_k) \neq 0$, then $\beta < 1$ if the correlation is negative, and $\beta > 1$ if the correlation is positive.[12] The R^2 accounts for less than a fraction of time if the correlation is negative, and more if it is positive.

In regression (3) we use 20-minute returns. A 20-minute announcement window accounts for 1/72 of the 24 hour day. Hence the R^2 is 1.4% if news returns and non-news returns are equally important.[13]

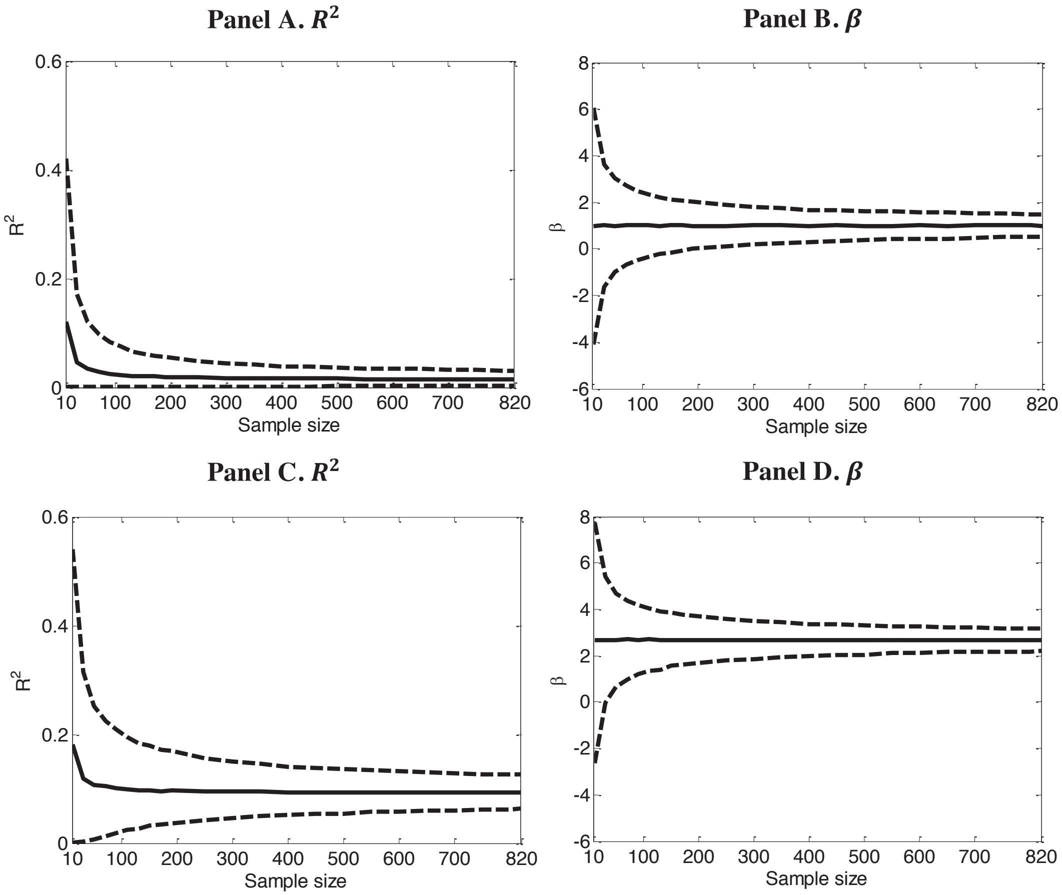
The coefficients derived are population coefficients. However estimating the sample coefficients is more complicated. While the β estimate is unbiased, the R^2 is biased upwards in small samples. Consider for example a sample with just two observations. It is always possible to draw a line through two points, thus the R^2 is always 1, and the estimation of the true R^2 is not possible. Therefore we present simulation results for various sample sizes to grasp the impact of covariance and sample size on R^2 and β. In Figure 2.1 we present simulation results when announcement returns and the rest of the day returns are uncorrelated, and when there is a correlation of 0.2. The sample size varies from 10 to 820 observations to cover the range of observations in our news data set. For the largest sample size, the simulation result is as expected theoretically. The R^2 in the case of intraday return independence is 1.4% and β is 1. However in small samples the R^2 is upwards biased, and confidence intervals for both R^2 and β are wide. Imposing a positive correlation of 0.20 between announcement returns and the rest of the day returns leads to a higher R^2 and a higher β, with confidence intervals shifted accordingly. The β for the largest sample size is 2.69 $(1 + 0.2\sqrt{71})$ and the R^2 is 10% $(2.69^2/72)$.

If the assumption of constant volatility holds, the results can be used to test the hypothesis that a particular intraday return is equally important as other intraday returns. However the assumptions do not hold. First, intraday bond returns are neither distributed

[12] The sample correlation of our news returns to the rest of the day returns is 0.01 and is statistically insignificant.

[13] Of course the assumption that all returns are equally important is not realistic. Returns during a certain time of the day, e.g. trading hours, around opening and closing of pit trading are more volatile even without macroeconomic news. For example if we assume that trading session returns are n-times more volatile than overnight returns and trading session takes one third of the total time, we can show that 20 minutes of trading session accounts for $\frac{n}{24(n+2)}$ of the total variance. In case the trading session return is 10 times more volatile than the overnight return, this means a 20-minute trading session return accounts for 3.5% of total variation. In the following section our bootstrap procedure accounts for such cases.

Figure 2.1. Simulation Results



These figures show the results for the regression $R_{total_k,t} = \alpha_k + \beta_k R_{k,t} + \varepsilon_t$, where log returns $R_{total_k,t}$ and $R_{k,t}$ are sampled from a standard normal distribution so that $R_{k,t}$ is part of $R_{total_k,t}$ and the variance of $R_{total_k,t}$ is 72 times larger than $R_{k,t}$. The ratio of the variances is selected to reflect that a 20 minute window is 1/72nd of the 24-hour day, assuming constant volatility of intraday returns. Panels A and B assume intraday return independence, while panels C and D show results assuming 0.2 correlation between announcement and non-announcement returns.

The results are given for different sample sizes. Panel A and C demonstrate the average R^2 of the regression (bold line) along with the 90% (dashed) confidence intervals. Panel B and D display the β_k of the regression. The bold line indicates the average β_k. The dashed lines indicate the 90% confidence bands.

normally[14] nor have constant intraday volatility. Bollerslev et al. (2000) find a distinctive intraday volatility pattern where volatility is higher at the opening and closing of the trading session. We cannot derive formulae for R^2 and β that account for the stylized facts of the bond market, thus we use a bootstrap procedure that uses bond market data to estimate the properties of equation (2.3). In the next section we describe the bootstrap procedure and the results from the bootstrap.

2.3.3.2 Bootstrap

We now describe the data-driven bootstrap procedure to derive the statistical properties of β_k and R^2 when there are no announcements. Estimating equation (2.3) on the days of announcement k we use intraday announcement returns, $R_{k,t_1}, R_{k,t_2}, \dots, R_{k,t_{N_k}}$, and daily returns $R_{total_k,t_1}, R_{total_k,t_2}, \dots, R_{total_k,t_{N_k}}$ on days t_1 to t_{N_k}. To establish properties of the regression in a world where news does not matter, the returns R_{k,t_i} and R_{total_k,t_i} are replaced with corresponding returns from days without announcements. Replacement returns for intraday return R_{k,t_i} should not have any announcement during its calculation window. Because of the intraday volatility patterns in the Treasury market we replace returns around announcements with returns on other days at the same time.

The simulation procedure includes two steps. In the first step we replace each of the announcement returns $R_{k,t_1}, R_{k,t_2}, \dots, R_{k,t_{N_k}}$ with corresponding non-announcement returns. The replacement returns should satisfy two conditions. First, returns should come from the same intraday interval as the announcement returns. Second, there should be no announcement in this intraday interval. For instance, a candidate return to replace the announcement return starting 8:25 and ending 8:45 is the return for the same interval from a day with no announcement during this interval. Finally, each intraday return R_{k,t_i} is paired with the same day total daily return, R_{total_k,t_i}. Note that total announcement returns may include returns from other announcements.

In the second step, we bootstrap regression (3). First we estimate regression (3) using the returns sampled in the first step:

[14] The Jarque-Bera test for both daily and 1-minute returns rejects the normality hypothesis.

$$R^{NA}_{total_k,t} = \hat{\alpha}_k + \hat{\beta}_k R^{NA}_{k,t} + \hat{\varepsilon}_t,$$

where $R^{NA}_{k,t}$ and $R^{NA}_{total_k,t}$ are the replaced non-announcement returns.

We then resample the response variable $R_{total_k,t}$:

$$R^{*}_{total_k,t} = \hat{\alpha}_k + \hat{\beta}_k R_{k,t} + \hat{\varepsilon}^{*}_t,$$

where $\hat{\varepsilon}^{*}_t$ is resampled (with replacement) from $\hat{\varepsilon}_t$. Finally, we estimate the regression

$$R^{*}_{total_k,t} = \alpha_k + \beta^{*}_k R_{k,t} + \varepsilon_t.$$

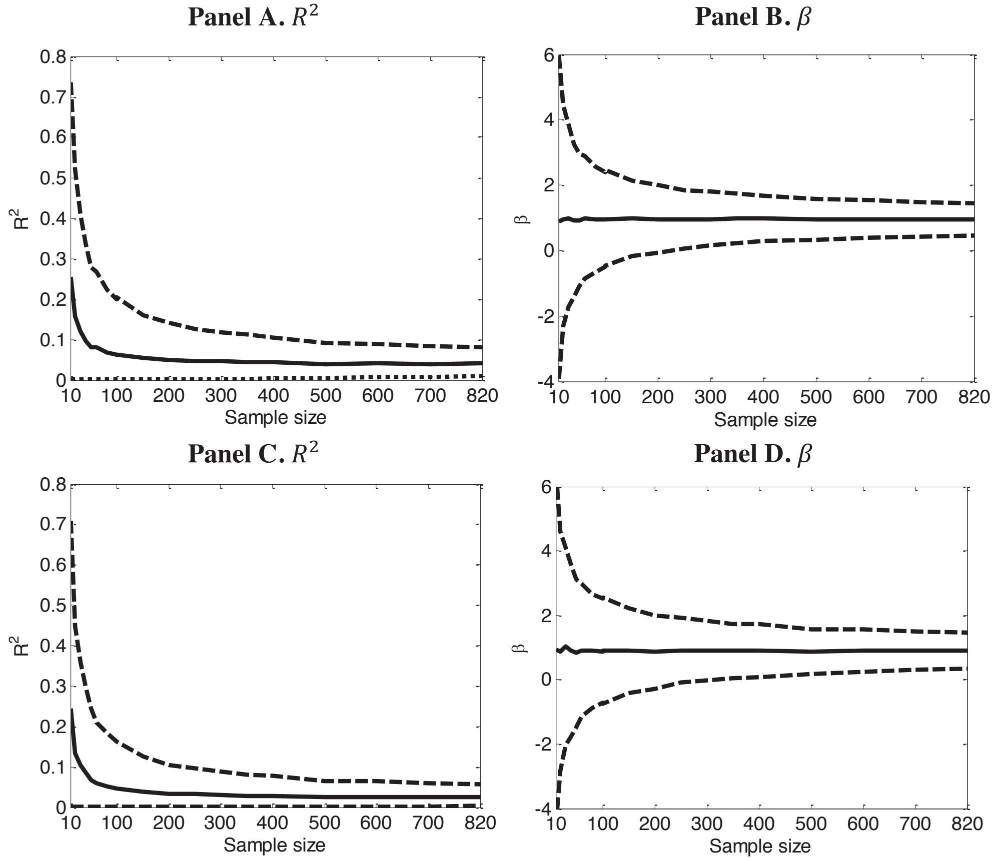
The first of the last two steps simulates daily returns, whereas the second step estimates the regression parameters for the simulated data.

Each step includes 1,000 repetitions, amounting to 1,000,000 simulations in total. From each repetition we collect estimates of β^{*}_k and R^2. This forms bootstrapped distributions that are used for inference. The bootstrap includes a two-step procedure to assure our sample is representative for the full period analyzed.

Figure 2.2 gives an example showing simulation results for an announcements that occur at 8.30 (announcement time of Nonfarm Payrolls) or 9.15 (Industrial Production), for sample sizes from 10 to 820 – the largest number of observations for our announcement sample. The R^2 is positively biased in small samples where the regression is overfitted, but decreases and stabilizes at 4.0% for 8.30[15] announcements and at 2.5% for 9.15 announcements. Both figures are higher than the previously noted 1.4% where we assume constant volatility (see Figure 2.1). Volatility is not constant during the day (Bollerslev, Cai, and Song, 2000) and is higher at the beginning of the open outcry trading session (8.20 EST) than it is later in the day. This illustrates the necessity to account for the announcement time during the day. Higher R^2 could also be because of return correlation. However Panel B demonstrates that β_k is not different from one. As illustrated in Section 3.3.1 this implies a return correlation is zero. Thus the resulting increase in R^2 is mainly due to seasonality in intraday volatility.

[15] Unreported 10.00 bootstrap results show, this time accounts for 4.0% of total bond return variation as well.

Figure 2.2. Bootstrap Results for 8:30 and 9:15 News



These figures show the results for the bootstrapped regression $R_{total_k,t} = \alpha_k + \beta_k R_{k,t} + \varepsilon_t$, where $R_{total_k,t}$ is the daily close to close return and $R_{k,t}$ is the intraday return from 8.25 to 8.45 (Panels A and B) or 9.10 to 9.30 (Panels C and D) with no news announced in this window. The bootstrap results are given for different sample sizes. Panels A and C demonstrate the average R^2 of the regression (bold line) along with 90% (dashed) confidence bound. Panels B and D show the same results for the β_k of the regression.

As an example we look at Nonfarm payrolls announcements that are announced at 8.30. With 195 observations (see Table 2.1) the R^2 of the regression in equation (2.3) will be significant at the 5% significance level if the R^2 is larger than 14.6% (the 95% confidence bound for sample size 195 in Figure 2.2). Similarly, the β_k is said to be statistically different from the theoretical value of 1 if the estimated β_k is lower than -0.25 or larger than 2.26. This wide confidence interval indicates that it is unlikely we find β_k to be significantly different from one. As expected confidence intervals shrink with sample size.

2.3.4 Total importance of the news

How important are the returns around macroeconomic announcements? To estimate the total importance of the news we aggregate intraday returns around macroeconomic announcements. The return, $R_{ann,t}$, is formed aggregating intraday returns around 57 announcements, starting 5 minutes before and ending 15 minutes after the announcement[16] on day t. We then estimate the regression

$$R_{total_t} = \alpha + \beta R_{ann,t} + \varepsilon_t. \tag{2.4}$$

The equation (2.4) is estimated both for the announcement days only and for all trading days. In latter case $R_{ann,t}$ is set to zero on the no-news days.

2.4 Results

2.4.1 Individual announcements

Table 2.2 shows the results of estimating equation (2.3) for all 57 individual announcements. For 26 announcements we find that the R^2 is significantly larger than the R^2 when there is no news. The critical values for the inference are bootstrapped as described in Section 3.3.2. After accounting for the double counting of the announcements that occur at the same time, there are 17 significant announcements (at 10% significance level).

The last column of Table 2.2 presents the ranking of the announcements based on the R^2 of regression (3). We first split the announcements into groups with a significant and insignificant R^2 (10% significance level). In each group we rank the announcements in descending order. If multiple announcements occur at the same time we cannot identify which one is more important. For example PPI and PPI core announcements occur at the same time. The importance of both announcements is lower if we base our ranking on PPI

[16] Announcement returns overlap if the announcements occur less than 20 minutes apart. We make sure the aggregating procedure includes returns only once.

(R^2=0.07) compared to ranking based on PPI Core (R^2=0.09). In such cases we base the joint ranking on the one with the largest number of observations.

Based on the size of R^2 our results indicate that FOMC rate announcements are the most important. On the 130 FOMC rate announcement days 55% of the variation in announcement day returns is explained by the return reaction to the announcement. This is significant at the 1% confidence level. It is followed by the Employment report that includes both Nonfarm Payrolls and Unemployment figures. The Employment report accounts for 46% of the return variation on the days of the Employment report.

Interestingly, both GDP Advanced and GDP Preliminary announcements are very similar in importance, each accounting for 36% of return variation, and ranking 3rd and 4th in importance. On the other hand the reaction to the GDP Final announcement is found to be not important, accounting for virtually none of the announcement day return variation.

Forward Looking is the most important category. Six announcements from this category (seven if both ISM announcements are included) explain a significant fraction of total daily return variation. Within this category ISM Manufacturing is the most important explaining 19% of its announcement day return variation. Import Prices is the most important in the Price category. The explanatory power of two significant announcements, Unit Labor Costs and Cost Civilian Workers, cannot be assigned exclusively to these announcements. The announcement time of these announcements overlaps with announcements from other categories. Consumption, Net Exports and Investment categories each have only one significant announcement.

Our methodology is able to evaluate the importance of the announcements without surprise data. FOMC Minutes are responsible for 11% of the daily return variation and is the second most important FOMC announcement. The Beige book announcement accounts for only 5% of announcement day return variation. Both these R^2s, however, are not statistically significant.

Table 2.2. Importance of Macroeconomic News

	Announcement	α	β	R^2	Obs.	Percentile	Rank
	Consumption						
1	Existing Home Sales	-2.21	1.66	0.21**	98	0.96	8
2	New Home Sales	1.81	0.99	0.09	197	0.83	21
3	PCE	-1.20	0.99	0.07	193	0.71	31
4	Pending Home Sales	1.62	1.20	0.12	95	0.86	18
	FOMC						
5	Beige Book	-4.18	1.04	0.05	104	0.65	33
6	FOMC Rate	2.10	1.03	0.55***	130	1.00	1
7	FOMC Minutes	-4.99	1.09	0.11	84	0.82	20
	Forward Looking						
8	Dallas Manufacturing Activity	9.64	-1.50**	0.09	51	0.66	22
9	Richmond Manufacturing	7.13	0.60	0.03	90	0.39	39
10	Empire State Manufacturing	9.44**	1.54	0.21*	117	0.93	7
11	NAHB Index	2.45	1.61	0.08	120	0.74	24
12	Philadelphia Fed Survey	-3.43*	1.31	0.18***	196	0.99	11
13	CB Consumer Confidence	4.68	0.95	0.12**	194	0.96	17
14	Chicago PMI	10.86**	1.17	0.18***	197	0.99	10
15	ISM Manufacturing[a]	0.33	0.94	0.19***	197	1.00	9
16	ISM Prices Paid[a]	1.34	0.85	0.15**	153	0.97	9
17	Building Permits[c]	6.46	1.05	0.09	128	0.77	28
18	Housing Starts[c]	7.87**	0.89	0.07	181	0.73	28
19	Leading Indicators	2.44	0.67	0.03	193	0.50	37
20	Michigan Consumer Sentiment Preliminary	1.83	1.44	0.16**	166	0.97	13
21	Michigan Consumer Sentiment Final	5.05	0.85	0.07	166	0.84	27
22	IBD/TIPP Economic Optimism	0.37	2.08	0.11	79	0.76	19
23	ISM Non-Manufacturing	-3.80*	0.66	0.05	172	0.60	35
	GDP						
24	GDP Advance[d]	5.96	1.27	0.36**	64	0.99	3
25	GDP Preliminary[e]	8.25	2.16	0.36**	65	0.99	4
26	GDP Final[f]	2.99	0.07	0.00	64	0.05	42

Table 2.2. Continued

	Announcement	α	β	R^2	Obs.	Percentile	Rank
27	GDP Personal Consumption Advance[d]	1.91	1.37	0.44**	41	0.98	3
28	GDP Personal Consumption Preliminary[e]	7.28	2.41	0.42**	41	0.99	4
29	GDP Personal Consumption Final[f]	4.40	0.31	0.01	41	0.19	42
	Government Purchases						
30	Nominal account	14.41**	1.15	0.04	61	0.45	36
31	Treasury Budget	-2.09	0.91	0.03	189	0.46	38
	Investment						
32	Durable Goods Orders[n]	-2.77	1.14	0.15**	185	0.96	15
33	Durable Goods Orders ex transportation[n]	-3.26	1.03	0.14*	136	0.91	15
34	Construction Spending[a]	2.83	0.60	0.06	116	0.65	9
35	Factory Orders	2.13	0.58	0.03	196	0.38	40
36	Wholesale Inventories/wholesale trade	1.88	1.23	0.05	197	0.58	34
37	Business Inventories	-1.86	0.96	0.07	189	0.71	29
	Net Exports						
38	Net Long-term TIC Flows	6.08	1.03	0.05	102	0.57	32
39	Trade Balance	2.16	1.24	0.15**	196	0.96	16
	Prices						
40	Import Prices	2.64	1.57	0.23***	172	0.99	6
41	PPI[g]	0.53	0.66	0.07	183	0.74	23
42	PPI Core[g]	0.39	0.69	0.09	195	0.82	23
43	CPI[h]	5.14	0.81	0.08	196	0.82	25
44	CPI Core[h]	5.07	0.85	0.09	195	0.84	25
45	Cost Civilian Workers[d]	10.08*	1.05	0.37**	64	0.99	3
46	Unit Labor Costs[b]	4.28	1.81	0.25**	111	0.99	5
47	Case Shiller House Price	7.62	0.83	0.01	76	0.29	41
	Real Activity						
48	Nonfarm Payroll Employment[j]	-2.20	0.85	0.46***	195	1.00	2
49	Unemployment[j]	-2.20	0.85	0.46***	195	1.00	2
50	Retail Sales[k]	-3.40*	0.88	0.15**	194	0.96	14
51	Retail Sales Less Autos[k]	-2.60	0.87	0.14*	191	0.95	14

Table 2.2. Continued

	Announcement	α	β	R^2	Obs.	Percentile	Rank
52	Capacity Utilization[m]	3.23	1.21	0.07	194	0.85	26
53	Industrial Production[m]	2.81	1.22	0.07	196	0.86	26
54	Personal Income	-0.87	1.00	0.07	197	0.71	30
55	Nonfarm Productivity[b]	4.50	1.77	0.24**	124	0.99	5
	Real Activity (Weekly)						
56	Initial Jobless Claims[i]	1.00	1.24	0.16***	820	1.00	12
57	Continuing Jobless Claims[i]	0.60	1.34	0.19***	557	1.00	12

The table gives the estimates for the regression of daily returns on the intraday returns around a macroeconomic announcement. *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively, using the bootstrapped distribution of the parameters. The percentile of the bootstrapped distribution is given for the R^2estimate. The percentile is used in ranking the announcements on importance. The announcements often occurring at the same time are given the same rank of the announcement with the most observations. Superscripts [a,…,n] indicate the announcements that occur together more than half of the time.

2.4.2 Pooled announcements

Table 2.3 shows that using all 57 announcements and all trading days in equation (2.4) we find 20% of the total return variation is attributed to macroeconomic news and FOMC releases. Only including days with at least one announcement we find that macroeconomic news accounts for 24% of the return variation. In comparison, announcement return time is only 1.2% of the total return time, and only 1.8 % of the return time on the announcement days. We calculate announcement return time as the fraction of the total time. For example if announcement returns are computed over 1 hour and our time horizon is one day, then the fraction is 1/24.

The table also demonstrates the importance of news aggregation. Although the FOMC target rate announcements are very important on the days when it is announced (R^2 = 55%) it only explains 3% of the total return variation because these announcements only occur every 6 weeks. Including the next 4 most important announcements (as ranked in Table 2.2) adds another 5% to the R^2, while increasing the list further to include the top 10 announcements with the highest R^2 adds another 5%. The top 17 most important announcements (27 announcements in total, some overlapping) can explain 17% of the

Table 2.3. Aggregate News Importance

	News days		All days	
	R^2	Obs.	R^2	Obs.
FOMC Rate	0.55	130	0.03	4223
Top 5	0.41	596	0.08	4223
Top 10	0.42	1265	0.13	4223
Top 17 (significant)	0.26	2294	0.17	4223
All	0.24	3211	0.20	4223

The table shows the R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$, with $R_{total_k,t}$ the daily returns, $R_{ann,t}$ the announcement time-return the return starting 5 minutes before and ending 15 minutes after each announcement on the announcement day. All returns are computed for 10-year U.S. bond futures. The rows give different sets of announcements used in independent variable construction: from the single most important FOMC Rate announcement to all announcements in our sample. Top 5, Top 10 and Top 17 indicate the sets of announcements with the largest significant R^2s as ranked in Table 2.2. Columns 'News days' and 'All days' indicate only news or all days are included in the regression. The sample starts October 30, 1996 and ends March 28, 2013

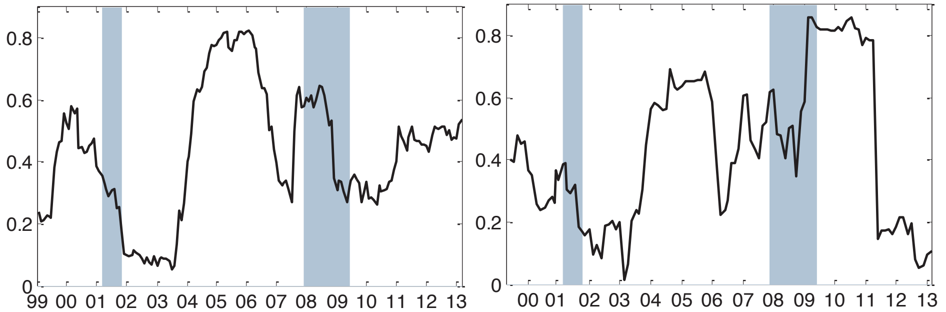
total daily return variation. Adding the remaining stand-alone insignificant announcements ranked 18 through 42 (30 announcements) increases the R^2 by a further 3%. Thus the effect on R^2 of including more announcements diminishes if the announcement is less important. The diminishing effect is also clear if only announcement days are considered. In that case including the least important announcements brings the R^2 down.

2.4.3 Does the relation between total daily return and the initial return reaction to news vary?

The non-farm payrolls announcement is often dubbed the king of announcements (Andersen and Bollerslev, 1998). The FOMC Rate announcement is another closely watched announcement by market participants. Our new methodology also indicates these are the most important announcements for Treasuries. We thus choose these announcements to further investigate the time variation in importance. We repeat the estimation of equation (2.3) in 24-month rolling windows. With 8 scheduled FOMC meetings and 12 scheduled Employment reports each year, a 24-month window includes 18 FOMC and 24 Employment observations. Figure 2.3 presents the regression R^2. In Panel A we present the results for the Employment Report (includes Non-Farm payrolls

Figure 2.3. Time-varying Relation between News and Total Day Return

Panel A. Non-farm Payrolls **Panel B.** FOMC Rate



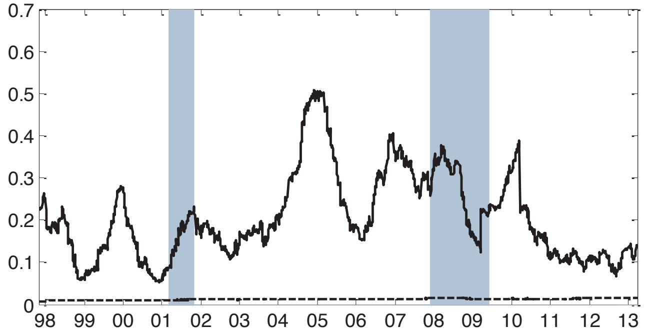
The figure shows the time-varying relation between the total announcement day return and the return accrued around non-farm payrolls announcements (Panel A) or around FOMC target rate announcements (Panel B). Shown is the R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{k,t} + \varepsilon_t$ using 24 month rolling windows. Shaded areas indicate NBER recession periods: March - November 2001 and December 2007 - June 2009.

and Unemployment figures) announcements. Although for the full sample Non-farm payroll announcements account for 46% of the daily return variation (see Table 2.2), there is considerable variation in the explanatory power over time. Reaching almost 60% in 2000 the R^2 is steadily decreasing until July 2003 when it explains only 5.4% of the variation in daily returns. From July 2003 onwards the importance of Nonfarm employment increases to reach a maximum of 82.4% in the 2-year rolling window ending February 2006. Afterwards the swings in importance are smaller. Since May 2010 the importance of employment data has increased from 26% to 54% at the end of our sample.

Panel B shows the explanatory power of FOMC Rate announcements. As noted the announcement returns account for 55% of total announcement day return variation in the full sample. However, explanatory power varies from 1.6% in March 2003 to 86% for the 2-year period ending in April 2009. In the most recent period the explanatory power drops to 10%. During the period the Fed was cutting its target rate from 2001 to 2003 the explanatory power of their announcements is decreasing. The explanatory power was rising throughout 2003 with the rate unchanged until mid-2004 when the Fed initiated the hiking of the target rate. The last increase in the target rate was in June 2006. In August 2007 the easing has started which ended in December 2008 with the target rate at the 0-0.25 interval.

To investigate the variation of the total news importance we estimate the regression (2.4) in rolling one-year windows. We have more observations thus we choose a shorter

Figure 2.4. Aggregated announcement importance



This figure demonstrates the varying importance of aggregated macroeconomic news. The bold line shows the variation of R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$, where $R_{total_k,t}$ is the daily return on day t, and $R_{ann,t}$ is the total intraday return around announcements on day t, starting 5 minutes before the announcement and ending 15 minutes after the announcement. The regression is estimated in rolling 1-year window using daily returns. The dashed line shows the fraction of total time attributed to the news returns around announcements. Shaded areas indicate the NBER recessions.

window to investigate the variation of news importance. Figure 2.4 shows that the R^2 of the regression varies from 5% in a one year period ending in December 2000, to 51% in a one year period ending in December 2004. In both cases the announcement time accounts for only 1% of total time.

2.4.4 What drives the time-variation in the importance of macroeconomic news?

Several studies find the relation between macroeconomic news and asset prices to be time-varying. Bacchetta and Van Wincoop (2004) propose a model where the importance of announcements varies over time. In their model the investors change their focus from one announcement to another. Boyd, Hu, and Jagannathan (2005) show that the impact of employment news depends on the stage of business cycle. For example, positive macroeconomic news can be perceived as good or bad depending on the state of the business cycle. Andersen et al. (2003) find that negative news has a larger price impact than positive news. Goldberg and Grisse (2013) show the reaction of government bonds to news is muted when the VIX is high or the Fed Funds futures rate is low. We also investigate the relation between investor sentiment and the importance of the news. For this we use the sentiment index of Baker and Wurgler (2006). Finally, Van Dijk, Lumsdaine, and van der Wel (2014) find that the federal funds futures rate is more volatile and news has larger impact when the next FOMC meeting is further away. We therefore investigate these candidates as drivers of the variation in news importance based on our novel method. In addition we study the combination of first conditioning upon the stage of business cycle and then upon the VIX and the sentiment indices.

2.4.4.1 Volatility and Federal Funds Rate

Table 2.4 Panel A shows the results of the regression in equation (2.4) where the sample is conditioned upon previous day levels of the VIX, the MOVE (Merrill Option Volatility Estimate for Treasury futures), the Baker and Wurgler (2006, 2007) sentiment index and Federal Funds Rate. Conditioning on the previous day levels of the indices accounts for the possibility that news may cause the changes in the indices. The level of the VIX is negatively related to the explanatory power of the regression. Periods of high VIX correspond to low explanatory power of news. This corresponds to Goldberg and Grisse (2013) finding that the reaction of government bonds to news is muted when the VIX is high. While the average VIX in the quintiles increases from 12.92 to 35.41 percent, the explanatory power decreases from 34% to 22%. News is most important when VIX is at its lowest. The importance decreases monotonically with increasing volatility, with the exception of the highest VIX level. However, the pattern is less clear when conditioning the regression sample upon the MOVE index or Federal Funds futures rate. For example, while the MOVE increases from 65.78 to 142.23 the R^2 only changes from 25% to 26% percent. The result for the Federal funds futures rate is different from Goldberg and Grisse (2013). Although news importance in a small interval around the announcement changes, so can the importance of the non-fundamental events outside this small interval. For example, if the reaction to the news decreases when the Federal Funds futures is low, but also the price does not move outside of reaction window (zero volatility), the news is the only driver of the bond prices. Our methodology measures the importance of economic news in relation to the total return, thus the results can only be the same if the Federal Funds rate and VIX affect all sources of return variation proportionally.

Table 2.4. Explaining the Variation in Explanatory Power

Panel A.

	VIX_{t-1}		$MOVE_{t-1}$		FFR_t		$SENT^{\perp}$		$\Delta SENT^{\perp}$	
	R^2	mean	R^2	mean	R^2	mean	R^2	mean	R^2	mean
1	0.34	12.92	0.25	65.78	0.12	0.13	0.36	-0.43	0.23	-1.65
2	0.29	17.48	0.21	82.95	0.32	0.68	0.22	-0.10	0.28	-0.49
3	0.21	20.98	0.23	96.45	0.23	2.37	0.29	0.05	0.28	-0.04
4	0.22	24.68	0.24	108.92	0.33	4.84	0.20	0.26	0.22	0.40
5	0.22	35.41	0.26	142.23	0.15	5.77	0.16	1.15	0.27	1.56
Panel B.										
Expansion	0.23	20.72	0.23	93.31	0.23	2.84	0.24	0.09	0.24	0.02
Recession	0.30	32.08	0.30	136.25	0.30	2.15	0.30	0.64	0.30	-0.42
Good	0.15	22.35	0.15	99.56	0.15	2.60	0.15	0.16	0.15	-0.01
Bad	0.16	22.23	0.16	98.93	0.16	2.88	0.16	0.20	0.16	-0.09

The table shows the R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$, with $R_{total_k,t}$ the daily returns, $R_{ann,t}$ the cumulative total return of the day around macroeconomic news. The returns are computed using 10-year U.S. bond futures. In Panel A we estimate 5 separate regressions with the sample period conditioned upon the 1-day lagged level of the VIX (VIX_{t-1}), the MOVE index ($MOVE_{t-1}$), the level of the Fed Funds rate (FFR_t), or the end-of-month Baker and Wurgler (2006, 2007) sentiment index of levels ($SENT^{\perp}$) and changes ($\Delta SENT^{\perp}$). Numbers 1 through 5 indicate the quintiles of the conditioning data. Column 'mean' gives the average value of the conditioning variable. Panel B splits the sample. First, we split into expansions and recessions of the NBER business cycle. Second, we split into the good and bad news days, where a good news day is defined as a day with positive $R_{ann,t}$. All estimations are based on the sample period October 1996 – March 2013, except for sentiment indices where the data is available until the end of 2010.

2.4.4.2 Investor sentiment

The last two columns of Panel A in Table 2.4 show the relationship of the importance of news for bond prices with two versions[17] of the Baker and Wurgler (2006, 2007) sentiment index. The index summarizes information from variables believed to proxy for investor sentiment. We test whether sentiment makes fundamental information less important when sentiment (or its changes) is extremely positive or negative. First, the explanatory power of macroeconomic news is negatively related to the sentiment-level index. The R^2 is 36% when the sentiment index is at its lowest (negative) and deceases to 16% when the

[17] For the description of the two versions of the indices (the sentiment-level and sentiment-changes) see Baker and Wurgler (2007).

sentiment index is at its highest (positive). This indicates that fundamental news is most important when sentiment is negative. Second, the relation between the sentiment-changes index and news importance is less clear. Our results do not lend direct support to the visual observation of Baker and Wurgler (2007) that "the volatility of sentiment rises in a speculative episodes.[18]This pattern suggests that the relative influence of fundamentals and sentiment on aggregate market returns changes over time". We expect the regression R^2s as function of changes in the sentiment-changes index to show a humped pattern with the peak at the moderate sentiment-changes index values, i.e. we expect news to be more important during less speculative periods. However the results of Panel A in Table 2.4 show the differences in R^2s are small when sentiment-changes index values are moderate and when they are extreme. Thus our findings do not lend support to the observation that news is less important during more speculative periods as measured by Baker and Wurgler (2007) sentiment-changes index.

2.4.4.3 Business cycle, sign of the news

In Panel B of the Table 2.4 we also investigate the effect of two more conditioning variables. First, we split the sample into NBER dated recession and expansion periods. Our findings show that the news is more important during recessions (R^2=0.30) than during expansions (R^2=0.23). Furthermore, conditioning upon the business cycle reverses the relation between news importance and the VIX, the MOVE, the Federal Funds Rate and the Baker and Wurgler (2006, 2007) sentiment index. Both the VIX and the MOVE are higher during recessions when the news is more important. The Federal Funds Rate is lower during recessions, while the sentiment-level is higher during recessions. All differences in means are statistically significant (results of the tests are not reported in the table).

Second, we split the sample into good (for the bond market) and bad news days. A day is defined as good news day if the total announcement return ($R_{ann,t}$ in equation 2.4) is positive; otherwise the day is defined as bad. The results in Table 2.4 show there is only 1% difference in explanatory power. Studies find that bad economic news (lower than expected growth or inflation) has a larger effect on bonds than good news. However these

[18] An example of what Baker and Wurgler (2007) see as speculative period is technology bubble at the end of 1990s.

Table 2.5. Explaining the Variation of News Importance over FED Policy Cycle

	Total		Good		Bad	
FED policy	R^2	Obs.	R^2	Obs.	R^2	Obs.
Easing	0.21	1069	0.05	503	0.21	566
After easing	0.28	1460	0.23	732	0.16	728
Hiking	0.26	568	0.23	260	0.09	308
After hiking	0.25	374	0.12	181	0.16	193
Quick ease	0.24	261	0.04	123	0.22	138
Null rate	0.23	909	0.27	472	0.08	437

The table shows the R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$ in different subsamples, with $R_{total_k,t}$ the daily return, and $R_{ann,t}$ the cumulative total return of the day around macroeconomic news. The returns are computed using 10-year U.S. bond futures. The sample is first split into FED policy periods. We then split the sample further into good and bad news days, where the a good (bad) news day is defined as a day with positive (negative) $R_{ann,t}$. The easing (hiking) period is defined as the period from the first interest rate cut (increase) after the last interest rate increase (cut) until the last interest rate cut (increase) before the next interest rate increase (cut). "After easing" ("after hiking") is the period after the easing ("hiking") period but before next hiking (easing). "Quick ease", is the period between 2007 September 18 - 2008 December 16 when the FED in a short time cut the target rate from 5.25% to 0-0.25%. The "null rate" period is the period after December 16, 2008 when the FED cut target rates to 0-0.25% range and stayed there. All estimations are based on the sample period October 1996 – March 2013.

studies only conclude that the market moves in reaction to the bad news are larger, but tell nothing on how much of the total daily return it accounts for.

2.4.4.4 Sign of the news and FED rate cycle

The results show that the split into good and bad news periods is not informative about the variation of news importance. It is possible that the importance of news depends on the stage of FED rate cycle. For example, when the rates are so low that they cannot go any lower good news (for bond returns) is not as important as bad. Therefore we investigate if good or bad news is more important during easing or hiking. In Table 2.5 we split the FED rate cycle into four periods: (1) easing, from the first rate cut until the last rate cut before the next rate increase; (2) hiking, from the first rate increase until the last rate increase before the next rate cut; (3) after easing, between easing and hiking; and, (4) after hiking, between hiking and easing. We further split the sample into good and bad news days as defined previously. Two key findings arise from such conditioning. First, without conditioning upon the news sign, the news is most important between the easing and hiking period ($R^2 = 0.28$). The news is least important during easing ($R^2 = 0.21$). The R^2

decreases monotonically from "after easing" until the end of easing period. Second, news that is contrary to the direction of FED rate changes is more important. For example good news (positive bond return) is much more important during hiking ($R^2 = 0.23$) than during easing period ($R^2 = 0.05$). The recent quick easing period (September 18, 2007 - December 16, 2008) and the close to zero rate period that followed afterwards is of particular importance. Results in the last two rows of Table 2.5 show that bad news is slightly more important during the quick easing period when compared to full sample easing periods. Also good news is only slightly more important in close to zero rate period compared to the full sample 'after easing' periods (R^2 of 0.27 during the zero rate period vs. 0.23 for the full sample 'after easing' period). Our results show that good and bad news are of different importance over the stage of FED rate cycle.

2.4.4.5 Business cycle, volatility, sentiment and FED announcements

Panels A through C of Figure 2.5 further investigate the effect of the VIX, sentiment-level and sentiment-changes index on the importance of news over the business cycle. We first condition the regression upon the VIX, sentiment-level and sentiment-changes index and then the stage of business cycle. The majority of the sample is an expansion period, thus results for the expansions are closer to the full sample results. First, Panel A demonstrates that the explanatory power for the same level of VIX is higher during recessions. Second, a higher level of sentiment is related to a decrease in the importance of the macroeconomic news. For the same level of sentiment, news is more important during recessions, especially for the positive levels of sentiment. Finally, Panel C sheds some light on the causes of the flat relationship between sentiment-changes index and news importance. We find during recessions news is more important when the sentiment-changes index is positive. During recessions news explains 42% of the bond return variation when the sentiment-changes index is positive and only 20% when the sentiment-changes index is negative. But during expansions the news is more important when the sentiment-changes index is negative. During expansions news explains 18% of the return variation when the sentiment-changes index is positive; and 30% when the sentiment-changes index is negative. A possible explanation for such a relationship is that during bad times (recession) negative sentiment changes makes investors more sentimental and less likely to value economic fundamentals. This is also true during good times (expansions) when the

Figure 2.5. Conditional News Importance

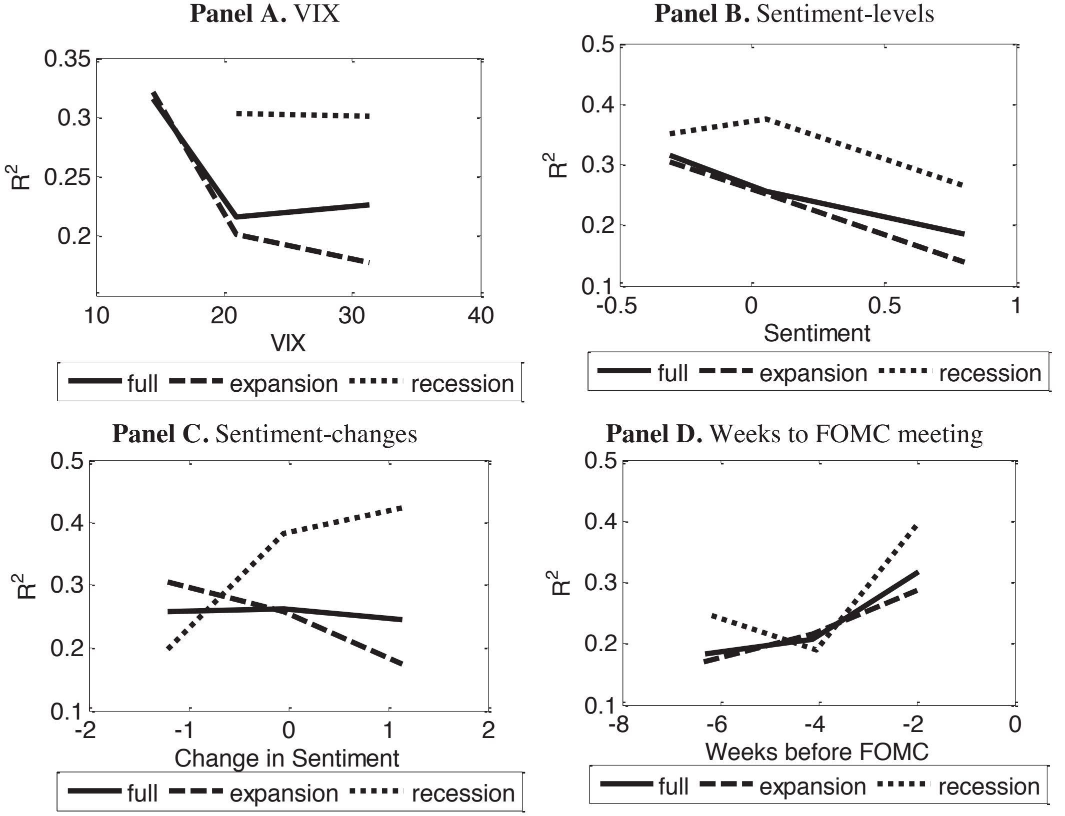


Figure shows R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$. with $R_{total_k,t}$ the total daily return, $R_{ann,t}$ cumulative total return of the day around macroeconomic news. The sample is first conditioned upon on the quantiles of the VIX (Panel A), the Baker and Wurgler (2006, 2007) sentiment level index (Panel B), the sentiment changes index (Panel C), time before the FOMC meeting (Panel D) and then upon the NBER expansion-recession. Regression results with less than 20 observations are omitted. The vertical axis demonstrates the average level of conditioning variable in each quantile. Solid line shows the R^2 for the full sample, while dashed and dotted lines show results for expansion and recession periods respectively. The split into recession expansion in Panel D is based on the date of the FOMC announcement.

positive sentiment change makes investors more sentimental, thus putting less weight on economic news. Thus we add an additional dimension to Baker and Wurgler (2007). Fundamental news is less important during extreme positive sentiment changes in expansions and extreme negative sentiment changes in recessions.

Finally, in panel D, we investigate news importance conditional upon the time between FOMC rate announcements. We split the days between FOMC announcement days in 3 equal periods. Our approach assumes the macroeconomic information is the most relevant for the next FOMC rate decision. Our findings indicate macroeconomic news is least important immediately after the announcement and increasingly more important as the next FOMC meeting date approaches. A related study (Van Dijk, Lumsdaine, and van der Wel, 2014) finds decreasing macroeconomic news impact and decreasing Fed funds futures volatility. We further split the sample into recessions and expansions based on the date of the FOMC meeting. The importance of news announcements increases closer to the FOMC date. However the increase in announcement importance is not monotonic during recessions.

2.5 Return vs. surprise regressions

2.5.1 Individual announcements

The literature finds macroeconomic news is especially important for bond markets (for a review of studies on bond markets see Fleming and Remolona, 1997). One of the reasons is that bond pricing is simple thus market participants are more likely to agree on the interpretation of the news (Fleming and Remolona, 1997). We estimate the importance of the individual announcements using equation (2.2) measuring the intraday response of bond prices to surprises in macroeconomic announcements. We also estimate equation (2.2) with the daily returns, $R_{total_k,t}$., as the dependent variable. The results are presented in Table 2.6. We also include the results from our novel method to make it easy to compare the results.

Table 2.6. Comparing the methodology

y_t: / x_t:	daily r_t / intraday r_t		daily r_t / surprise S_t		intraday r_t / surprise S_t		
	β	R^2	β	R^2	β	R^2	**Obs.**
Consumption							
1 Existing Home Sales	1.66	0.20*	-8.84**	0.04	-4.95***	0.17	97
2 New Home Sales	0.99	0.09	-5.44**	0.02	-4.58***	0.15	197
3 PCE	0.99	0.07	-3.15	0.01	-1.34**	0.02	192
4 Pending Home Sales	1.23	0.13	-8.51*	0.05	-4.62***	0.16	94
FOMC							
6 FOMC Rate	1.01	0.56***	-8.53*	0.03	-4.63	0.01	128
Forward Looking							
8 Dallas Manufacturing Activity	-1.42**	0.08	5.20	0.03	-1.75	0.08	50
9 Richmond Manufacturing	0.58	0.02	-7.06	0.03	-2.77***	0.06	89
10 Empire State Manufacturing	1.54	0.21*	-4.82	0.01	-4.38***	0.12	117
11 NAHB Index	1.61	0.08	-5.90**	0.03	-1.09*	0.03	120
12 Philadelphia Fed Survey	1.32	0.18**	-11.75***	0.08	-5.97***	0.21	192
13 CB Consumer Confidence	0.95	0.12**	-5.40	0.02	-7.79***	0.29	193
14 Chicago PMI	1.14	0.17**	-13.66***	0.11	-8.90***	0.36	194
15 ISM Manufacturing[a]	0.95	0.18***	-16.90***	0.13	-13.07***	0.40	196
16 ISM Prices Paid[a]	0.85	0.15**	-8.26**	0.03	-6.00***	0.08	153
17 Building Permits[c]	1.05	0.09	-9.80**	0.06	-1.60	0.02	128
18 Housing Starts[c]	0.89	0.07	-0.17	0.00	-1.41*	0.01	181
19 Leading Indicators	0.66	0.03	-4.04	0.01	-2.16***	0.04	191
20 Michigan Consumer Sentiment Preliminary	1.44	0.16**	-8.71***	0.04	-3.59***	0.08	166
21 Michigan Consumer Sentiment Final	0.85	0.07	-0.93	0.00	-0.76	0.00	166
22 IBD/TIPP Economic Optimism	2.20	0.12	4.95	0.01	-0.24	0.00	71
23 ISM Non-Manufacturing	0.66	0.05	-13.27***	0.11	-5.85***	0.20	170
GDP							
24 GDP Advance[d]	1.27	0.36**	-9.21	0.03	-8.86***	0.14	64
25 GDP Preliminary[e]	2.16	0.36**	0.32	0.00	-2.70**	0.06	64
26 GDP Final[f]	0.07	0.00	3.50	0.01	-1.51	0.03	64

Table 2.6. Continued

y_t: / x_t:	daily r_t / intraday r_t		daily r_t / surprise S_t		intraday r_t / surprise S_t		
	β	R^2	β	R^2	β	R^2	**Obs.**
27 GDP Personal Consumption Advance[d]	1.36	0.43**	-13.73*	0.08	-5.10*	0.04	40
28 GDP Personal Consumption Preliminary[e]	2.43	0.43**	-12.90	0.09	-5.52***	0.22	40
29 GDP Personal Consumption Final[f]	0.31	0.01	-6.50	0.03	-3.38**	0.12	41
Government Purchases							
30 Nominal account	1.15	0.04	0.58	0.00	-0.13	0.00	61
31 Treasury Budget	0.91	0.03	2.04	0.00	0.00	0.00	187
Investment							
32 Durable Goods Orders[n]	1.14	0.15**	-4.10	0.01	-3.82**	0.08	185
33 Durable Goods Orders ex transportation[n]	1.03	0.14*	-11.55***	0.08	-7.42***	0.26	136
34 Construction Spending[a]	0.60	0.06	-5.30	0.02	-0.28	0.00	116
35 Factory Orders	0.58	0.03	-2.10	0.00	-1.98**	0.03	196
36 Wholesale Inventories/wholesale trade	1.23	0.05	-4.26	0.01	-0.02	0.00	195
37 Business Inventories	0.96	0.07	-1.30	0.00	0.16	0.00	188
Net Exports							
38 Net Long-term TIC Flows	0.97	0.05	2.03	0.00	0.62	0.01	97
39 Trade Balance	1.24	0.15**	-6.10**	0.03	-2.33***	0.04	196
Prices							
40 Import Prices	1.57	0.23***	-0.53	0.00	-0.80	0.00	172
41 PPI[g]	0.66	0.07	-1.59	0.00	-5.10***	0.11	182
42 PPI Core[g]	0.69	0.09	-7.65***	0.04	-7.01***	0.18	194
43 CPI[h]	0.81	0.08	-5.77	0.01	-2.82*	0.03	196
44 CPI Core[h]	0.85	0.09	-5.76	0.01	-8.56***	0.23	194
45 Cost Civilian Workers[d]	1.05	0.37***	-5.42	0.02	-5.26*	0.05	64
46 Unit Labor Costs[b]	1.81	0.25**	0.60	0.00	-0.21	0.00	109
47 Case Shiller House Price	0.81	0.01	5.27	0.01	-1.75*	0.06	70
Real Activity							
48 Nonfarm Payroll Employment[j]	0.86	0.46***	-25.20***	0.21	-26.87***	0.37	193
49 Unemployment[j]	0.85	0.46***	4.30	0.01	9.22***	0.04	192
50 Retail Sales[k]	0.88	0.15**	-13.29***	0.09	-7.54***	0.15	194
51 Retail Sales Less Autos[k]	0.85	0.14*	-10.12***	0.05	-8.47***	0.19	189

Table 2.6. Continued

y_t: / x_t:	daily r_t / intraday r_t		daily r_t / surprise S_t		intraday r_t / surprise S_t		
	β	R^2	β	R^2	β	R^2	**Obs.**
52 Capacity Utilization[m]	1.12	0.06	-8.12**	0.04	-2.52***	0.09	192
53 Industrial Production[m]	1.21	0.07	-4.36	0.01	-2.67***	0.09	195
54 Personal Income	1.00	0.07	0.75	0.00	-0.15	0.00	196
55 Nonfarm Productivity[b]	1.78	0.24**	3.05	0.01	-0.08	0.00	121
Real Activity (Weekly)							
56 Initial Jobless Claims[i]	1.24	0.16***	8.90***	0.04	4.16***	0.10	814
57 Continuing Jobless Claims[i]	1.29	0.18***	2.51	0.00	1.96**	0.02	512

This table gives the estimates for the regression of daily return on the intraday return around a macroeconomic announcement (equation 3.3 in the text), on the surprise element of the announcement (equation 2.2) and intraday return on the surprise (equation 2.2) . *, ** and *** indicate statistical significance at 10%, 5% and 1% levels, respectively, using the bootstrapped distribution of the parameters for regression (2.3), and HAC errors for regression (2.2). Superscripts [a,…,n] indicate the announcements that occur together more than half of the time.

First, we find for intraday returns that the surprises of 39 (of 55) macroeconomic announcements have a significant (at least at the 10% confidence level) impact on the 10-year Treasury futures returns. The most important announcements explain up to 40% (ISM Manufacturing) of the 20 minute return variation around the news. Second, results from estimating regression (2.2) are much weaker when daily returns are used. Only 21 announcements are significant at the 10% confidence level. The maximum R^2 decreases to 21% (Non-farm Payrolls). The decrease in average R^2 from 10% to 3% indicates surprises in announcements, on average, seem to be not as important when daily returns are used. Third, our novel methodology identifies 26 significant announcements

Using our methodology we are able to rank announcements that are important for the market participants. We select the 5 most important announcements from both the surprise regression in equation (2.2) based on daily returns[19] and our novel regression in equation (2.3). In both cases we rank significant announcements from the highest to the lowest R^2. Our novel method cannot distinguish which figure is most important if multiple figures are announced at the same time. Therefore we choose to assign the rank of announcement with

[19] We compare results of our novel method to the results of daily surprise regression, because both regressions are estimating the importance of news for the same daily return.

most observations. The new methodology suggests a striking change in what are considered important announcements. First, the FOMC rate that is apparently not important in the surprise regression[20] is found to be the most important in our novel regression, accounting for 56% of the variation in the returns on target rate announcement days. The apparent disconnect between monetary policy surprises and long term bond returns in the standard surprise regression is documented in the literature. Gurkaynak, Sack, and Swanson (2005b) argues that in many standard macroeconomic models macroeconomic or monetary shocks (surprises) have only a transitory effect on the future path of interest rates and thus a limited response of long-term interest rates. Gurkaynak, Sack, and Swanson (2005a) show that for longer term bonds both target rate surprises and future path surprises are needed to explain bond price variation. Our novel methodology can identify the importance of news announcements without using the surprise component.

Second, the Employment Report, containing Non-farm Payrolls and Unemployment figures, is the second most important announcement ($R^2 = 0.46$). Here we find surprises useful in deciding which announcement is more important. Regression using surprises shows that Non-farm Payroll (R^2 =0.37) announcement is much more important than Unemployment (R^2 =0.04). Third, the Employment report is followed by Advance and Preliminary GDP reports, both accounting for 36% of return variation. Further, it is surprising that the report on Efficiency of Industrial Workers, including Nonfarm Productivity and Unit Labor Costs figures, is the fifth most important announcement with an R^2 =0.24. It is, however, not found to be important with the surprise regression. Finally, ISM Manufacturing, Chicago PMI, Durable Orders excluding transportation and Conference Board Consumer Confidence figures are in top 5 most important announcements according to the surprise regression, but rank much lower in our novel regression. This indicates these announcements are much less important than previously believed, as they do not lead to sizeable permanent changes in bond prices.

[20] We estimate the surprise regression using different methods to estimate FOMC target rate surprises. The status of the FOMC announcement remains "not important" using surprises estimated from both daily and intraday FED funds futures. Kuttner (2001) finds the FOMC target rate announcement is the most important for 3-month T-bills and diminishes with the maturity.

2.5.2 Aggregated announcements

We continue with the comparison between return- and surprise-based regressions for aggregated news. It is straightforward to estimate the importance using the novel methodology. We aggregate intraday returns around macroeconomic news. However we cannot replace the returns in regression (2.4) with standardized surprises of the news. The return size around news already tells how important the announcement is, thus surprises are at disadvantage if the sign and size of the announcement impact is not accounted for. We weight the surprises (with hindsight) by their impact on high frequency bond prices around macroeconomic news, thus accounting for the sign and size of the impact. We then aggregate surprises daily and estimate equation (2.4) on all days and on the announcement days when surprises are available.

For ease of comparison Table 2.7 Panel A repeats the estimation results when the novel return-based news measure is used. Panel B shows the results when aggregated surprises are used. Aggregate weighted surprises are able to explain 8% of the total announcement day variation and only 6% of total return variation.[21] In comparison, return-based news estimates are able to explain three times more variation on announcements days (see Panel A, surprises explain 8%, whereas return-based news explains 24%). The ratio between explanatory powers increases further if all days are used (surprises explain 6%, whereas return-based news 20%). We also report results when only the impact sign is used to weight the surprises. The R-squared drops from 8% to 5% on the news days, and from 6% to 4% when all trading days are used. This shows the importance of weighting the surprises of different announcements.

Panel C of Table 2.7 reports the results of an additional robustness test. We replace the surprises with the standardized changes of the macroeconomic variables. The changes in variables are standardized dividing changes by their sample standard deviations. As for surprises we weight the standardized changes by their impact on high frequency returns around the announcement. The changes in macroeconomic variables can be interpreted as surprises where the previous value is used as the forecast for the next value. In comparison

[21] We also test multiple regression with non-aggregated announcements. That allows each weighted surprise to have different impact on daily return. Adjusted R-squared in this regression is 8%. This is in line with Hardouvelis (1988) findings that economic news explain up to 7.6% of total daily bond yield variation. The results are also in line with Altavilla, Giannone, and Modugno (2014) who find up to 8% can be explained by macroeconomic surprises.

Table 2.7. Aggregate News Importance

	News days	All days
	R^2	R^2
Panel A. Announcement returns		
Returns	0.24	0.20
Panel B. Surprises		
Surprise (weighted)	0.08	0.06
Surprise (non-weighed)	0.05	0.04
Panel C. Changes in macroeconomic variables		
Changes (weighted)	0.04	0.04
Changes (non-weighted)	0.03	0.02

The table shows the R^2 of the regression $R_{total_k,t} = \alpha_k + \beta_k R_{ann,t} + \varepsilon_t$, with $R_{total_k,t}$ the daily returns, $R_{ann,t}$ the announcement time return (the return starting 5 minutes before and ending 15 minutes after each announcement on the announcement day). All returns are computed for 10-year U.S. bond futures. The table gives the regression R^2s of daily returns on the aggregated announcement time return (Panel A), surprises (Panel B) and changes in macroeconomic variables (Panel C). Announcement time includes windows starting 5 minutes before and ending 15 minutes after each announcement. Changes in macroeconomic variables are standardized by dividing the change by full sample standard deviation. Surprises are weighted ('weighted') by their full sample impact (beta in regression (2.2)) on high frequency prices, or only by the impact sign ('non-weighted'). Similarly, Standardized changes in macroeconomic variables are weighted ('weighted') by their full sample high frequency impact (beta in regression (2.2)) on bond prices. Or the standardized changes are weighed only by the impact sign ('non-weighted'). Columns 'News days' and 'All days' report R^2 of a regression applied to news days or all days.

to surprise-based news, the explanatory power decreases further to 4%. If only the sign of the impact on the market is used, the explanatory power decreases to 3% on news days and a mere 2% on all sample days. This allows us to conclude that changes in macroeconomic variables are inferior to macroeconomic surprises in explaining bond returns. In turn, macroeconomic surprises are inferior to our novel method based on the market return reaction to news.

The novel methodology demonstrates that macroeconomic news is much more important than previously thought. Both weighted surprises and weighted changes in macroeconomic variables explain less of the daily bond return variation. Note that in 'news-day' regressions we use a smaller sample excluding the days when surprises are not available. FOMC minutes and Beige book announcements are excluded for the same reason, thus our news importance is estimated using 55 of 57 announcements. This makes very little difference (R^2 is also 24%) since FOMC minutes and Beige book are previously found to be not important. This indicates our methodology is robust to the inclusion of non-important news.

2.6 Conclusion

We introduce a novel methodology to evaluate the importance of news announcements for bond prices. Instead of using surprises in news announcements we regress daily returns on the 20-minute returns around macroeconomic news announcements. An announcement is considered important if the initial reaction is significantly related to the total announcement day return.

The new methodology has several advantages. First, the regression R-squared gives a direct indication how much of the variation in daily returns can be attributed to news announcements. Second, we can analyze the importance of individual announcements for bond markets in a new way with possibly different conclusions. Third, we directly measure the market reaction as opposed to using the indirect measure of news surprises. Fourth, we do not need surveys to compute surprises allowing us to take into account more announcements and use a longer sample.

We contribute to the literature in three ways. First, the existing methodology based on news surprises indicates that only 6% of the total daily bond return variation is explained by news. Using our novel methodology we find macroeconomic announcements account for 20% of the total daily bond return variation. Second, individually, the most important announcements are the FOMC target rate and employment reports. Whereas the importance of non-farm payrolls figure of employment report is well-known, we provide strong evidence of the importance of FOMC target rate announcements for long term bonds. In fact these announcements can explain 55% of the variation in bond returns on days that these announcements are made. The literature does not find FOMC target rate surprises are important for long term bonds. The difference between our finding and findings in the literature means other information than the FOMC target rate surprise is driving long term bond returns. This is in line with Gurkaynak, Sack, and Swanson (2005b) finding that FOMC statements rather than target rate surprises are important for long term government bonds. Our methodology is able to identify the important announcements even without a proxy for the content of the FOMC statements. Third, we find the importance of news varies over time. News is more important when the sentiment-level index is low (negative). News is more important when the VIX or Baker and Wurgler (2007) sentiment-changes index contradict the business cycle direction. For example during recessions when sentiment changes are positive or during expansions when VIX is high. Also, we find news that is contrary to the direction of FED rate changes is more important. For example good news is much more important during hiking than during easing period.

The shortcoming of our methodology is that we are not able to identify which announcement is triggering the market response if multiple figures are announced at the same time. This is where the relation between surprises and the 20-minute return around the announcement is still useful.

There are several potential directions for further research. First, we can review the studies that do not find a significant relation between economic news and asset prices. The traditional research agenda so far was to look for better measures of news in announcements[22] or a different source of the news (e.g. semantic analysis of news articles, Tetlock, 2007, or FOMC minutes, Boukus and Rosenberg, 2006). For example Kuttner (2001) is the first to use the FED funds futures change as monetary surprise. Gurkaynak, Sack, and Swanson (2005b) use a proxy for a surprise in the future path of interest rates. Searching for the relation between the proposed news measures is a difficult task not having prior knowledge of whether the news moves the market. Therefore, we propose first using our novel methodology to identify events that move the market. Second, the new method makes it easy to evaluate the importance of announcements that do not have forecast values. Forecasts are available for many U.S. macroeconomic figures. However, forecast data for other countries is scarce. Our methodology can be used in these cases to evaluate the importance of macroeconomic announcements. Also it allows investigating the importance of news that has no explicit expectation and thus a surprise component

[22] Early studies using forecasting models to infer the market expectation, later studies using survey data for expectations.

cannot be calculated. For example the importance of speeches of Federal Reserve officials for financial markets can now be evaluated

Chapter 3

Does aggregate macroeconomic news drive carry returns?

Joint work with Dr. M.P.E. Martens

3.1 Introduction

Over the last decade two generally separate strands of literature have studied i) whether currency returns can be attributed to fundamental shocks; and ii) the determinants of the returns to carry trades. As for the former strand, several studies have convincingly shown that exchange rates do respond to the release of macroeconomic news (surprises) in short intervals around those releases (e.g. Andersen et al., 2003). As for the latter strand, numerous studies have tried to explain the empirical observations that, contrary to the Uncovered Interest Parity, the return to a trading strategy going long high interest rate currencies and going short low interest rate currencies– i.e. the return to carry trades – is on average positive and large. There is agreement amongst those studies that carry trade returns must be compensating investors for the risk of holding high-yield currencies performing poorly during "bad" times. Yet, there is no agreement as to what these bad times are.

We add to both strands of literature and also provide a link between the two. First, high-frequency studies on the response of currencies to macroeconomic news focus exclusively on currencies paying low interest rates. The finding is that these currencies react to macroeconomic news consistent with predictions from Taylor-rule models – namely, "good" U.S. news makes the U.S. Dollar (USD) stronger.[23] We find that currencies paying high interest rates often react the opposite way. We demonstrate that these currencies do

[23] See for example Andersen et al. (2003).

react to macroeconomic news, but the reaction sign is changing over time. Sometimes "good" news makes the USD stronger, sometimes "good" news makes the currencies with high interest rates stronger. Kim (1998) attributes the latter to the perception that a U.S. economic boom can trigger a global boom. Similarly, Fratzscher (2009) argues that bad economic news about the U.S. economy may be perceived as even worse news to other economies. We therefore label news that draws a reaction inconsistent with predictions from Taylor-rule models as sentimental.

Second, we build a novel sentimental news index, which aggregates surprises in macroeconomic news announcements that trigger a reaction of currencies with high interest rates opposite to that expected by Taylor-rule models. Note that for this index bad news implies bad news for carry trades, since the long leg (high yield) of the carry trade depreciates and the short leg (low yield) appreciates. Hence disappointing economic news is a characterization of bad times. We find that the sentimental news index can explain 12 percent of the monthly variation in carry returns. This figure rises to 27 percent for months where the majority of the news announcements draw a sentimental reaction.

To further understand the uniqueness of the information captured by the sentimental news index, we examine its relation to other known measures of bad times for carry returns. Brunnermeier, Nagel, and Pedersen (2009) and Hu, Pan, and Wang (2013) consider proxies for liquidity looking at the TED spread and treasury yield curve noise, respectively. Lustig, Roussanov, and Verdelhan (2011) and Menkhoff et al. (2012) look at shocks to equity volatility and currency volatility, respectively. We find that the sentimental index is negatively correlated with changes in VIX (S&P options implied volatility), CVIX (currency implied volatility), the TED spread, and treasury yield curve noise. Hence a low reading of the sentimental index, indicating predominantly bad macroeconomic news, coincides with increases in volatility and decreases in liquidity. The sentimental index, however, also provides new information not already captured by volatility and liquidity. The four aforementioned measures combined explain just 12 percent of the variation in the sentiment index.

The sentimental index in part captures information included in the volatility and liquidity measures. Hence we provide a partly economic-news related explanation for why both volatility and liquidity have explanatory power for carry returns. Combined the four volatility and liquidity measures explain 41 percent of the variation in monthly carry returns. Making the four measures orthogonal to the sentimental index[24] reduces the explanatory power to 29 percent. Hence 12 percent of the 41 percent explanatory power can be attributed to the novel macroeconomic news index. Combining the news index with the volatility and liquidity measures explains 44 percent of the variation in monthly carry returns. Hence the sentimental index also includes information not already captured by the volatility and liquidity measures.

It is also vital to consider the sentimental index (S) and not a general news index (N). The reciprocal, a fundamental news index (F) aggregating news surprises where currencies that pay high interest rates react according to Taylor rules, has no explanatory power for carry returns. The general news index[25], the sum of S and F, only explains 7 percent of monthly carry returns, compared to 12 percent when using S only. Also the fundamental news index has no correlation at all with the four volatility and liquidity measures.

Finally, if the sentimental news index provides information about "bad" times in general, it should also have explanatory power for equity returns. We find that the sentimental news index explains 14 percent of the variation in monthly S&P 500 index returns. This figure rises to 26 percent for months where the majority of the news announcements draw a sentimental reaction. In the literature we have not come across of such a large impact of news at the monthly frequency.[26] Hence our aggregate news indices show a much stronger link between asset prices and news than previously documented.

This chapter contributes to the existing literature in several dimensions. First, we investigate the differences in the reactions of currencies with high and low interest rates to macroeconomic news.[27] We also explore the reaction of the carry portfolio to news.[28] We

[24] For example Andersen and Bollerslev (1998) and Martin Evans and Lyons (2005) show that after important news and especially bad news currency volatility is higher for several hours to multiple days, with U.S. news the most important (Andersen et al., 2003). It makes more sense to assume volatility changes are partly driven by news surprises then to assume that volatility changes drive macroeconomic surprises.

[25] Note that Citi Group a few years ago released such indices for several countries. The end-of-month U.S. Citigroup economic news index has correlations of 0.55, 0.33 and 0.41 with our general (N), fundamental (F) and sentimental (S) news indices, respectively. However the relation of the CITI news index and asset prices is much weaker compared to our indices (the results are available from authors upon request).

[26] McQueen and Roley (1993) investigate announcement day returns and find news explains up to 3.9% of announcement day returns. Andersen et al. (2007) analyze intraday reactions to macroeconomic news. According to conservative calculations of Martin Evans and Lyons (2008), explaining short intervals around the news can only help explaining at most 2 percent of total price variation. Harju and Hussain (2011) analyze intraday reactions of European stock indices to the U.S. macroeconomic news. Their model that includes news explains up to 2.5% total return variation. We contribute to the stream of the literature initiated by Shiller (1981) that find it difficult reconcile stock price variation with its fundamentals.

[27] Fleming and Remolona (2001), Brenner, Pasquariello, and Subrahmanyam (2009), and Vrugt (2009) study differences in reactions of high and low yielding assets for Treasury and corporate bond markets.

find that currencies with low interest rates react predominantly as expected according to Taylor rule models, whereas currencies with high interest rates also regularly react in the opposite direction. This is in line with two existing strands of literature. Christiansen, Ranaldo, and Söderlind (2011) demonstrate that the currency exposure to equity and bond markets depends on currency market volatility. On average the risk exposure of currencies with low interest rates is dominated by the bond market in both high- and low-volatility regimes. On the other hand the risk exposure of currencies with high interest rates is on average dominated by the bond market in the low-volatility regime and by the equity market in the high-volatility regime. Given this time variation in the relationship of currencies with bond and equity markets, it is interesting to see how bond and equity markets react to macroeconomic news. Andersen et al. (2007) show that negative news is always good for the bond market and vice versa. But for the equity market the same news can be interpreted as good or bad depending on the state of the economy. The combined results of Christiansen, Ranaldo, and Söderlind (2011) and Andersen et al. (2007) suggest that volatility is a key driver in the time variation of the sign of the reaction of currencies with high interest rates to macroeconomic news. Indeed we do find such a relation.

The second contribution is that we provide a news-based definition of "bad" times which can explain part of the variation in carry returns. In that sense we add to the literature that has so far considered volatility and liquidity as indicators of "bad" times. In addition we connect the literature on the high-frequency response of currencies to news to the literature on explaining carry returns. We do so by defining a novel news index based on the time-varying response of currencies with high interest rates to macroeconomic news announcements.

Finally the novel news index is important for a better understanding of the relationship between macroeconomic news announcements and asset prices in the medium term. The news index can explain a sizeable portion of the variability in both monthly currency carry and monthly S&P 500 returns. Previous studies have found it difficult to link economic fundamentals and asset prices at this frequency, starting with the disconnect puzzle of Meese and Rogoff (1983).[29] Hence the aggregation of news in combination with the

[28] Hutchison and Sushko (2013) look at the impact of macroeconomic news announcements on carry trade activity.

[29] An exception is Mark (1995) who finds that exchange rate deviations from the fundamental value have predictive power for exchange rates.

reaction sign of high yield currencies can be seen as a breakthrough in linking fundamentals to asset prices in the medium term. It is not that news is not important. It is the time-variation in the reaction sign which makes it difficult to show news is important for asset prices.

3.2 Data

3.2.1 Exchange rates

Midpoint spot exchange rates are collected from Dukascopy[30] at the 5-minute frequency for G10 currencies (AUD, CAD, CHF, EUR, GBP, JPY, NOK, NZD, and SEK[31]) versus the U.S. Dollar (USD) for the period October 1, 2003 - July 31, 2014. The starting date is motivated by the availability of quality Bloomberg survey data on macroeconomic figures. Exchange rates are reported in USD per unit of foreign currency, so an increase in the exchange rate represents an appreciation of the foreign currency against the Dollar. Exchange rate returns are multiplied by 10,000 to obtain the changes in basis points (bps).

Measuring asset returns in a short 5-minute window is motivated by the nature of the event study. The Efficient Market Hypothesis (EMH) states that information is impounded into asset prices immediately, and this is supported by findings in the literature suggesting that the adjustment occurs quickly and is short-lived (e.g., Andersen et al., 2003; Dominguez, 2003). The finding of a strong relationship between fundamentals and exchange rates relies on avoiding the contamination of the return with other events that may happen around the announcement. Thus, the purest relationship between fundamentals and asset prices can only be established at a high frequency.

3.2.2 Yield portfolios

We construct yield portfolios by ranking currencies according to 3-month London Interbank Offered Rates (LIBORs). Each day, the three highest interest rate currencies are included in the equally weighted high-yield currency portfolio, and the bottom three currencies are included in the equally weighted low-yield portfolio. All the currency

[30] www.dukascopy.com. Dukascopy offers direct access to the Swiss Foreign Exchange Marketplace. This market provides the largest pool of electronic communication network spot forex liquidity available for banks, hedge funds, other institutions, and professional traders. In contrast to indicative quotes, Dukascopy quotes are tradable.

[31] AUD - Australian Dollar, CAD - Canadian Dollar, CHF - Swiss Franc, EUR - Euro, GBP - Pound Sterling, JPY - Japanese Yen, NOK - Norwegian Krone, NZD - New Zealand Dollar, and SEK - Swedish Krona.

returns are measured against the USD. The USD can be included in one of the two portfolios with a zero return. Buying currencies in the top 3 portfolios and selling currencies in the bottom portfolio (using currency forwards) is known as the popular carry strategy.

3.2.3 Macroeconomic announcements

We use real-time data on 50 expected and realized U.S. macroeconomic announcement figures (including the 25 U.S. announcements used by Andersen et al. (2003, 2007) that we collect from Bloomberg. In studies covering the period after 2003, Bloomberg replaced previously popular International Money Market Services (MMS) data that were discontinued in 2003.[32] Bloomberg is a widely used data source by market participants. Thus, the issue that forecasts do not reflect true market expectations is mitigated. Bloomberg screens display consensuses and actual figures as they appear, therefore providing a point of reference for traders who react to news. Vrugt (2009) verifies that Bloomberg data is efficient and unbiased.

Table 3.1 provides a brief description of the U.S. economic data used in this chapter. We show starting and ending dates, the number of observations, and the time and frequency of the announcements. Most of the announcement data cover the period October 2003 to July 2014 and include both consensus (median of economists') forecasts and actual announced figures.

The surprise part of the announcement is calculated as the difference between actual and consensus values. In order to compare the market impact across the announcements, we standardize the surprises by dividing by its full sample standard deviation just like Balduzzi et al. (2001). Hence, the standardized surprise for announcement k at time t is

$$S_{k,t} = \frac{A_{k,t} - E_{k,t}}{\hat{\sigma}_k}, \tag{3.1}$$

[32] In September 2003, Informa acquired MMS, a popular source of survey data, and discontinued the survey. The resulting sharp increase of replies to Bloomberg surveys implies that market participants regarded it as the new source of market consensus. Brenner, Pasquariello, and Subrahmanyam (2009) note that joining several sources of survey data is not viable because of potentially different survey methodologies (e.g., the MMS survey is closed on the last Friday the week before the announcement, while Bloomberg's last chance to give a reply is 3 days before the announcement).

where $E_{k,t}$ is the expected and $A_{k,t}$ the actual figure of announcement k at time t, and $\hat{\sigma}_k$ is the full sample standard deviation of surprises $A_{k,t} - E_{k,t}$.

In accordance with Faust et al. (2007), we define the sign of the surprise such that positive surprises represent stronger-than-expected growth or higher-than-expected inflation, i.e., good news. As a result, the signs of six announcements – the treasury budget, initial and continuing jobless claims, business and wholesale inventories, and the unemployment rate – are changed. Existing studies[33] find high-frequency exchange rate reactions to macroeconomic news to be in line with the predictions from Taylor-rule models (see for example Engel and West, 2005, and Engel et al., 2007). Upon the arrival of news that raises market expectations about the future path of the home country's short-term interest rates, the currency of the country tends to appreciate. Hence, larger-than-expected U.S. growth or inflation figures would raise expectations of higher interest rates, and subsequently an immediate USD appreciation against foreign currencies. It is expected that the central bank increases interest rates eventually, which makes U.S. assets more attractive, inducing a Dollar appreciation to equilibrate the asset market (Engel et al., 2007). Our definition of good news is therefore consistent both with theoretical exchange rate models and the empirical findings in the literature.

As in the study by Andersen et al. (2003), we group the U.S. announcements into eight categories: GDP, real activity, four components of GDP (consumption, investment, government purchases, and net exports), prices, and forward-looking announcements. The announcements within each sentiment group are in chronological order.[34]

In our analysis, we include seemingly overlapping figures (e.g., headline CPI and CPI Core) for several reasons. First, headline CPI and PPI news announcements are less than 50 percent correlated with their core[35] versions. Second, market participants often choose to put more weight on the versions of the data that exclude more volatile components.

[33] See for example Edison (1997), Almeida et al. (1998), Andersen et al. (2003) Chaboud, Chernenko, and Wright (2008), Ehrmann and Fratzscher (2005), Clarida and Waldman (2008), Faust et al. (2007), D'Arcy and Poole, (2010), and Fatum et al. (2010).

[34] To arrange the monthly announcements in chronological order, we use the median rank of announcement appearances in our sample. The standard deviations of the ranks are low, providing evidence for consistent chronological ordering in our sample.

[35] Core inflation excludes volatile components such as energy and food.

Table 3.1. Summary of the U.S. macroeconomic announcement data

	Announcement	Time (EST)	Dates	Frequency	Obs.
	Consumption				
1	Existing Home Sales	10:00	06/27/06 - 07/22/14	M	98
2	New Home Sales	10:00	10/27/03 - 07/24/14	M	129
3	Pending Home Sales	10:00	06/01/05 - 07/28/14	M	111
	Forward-looking				
4	Empire State Manufacturing	8:30	10/15/03 - 07/15/14	M	130
5	NAHB Index	13:00/10:00[ǂ]	10/16/03 - 07/16/14	M	130
6	Philadelphia Fed Survey	10:00	10/16/03 - 07/17/14	M	130
7	CB Consumer Confidence	10:00	10/28/03 - 07/29/14	M	130
8	Michigan Consumer Sentiment (P)	9:55	10/17/03 - 07/18/14	M	130
9	Michigan Consumer Sentiment (F)	9:55	10/31/03 - 06/27/14	M	129
10	Chicago PMI	9:45	10/31/03 - 07/31/14	M	130
11	ISM Manufacturing[a]	10:00	10/01/03 - 07/01/14	M	130
12	ISM Prices Paid[a]	10:00	10/01/03 - 07/01/14	M	130
13	ISM Non-Manufacturing	10:00	02/05/08 - 07/03/14	M	78
14	Building Permits[b]	8:30	10/17/03 - 07/17/14	M	130
15	Housing Starts[b]	8:30	10/17/03 - 07/17/14	M	130
16	Leading Indicators	10:00	10/20/03 - 07/18/14	M	130
	GDP				
17	GDP (A)	8:30	10/30/03 - 07/30/14	Q	44
18	GDP (P)	8:30	11/25/03 - 05/29/14	Q	43
19	GDP (F)	8:30	12/23/03 - 06/25/14	Q	43
	Government Purchases				
20	Treasury Budget	14:00	10/20/03 - 07/11/14	M	130
	Investment				
21	Durable Goods Orders	8:30	10/28/03 - 07/25/14	M	130
22	Construction Spending	10:00	10/01/03 - 07/01/14	M	129
23	Factory Orders	10:00	10/02/03 - 07/02/14	M	129
24	Wholesale Inventories	10:00	10/08/03 - 07/10/14	M	130
25	Business Inventories	10:00	10/16/03 - 07/15/14	M	130
	Net Exports				
26	Trade Balance	8:30	10/10/03 - 07/03/14	M	130

Table 3.1. Continued

Announcement	Time (EST)	Dates	Frequency	Obs.
Prices				
27 Import Prices	8:30	10/09/03 - 07/15/14	M	129
28 PPI[c]	8:30	10/10/03 - 01/15/14	M	124
29 PPI Core[c]	8:30	10/10/03 - 07/16/14	M	130
30 CPI[d]	8:30	10/16/03 - 07/22/14	M	130
31 CPI Core[d]	8:30	10/16/03 - 07/22/14	M	129
32 PCE	8:30	10/31/03 - 06/26/14	M	129
33 Cost Civilian Workers	8:30	10/30/03 - 07/31/14	Q	44
34 Unit Labor Costs (P)	8:30	11/06/03 - 05/07/14	Q	43
35 Unit Labor Costs (F)	8:30	12/03/03 - 06/04/14	Q	43
36 GDP Price Index (A)	8:30	07/29/05 - 07/30/14	Q	37
37 GDP Price Index (P)	8:30	05/26/05 - 05/29/14	Q	37
38 GDP Price Index (F)	8:30	06/29/05 - 06/25/14	Q	37
Real Activity				
39 ADP Employment	8:15	08/30/06 - 07/30/14	M	96
40 Non-farm Payroll Employment	8:30	10/03/03 - 07/03/14	M	130
41 Unemployment[e]	8:30	10/03/03 - 07/03/14	M	130
42 Retail Sales[e]	8:30	10/15/03 - 07/15/14	M	130
43 Capacity Utilization	9:15	10/16/03 - 07/16/14	M	130
44 Industrial Production	9:15	10/16/03 - 07/16/14	M	130
45 Personal Income	8:30	10/31/03 - 06/26/14	M	129
46 Consumer Credit	15:00	10/07/03 - 07/08/14	M	130
47 Non-farm Productivity (P)	8:30	11/06/03 - 05/07/14	M	43
48 Non-farm Productivity (F)	8:30	12/03/03 - 06/04/14	Q	42

Table 3.1. Continued

Announcement	Time (EST)	Dates	Frequency	Obs.
Weekly Real Activity				
49 Initial Jobless Claims[f]	8:30	10/02/03 - 07/31/14	W	566
50 Continuing Jobless Claims[f]	8:30	10/09/03 - 07/31/14	W	555

The table gives the starting and ending dates (mm/dd/yyyy), the number of observations, and the time and frequency of the macroeconomic announcements. The data is collected from Bloomberg. We group the U.S. announcements into eight categories: GDP, the four components of GDP (consumption, investment, government purchases, and net exports), real activity, prices, and forward-looking. Within each group, the announcements are in chronological order. Announcements marked with the same superscripts (e.g., *a, b, c, d, e, f)* occur at the same time. Frequency: Q - quarterly, M - monthly, W - weekly. In previous studies (e.g., Andersen et al., 2003), ISM announcements are known under the name NAPM.
ǂ For the period 5/15/2003-6/15/2010 the announcement time is 13:00 EST.
Abbreviations: EST - eastern standard time, PCE - personal consumption expenditures, NAHB - National Association of Home Builders, CB - Conference Board, PMI - Purchasing Managers Index, ISM - Institute of Supply Management (former NAPM - National Association of Purchasing Managers), GDP - gross domestic product, PPI - producer price index, CPI - consumer price index, ADP - Automatic Data Processing. A, P and F stands for advance, preliminary and final, respectively.

Finally, although core figures are expected to provide more information, we include the headline versions to be consistent with previous studies (Andersen et al., 2003, Faust et al. 2007).

Our macroeconomic news data includes different vintages of the data. GDP and GDP Price Index figures are updated three times in Advance, Preliminary and Final releases. Michigan Consumer Sentiment, Unit Labor Costs and Non-farm Productivity each have Preliminary and Final releases.

3.3 Response differences of high- and low-yield currencies

We specify and estimate two models of the impact of macroeconomic news on exchange rates. The first model estimates the impact of news on the conditional mean and relies on a consistent direction of the reaction. The second model estimates the effects on conditional volatility, thus allowing for time variation in the response direction. We show that the perceived impact of news on high-yield currencies depends on the model used.

3.3.1 Methodology

To provide evidence that economic fundamentals are relevant for asset prices, a large and active event study literature has developed.[36] The basic tool in this literature is the following univariate regression

$$R_{k,t} = \alpha_k + \beta_k S_{k,t} + \varepsilon_t, \tag{3.2}$$

where $R_{k,t}$ is the change in the asset price in a small window following the announcement k at time t, and $S_{k,t}$ is the standardized surprise of the announcement k at time t, see equation (3.1). The coefficient β_k measures the impact of the announcement k on the asset return.

Recent studies suggest that the impact of an announcement can be time-varying. Findings by Andersen et al. (2007) and Fratzscher (2009) point towards a changing sign of the reaction that depends on the business cycle and/or market level of stress. Changes over time in the reaction sign mean that the impact of an announcement estimated using equation (3.2) is biased towards zero (McQueen and Roley, 1993).

To avoid biased estimates due to variation in the reaction sign, we relate the absolute surprise to the absolute size of the currency reaction

$$\left|R_{t_k} - \bar{R}_{t_k}\right| = \alpha_k + \beta_k D_{t_k}\left|S_{k,t}\right| + \varepsilon_t, \tag{3.3}$$

where R_{t_k} are all trading-day returns in the interval of the day (for example, for non-farm payrolls, the announcement time t_k is 8:30-8:35) when the announcement k occurs, excluding days when announcement k does not occur but other announcements occur. By including days without macroeconomic news, we control for the increase in volatility that is not related to the news.

Andersen and Bollerslev (1998) find that the distinct intraday volatility pattern of DEMUSD is related to the activity cycle of financial centers. The same study finds that

[36] The literature studies the impact of macroeconomic announcements on different asset classes. For example, Andersen et al. (2003) investigate currencies, Faust et al. (2007) currencies and interest rates, Balduzzi et al., (2001) bonds, Andersen et al. (2007) the joint reaction of T-bills, equities and exchange rates, Kilian and Vega (2011) energy commodities, and Elder et al. (2012) metals.

there is very little evidence of predictability of the intraday conditional mean. Thus, such control is not necessary in equation (3.2). $\bar{R}_{t_k}$ is the sample mean of the returns. Although none of the analyzed mean returns is statistically different from zero, we deduct the average return to be consistent with volatility studies (e.g. Andersen and Bollerslev, 1998; Ederington and Lee, 1993). D_{t_k} is a dummy for announcement k at time t. Thus, α_k estimates the background volatility (e.g., bid-ask bounce and time-of-the-day activity patterns) unrelated to macroeconomic news, and β_k estimates the impact (in excess of background noise) on the returns of a one standard deviation surprise in announcement k.

This approach in equation (3.3) is similar to that used by Ederington and Lee (1993). However, they regress the absolute centered return on a dummy for the announcement. The authors do not use the surprise component by arguing that the forecast should accurately reflect market expectations. Because traders receive the actual value next to the consensus value on the Bloomberg screen, it is likely that economists' consensus is an anchor for the market participants and thus acts as the true market expectation. The use of absolute surprises and control for volatility patterns is similar to the approach used by Fleming and Remolona (1997).

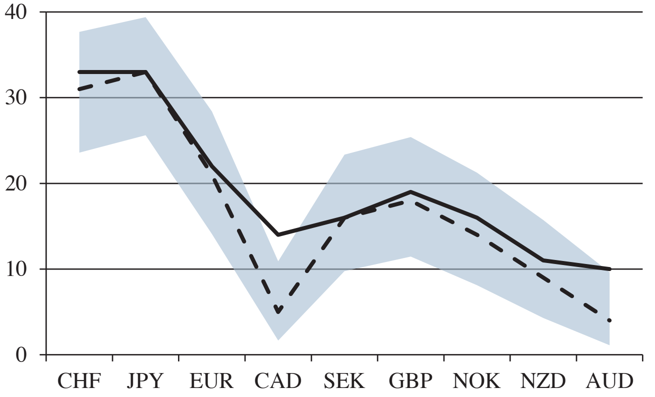
3.3.2 Effect on the mean

We start with the estimates of equation (3.2) for each currency separately. This approach leads to the conclusion that few U.S. announcements have a significant effect on USD crosses with high-yield currencies, whereas crosses with low-yield currencies react significantly to most news announcements.[37]

For each of the currencies analyzed, Figure 3.1 shows the number of significant announcements and the number of significant announcements with reaction sign predicted by Taylor-rule models (“fundamental”, i.e., good news for the U.S. is good news for the USD). The currencies are in increasing order of average interest rate rank in our sample period, with CHF most often being the lowest interest rate currency and AUD most often the highest. The lower the yield of the currency, the more significant the impact the announcements have on these currencies. Quite often, we see reactions opposite to the prediction of Taylor-rule models ("sentimental"; good news for the U.S. is good news for foreign currency). To eliminate those cases, leaving only significant “fundamental”

[37] Detailed results are available from authors upon request.

Figure 3.1. Number of significant announcements



The figure summarizes for each currency how often β_k in equation (2) is significant at the 10 percent significance level for the 50 announcements k listed in Table 2. The solid line depicts the number of statistically significant U.S. announcements, and the dashed line depicts the number of significant announcements with a "fundamental" response on average (good news for the U.S. is good news for the USD). The shaded area provides a 90 percent confidence interval for the dashed line based on the Clopper-Pearson (1934) method, assuming that the significance of each announcement k is independent. Currencies are sorted according to their average interest rate in the full sample (October 2003 – July 2014) with AUD having on average the highest interest rate.

reactions makes the difference between low- and high-yielding currencies even more pronounced. The effect is strongest between the currencies that are almost always in the high- and low-yield portfolios. Confidence intervals for the Japanese Yen (JPY) and Swiss Franc (CHF) do not overlap with those of the New Zealand Dollar (NZD) and the Australian Dollar (AUD). It demonstrates that high-yield currencies have a significantly lower number of significant "fundamental" responses to news announcements when judged by the results from equation (3.2).

3.3.3 Non-farm payrolls

To gain greater insight into the difference between the responses to news announcements of high- and low-yield currencies, we provide an example for non-farm payrolls. Several studies find that non-farm payrolls constitute one of the most influential announcements; see for example Andersen and Bollerslev (1998).

Table 3.2 provides the estimates of equation (3.2) for non-farm payrolls. Our results for the JPY, CHF, EUR and GBP are consistent with the findings of previous studies (Andersen et al., 2003; Faust et al., 2007). These currencies react strongly to non-farm payroll announcements in a "fundamental" way (good news for the U.S. is good news for the USD). Results for the currencies that are generally not analyzed in the high-frequency macroeconomic reaction literature are striking. There is no significant reaction to non-farm payrolls of the AUD, NZD and CAD, and only a small impact on NOK and SEK.

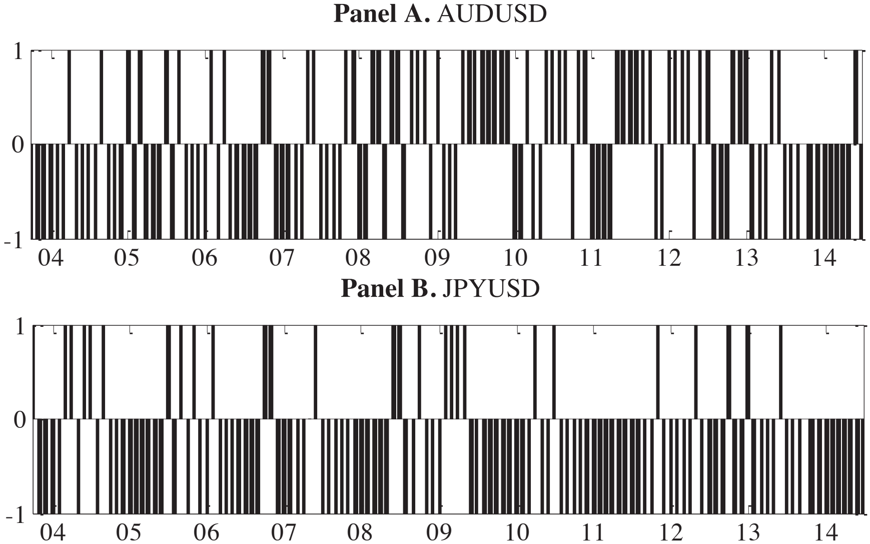
An important question to ask is whether U.S. news really has no impact on some currencies or whether our model estimates are biased towards zero because we do not take the possible changes in the sign of the reaction to news into account. We compare two currencies: The Australian Dollar which on average does not react to payroll announcements, and the Japanese Yen which reacts significantly to payroll announcements. The currencies differ in yields as well: the Australian short-term interest rate is among the highest on average, whereas the Japanese short-term interest rate is among the lowest on average.

Table 3.2. Impact of non-farm payrolls

	β	R^2
JPY	-25.60***	0.37
CHF	-21.03***	0.28
EUR	-15.25***	0.20
GBP	-11.31***	0.19
NOK	-11.00***	0.11
SEK	-11.06**	0.10
AUD	-6.71	0.04
NZD	-5.89	0.03
CAD	2.72	0.01

Estimates of the regression $R_t = \alpha + \beta S_t + \varepsilon_t$, with R_t representing the 5-minute returns following surprises, S_t, in non-farm payrolls. All currencies are measured against the USD, and the sample period covers October 2003 to July 2014. P-values are calculated using HAC-consistent errors. The first four currencies are the same as those analyzed by Andersen et al. (2003).

Figure 3.2. Payroll surprises and 5-minute currency reactions



The relationship between surprises in non-farm payrolls and the exchange rate reaction (AUDUSD and JPYUSD) is represented by "-1" bar if the surprise and currency return are of opposite signs, and "+1" otherwise. Taylor-rule exchange rate models predict a negative relationship between surprises and returns, where an improvement in U.S. economic conditions leads to a depreciation of foreign currency. The sample period is October 2003 to July 2014.

In Figure 3.2, we plot the signs of the surprise and return relationship. A “+1” indicates that a positive (negative) surprise leads to appreciation (depreciation) of the foreign currency, and a “-1” indicates that a positive (negative) surprise leads to depreciation (appreciation) of the foreign currency. The figure reveals a strong pattern: the Japanese Yen has predominantly the same (i.e., “fundamental”) reaction to payroll surprises. However, the Australian Dollar often reacts in the opposite (“sentimental”) way. Before 2008, the AUD mostly reacted in the same direction as the JPY – both appreciated (depreciated) in response to bad (good) non-farm payroll news. In 2008-2012, AUD reactions are mostly opposite to the JPY reactions. The changed sign in the response of the AUD is not constrained to the recession period[38], as in the study by Andersen et al. (2007), or the crisis period (July 2008 – January 2009) as in the study by Fratzscher (2009). The

[38] NBER recession: 2007 December - 2009 June. McQueen and Roley (1993) use industrial production to define the state of the economy. Alternatively, Andersen et al. (2007) use changes in non-farm payrolls as an expansion-recession classification. The authors claim that this classification is close to both NBER- and industrial production-based classifications.

finding suggests that the model in equation (3.2), used to estimate announcement effects, is inappropriate for high-yield currencies. Because the results for the highest- and the lowest-yield currencies differ the most, we proceed with the analysis using dynamic yield-based currency portfolios.[39]

3.3.4 Return responses of high- and low-yield currency portfolios

Table 3.3 shows the results of equation (3.2) for the high- and low-yield portfolios. For 33 of 50 announcements, the response of the low-yield portfolio is significant, at least at the 10 percent confidence level. However, for the high-yield currencies, only 12 announcements on average draw a significant response. For the low-yield portfolio, the sign of all but one significant announcement (Consumer Credit) is "fundamental." But for the high-yield portfolio, the average response to 3 of the 12 significant announcements is "sentimental." In this respect, the forward-looking category stands out – 2 of the 3 "sentimental" announcements are in this category. These announcements are the Conference Board Consumer Confidence and ISM Prices Paid. In the real activity category, Consumer Credit also tends to draw a "sentimental" response from high-yield currencies.

The different announcement effects on high- and low-yield currencies relate to the literature in two ways. Empirical pricing models (Lustig et al., 2011; Menkhoff et al., 2012) show that two factors, the "Dollar" and the "carry trade" risk, are important in currency pricing. The Dollar risk factor is the equally weighted foreign currency portfolio; the carry trade factor is the difference between the highest- and lowest-yield currency portfolios. Both studies relate the carry trade factor to global risk. Menkhoff et al. (2012) define global risk as the average of absolute currency returns; Lustig et al. (2011) show that carry trade risk is closely related to the volatility of equity markets around the world. All currencies load equally on Dollar risk, whereas high- and low-yield currencies load with an opposite sign on global risk. An increase in global risk on average leads to an appreciation of low-yield currencies and a depreciation of high-yield currencies. Hence our findings for the differences in reactions to forward-looking news announcements of high- and low-yield currencies are in line with the predictions of the aforementioned empirical pricing models.

[39] Detailed results for the 9 individual currencies are available in the Appendix at the end of the chapter.

Table 3.3. Announcement effects on returns and volatilities

	Impact on Return				Impact on Volatility			
Announcement	β_{LOW}	R^2	β_{HIGH}	R^2	β_{LOW}	R^2	β_{HIGH}	R^2
Consumption								
1 Existing Home Sales	-2.30**	0.10	2.21	0.04	2.58***	0.05	4.01***	0.04
2 New Home Sales	-4.06***	0.25	-1.41*	0.02	3.39***	0.06	2.04***	0.01
3 Pending Home Sales	-1.39**	0.04	1.89	0.04	1.15***	0.01	2.42**	0.02
Forward-looking								
4 Empire State Manufacturing	-3.07***	0.15	-0.26	0.00	3.18***	0.10	2.38***	0.03
5 NAHB Index	-1.63***	0.21	-0.94	0.03	0.83***	0.01	0.83*	0.00
6 Philadelphia Fed Survey	-3.54***	0.30	1.86	0.04	2.74***	0.06	4.05***	0.04
7 CB Consumer Confidence	-2.08**	0.07	3.06*	0.08	2.57***	0.04	4.61***	0.06
8 Michigan Consumer Sentiment (P)	-1.98***	0.12	-1.38**	0.04	1.49***	0.02	1.33***	0.01
9 Michigan Consumer Sentiment (F)	-0.83**	0.03	-0.97*	0.02	0.63**	0.00	0.93**	0.00
10 Chicago PMI	-1.58**	0.07	-1.06	0.02	1.64***	0.02	1.28**	0.00
11 ISM Manufacturing[a]	-5.38***	0.33	1.30	0.01	4.42***	0.10	4.44***	0.05
12 ISM Prices Paid[a]	-1.17	0.02	2.76**	0.05	3.25***	0.05	4.04***	0.04
13 ISM Non-Manufacturing	-4.07***	0.31	-0.61	0.00	2.89***	0.07	2.65***	0.02
14 Building Permits[b]	-0.83	0.01	-0.31	0.00	3.38***	0.11	2.42***	0.03
15 Housing Starts[b]	-1.59**	0.04	-0.53	0.00	3.25***	0.10	2.00***	0.02
16 Leading Indicators	-0.94**	0.03	-0.23	0.00	0.84***	0.00	0.88	0.00
GDP								
17 GDP (A)	-9.43***	0.40	-5.27*	0.12	9.10***	0.23	7.90***	0.10
18 GDP (P)	-3.41***	0.20	-2.17	0.04	3.74***	0.07	2.94**	0.02
19 GDP (F)	-3.38***	0.29	-2.7**	0.12	2.45***	0.03	2.73***	0.02
Government Purchases								
20 Treasury Budget	-0.17	0.01	-0.37	0.01	-0.13	0.00	-0.05	0.00
Investment								
21 Durable Goods Orders	-3.40***	0.13	-0.89	0.01	4.51***	0.17	3.59***	0.06
22 Construction Spending	1.16	0.02	0.78	0.00	2.63***	0.03	4.24***	0.04
23 Factory Orders	-1.6***	0.07	-0.69	0.01	1.17***	0.01	1.17**	0.00
24 Wholesale Inventories	0.65	0.02	0.79	0.01	0.86**	0.00	1.11**	0.00
25 Business Inventories	0.38	0.00	0.43	0.00	1.13***	0.01	0.66	0.00
Net Exports								
26 Trade Balance	-5.29***	0.13	-3.39**	0.08	5.70***	0.14	4.38***	0.08

Table 3.3. Continued

	Impact on Return				Impact on Volatility			
Announcement	β_{LOW}	R^2	β_{HIGH}	R^2	β_{LOW}	R^2	β_{HIGH}	R^2
Prices								
27 Import Prices	-2.02*	0.04	-1.56	0.02	3.82***	0.11	3.64***	0.06
28 PPI[c]	-2.09***	0.05	-0.86	0.01	3.04***	0.08	2.63***	0.03
29 PPI Core[c]	-2.59***	0.09	-1.76***	0.03	3.39***	0.10	2.11***	0.02
30 CPI[d]	-0.72	0.00	-1.52	0.02	4.10***	0.12	3.95***	0.06
31 CPI Core[d]	-3.63***	0.11	-4.55***	0.15	5.00***	0.17	4.49***	0.08
32 PCE	-0.62	0.01	-0.36	0.00	1.13***	0.01	0.57	0.00
33 Cost Civilian Workers	1.56	0.02	-0.84	0.01	4.46***	0.07	2.92***	0.02
34 Unit Labor Costs (P)	1.62	0.05	1.57	0.03	2.43***	0.03	2.47***	0.01
35 Unit Labor Costs (F)	-0.32	0.00	-0.4	0.00	1.57***	0.01	0.78	0.00
36 GDP Price Index (A)	0.41	0.00	0.06	0.00	6.79***	0.14	6.88***	0.08
37 GDP Price Index (P)	0.06	0.00	-0.31	0.00	2.13***	0.02	1.21	0.00
38 GDP Price Index (F)	0.81	0.02	0.20	0.00	1.92**	0.02	1.42**	0.00
Real Activity								
39 ADP Employment	-5.16***	0.38	-0.37	0.00	5.3***	0.20	4.56***	0.05
40 Non-farm Payroll Employment	-15.82***	0.33	-6.72*	0.05	17.34***	0.42	19.70***	0.41
41 Unemployment[e]	-2.65	0.01	0.95	0.00	12.77***	0.24	15.14***	0.25
42 Retail Sales[e]	-4.44***	0.16	0.85	0.00	5.04***	0.16	6.67***	0.17
43 Capacity Utilization	-1.09**	0.05	0.17	0.00	1.24***	0.01	1.37**	0.01
44 Industrial Production	-1.15***	0.06	0.25	0.00	1.01***	0.01	1.34**	0.01
45 Personal Income	-0.41	0.00	0.31	0.00	1.17**	0.02	0.84	0.00
46 Consumer Credit	0.49***	0.05	0.68*	0.03	0.09	0.00	0.47	0.00
47 Non-farm Productivity (P)	-0.53	0.01	0.26	0.00	2.13***	0.03	2.7***	0.02
48 Non-farm Productivity (F)	-2.03***	0.13	-0.99	0.02	1.77***	0.02	2.4***	0.01

Table 3.3. Continued

	Impact on Return				Impact on Volatility			
Announcement	β_{LOW}	R^2	β_{HIGH}	R^2	β_{LOW}	R^2	β_{HIGH}	R^2
Weekly Real Activity								
49 Initial Jobless Claims[f]	-1.64**	0.04	0.68	0.01	2.00**	0.07	2.31**	0.05
50 Continuing Jobless Claims[f]	-0.8**	0.01	0.03	0.00	2.08***	0.07	2.67***	0.07

Estimates of the impact of news on the 5-minute return and volatility of high- (β_{HIGH}) and low- (β_{LOW}) yield currency portfolios. Models (1) $R_{k,t} = \alpha_k + \beta_k S_{k,t} + \varepsilon_t$ and (2) $|R_{k,t} - \bar{R}_k| = \alpha_k + \beta_k D_{k,t}|S_{k,t}| + \varepsilon_t$ are used to measure the impact of news impact on return and volatility. Here $R_{k,t}$ is the 5-minute return of high- (HIGH) or low- (LOW) yield currency portfolios, and $S_{k,t}$ is the standardized surprise of announcement k. For equation (1) only announcement returns are used. Equation (2) uses all returns that occur in the same 5-minute interval of the day as the announcement; thus, dummy $D_{k,t}$ is equal to 1 if the return is associated with the macroeconomic surprise $S_{k,t}$, and zero otherwise. $\bar{R}_k$ is the sample mean, $\bar{R}_k = \frac{1}{T_k}\sum_{t=1}^{T_k} R_{k,t}$, of the returns. *, ** and *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively, using HAC errors. Announcements marked with superscripts *a, b ,c ,d, e ,f* occur at the same time. A, P and F stands for advance preliminary and final, respectively. The signs of Treasury Budget, Wholesale Inventories, Business Inventories, Unemployment, Initial Jobless Claims, and Continuing Jobless Claims surprises are changed to mean good economic news.

The question remains of why so few U.S. announcements seem to have a significant impact on high-yield currencies, whereas for low-yield currencies most of the announcements are important. We hypothesize that while some announcements may give more information on the Dollar and global risks, other announcements may have time-varying information content. For example, Boyd et al. (2005) and Andersen et al. (2007) explain the time variation in the reaction of equity markets by the information the news carries; sometimes, the news provides information about growth, whereas at other times, it is concerned with the discount factor. In addition, Christiansen et al. (2011) show that the exposure of high-yield currencies to the equity market is time-varying and positively related to currency market volatility, as an increase in the market volatility strengthens the relationship between the high-yield currencies and equities.

3.3.5 Volatility responses of high- and low-yield currency portfolios

We hypothesize that the low number of announcements significantly affecting high-yield currencies may be due to variation in the reaction sign. We therefore proceed with estimating volatility equation (3.3) for both high- and low-yield currency portfolios. Table 3 shows the results. First, the number of significant announcements increases to 48 and 42 (out of a max of 50) for low- and high-yield currency portfolios, respectively. The increase is especially large for high-yield currencies, which according to estimates of equation (3.2), significantly react to only 12 macroeconomic announcements. Second, the low-yield portfolio estimates for coefficient β_k in equations (3.2) and (3.3) have a strong correlation of -0.74, whereas the correlation is only -0.36 for the high-yield portfolio (detailed results are provided in the Appendix at the end of the chapter). The estimates of coefficient β_k in equation (3.3) for high-yield and low-yield portfolios are highly correlated (0.96), whereas the correlation of the estimates of equation (3.2) is only 0.68, pointing towards the conclusion that the absolute importance of the announcements is similar for high- and low-yield currencies. In combination with the estimates of equation (3.2), we conclude that the interpretation of the same information (the direction of the reaction) is different for high- and low-yield currencies. In light of these findings, we conclude that insignificant results of the traditional approach in equation (3.2) must be caused by the changing sign in the response of high-yield currencies to surprises in news and not because these announcements are not important for high-yield currencies.

3.3.6 Time variation in the frequency of sentimental reactions

The sign of the response of especially high-yield currencies varies over time. When good (bad) news leads to the appreciation (depreciation) of the USD, we call it a “fundamental” reaction. When good (bad) news leads to the depreciation (appreciation) of the USD, we call it a “sentimental” reaction.

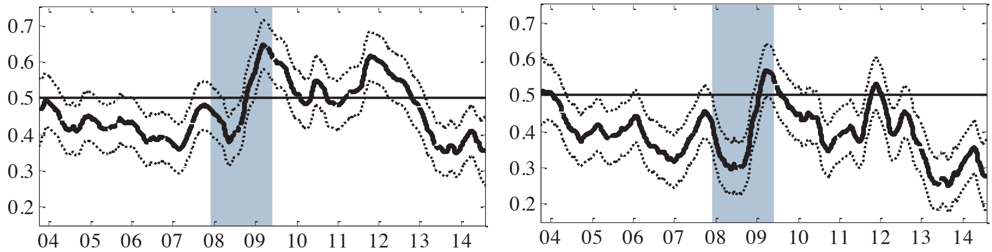
To gauge (1) the persistence and (2) the variation over time of "fundamental" and "sentimental" reactions, we model the fraction of "sentimental" reactions in a framework of a basic local-level state space model. The model can be written as

$$\begin{aligned} x_t &= \mu_t + \varepsilon_t, \quad \varepsilon_t \sim NID(0, \sigma_\varepsilon^2), \\ \mu_{t+1} &= \mu_t + \upsilon_t, \quad \upsilon_t \sim NID(0, \sigma_\upsilon^2), \end{aligned} \tag{3.4}$$

where x_t is the fraction of "sentimental" reactions at time t, μ_t is the unobserved level at time t, ε_t is the observation and υ_t is the level of disturbance at time t. The disturbances are normally and independently distributed with mean zero and variances σ_ε^2 and σ_υ^2. The parameters σ_ε^2 and σ_υ^2can be estimated by maximum likelihood. Estimates of the

Figure 3.3. Time-varying sign of macroeconomic reactions

Panel A. High-yield currencies **Panel B.** Low-yield currencies



These figures show the frequency of the sentimental reactions of currency portfolios to surprises in macroeconomic news announcements. When good (bad) news leads to an appreciation (depreciation) of the foreign currencies, we label it sentimental, otherwise we label it fundamental. We then estimate the local-level state space model to gauge the frequency of sentimental reactions aggregated over all 50 macroeconomic announcements shown in Table 3. The solid line is the Kalman-smoothed estimate of the frequency of local-level sentimental reactions, and the dashed lines are 90 percent confidence bounds. Panel A shows the frequency of sentimental reactions for the high-yield currencies and Panel B for the low-yield currencies. The shaded area highlights the NBER recession period from December 2007 to June 2009.

unobserved value of μ_t at each point in time and its standard error conditional on the whole sample are formed using the Kalman smoother (see for example Durbin and Koopman, 2012). We use all of the U.S. announcements in the estimation. For comparison, we also estimate the fraction of good news (positive surprises).

Figure 3.3 shows the news-based sentiment measure, i.e., the fraction of sentimental reactions to surprises in news announcements. The average sign of the response of the high-yield currency portfolio to news is time-varying; see the left panel of Figure 3.3. Firstly, from 2004 to 2008, the high-yield currency portfolio responds more often in a "fundamental" way. In 2009, however, the reactions are predominantly "sentimental." The year 2010 is more balanced, with frequent switches between "fundamental" and “sentimental" reactions. However from mid-2011 till mid-2012 “sentimental” reactions dominate again. From 2013 onwards, the reactions are again fundamental.

In contrast, the low-yield currency portfolio does not have any period where the fraction of sentimental reactions to news significantly exceeds that of fundamental reactions. Still, there is variation in the ratio of sentimental and fundamental reactions that is similar to that for high-yield currencies.

3.3.7 News, business cycle and FX reactions

Andersen et al. (2003) show that the reactions of exchange rates to positive and negative news are asymmetric – the reactions to negative news are stronger in periods of economic expansion. Andersen et al. (2007) find an asymmetric reaction of the equity market over the business cycle. Good news during expansion periods is bad for stocks, whereas it is good for stocks during recession periods. Veronesi (1999) assumes that investors believe that the economy follows a two-stage process where the low and high stages correspond to recessions and expansions, respectively. Because good (bad) news in the low (high) state increases the uncertainty about the stage of the economy, investors require additional compensation for the state risk. This makes stock prices overreact to bad news in good times and underreact to good news in bad times.

For the high-yield currency portfolio, we examine whether the frequency of fundamental and sentimental reactions to news depends on the stage of the business cycle and the sign of the news. Panel A of Table 3.4 shows that the frequency of positive and negative news surprises does not significantly differ from 50 percent during both recessions and expansions.

Panel B in Table 3.4 shows that both good and bad news slightly more often trigger a fundamental response of the high-yield currency portfolio, i.e., good U.S. news leads to the appreciation of the USD. The good news is slightly more likely to be sentimental. News during expansions draws significantly less sentimental reactions. The difference between the number of sentimental and fundamental reactions is not statistically significant in recessions. Combining the distinction between good news and bad news with the business cycle, we see that it is mainly positive news during expansions that leads to a significantly higher fraction of "fundamental" reactions of the high-yield currency portfolio to news.

In general, the results in Table 3.4 at best indicate a weak dependence between the number of sentimental reactions on the one hand and the sign of news surprises and the status of the business cycle on the other hand. Hence, a sentimental reaction is something new beyond the sign of news surprises and the business cycle. We therefore look for other explanatory variables for the time variation in the sentiment.

Table 3.4. Business Cycle, News and FX reactions

Panel A.

	Good	Bad	%Good
Recession	392	419	0.48
Expansion	2444	2422	0.50

Panel B.

	Fundamental	Sentimental	%Sentimental
Good	1497	1331	0.47***
Bad	1536	1294	0.46***
Expansion	2614	2234	0.46***
Recession	419	391	0.48
Good Expansion	1293	1144	0.47***
Good Recession	204	187	0.48
Bad Expansion	1321	1090	0.45
Bad Recession	215	204	0.49

The table shows in Panel A the frequency of good news (‘Good’) and bad news (‘Bad’) as measured by surprises in macroeconomic announcements during recessions and expansions as classified by the NBER. In Panel B, we also consider the interaction of good and bad news and expansions and recessions with the frequency of times that the high-yield currency portfolio responds in a fundamental or sentimental way to news. When good (bad) news leads to an appreciation of the high-yielding currencies, we label it sentimental (fundamental), and when good (bad) news leads to a depreciation of the high-yielding currencies, we label it fundamental (sentimental). The reported p-values test the null hypothesis that the frequency of the object does not deviate from 50 percent. The sample period is October 2003 to July 2014.
***, **, * indicate parameter significance at the 1, 5 and 10 percent levels, respectively.

3.3.8 Sentimental reactions and currency volatility

Implied volatility indices are thought to measure investor fear. The VIX, based on the implied volatilities of options on the S&P500 index, is a commonly used proxy to gauge investor fear about the U.S. economy. In the foreign exchange market, the fear cannot be

Table 3.5. CVIX and the reactions to macroeconomic news

	CVIX	Fundamental	Sentimental	%Sentimental
Low	6.9	680	452	0.40***
2	8.4	632	455	0.42***
3	9.6	615	478	0.44***
4	11.2	601	569	0.49
High	14.9	505	671	0.57***

This table shows the relationship between Deutsche Bank's currency volatility index CVIX and the frequency of fundamental and sentimental reactions to surprises in macroeconomic news announcements for the high-yield currency portfolio. When good (bad) news leads to an appreciation (depreciation) of the high-yielding currencies we label it sentimental, otherwise we label it as fundamental. The high-yield currency portfolio reactions are divided over implied volatility quintiles (low, 2, 3, 4, high CVIX). The quintiles are formed using all daily observations of CVIX in the sample period of October 2003 to July 2014. The average CVIX levels within the quintiles are given in the second column. The reactions are matched with the last available end-of-day (17.00 EST) volatility quintile before the news announcement. The reported p-values are for the null hypothesis that the fraction of sentimental is equal to 50 percent. ***, **, * indicate significance at 1 percent, 5 percent, and 10 percent levels, respectively.

assigned to a particular country and thus should be regarded as *global*. We therefore use the implied currency market volatility index (CVIX) of Deutsche Bank[40] as global proxy for investor fear. We divide announcements into quintiles based on the last available end-of-day value of CVIX before the announcement. For each announcement, we have the response sign of the high-yield currency portfolio. We then count for each CVIX quintile how often we see a "fundamental" or "sentimental" response of the high-yield currency portfolio to news.

The results in Table 3.5 show a strong relationship between the level of implied currency volatility and the frequency of sentimental reactions of the high-yield currency portfolio to news. The fraction of sentimental reactions increases monotonically with the level of implied volatility – from 40 percent in the lowest quintile to 57 percent in the highest volatility quintile.[41] In the next section, we directly link carry performance to economic news.

[40] http://www.globalmarkets.db.com/new/docs/DBGuideToFXIndices.pdf (Bloomberg: CVIX3I Index).
[41] The findings are similar when using VIX or currency volatility in the past month.

3.3.9 News and carry strategy returns

In the second half of 2008, most of the currencies depreciated against the USD, with the exception being the Japanese Yen, which appreciated strongly in the same period. Fratzscher (2009) demonstrates that this coincided with predominantly negative economic news and a change in the reaction sign to U.S. macroeconomic news. Fratzscher hypothesizes that the bad economic news "may either have been perceived as even worse news for other economies, or have triggered an actual or expected repatriation of capital from foreign markets." Brunnermeier, Nagel, and Pedersen (2009) conjecture that "sudden exchange rate moves unrelated to news can be due to the unwinding of carry trades." The period analyzed by Fratzscher (2009) is characterized by large losses on the carry trade. Thus, the two studies disagree about whether carry unwinding can be related to the news. Besides providing additional facts regarding the dispute, we shed some light on the relationship between sentimental reactions, news and carry performance from September 2008 to September 2009 when the carry strategy experienced large losses and gains.

To relate carry performance to news and sentimental reactions, we divide the September 2008 to September 2009 period into two half-year periods. In support of Fratzscher (2009), the period September 2008 to March 2009 is dominated by negative economic news (63 percent of the time, the surprises in news announcements are negative) and carry losses (-22.6 percent in total). Interestingly, March 2009 to September 2009 is dominated by good news (57 percent good news) and positive carry performance (19 percent in total).

The entire period is dominated by sentimental reactions[42] and increased volatility (CVIX) that is larger in the first period but remains elevated in the second period. The carry strategy demonstrates large losses in the first half and large gains in the second half of the period. Hence, we add to the conclusion of Menkhoff et al. (2012), who find that carry currencies are negatively related to innovations in global FX volatility. But what we add is that in the "sentimental" environment carry can both gain and lose depending on the dominance of good or bad economic news.

[42] In both periods, the majority of the reactions are sentimental; however, statistical significance is found only in the second period.

3.4 News-based indices and asset returns

Announcement studies find a strong relationship between economic news and asset returns in short windows around announcement times. However, few studies find a link between economic fundamentals and asset returns in the medium term. In this section, we bridge the two streams of literature and connect macroeconomic news to monthly asset returns. We construct macroeconomic news indices and show that the impact of news on asset prices extends into the medium term.

3.4.1 Construction of the news indices

Several brokers have launched macroeconomic news indices, with Citi's Economic Surprise Indices (CESI) perhaps most popular. The basic concept is to aggregate over time the surprises of all available macroeconomic news announcements to get a measure of the imbalance between good news (positive surprises) and bad news (negative surprises).

Combining the findings in the literature and in this chapter, we construct three U.S. news indices[43]: general news, sentimental news and fundamental news. In constructing these indices we make six choices:

i. Include all available announcements. More announcements provide a more complete picture of the macroeconomic situation.

ii. Include the size of standardized surprises because larger surprises have a larger impact on the market (e.g., Andersen et al., 2003).

iii. Weight surprises by their impact on return volatility, not returns. Given the time-varying response of high-yield currencies (documented in Section 3.3) and equities, positive and negative responses to the same (e.g., good) news will push average return reactions towards zero. In addition, some news is more important than other news, and this should be reflected in the weighting scheme.

iv. Weights are time-varying to account for the changing importance of announcements (the scapegoat models of Bacchetta and Van Wincoop (2004)).

[43] We focus on U.S. news for two reasons: First U.S. news is the most important economy, see e.g. Andersen et al. (2003). Second the U.S. Dollar in crisis times has the role of a safe haven currency (e.g. Froot and Thaler, 1990; Cumby, 1988). This way we can use the time-variation in the reaction sign of the risky currencies vis-à-vis the safe haven U.S. Dollar to construct our novel sentimental news index.

v. Measure surprise impact on return volatility in a short window around macroeconomic announcements to prevent contamination. The literature finds news has immediate impact on asset prices (Andersen et al., 2003) with little trading (e.g. Balduzzi, Elton, and Green, 2001).

vi. Take into account the time variation in the response sign to news of high-yield currencies.

The importance of considering these six choices to construct the news indices is analyzed in Section 4.6.

The general news index is based on the weighted sum of standardized macroeconomic surprises. We aim to relate news and monthly asset returns; thus, the news index is the weighted sum of news in month τ

$$N_\tau = \sum_{k \in A} \sum_{t \in \tau} w_{k,t} S_{k,t}, \tag{3.5}$$

where weights $w_{k,t}$ are the rolling one-year estimates of β_k in equation (3.3) for the high-yield portfolio.[44] The symbol A denotes the set of news items included in the index calculation (see Table 3.3). Based on our insights into the response to news of high-yield currencies, we split the news index into two parts. First, we consider only news that draws a fundamental response from the high-yield currency portfolio, i.e. a response in line with the predictions of Taylor rule models,

$$F_\tau = \sum_{k \in A} \sum_{t \in \tau} w_{k,t} S_{k,t} D_{k,t}, \tag{3.6}$$

where $D_{k,t}$ equals 1 if the high-yield portfolio appreciates (depreciates) vis-à-vis the USD in response to bad (good news). Second, we consider only news that draws a sentimental response from the high-yield currency portfolio

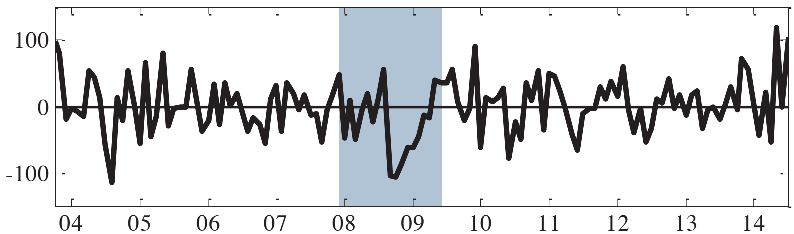
[44] The use of this news index and several of the aforementioned five considerations in constructing the index is largely inspired by the Citigroup economic surprise indices (see Bloomberg: CESIUSD Index). The end-of-month U.S. Citigroup economic news index has correlations of 0.55, 0.33 and 0.41 with our general (N), fundamental (F) and sentimental (S) news indices, respectively.

$$S_\tau = \sum_{k \in A} \sum_{t \in \tau} w_{k,t} S_{k,t} \left(1 - D_{k,t}\right). \qquad (3.7)$$

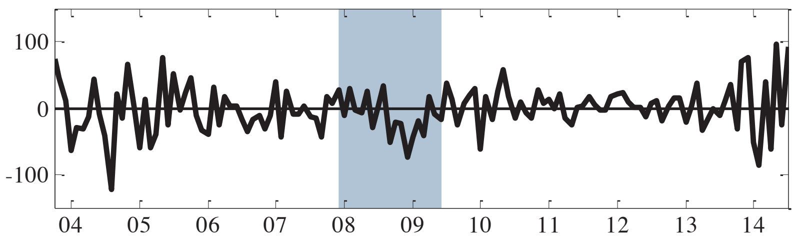
Figure 3.4 presents the monthly plots of each of the three indices. A positive value for F_τ indicates the news in month τ was on average good for the U.S. dollar. A positive value for S_τ, however, shows on average news was good for high yield currencies. Because N is the sum of F and S, a positive value does not consistently indicate good or bad information for any asset in particular. Positive N indicates the news is positive for the U.S. economy in general.

Figure 3.4. News indices

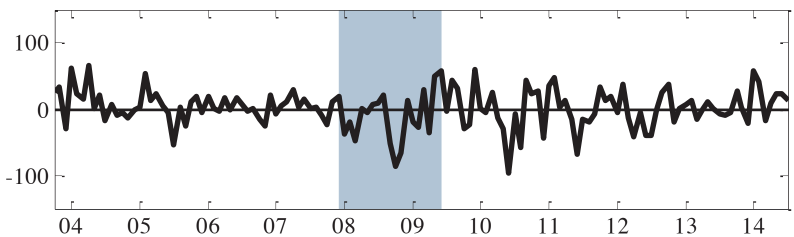
Panel A. General news index (N)



Panel B. Fundamental news index (F)



Panel C. Sentimental news index (S)



This figure shows the monthly news indices defined in equations (5) (general news index N), (6) (fundamental news index, F) and (7) (sentimental news index, S). The shaded area highlights the NBER recession period from December 2007 to June 2009.

3.4.2 News indices and carry returns

We regress the monthly returns of the carry (long the top 3 highest yield currencies, short the bottom 3 lowest yield currencies[45]) on the news indices. The estimates are reported in Table 3.6. Panel A of Table 3.6 shows the news index N has a highly significant beta and explains 7 percent of the variation in the monthly carry returns. Hence the aggregate measure of surprises in all news announcements in a given month shows that news is important for monthly carry returns. The sign of the beta indicates that on average carry returns are higher when there are more positive surprises in macroeconomic news announcements.

In contrast the news index F, based on the subset of news that triggers a reaction of the high interest rate currencies in line with what Taylor rule models predict, does not explain any of the variation in the monthly carry returns and has an insignificant beta. One explanation is that in the case of fundamental news, both the low-yield and the high-yield currencies move in the same direction vis-à-vis the USD, reducing the impact on the high-minus low-yield returns, i.e., the carry.

Given that the news index N is the sum of news indices F and S, the results indicate the explanatory power of news index N must all come from the sentimental news index S. The results in Table 3.6 show that S, based on the subset of news that triggers a reaction of the high interest rate currencies opposite to what Taylor rule models predict, explains 12% of the monthly carry returns with a highly significant beta. The highly significant positive beta coefficient of 1.45 indicates that bad economic news is bad for carry returns. To put the R^2 of 12% into perspective we note that the 5 minute intraday returns following announcements only cover 0.3% of total time. In addition, in the index we are not using return size, but only the weight, sign of the reaction and the surprise in the announcement.

[45] The carry portfolio is formed following Lustig, Roussanov, and Verdelhan (2011) methodology. We apply their methodology for G10 currencies, with monthly portfolio rebalancing.

Table 3.6. News and carry returns

	N	***F***	***S***
Panel A. Full sample			
β	0.73**	0.10	1.45**
R^2	0.07	0.00	0.12
$\bar{R}^2$	0.06	-0.01	0.11
Panel B. Sentimental period			
β	1.79**	0.05	2.15***
R^2	0.23	0.00	0.27
$\bar{R}^2$	0.21	-0.02	0.25

The table presents the results from regressing monthly carry returns on monthly news indices. *N* is the general news index, *F* is based on the subset of news announcements that trigger a reaction of the high yield currencies in line with Taylor rule models, and *S* is based on the announcements that trigger a reaction opposite to that expected by Taylor rule models, see equations (5) to (7). Panel A sample includes 130 monthly observations from October 2003 until July 2014. Panel B includes 47 observations when more than half of the news during the month draws sentimental reaction. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors.

Panel B of Table 3.6 reports regression results for months when more than half of the news draws a sentimental reaction. The news index N explains 23% of the variation in monthly carry returns. The explanatory power jumps to 27% when the sentimental news index S is used. The fundamental news index F does again not explain any of the carry return variation. Thus it is news that draws a sentimental reaction in the exchange rates for high-yielding currencies that drives carry returns.

The results show it is crucial to consider the response sign of high interest rate currencies when constructing the news index. Most importantly we show that at the monthly horizon news is also important for currency returns. This fills a gap in the literature that has so far found it difficult to link fundamentals to exchange rates in the medium term.

3.4.3 The impact of news on changes in volatility and liquidity

To further understand the sentimental news index, we examine its relation to other known measures of bad times for carry returns. Table 3.7 shows the results from regressing changes in currency volatility ($\Delta CVIX$), U.S. stock market volatility (ΔVIX), U.S. yield curve noise ($\Delta NOISE$) and the TED spread (ΔTED) on the news indices. From the betas in the final column of Table 3.7 we see that there is a negative relationship between the sentimental news index (S) and the changes in volatility and liquidity. Hence a low reading

Table 3.7. News impact on changes in volatility and liquidity

	N	***F***	***S***
Panel:$\Delta CVIX$			
β	-0.004	0.000	-0.010
R^2	0.02	0.00	0.04
Panel: ΔVIX			
β	-0.021	-0.002	-0.043**
R^2	0.04	0.00	0.07
Panel: $\Delta NOISE$			
β	-0.007	-0.002	-0.011
R^2	0.05	0.00	0.08
Panel: ΔTED			
β	-0.007	0.000	0.001
R^2	0.05	0.00	0.02

The table presents the results from regressing monthly changes in volatility and liquidity measures on the three news indices. The volatility measures are the currency implied volatility index ($CVIX$) and the S&P 500 implied volatility index (VIX). The liquidity measures are the treasury yield curve noise ($NOISE$) and the TED spread (TED). The news index N aggregates all the surprises in U.S. macroeconomic news announcements in a given month, weighting the individual surprises according to the past 1-year betas from equation (3). N is split into news that triggers a response in line with the predictions of Taylor rule models (F) and news that draws a response in the opposite direction (S), see equations (5) to (7). The sample includes 130 observations from October 2003 until July 2014. Exception is changes in noise measure, where the noise data is available from October 2003 until December 2012, thus 111 observations. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors.

of the sentimental index, indicating predominantly bad macroeconomic news in a given month, coincides with an increase in currency and stock market volatility and a decrease in liquidity measured by growing pricing errors in the U.S. treasuries. It should be noted that only the relation between S and ΔVIX is statistically significant.

Table 3.7 also reports the results for the general news index and the fundamental news index. This again shows the importance of the novel sentimental index. There is no significant impact of news that triggers a fundamental reaction from the exchange rate between the USD and high interest rate currencies.

We also regress the sentimental news index (S) simultaneously on the two volatility and two liquidity measures (results not reported in Table 3.7). Using all 4 measures in the period October 2003 – July 2014 the adjusted R-squared is 9.0 percent. Because noise data after December 2012 is not available we regress 3 measures in the sample ending in December 2012. The adjusted R-square is 11.8 percent. Hence it is clear that the sentimental index provides new information not already captured by volatility and liquidity measures. We proceed with investigating whether this information is also relevant for explaining carry returns.

3.4.4 Explaining carry returns by news, volatility and liquidity

Lustig et al. (2011), Menkhoff et al. (2012), Brunnermeier, Nagel, and Pedersen (2009) and Hu, Pan, and Wang (2013) show that carry returns can be partly explained by equity volatility, currency volatility, the TED spread and treasury yield curve noise, respectively. In this section we investigate the explanatory power for our data, both for the original measures and when making them orthogonal to the sentimental news index (S). That way we can measure to what extent the news index provides an economic-news based explanation for why both changes in volatility and liquidity have explanatory power for carry returns. In addition we can show the added value of the sentimental news index in explaining carry returns.

Panel A in Table 3.8 shows the results when we regress the monthly carry returns on just a single explanatory variable. The first column shows that the news index S explains 11% (adjusted R-squared) of the variation in carry returns, a result we already found in Section 3.4.2. and Table 3.6. Of the volatility indicators the equity volatility index (VIX) has the highest explanatory power at 32%, and currency volatility ($CVIX$) has the second highest, consistent with the conclusions of Lustig et al. (2011) and Menkhoff et al. (2012). This drops to 24% for $\Delta VIX^{\perp}$ which are the residuals from the regression of VIX on S - see the final column of Table 3.7 for this regression. Hence 8% (difference between 32% and 24%) of the explanatory power for carry returns of the VIX can be attributed to the news index. In general the news index S explains between one fifth and one third of the explanatory power of the volatility and liquidity measures. This is an interesting result in line with previous studies (e.g. Ederington and Lee (1993), Fleming and Remolona (1999) and Balduzzi, Elton, and Green (2001), Bailey, Zheng, and Zhou (2014) among others) that find that the arrival of public news can explain a substantial fraction of the increase in volatility after announcements. Andersen and Bollerslev (1998) conclude that announcement effects on daily or lower frequency volatility are of lesser economic importance. However, none of these studies investigate the effect of good and bad news.

Panel B of Table 3.8 shows the results when including multiple explanatory variables for carry returns at the same time in the sample from October 2003 to December 2012.[46] In the first multiple regression we combine the volatility and liquidity measures. Together they explain 41% of the variation in carry returns. In the second multiple regression we use the same measures but now orthogonalized to the news index S. The adjusted R-squared drops from 41% to 29%. Hence nearly one third of the combined explanatory power of the volatility and liquidity measures is news-related. The only remaining significant variable is the change in VIX. The final multiple regression adds the news index S. News combined with volatility and liquidity measures can explain 44% of the variation in monthly carry returns. 15% of this can be attributed to news. From the first multiple regression we can also see that the sentimental news index contains information that is not already contained in the volatility and liquidity measures, because the adjusted R-squared rises from 41% to 44%.[47]

[46] Hu, Pan, and Wang (2013) noise measure data is available until the end of 2012.

[47] We also run the regression of carry returns on news index S and all original volatility and liquidity measures (i.e. not orthogonalizing them to S). Of the course the adjusted R-squared is again equal to 44%. The t-value of the beta of the news index is equal to 2.43. Hence the news index remains statistically significant.

Panel C of Table 3.8 repeats the previous analysis for the sample October 2003 to July 2014, but without the noise measure. The conclusions do not change. Nearly a quarter of the combined explanatory power of the volatility and liquidity measures is news-related.

Table 3.8. Explaining carry returns with news, volatility and liquidity

	S	$\Delta CVIX$	$\Delta CVIX^{\perp}$	ΔVIX	$\Delta VIX^{\perp}$	$\Delta NOISE$	$\Delta NOISE^{\perp}$	ΔTED	$\Delta TED^{\perp}$
Panel A. Single-variable regressions									
β	1.45**	-48.54***	-43.75***	-14.95***	-13.48***	-53.53***	-45.62***	47.83	22.41
$\bar{R}^2$	0.11	0.27	0.21	0.32	0.24	0.26	0.17	0.00	-0.01
Panel B. Multiple regressions									
β		-10.38		-10.56***		-24.44*		64.33*	
$\bar{R}^2$					0.41				
β			-12.26		-9.53***		-19.93		50.79
$\bar{R}^2$					0.29				
β	1.61***		-12.19		-9.08***		-20.79		46.89
$\bar{R}^2$					0.44				
Panel C. Multiple regressions excluding ΔNOISE									
β		-21.32*		-11.52***				70.17	
$\bar{R}^2$					0.37				
β			-21.15		-10.19***				53.78
$\bar{R}^2$					0.28				
β	1.45***		-21.15**		-10.19***				53.78
$\bar{R}^2$					0.40				

The table presents the results from regressing monthly carry returns on the sentimental news index (S) and monthly changes (Δ) in volatility and liquidity measures. The volatility measures are the currency implied volatility index ($CVIX$) and the S&P 500 implied volatility index (VIX). The liquidity measures are the treasury yield curve noise ($NOISE$) and the TED spread (TED). The news index S aggregates all the surprises in U.S. macroeconomic news announcements in a given month that trigger a response of high interest rate currencies opposite to that predicted by Taylor rule models, weighting the individual surprises according to the past 1-year betas from equation (3), see equation (7). The symbol $\perp$ denotes that we orthogonalized the variable to S by regressing the variable on S and using the residuals. Panel A shows the results when using only 1 variable at a time in the regression, showing the coefficient of that variable (β) and the adjusted R-squared ($\bar{R}^2$). *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors. Panel B combines multiple variables into one regression, with betas and coefficients indicating which variables are included. Panel C excludes $NOISE$ variable. All regressions include constant (not reported).
Sample period includes 130 monthly observations in period from October 2003 to July 2014.The data for $NOISE$ ends in December 2012, thus regressions that include this variable have 111 observations.

The sentimental news index, volatility and liquidity measures together explain 40% of carry returns. 12% of this can be attributed to the sentimental news index.

3.4.5 Stock returns and news

If the sentimental news index provides information about "bad" times in general, it should not only have explanatory power for carry returns, but also for equity returns. Table 3.9 presents the results when regressing S&P500 returns on the three news indices in equations (3.5) to (3.7).

The results in Panel A show that the general news index (*N*) explains 14% of the variation in monthly S&P500 returns. Panel B shows that when more than half of the news in a month draws a sentimental reaction the general news index explains 26% of the

Table 3.9. News and stock returns

	N	***F***	***S***
Panel A. Full sample			
β	3.55***	1.58*	5.42**
R^2	0.13	0.02	0.14
$\bar{R}^2$	0.12	0.01	0.13
Panel B. Sentimental period			
β	7.33***	1.45	8.14***
R^2	0.25	0	0.26
$\bar{R}^2$	0.23	-0.02	0.24

The table presents the results from regressing monthly S&P 500 returns on monthly news indices. *N* is the general news index, *F* is based on the subset of news announcements that trigger a reaction of the high yield currencies in line with Taylor rule models, and *S* is based on the announcements that trigger a reaction opposite to that expected by Taylor rule models, see equations (5) to (7). Panel A sample includes 130 observations from October 2003 until July 2014. Panel B includes 47 observations when more than half of the news during the month draws sentimental reaction. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors.

variation in monthly S&P500 returns. In the literature we have not come across of such a large impact of news at the monthly frequency. Explaining medium term returns with fundamentals is still a puzzle. Fama (1990), for example, finds future production growth rates can explain 43 percent of annual returns, but only 6 percent of the monthly equity returns. On a daily frequency McQueen and Roley (1993) find that macroeconomic news explains up to 4 percent of S&P 500 returns on the news days. Andersen et al. (2007) investigate equity reaction to macroeconomic news in a short interval around macroeconomic news. However, according to conservative calculations of Evans and Lyons (2008), explaining short intervals around the news can only help explaining at most 2 percent of total price variation. Hence our aggregate news indices show a much stronger link between news and total asset returns than previously documented.

The results for the S&P500 again show that the sentimental news index (S) has the largest explanatory power for S&P500 returns with an R-squared of 14%. In contrast to the carry results in Table 3.6 the fundamental news index also has explanatory power with an R-squared of 2%. These results show that good U.S. news is especially good for the U.S. equity market[48] when there is a sentimental but not a fundamental reaction of high yield currencies to news.[49] The explanatory power of the macroeconomic news comes from the sentimental (S) and not the fundamental (F) news index. Depending on the different theories, this coincides with the notion that good news for the U.S. is good for the world and/or investor sentiment (Kim, 1998 and Fratzscher, 2009) triggering a rally in risky assets.

3.4.6 Robustness

We made a number of choices when constructing news indices in Section 3.4.1. Table 3.10 presents the results for the regressions of monthly carry returns on different versions of news indices. Panels A through E investigate the importance of the aspects (i) through (v)

[48] The results are not limited to U.S. market. The results for MSCI world equity, developed and emerging indices are similar. The results are not reported in the table, but available upon request from the authors.
[49] Controlling for changes in VIX does not change the conclusions. Changes in VIX explain 27% of the variation in S&P500 returns, which reduces to 20% when orthogonalizing the VIX to the sentimental news index. Putting both the sentimental news index S and changes in VIX in the equation explains 33% of the variation in S&P500 returns and the t-statistic of the beta for S is 3.34. Hence economic news in part explains changes in VIX. And economic news has explanatory power for S&P500 returns not already captured by changes in VIX as the adjusted R-squared increases from 27% using just changes in VIX to 33% when adding the sentimental news index S.

Table 3.10. Alternative ways to construct the news indices

	N	***F***	***S***
Panel A. Andersen et al. (2003) announcements			
β	0.70*	0.19	1.88**
R^2	0.04	0.00	0.08
Panel B. Equal surprise size			
β	0.29	-0.20	0.90
R^2	0.01	0.00	0.04
Panel C. Equally weighted surprises			
β	3.81**	1.64	6.37**
R^2	0.09	0.01	0.11
Panel D. Full sample surprise weights			
β	0.78**	0.10	1.66**
R^2	0.07	0.00	0.13
Panel E. 20 min window			
β	0.73**	0.47**	1.09*
R^2	0.08	0.03	0.06
Panel F. Return index			
β	0.35	0.01	0.76**
R^2	0.03	0.00	0.08

The table presents the results from regressing monthly carry returns on monthly news indices constructed in a different way than the one analyzed in the previous tables. *N* is the general news index, *F* is based on the subset of news announcements that trigger a reaction of the high yield currencies in line with Taylor rule models, and *S* is based on the announcements that trigger a reaction opposite to that expected by Taylor rule models. The sample includes 130 monthly observations from October 2003 until July 2014. Panels A though F show different versions of the news indices. Panel A news indices use only the 25 macroeconomic news announcements used in Andersen et al. (2003). Panel B uses +1 and -1 as surprises, thus eliminating surprise size effect. Panel C, weights all announcements equally instead of more weight for more important announcements. Panel D uses full sample impacts on volatility from equation (3) instead of a rolling window. Panel E uses 20 min windows starting 5 minutes before announcements for the returns used to compute surprise weights w in equations (5) through (7) instead of the first five minutes after the announcement. Panel F aggregates high interest rate portfolio returns in the 5 min following macroeconomic news instead of surprises. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors.

listed in Section 3.4.1. The importance of classifying news as sentimental and fundamental, i.e. aspect (vi), is already demonstrated in 3.4.2 through 3.4.5.

In Panel A we use only the 25 U.S. announcements used in Andersen et al. (2003, 2007). The explanatory power of the sentimental news index S for monthly carry returns drops from 12% (see Table 3.6) to 8%. Hence using as many announcements as possible is important. Panel B shows the importance of surprise size. The news indices have less explanatory power for carry returns after replacing positive surprises with +1 and negative surprises with -1 in the indices. The sentimental news index then explains only 4% of the variation in monthly carry returns. Panel C demonstrates the effect of weighing the surprises equally, as opposed to using the weights based on equation (3.3). The general news index N explanatory power increases from 7% to 9%, and the explanatory power of sentimental news index S decreases from 12% to 11%. Weighting surprises using static weights derived from the full sample regressions in equation (3.3) is considered in Panel D. The difference between time-varying and static weights is negligible. Combined with the previous result apparently weighting of different news announcements is somewhat surprisingly not relevant for the results. In Panel E the news indices use the surprise weights estimated from equation (3.3) using 20-minute returns (from 5 minutes before to 15 minutes after the announcement) instead of the first five minutes after the announcement. While explanatory power of the general news index increases from 7% to 8%, the explanatory power of the sentimental news index, S, decreases from 12% to 6%. Part of this explanatory power is transferred to the fundamental news index. The explanatory power of F rises from 0% to 3% and the sign is positive which is inconsistent with Taylor rule models. This demonstrates the importance of using short windows around news to limit the risk of non-news noise in the returns and wrongly labeling sentimental reaction as fundamental.

In the last Panel F we consider the news index that aggregates the high interest rate portfolio returns in the 5 minutes after macroeconomic news. If multiple macroeconomic figures are announced, a return is included in the news index only once. If there is at least one sentimental (fundamental) surprise, the return is included in the return-based sentimental (fundamental) index once. Such an index has several potential advantages over the indices using surprises. First, the news return reflects all the new information available to the market participants, also including news not measured by the surprises. Second, a larger return means more important information, thus the time variation of the importance is instantaneous, as compared to our rolling regressions. Even with these advantages only the sentimental return index is significantly related to the carry returns. However the explanatory power of the return based sentimental index is only 8% compared to our sentimental index that explains 12% of the variability in carry returns.

3.5 Conclusion

Over the last decade two generally separate strands of literature have studied i) whether currency returns can be attributed to fundamental shocks; and ii) the determinants of the returns to carry trades. We link the two together and contribute to both strands of literature.

The results in event studies showing the strong and systematic high frequency reaction of currencies to macroeconomic news have been celebrated as a concrete support for Taylor-rule models and the connection between economic fundamentals and exchange rates. We show that the consistent relationship between exchange rates and economic fundamentals is only valid for low-yield currencies. The evidence for high-yield currencies is conflicting and more in line with the findings of Fratzscher (2009) and exchange rate models allowing for a change in the relationship between fundamentals and exchange rates (e.g., Lucas, 1982). The unconditional return reaction of high-yield currencies to surprises in most of the announcements is insignificant, and the sign of significant news responses is often inconsistent with the predictions of Taylor-rule models. High-yield currencies respond to surprises in macroeconomic news announcements significantly in terms of volatility, but the sign of the response changes over time. The direction of the response of high-yield currencies is strongly related to global volatility.

We construct a monthly news index, aggregating the news surprises from 50 U.S. macroeconomic announcements. We then split this index into a fundamental news index by selecting only news surprises that trigger a response from high-yield currencies in accordance with Taylor-rule models and a sentimental news index based on all news surprises that trigger a reaction of high-yield currencies opposite to that predicted by Taylor-rule models. We then link the monthly news indices to monthly FX carry and equity returns. The results indicate that the sentimental index is an important explanatory variable. Only considering good versus bad news explains 7 percent of the variation in monthly carry returns. This rises to 12 percent when using the sentimental news index. The results indicate that bad macroeconomic news is bad for carry returns. Hence bad news is an alternative for using volatility or liquidity as indicators of bad states. Actually the novel sentimental index explains part of volatility and liquidity changes, and the index remains a significant factor explaining carry returns after controlling for volatility and liquidity.

If the sentimental index is an important indicator of bad states it should also have explanatory power for equity returns. It does. The news index can explain 14% of the variation in S&P500 returns. Hence the aggregation of news in combination with the reaction sign of high yield currencies can be seen as a breakthrough in linking fundamentals to asset prices in the medium term. It is not that news is not important. It is the time-variation in the reaction sign which makes it hard to show news is important for asset prices. Our novel sentimental news index overcomes this problem and does show news is important. In periods where sentimental news reactions dominate fundamental news reactions the news index even explains 27% of the variation in monthly carry returns and 24% of the variation in monthly S&P500 returns.

3.6 Appendix

Table A.1. Impact of macroeconomic announcements on individual currencies

Announcement	JPY	R^2	CHF	R^2	EUR	R^2	SEK	R^2	CAD	R^2	NOK	R^2	GBP	R^2	AUD	R^2	NZD	R^2
Consumption																		
1 Existing Home Sales	-6.67***	0.26	-2.92	0.05	-0.71	0.00	1.77	0.02	3.21***	0.09	1.32	0.01	0.41	0.00	2.34	0.04	2.66	0.03
2 New Home Sales	-5.77***	0.23	-5.09***	0.18	-3.66***	0.15	-2.85**	0.06	-0.34	0.00	-2.29**	0.04	-2.66***	0.12	-1.37	0.02	-1.19	0.01
3 Pending Home Sales	-5.21***	0.21	-2.11**	0.05	-0.95	0.01	1.25	0.01	2.79***	0.08	0.95	0.01	0.19	0.00	2.8*	0.07	1.86	0.02
Forward-looking																		
4 Empire State Mfg.	-5.28***	0.18	-4.05***	0.13	-2.54***	0.07	-1.61	0.02	0.82	0.01	-1.47	0.02	-1.29**	0.02	-0.26	0.00	0.01	0.00
5 NAHB Index	-2.21***	0.20	-1.92***	0.11	-1.66***	0.10	-2.04***	0.10	-0.51	0.01	-1.5**	0.05	-1.71***	0.13	-0.48	0.00	-1.16*	0.03
6 Philadelphia Fed Surv.	-6.83***	0.35	-5.09***	0.24	-2.22**	0.07	-0.74	0.01	2.66**	0.09	0.13	0.00	-0.79	0.01	2.5*	0.06	2.51*	0.05
7 CB Consumer Conf.	-6.31***	0.33	-2.55*	0.04	-0.16	0.00	3.54	0.05	4.13***	0.15	2.3	0.03	-0.29	0.00	3.19*	0.07	3.2	0.07
8 Michigan Cons.Sent. (P)	-2.1***	0.08	-3.1***	0.13	-2.11***	0.06	-1.94**	0.04	-0.23	0.00	-2.42***	0.06	-2.15***	0.10	-0.85	0.01	-1.26*	0.02
9 Michigan Cons.Sent. (F)	-0.92*	0.02	-1.23**	0.03	-0.85*	0.02	-1.69***	0.04	0.17	0.00	-1.47**	0.04	-0.88*	0.02	-0.96	0.01	-0.38	0.00
10 Chicago PMI	-1.84*	0.05	-1.89**	0.05	-1.5*	0.04	-1.76*	0.04	-0.51	0.01	-2.17**	0.05	-0.74	0.01	-1.01	0.01	-0.57	0.00
11 ISM Mfg	-10.41***	0.44	-7.35***	0.22	-3.02**	0.07	-1.44	0.01	2.26	0.04	-0.66	0.00	-2.16*	0.04	1.92	0.02	1.28	0.01
12 ISM Prices Paid	-3.84***	0.06	-2*	0.02	-0.25	0.00	0.35	0.00	1.59	0.02	1.2	0.01	0.29	0.00	3.65***	0.07	3.4**	0.06
13 ISM Non-Mfg	-8.93***	0.44	-6.62***	0.27	-3.19**	0.09	-1.61	0.02	1.31	0.02	-1.54	0.02	-2.15*	0.06	0.04	0.00	-0.34	0.00
14 Building Permits	-1.32	0.02	-0.64	0.00	-0.56	0.00	0.08	0.00	-0.02	0.00	-1.04	0.01	-0.95	0.01	-0.27	0.00	-0.56	0.00
15 Housing Starts	-3.13***	0.09	-2.16**	0.03	-1.08	0.01	-0.67	0.00	0.48	0.00	-1.3	0.01	-0.56	0.00	-0.45	0.00	-0.25	0.00
16 Leading Indicators	-2.35***	0.05	-0.88	0.01	-0.57	0.01	-0.73	0.01	0.09	0.00	-0.25	0.00	-0.31	0.00	0.36	0.00	-0.95	0.01
GDP																		
17 GDP (A)	-11.96***	0.34	-13.62***	0.40	-10.68***	0.33	-8.13**	0.21	-2.44	0.03	-8.26**	0.26	-8.28***	0.23	-5.2	0.09	-5.52*	0.11
18 GDP (P)	-6.32***	0.22	-3.85**	0.12	-2.97*	0.07	-3.2*	0.06	-1.24	0.01	-2.84	0.05	-1.49	0.03	-1.78	0.02	-1.88	0.03
19 GDP (F)	-5.7***	0.21	-4.5***	0.23	-3.34***	0.23	-3.48**	0.17	-2.96	0.07	-1.39	0.03	-2.07*	0.13	-2.12*	0.06	-4.34**	0.15

Table A.1. Continued

Announcement	JPY	R^2	CHF	R^2	EUR	R^2	SEK	R^2	CAD	R^2	NOK	R^2	GBP	R^2	AUD	R^2	NZD	R^2
Government Purchases																		
20 Treasury Budget	-0.36	0.01	0.19	0.00	0.11	0.00	-0.03	0.00	-0.55**	0.02	0.23	0.00	0.59	0.03	-0.36	0.00	-0.98***	0.03
Investment																		
21 Durable Goods Orders	-5.59***	0.18	-4.4***	0.09	-2.76***	0.07	-1.85	0.02	0.83	0.01	-2.01*	0.03	-2.36***	0.06	-0.66	0.00	-0.63	0.00
22 Construction Spending	0.94	0.00	2.58*	0.03	1.39	0.01	1.13	0.01	0.44	0.00	2.13	0.02	0.73	0.00	0.1	0.00	0.26	0.00
23 Factory Orders	-2.51***	0.09	-2.63***	0.07	-1.76**	0.05	-1.68**	0.03	-0.03	0.00	-1.98***	0.04	-1.42**	0.05	-0.66	0.01	0.39	0.00
24 Wholesale Inventories	0.44	0.00	1.27	0.02	0.72	0.01	0.59	0.00	0.92	0.02	0.68	0.01	0.62	0.01	0.99	0.02	0.57	0.01
25 Business Inventories	0.53	0.00	1.45	0.03	0.17	0.00	0.67	0.00	-0.1	0.00	0.24	0.00	0.01	0.00	0.61	0.01	-0.02	0.00
Net Exports																		
26 Trade Balance	-6.15***	0.11	-7.44***	0.15	-5.62***	0.12	-5.71***	0.11	-5.46**	0.07	-4.92***	0.09	-4.35***	0.12	-2.98**	0.06	-3.62**	0.07
Prices																		
27 Import Prices	-2.09	0.02	-2.21*	0.03	-1.48	0.02	-2*	0.03	-3.18**	0.06	-1.79	0.03	-1.91*	0.03	-1.85	0.02	-1.71	0.02
28 PPI	-3.28***	0.06	-1.73*	0.02	-1.6*	0.02	-1.74*	0.02	-0.97	0.01	-1.65*	0.02	-1.28	0.02	-0.19	0.00	-1.59	0.02
29 PPI Core	-3.01***	0.05	-2.68***	0.05	-2.63***	0.06	-2.7***	0.06	-1.44**	0.02	-2.6***	0.05	-2.41***	0.06	-2.05***	0.04	-2.66***	0.06
30 CPI	-0.76	0.00	-0.76	0.00	-0.83	0.00	-0.62	0.00	0.27	0.00	-1.02	0.01	-1.03	0.01	-2.32	0.03	-1.84*	0.02
31 CPI Core	-4.36***	0.10	-4.54***	0.09	-3.31***	0.06	-3.78***	0.09	-2.19**	0.05	-3.69***	0.07	-3.39***	0.09	-6.33***	0.20	-4.82***	0.14
32 PCE	-1.26**	0.01	-1.19	0.01	-0.57	0.00	-0.16	0.00	-0.2	0.00	-0.57	0.00	-0.49	0.00	-0.18	0.00	0.01	0.00
33 Cost Civilian Workers	1.37	0.01	3.2	0.03	1.2	0.01	-0.48	0.00	-3.3	0.06	0.7	0.00	1.78	0.02	-0.91	0.01	-0.46	0.00
34 Unit Labor Costs (P)	-0.12	0.00	2.64	0.04	2.38	0.02	2.27	0.02	1.05	0.01	2.56*	0.03	2.2**	0.11	1.63	0.04	1.34	0.03
35 Unit Labor Costs (F)	-0.34	0.00	-0.48	0.00	-0.76	0.00	-0.24	0.00	-1.02	0.01	0.25	0.00	-0.39	0.00	-0.69	0.01	-0.66	0.01

Table A.1. Continued

Announcement	JPY	R^2	CHF	R^2	EUR	R^2	SEK	R^2	CAD	R^2	NOK	R^2	GBP	R^2	AUD	R^2	NZD	R^2
36 GDP Price Index (A)	-0.07	0.00	1.01	0.00	-0.29	0.00	-1.25	0.00	-0.16	0.00	-0.22	0.00	-0.6	0.00	-0.26	0.00	1.12	0.00
37 GDP Price Index (P)	-1.1	0.01	0.11	0.00	-0.15	0.00	0.97	0.01	-0.17	0.00	-0.09	0.00	-1.36	0.03	-0.95	0.01	-0.39	0.00
38 GDP Price Index (F)	2.66	0.04	0.98	0.01	0.48	0.00	1.93	0.05	1.37	0.01	0.98	0.02	0.3	0.00	-0.9	0.01	0.4	0.00
Real Activity																		
39 ADP Employment	-12.27***	0.57	-7.26***	0.27	-4.14***	0.19	-1.65	0.02	2.51***	0.09	-1.5	0.02	-2.8***	0.12	0.36	0.00	-0.1	0.00
40 Non-farm Payroll Employment	-25.6***	0.37	-21.03***	0.28	-15.25***	0.20	-11.06**	0.10	2.72	0.01	-11***	0.11	-11.31***	0.19	-6.71	0.04	-5.89	0.03
41 Unemployment	-5.1	0.01	-3.51	0.01	-2.06	0.00	0.18	0.00	2.72	0.01	-0.33	0.00	-1.12	0.00	1.4	0.00	0.88	0.00
42 Retail Sales	-9.18***	0.29	-4.77***	0.10	-3.02*	0.06	-2.43	0.03	1.43	0.02	-1.58	0.01	-3.08	0.06	2.26	0.03	0.77	0.00
43 Capacity Utilization	-2.2***	0.10	-1.78**	0.05	-0.92	0.02	-0.52	0.00	0.97*	0.02	-0.48	0.00	-0.5	0.01	0.33	0.00	0.55	0.00
44 Industial Production	-2.17***	0.10	-1.74**	0.05	-0.77	0.01	-0.21	0.00	1.11**	0.03	-0.37	0.00	-0.72	0.01	0.61	0.01	0.27	0.00
45 Personal Income	-0.73	0.01	-0.41	0.00	-0.16	0.00	-0.11	0.00	0.47	0.00	0.15	0.00	0.05	0.00	0.41	0.00	0.2	0.00
46 Consumer Credit	-0.31	0.01	0.81**	0.05	0.94***	0.10	0.35	0.01	1.3***	0.11	0.77**	0.03	0.4	0.01	1.09**	0.04	0.24	0.00
47 Non-farm Productivity (P)	-1.41	0.03	-0.96	0.01	-2.13	0.02	-0.28	0.00	0.06	0.00	-1.13	0.01	-1.09	0.03	0.27	0.00	0.88	0.01
48 Non-farm Productivity (F)	-2.08**	0.07	-3.02**	0.12	-1.38	0.02	-2.54**	0.07	-0.34	0.00	-3.29***	0.12	-1.39**	0.04	-0.14	0.00	-0.23	0.00
Weekly Real Activity																		
49 Initial Jobless Claims	-3.81**	0.10	-1.8*	0.02	-0.4	0.00	0.07	0.00	1.6***	0.02	-0.18	0.00	-0.51	0.00	1.01**	0.01	0.67	0.00
50 Continuing Jobless Claims	-1.91***	0.02	-0.95*	0.01	-0.41	0.00	0.66	0.00	0.82	0.01	0.09	0.00	-0.67	0.01	0.08	0.00	0.09	0.00

The table gives the estimates of standardized surprise impact (β_k) of equation $R_{k,t} = \alpha_k + \beta_k S_{k,t} + \varepsilon_t$ for G10 currencies against USD. $R_{k,t}$ is the 5-minute return following the macroeconomic surprise $S_{k,t}$. All currency returns are expressed in basis points. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively, using HAC errors. Announcements marked with superscripts a, b ,c ,d, e ,f occur at the same time. A,P and F stands for advance preliminary and final, respectively. The signs of Treasury Budget, Wholesale Inventories, Business Inventories, Unemployment, Initial Jobless Claims, and Continuing Jobless Claims surprises are changed to mean good economic news.

Chapter 4

Macroeconomic news and price discovery in international bond markets

Joint work with J.G. Duyvesteyn and Dr. M.P.E. Martens

4.1 Introduction

The Efficient Market Hypothesis of Fama (1970) implies that all known information is reflected in the current price. This means that the announcement of a macroeconomic figure should be reflected in asset prices immediately and fully. Price jumps following the release of macroeconomic information is seen as evidence for market efficiency.[50] In general studies on individual markets show (local) macroeconomic news is impounded into asset prices within minutes, and certainly within a day (Ederington and Lee, 1995, Andersen et al., 2003, Green, 2004). This chapter investigates whether aggregated international macroeconomic news has effect on international government bond markets beyond the announcement day.

To investigate the relation between macroeconomic news and government bond prices we follow a rather different approach than is common in the literature analyzing the impact of news on asset prices. First, we use publicly available aggregate macroeconomic news indices for G10 countries as well as a composite global news index. These news indices are based on the surprises in news announcements, comparing surveys with actual figures. Per country these indices provide a measure of the average direction of surprises in the recent period. Similarly the global news index summarizes whether globally news is on

[50] For example Ederington and Lee (1993), Andersen et al. (2003); Andersen et al. (2007) and Faust et al. (2007) study the reaction of asset prices to macroeconomic news announcements. Specifically for bond markets see for example Hardouvelis (1988), McQueen and Roley (1993), Fleming and Remolona (1999), Balduzzi, Elton, and Green (2001), Gurkaynak, Sack, and Swanson (2005a), Gurkaynak, Sack, and Swanson (2005b), Faust et al. (2007), Andersen et al. (2007), and Altavilla, Giannone, and Modugno (2014).

average surprising on the positive or negative side. These aggregate news indices allow us to investigate whether market participants incorporate *aggregate* macroeconomic information efficiently.

Second, we use these aggregate news indices to forecast short term bond market returns. Existing studies focus either on the immediate reaction to economic news or forecasting a long term return. The majority of the studies focusing on long term predictability use latent factors. Cochrane and Piazzesi (CP; 2005) find latent U.S. yield curve factors predict one-year bond returns. Ludvigson Ng (2009) show U.S. macroeconomic factors enhance the predictability of one-year U.S. excess bond returns. Dahlquist and Hasseltoft (2013) construct local CP factors (U.K., Germany, U.S. and Switzerland) and a global factor equal to the GDP-weighted average of the local factors. The authors find that the global factor predicts similar or better than the local factor.

Third, we investigate the relation between *international* macroeconomic news and *international* government bond prices. Global economies and international bond markets became more integrated in the last couple of decades (Dahlquist and Hasseltoft, 2013). Thus relevant news from any major economy should be important for all international bond markets. However there is mainly evidence in the literature that U.S. macroeconomic news is important for global bond prices, not so much the other way around.[51] If international macroeconomic news is not incorporated immediately and fully, it may be incorporated with a delay. We will investigate this possibility.

We have several important findings. First, we confirm for the aggregated news indices that for all bond markets U.S. macroeconomic news is by far the most important contemporaneously, i.e. international bond prices react immediately to U.S. news. Second, aggregate global economic news is not incorporated into bond prices efficiently. As a result global economic news, especially from Europe and Japan, has predictive power for international bond returns including U.S. bond returns. This is a new finding not documented before in the literature. The implications are (i) that international news other than from the U.S. is important for international bond markets, including the U.S. bond

[51] All studies on the link between international economic news and international bond markets include U.S. economic news and one or more other countries. See for example, Kim and Sheen (2000) [Australia], Gravelle and Moessner (2001) [Canada], Ehrmann and Fratzscher (2005a) [Euro area], Craine and Martin (2008) [Australia], Andersson, Overby, and Sebestyén (2009) [Euro area, Germany, France, Italy, Spain, Belgium, and U.K.].

market; and (ii) the bond markets are inefficient because they incorporate international news with a delay. This delay is serious because our sampling frequency is weekly. International news from week t significantly predicts bond returns in week $t + 1$.

We test three hypotheses for our finding that global economic news is not efficiently incorporated into bond prices: (i) Limited attention; (ii) bond market momentum; and (iii) persistence in global economic news. We find evidence that our results are consistent with limited attention and driven by persistence in global economic news. Bond market momentum cannot explain our findings. We now discuss the three hypotheses in more detail.

Peng (2005) put forward the limited attention hypothesis that prescribes that new information can be included in prices with a delay due to the limited processing power of investors. Peng and Xiong (2006) shows that limited attention can lead to category-learning behavior, i.e. rational investors will allocate their attention to the most important factors. Empirical evidence provides support for this hypothesis. For example Ramnath (2002) and Cohen and Frazzini (2008) show that due to limited attention of investors the stock price of a firm does not immediately react to news about related firms (e.g. related through a customer-supplier link). Attention-grabbing and market-moving news like U.S. payrolls consumes the limited resources of investor attention thus limiting attention to otherwise important news from other major economies. If the limited attention hypothesis holds, global economic news coming in close proximity before the attention grabbing announcement will have limited impact on the bond markets. The news will only impact the bond markets after the attention grabbing news has been released, causing predictability in bond returns. On the other hand global economic news announced after the attention grabbing announcement should have an immediate impact on the bond markets when there is no limited attention, i.e. no release of attention grabbing U.S. news. This is indeed what we find. We find no predictability from global economic news when there is no proximity of important U.S. announcements. And we do find global economic news predicts international bond prices when economic figures are released close to important U.S. announcements. In addition, the contemporaneous bond market relation to non-U.S. economic news preceding important U.S. economic news is significantly weaker compared to the time when there is no important U.S. economic announcement scheduled. Hence we do find evidence for the limited attention hypothesis.

The inefficiency of international bond prices with respect to incorporating global news could also be driven by bond return momentum. A Ilmanen (1997), Yamada (1999), Luu and Yu (2012) and Moskowitz, Ooi, and Pedersen (2012) show past government bond returns predict future government bond returns in developed country bond markets (Australia, Canada, Germany, Japan, U.S. and U.K.). If news drives these past bond returns, it will appear that the same old news is correlated with future bond returns. However taking into account bond momentum does not eliminate the predictability of global economic news for international bond prices. Hence bond return momentum cannot explain our key result.

The final possible explanation is predictability in local or global news. If global news predicts next week's local or global news and news explains bond returns contemporaneously, it will appear that global news predicts bond returns. Macroeconomic news surprises are defined as the difference between announced figures and consensus forecasts. Gorain (2011) finds that closely related foreign economic news predicts U.S. news. For example, surprises in the U.K. Purchasing Managers Index (PMI) predict surprises in the U.S. Institute for Supply Management (ISM) index. Thus if the U.S. ISM surprise has an immediate impact on U.S. bond returns it will appear that the U.K. PMI surprise predicts U.S. bond returns. Our findings indicate that changes in economic surprise indices are to some extent predictable. However international bond markets fail to adjust, and react both to the predictable and unpredictable components of global surprise index changes. This finding is contrary to Campbell and Sharpe (2009) who show that U.S. government bond market reacts only to the unpredictable part of economic surprises. However Campbell and Sharpe use the previous month releases of the same announcement to determine expected and unexpected components of the surprises. Adjustment to all global macroeconomic information may require advanced processing skill from investors and economists. We conclude that predictability in the global news indices contributes to explaining our key finding.

We contribute to the literature in multiple ways. First, whereas the macroeconomic news literature focuses on immediate news impact, we focus on the delayed reaction to the news. To our best knowledge only Martin Evans and Lyons (2005) analyze if the reaction to the news extends beyond the announcement day. They do find macroeconomic news affects the foreign exchange market beyond the day of announcement. However, contrary to our findings Evans and Lyons find a reversal and not the continuation of the reaction. Second, our main analyses are based on aggregated news, as opposed to individual announcements. Most existing studies focus on the response of asset prices to individual announcements. Only a few studies (Scotti, 2013; Brazys and Martens, 2014) analyze the contemporaneous relation between aggregate economic news and asset prices. And as far as we know there are no studies examining the efficiency of aggregate news incorporation. Aggregate news provides a more complete and less noisy estimate economic news. Third, we analyze international macroeconomic information diffusion in international government bond markets. Unlike the literature we use direct economic news and not returns. To study gradual information diffusion the literature mainly focuses on the response of asset prices to their own or related asset returns in a related industry (e.g. Cohen and Frazzini, 2008 and Menzly and Ozbas, 2010) or related country (Rizova, 2010). Finally our analyses focus on short term predictability and information inefficiency in bond markets. The majority of the studies focus on long term predictability using latent factors or information diffusion spanning months.

4.2 Data and sample statistics

4.2.1 Surprise indices

Is the economy performing better or worse than expected? The need for a tool to summarize economic news and to answer the question is suggested by a plethora of economic surprise indices constructed by financial institutions, e.g. the Citigroup Economic surprise, Nomura Growth, HSBC Surprise, and RBC Surprise indices. Until recently the academic literature largely ignored the need to summarize the news, the recent exceptions being Scotti (2013) and Brazys and Martens (2014) . Scotti (2013) aggregates weighted economic surprises. The weights depend on the underlying economic indicator contribution to the economic condition index (Aruoba, Diebold, and Scotti, 2009). Although their set of indices cover 5 major economies (U.S., Euro Zone, Japan, United Kingdom and Canada), the indices use at most 6 announcements. Brazys and Martens (2014) weights 50 different types of economic surprises by their impact on the foreign exchange market. However their indices are limited to the U.S. We choose Citigroup surprise indices for three reasons. First, the choice is motivated by the popularity of the index in the financial media.[52] Second, the indices cover major economies and use a wide range of economic announcements. Third, the methodology used to construct indices accounts for findings in the academic literature. For example the indices account for the time-varying importance of the news for market participants. The model of Bacchetta and Van Wincoop (2004) shows that market participants may assign time-varying importance to economic fundamentals. Ideally, we could construct a surprise index that has the strongest relation to the bond markets whereas the weights in the Citigroup economic surprise indices depend on currency reactions. However using an independently constructed surprise index we avoid a potential datamining exercise. We leave it for further research to construct surprise indices calibrated to the reactions of bond markets to economic news.

Citigroup economic surprise indices summarize the outcomes of recent macroeconomic announcements. The surprise is defined at the difference between the actual data figure and the consensus expectation of a group of analysts. A positive (negative) reading of the surprise index indicates that on balance the economic surprises have been positive (negative). Note that the positive (negative) value does not mean that economy was doing well (bad), it merely shows that economists were overly pessimistic (optimistic) when forecasting economic variables. Instead we should interpret this as the economy doing better (worse) than expected.

The economic surprise index at time t, SI_t, is weighed sum of standardized surprises $S_{k,\tau}$

$$SI_t = \sum_{d=1}^{90} \left(\frac{\ln(90-d+1)}{\ln(90)} \sum_{\tau=t-d+1} w_{k,\tau} S_{k,\tau} \right). \tag{4.1}$$

The surprises are calculated as the difference between the consensus expectation (Bloomberg survey median) and actual release. The surprises are standardized dividing by the sample standard deviation following Balduzzi, Elton, and Green (2001). Standardized surprises in the index are weighted by two weights. First, $w_{k,\tau}$ is the weight for announcement k at time τ. It is calculated as the standardized surprise impact on the spot exchange rate return in the interval starting one minute before and ending one minute after

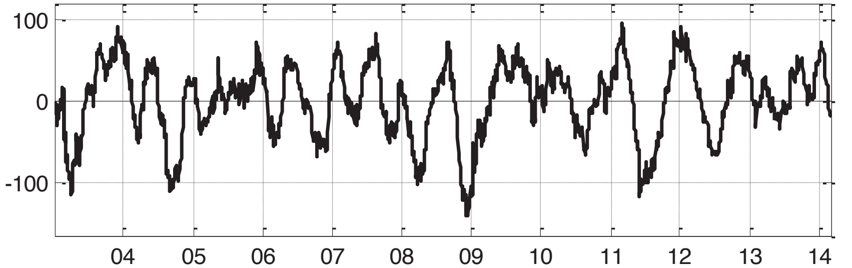
[52]For example "Europe stock fund inflows reverse sharply" Financial Times, 16 September 2014.

the announcement. The particular cross for each country index is selected based on trading volume in the exchange rates (James and Kasikov, 2008). The weights are reviewed annually, thus the relative importance of the announcements can change. Second the surprises in 3-month rolling window are weighed using exponentially decaying weights. Thus recent news receives higher weights than less recent news. This also mitigates the effect of disappearing surprise data when the window is rolled.

Figure 4.1 illustrates the dynamics of the U.S. economic surprise index of Citigroup. The index oscillates between negative and positive values. In this chapter we focus on establishing a relationship between *changes* in surprise indices and excess bond returns. An example motivates the focus on changes instead of levels. Consider the index is at 0. Then focusing on the level of the index would mean discarding information how the index arrived at 0. If the index arrived at zero from a negative reading due to a recent accumulation of positive economic news we expect bond returns to be negative. Better than expected economic news means that central banks to react to inflationary pressures by raising target rates, thus negative bond returns. If, however, the index arrived at zero from a positive reading due to a recent bout of negative news we expect bond returns to be positive. Hence only considering the current level of the surprise index does not tell the full story. Changes in a short window (e.g. a week) is approximately equal to the sum of weighted economic surprises in the short window.

What size of the window for the surprise changes is relevant when investigating the relation between bond returns and surprises? We investigate the efficiency of bond markets

Figure 4.1. U.S. Economic Surprise Index



This figure displays the Citi economic surprise index for U.S. (Bloomberg: CESIUSD Index). The Citi surprise index is a weighted sum of economic surprises in the past 90 days. Surprises are weighted by their impact on the market and weights that decay with time: more recent surprises receive more weight.

to incorporate international news. The existing literature documents that news is incorporated in asset prices immediately, thus we investigate the shortest periods possible. For the purpose of robustness we limit the choice set to the standard calendar frequencies: daily, weekly, monthly. News indices are updated daily and thus the indices change even if there is no news announced. However macroeconomic announcements are not made daily. For example announcements in the U.S. surprise index cover 51% of the trading days. Thus the remaining 49% of the daily changes in index are noise and not suitable for investigation. This motivates to choose to investigate the next lower frequency changes in surprise index. The weekly frequency assures that at least one announcement is made during the week.

We use Citi macroeconomic news indices for the G10 countries (Australia, Canada, Switzerland, Euro Zone, United Kingdom, Japan, Norway, New Zealand, Sweden, and United States) gathered from Bloomberg[53] for the period January 1, 2003 – March 4, 2014. Using country level Citi surprise indices we construct global indices. The global G10 index is the GDP-weighted average of the G10 country indices. We use previous year GDP measured in USD, constant prices and OECD base year (2005). The U.S., Euro Zone, Japan and United Kingdom get the largest weights, with shares of respectively 42%, 30%, 11% and 7% at the end of the sample. To summarize foreign macroeconomic news for a certain country we construct global-ex-local indices, which are GDP-weighted averages of G10 indices excluding the local index. GDP-weighing is commonly used in the literature when constructing global factors, for example Dahlquist and Hasseltoft (2013) or Hellerstein (2011).

Table 4.1 shows summary statistics of levels (Panel A) and changes (Panel B) for the individual country and G10 global indices. In this chapter we use the 5-day change in the surprise indices to forecast 5-day bond returns and to establish the contemporaneous relationship with 5-day bond returns. Therefore the table gives averages of the sample statistics for the 5-day changes starting on different weekdays. The average level and weekly changes of the indices vary from negative to positive. The standard deviation of both levels and changes of the G10 index is lower than any country index, suggesting noise reduction. For example weekly U.S. surprise index changes have the lowest standard

[53] The indices are updated daily at 5 PM London time, source: Bloomberg.

Table 4.1. Surprise index summary statistics

	SI_{AU}	SI_{CA}	SI_{CH}	SI_{EU}	SI_{UK}	SI_{JP}	SI_{NO}	SI_{NZ}	SI_{SE}	SI_{US}	SI_{G10}
Panel A. Level											
Mean	9.59	8.78	3.98	7.16	11.84	-2.12	1.35	4.30	0.17	1.93	4.22
Std.	48.11	52.48	72.90	60.77	43.68	37.14	56.86	43.07	44.77	45.42	31.29
Skewness	0.07	-0.33	-0.33	-0.41	0.24	0.02	0.24	-0.26	0.08	-0.59	-0.65
Kurtosis	3.19	4.89	4.24	3.30	2.67	2.62	3.24	2.57	2.17	2.86	3.37
Autocorrelation	0.93	0.91	0.96	0.96	0.90	0.92	0.92	0.92	0.90	0.95	0.97
N.obs.	583	583	583	583	583	583	583	583	583	583	583
Panel B. Changes											
Mean	-0.08	-0.18	-0.04	0.05	0.00	-0.01	0.00	0.11	0.12	-0.01	0.00
Std.	18.05	22.06	20.47	17.92	19.10	14.60	23.25	17.42	20.33	14.06	8.15
Skewness	0.49	0.42	0.56	0.16	0.08	-0.20	0.01	0.71	-0.12	0.06	0.10
Kurtosis	7.95	4.70	10.32	4.13	5.43	5.76	6.46	6.64	5.23	3.99	3.37
Autocorrelation	0.03	0.10***	0.10***	0.14***	0.02	0.10***	0.07**	0.05	0.06**	0.15***	0.18***
N.obs.	582	582	582	582	582	582	582	582	582	582	582

This table provides sample statistics for Citi surprise indices for the period January 1, 2003 – March 4, 2014. Panel A shows the sample statistics of surprise index levels. Panel B gives the statistics for the weekly (5 trading day) changes (non-overlapping periods). The statistics are averages of 5 statistics computed on weekly changes starting on different days of the week. The statistics do not depend much on the day of the week. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively .Indices are coded by the countries they represent: AU – Australia, CA – Canada, CH – Switzerland, EU – Euro Zone, UK – United Kingdom, JP – Japan, NO – Norway, NZ – New Zealand, SE – Sweden, US – United States, G10 – the GDP-weighted average of the country surprise indices listed before.

deviation of 14.06, whereas the G10 surprise index changes have a standard deviation of only 8.15. Standard deviations of changes are similar across country indices. By construction the level of the index is highly auto-correlated. The changes of all but Australian, New Zealand and United Kingdom surprise indices are significantly auto-correlated, ranging from 0.06 to 0.15. The noise reduction benefits are also reflected by the high auto-correlation of 0.18 of the G10 surprise index changes.

Table 4.2 displays correlations between the surprise indices both for levels and 5-day changes. Numbers above diagonal shows correlations of levels and numbers below diagonal show correlation of changes. Correlations between the levels of the indices are stronger than those for changes. The strength of correlations of the G10 surprise index with its components is driven by each country's weight in the G10 index. Because of their large

Table 4.2. Surprise index correlations

	SI_{AU}	SI_{CA}	SI_{CH}	SI_{EU}	SI_{UK}	SI_{JP}	SI_{NO}	SI_{NZ}	SI_{SE}	SI_{US}	SI_{G10}
SI_{AU}	-	0.18	0.01	-0.08	0.02	0.08	0.17	-0.01	0.05	0.02	0.03
SI_{CA}	0.04	-	0.38	0.14	-0.09	0.15	-0.02	0.13	-0.12	0.06	0.21
SI_{CH}	0.01	0.12	-	0.36	-0.15	0.07	-0.10	0.02	0.06	0.19	0.37
SI_{EU}	-0.06	0.03	0.02	-	0.23	0.07	-0.11	0.06	0.21	0.20	0.76
SI_{UK}	-0.04	-0.09	-0.01	0.06	-	0.07	0.02	-0.05	0.17	0.33	0.43
SI_{JP}	0.05	0.03	0.00	-0.02	-0.01	-	-0.09	-0.05	-0.12	0.14	0.29
SI_{NO}	-0.02	-0.01	0.01	-0.01	-0.04	-0.05	-	-0.11	0.11	-0.04	-0.09
SI_{NZ}	0.08	0.11	0.03	-0.05	-0.04	-0.03	-0.03	-	-0.08	-0.16	-0.06
SI_{SE}	-0.07	-0.02	0.01	0.03	0.10	-0.05	-0.01	-0.02	-	0.10	0.20
SI_{US}	0.04	0.03	0.06	-0.03	0.05	-0.03	0.08	-0.09	0.03	-	0.75
SI_{G10}	0.04	0.14	0.09	0.66	0.22	0.20	0.05	-0.09	0.07	0.66	-

Table gives CITI surprise index (*SI*) sample correlations for the period January 1, 2003 – March 4, 2014. Number above (below) diagonal shows sample correlations of index levels (changes) every 5 trading days (non-overlapping periods, Friday-to-Friday). Indices are coded by countries they represent: AU – Australia, CA – Canada, CH – Switzerland, EU – Euro Zone, UK – United Kingdom, JP – Japan, NO – Norway, NZ – New Zealand, SE – Sweden, US – United States, G10 – GDP-weighted average of the country surprise indices listed before.

weight in the G10 surprise index, the EU and U.S. surprise index changes have the highest correlations with the G10 surprise index changes at 66% and 66%, respectively.

4.2.2 Bond returns

In this chapter we use J.P. Morgan government bond indices[54] for developed markets: Australia, Canada, Germany, United Kingdom, Japan, New Zealand, Sweden and U.S. J.P. Morgan government bond indices are among the most frequently used benchmarks (Fabozzi, 1997) .The choice of the countries is motivated by the availability of J.P. Morgan government bond indices. Table 4.3 gives summary statistics of weekly country excess returns over 3-month Libor. We choose weekly returns to match the frequency of the surprise index changes. All returns are in local currency.

The JP Morgan bond indices are based on mid rates for bonds at the close of business in the local JPM office for all markets except Australia, New Zealand, and Sweden where a

[54] obtained from Bloomberg

Table 4.3. Return summary statistics

	R_{AU}	R_{CA}	R_{DE}	R_{UK}	R_{JP}	R_{NZ}	R_{SE}	R_{US}
Mean	0.53%	2.75%	2.60%	2.21%	1.38%	0.94%	2.29%	2.26%
Std.	29.69%	29.37%	31.05%	43.53%	15.95%	25.24%	30.44%	33.64%
Skewness	0.00	-0.06	-0.05	0.06	-0.60	0.10	0.00	-0.18
Kurtosis	3.54	3.31	3.49	4.82	5.70	5.03	4.19	3.67
Autocorrelation	-0.05	-0.03	-0.06	-0.10***	-0.01	0.06	-0.04	-0.03
N.obs.	583	583	583	583	583	583	583	583

Table gives sample statistics for 5-trading day (non-overlapping) excess returns of JPM global bond indices for the period January 1, 2003 – March 4, 2014. The excess return is calculated as the bond index return earned over 3-month Libor in the local currency in basis points. Indices are coded by countries they represent: AU – Australia, CA – Canada, DE – Germany, UK – United Kingdom, JP – Japan, NZ – New Zealand, SE – Sweden, US – United States. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively

third party source is used. Accrued interest is calculated according to the country-specific market conventions on a settlement day basis. The universe of bonds specifically excludes: floating rate notes, perpetuals, bonds with less than one year to maturity, bonds targeted at the domestic market for tax reasons, and bonds with callable, puttable or convertible features.

Average annualized excess returns are positive for all of the countries analyzed, ranging from 0.53% in Australia to 2.75% in Canada. U.S. bonds on average have an excess return of 2.26% per annum. We also note that at the weekly frequency the autocorrelation is negative[55] for all markets except New Zealand. Only the mean reversion in U.K. bond returns is statistically significant.

4.3 Methodology

4.3.1 Relation between international news and international bond returns

We estimate the contemporaneous relationship between the change in news indices and bond excess returns by running the regression

$$R_{t-4:t} = \alpha_k + \beta' \Delta SI_{t-4:t} + \varepsilon_t, \qquad (4.2)$$

[55] The common empirical finding is that returns are negatively correlated in very short (a week or shorter) periods. For a review see Ilmanen (2011).

where $R_{t-4:t}$ is weekly excess government bond return starting from business day $t-4$ and ending on day t. $\Delta SI_{t-4:t}$ is a vector[56] of weekly surprise indices changes in the interval that is contemporaneous with the bond return interval. The challenge to correctly align news indices and bond returns is discussed in Section 4.3.3. We calculate weekly returns and changes in surprise indices daily. Following Ludvigson and Ng (2009) we use Newey-West standard errors with eight lags to ensure the procedure fully corrects for the MA(5) error structure that arises due to using overlapping observations.

Positive economic news implies higher short-term interest rates and thus a negative impact on bond prices. Faust et al. (2007) and Andersen et al. (2007) find U.S. news affects both U.S. and foreign interest rates in the same direction. The same impact sign is also expected for the foreign news.

Similarly we estimate the forecasting relationship between the news indices and bond excess returns running the regression

$$R_{t+1:t+5} = \alpha_k + \beta' \Delta SI_{t-4:t} + \varepsilon_t, \tag{4.3}$$

where $R_{t+1:t+5}$ is weekly excess government bond return starting on day $t+1$ and ending on business day t+5. $\Delta SI_{t-4:t}$ is a vector of weekly surprise indices changes from day $t-4$ to day t. The intervals of changes in surprise indices and bond returns are aligned so that there would be no look ahead bias. More details are provided in Section 4.3.3. Following Ludvigson and Ng (2009) we use Newey-West standard errors with eight lags to ensure the procedure fully corrects for the MA(5) error structure.

If the markets are efficient in incorporating macroeconomic information there should be no relation between the news and future excess bond returns, i.e. $\beta = 0$. However if markets do not fully incorporate the information we expect the same negative sign as in the contemporaneous case, i.e. $\beta < 0$.

4.3.2 Decomposition of R-squared

When analyzing the predictive or contemporaneous explanatory power in a multivariate regression it is important to understand the contribution of the economic surprise index of each country k ($\Delta SI_{t,k}$ in the vector ΔSI_t). We use Feldman's (2005) proportional marginal

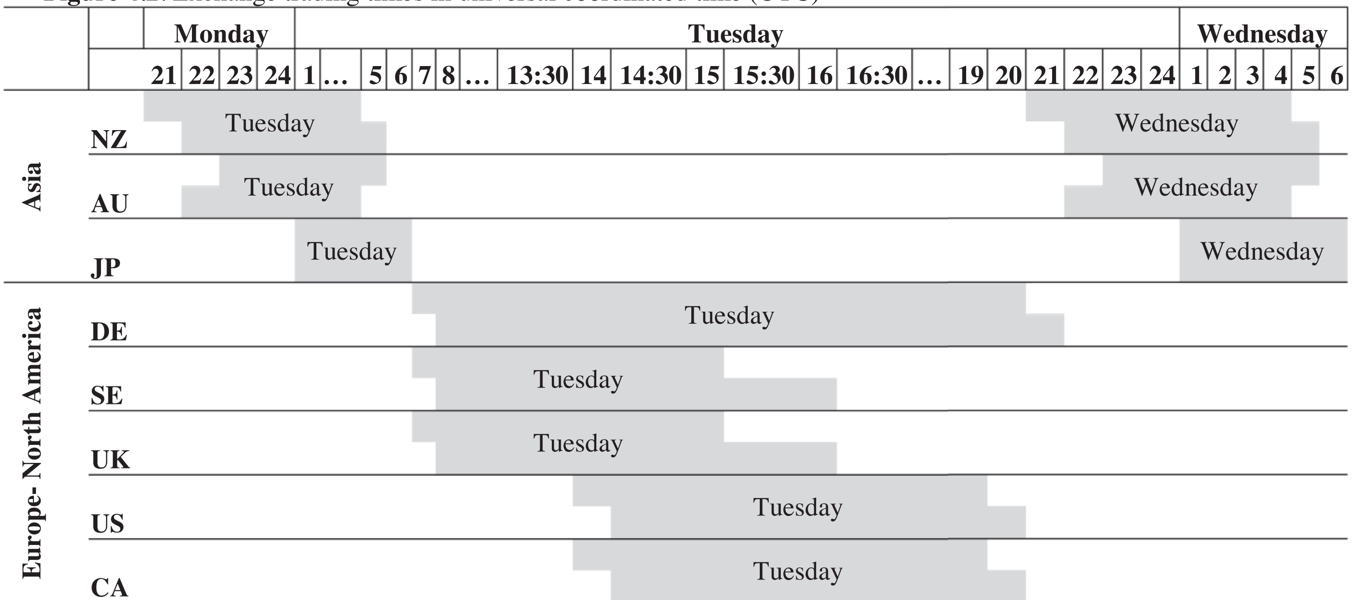
[56] It is a scalar if we only use one surprise index.

variance decomposition to assign the proportion of explanatory power to each independent variable. The decomposition is based on the average increment to R^2 for each variable. To calculate the average increment to R^2 for $\Delta SI_{t,k}$, each variable is entered into the model, one at a time, and the increment to R^2 when $\Delta SI_{t,k}$ is added to the model is averaged over all possible orderings of $\Delta SI_{t,k}$ entry to the model. Standardizing average increments to sum up to 1 gives the proportion of explanatory power each surprise index accounts for.

4.3.3 Timing issues

We recognize that national bond markets operate in different time zones and hence have different opening and closing times. Therefore daily return observations are nonsynchronous. National macroeconomic news of a country usually arrives during local trading hours. Figure 4.2 illustrates trading times of national stock exchanges. Trading times of the exchanges split naturally into non-overlapping trading zones of Asia (New Zealand, Australia and Japan) and Europe-America (Germany, Sweden, U.K., U.S. and Canada). The figure indicates that the trading day in Asia always ends before the trading starts in Europe and North America. The session of the following trading day in Asia opens after the European and American markets are already closed. Thus it is important to account for time differences when analyzing relationships between global news and international bond markets. Consider, for example, the Japanese market that closes before the opening of U.S. market. U.S. macroeconomic news cannot be incorporated into Japanese bonds on the same calendar day, because the Japanese bond market is already closed for the day when the news is released. Only at the opening of the Japanese bond market on the next trading day the U.S. news can be incorporated. The 5-day intervals in the predictive regression in equation (4.3) would overlap if U.S. macroeconomic surprises are not lagged by one calendar day. Ignoring the different trading hours of the international markets could lead to a false conclusion that Japanese bond returns are strongly predictable. Such predictability cannot be exploited in practice and is not a sign of market inefficiency. For the same reason the intervals in the contemporaneous regression (4.2) would only overlap by four days, thus the contemporaneous relation would be weaker. The other way around is easier in this case. Japanese macroeconomic news can be incorporated on the same day in European and U.S. bond prices.

Figure 4.2. Exchange trading times in universal coordinated time (UTC)



This figure displays the trading session times of eight stock exchanges in universal coordinated time (UTC). The shaded areas show trading session times of for seven equity markets. For each country the upper (lower) shaded area shows summer (winter) trading times. Text in the shaded areas indicates the weekday of the trading session in local time. The exchanges are coded AU – Australia (Australian Securities Exchange), CA – Canada (Toronto Stock Exchange), DE – Germany (Frankfurt Stock Exchange), UK – United Kingdom (London stock Exchange, FTSE), JP – Japan (Tokyo Stock Exchange), NZ – New Zealand (New Zealand Stock Market), SE – Sweden (Stockholm Stock Exchange), U.S. – United States (New York Stock Exchange).

Asian markets are already closed when economic information from Europe and North America is announced. Therefore it is incorporated into bond prices during the following trading day. Contemporaneous relationships, therefore, should be investigated based on day $t+1$ Asian information and day t European and North-American information. Predictive relationships from Europe and North-America to Asian markets should make use of day $t+2$ Asian market returns.

4.4 Results and analysis

4.4.1 Contemporaneous

The literature finds individual economic news especially important at high frequency (Andersen et al., 2007, Faust et al., 2007). To our best knowledge only Scotti (2013) and Brazys and Martens (2014) investigate the relationship between aggregated news and asset prices. Scotti (2013) regresses daily exchange rate returns on daily surprise indices, Brazys and Martens (2014) regress monthly equity and currency carry returns on aggregated surprises in the same month. However both studies focus on the relationship between asset

Table 4.4. Contemporaneous relationship between bond returns and macroeconomic news

	$\beta_{t,L}$	R^2	$\beta_{t,G}$	R^2	$\beta_{t,L}$	$\beta_{t,GxL}$	R^2
Australia	-0.32***	0.011	-1.53***	0.047	-0.32***	-1.47***	0.056
Canada	-0.42***	0.027	-1.26***	0.032	-0.42***	-1.08***	0.052
Germany	-0.23**	0.005	-1.17***	0.026	-0.23**	-1.02***	0.029
U.K.	-0.36**	0.007	-1.47***	0.021	-0.36**	-1.25***	0.023
Japan	-0.01	0.000	-0.68***	0.029	-0.01	-0.60***	0.028
New Zealand	-0.21*	0.005	-1.19***	0.038	-0.21*	-1.22***	0.045
Sweden	-0.24***	0.007	-1.29***	0.033	-0.24***	-1.24***	0.038
U.S.	-1.02***	0.049	-1.66***	0.044	-1.02***	-0.54**	0.056

We regress weekly excess returns of JPM bond indices on weekly changes in local ($\beta_{t,L}$) and global ($\beta_{t,G}$) surprise indices. The global surprise index is constructed as the GDP-weighted average of the G10 country surprise indices. We also jointly regress changes in the local surprise index and changes in the global surprise index excluding the local surprise index ($\beta_{t,GxL}$), i.e. foreign news. When computing global indices for Australia, Japan and New Zealand the individual European and North American surprise indices are lagged one day to account for the fact that this information is not be available on the same calendar day for these markets. For all countries we use their local surprise indices except for Germany, where we use the Eurozone surprise index. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. We use Newey-West standard errors with 8 lags to ensure the procedure fully corrects for the MA(5) error structure caused by using overlapping weekly data.

returns and aggregated news contemporaneously, whereas we will also look at the impact of past news on future bond returns. We first establish the contemporaneous relationship between changes in news indices and excess bond market returns. In Table 4.4 we give estimates of regression (4.2) for each country's excess bond returns where exogenous variables are changes in local, global and foreign news indices. We find local indices are statistically significantly related to the excess returns in local bond markets except for Japan. The relationship is even stronger when the global news index is considered. Global news explains up to 4.7% of the variation in weekly bond returns. In the last three columns of Table 4.4 we show that both foreign and local news are important in explaining contemporaneous bond returns, also for the U.S. The coefficients, however, suggest that for the U.S. local news is more important than foreign news whereas for the other countries foreign news is more important. The impact of local, global and foreign news is as expected: positive economic news is bad news for bond returns.

4.4.2 Predictability

If news is incorporated into bond prices efficiently news cannot have predictive power. Table 4.5, however, provides initial evidence for predictive power of macroeconomic news for bond markets. Table 4.5 provides the results for the regression in equation (4.3), where we regress weekly excess bond returns on past weekly changes in news indices. First, local economic news surprises generally do not have predictive power for most of the local bond markets. Exceptions are Germany and U.K. The predictive sign of U.K. news indicate the U.K. bond market over-reacts to the economic news and then mean-reverts the following week. Second, global news has statistically significant predictive power for all bond markets except for the U.K. The negative sign of the predictive betas indicate that global news does not receive enough attention in local bond markets. Finally, putting local and foreign news into competition, the results show that foreign news drives predictive power in 7 of the 8 markets analyzed.

4.4.3 Which countries contribute to the explanatory and predictive power?

4.4.3.1 Explanatory power

Are all countries equally important in explaining excess returns? As described in the data section global indices are constructed using GDP weights. This imposes the restriction that economic news from larger economies is more important. Table 4.6 gives results of regression (4.2) where each G10 news index is included separately, allowing the regression to determine the relative importance. The table also shows the decomposition of the explanatory power (numbers in brackets). We find only news from the two largest economies, the U.S. and the Euro Zone, has a statistically significant relation with the excess bond returns in each country analyzed. Standard deviations of the index changes are similar (see Table 4.1 Panel B), thus the news impact coefficients in Table 4.6 can be

Table 4.5. Forecasting: Global vs. Local

	$\beta_{t,L}$	R^2	$\beta_{t,G}$	R^2	$\beta_{t,L}$	$\beta_{t,GxL}$	R^2
Australia	0.11	0.001	-0.84***	0.014	0.10	-0.83***	0.016
Canada	-0.13	0.002	-0.76***	0.012	-0.11	-0.70***	0.013
Germany	-0.19*	0.003	-0.50**	0.005	-0.20*	-0.27	0.005
U.K.	0.34**	0.006	-0.50	0.002	0.36**	-0.70**	0.011
Japan	-0.04	0.000	-0.25**	0.004	-0.05	-0.20*	0.004
New Zealand	0.06	0.000	-0.47**	0.006	0.04	-0.47**	0.006
Sweden	-0.04	0.000	-0.49**	0.005	-0.04	-0.48**	0.005
U.S.	-0.22	0.002	-1.10***	0.019	-0.24*	-0.91***	0.022

We regress weekly excess returns of JPM bond indices on the lagged changes in local ($\beta_{t,L}$) and global ($\beta_{t,G}$) surprise indices. The global index is constructed as the GDP-weighted average of the G10 individual surprise indices. We also use a multiple regression of weekly excess bond returns on lagged local surprise index changes and lagged changes in the global surprise index excluding the local surprise index ($\beta_{t,GxL}$). Excess returns are calculated daily and accumulated for 5 days. When computing global surprise indices individual European and North American surprise indices are lagged one day to account that this information is not be available for these markets. For all countries we use their local surprise indices except for Germany, where we use Eurozone surprise index. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. We use Newey-West error with 8 lags to ensure the procedure fully corrects for the MA(5) error structure caused by using overlapping weekly data.

Table 4 6. Joint explanatory (contemporaneous) power of the global index components

Y	SI_{AU}	SI_{CA}	SI_{CH}	SI_{EU}	SI_{UK}	SI_{JP}	SI_{NO}	SI_{NZ}	SI_{SE}	SI_{US}	R^2
R_{AU}	-0.35***	-0.20**	-0.14	-0.18*	-0.32***	-0.07	-0.05	-0.06	-0.14	-0.76***	0.078
	[0.19]	[0.07]	[0.03]	[0.02]	[0.11]	[0.01]	[0.00]	[0.01]	[0.05]	[0.52]	
R_{CA}	-0.02	-0.39***	-0.18*	-0.22**	-0.06	0.02	-0.07	-0.03	-0.11	-0.62***	0.063
	[0.00]	[0.40]	[0.08]	[0.08]	[0.01]	[0.00]	[0.01]	[0.00]	[0.03]	[0.40]	
R_{DE}	0.04	-0.17*	-0.10	-0.24**	-0.10	-0.07	-0.04	-0.02	-0.04	-0.58***	0.033
	[0.00]	[0.13]	[0.04]	[0.16]	[0.03]	[0.01]	[0.01]	[0.00]	[0.01]	[0.60]	
R_{UK}	0.08	-0.23*	-0.09	-0.40**	-0.32**	0.14	-0.15	-0.18	-0.07	-0.59***	0.033
	[0.01]	[0.13]	[0.02]	[0.22]	[0.18]	[0.02]	[0.05]	[0.04]	[0.01]	[0.32]	
R_{JP}	-0.08	-0.03	-0.04	-0.14**	-0.12*	-0.01	-0.01	0.00	0.01	-0.33***	0.034
	[0.06]	[0.04]	[0.00]	[0.09]	[0.15]	[0.00]	[0.00]	[0.00]	[0.00]	[0.65]	
R_{NZ}	-0.14*	-0.14*	-0.12	-0.21**	-0.19**	-0.16	0.00	-0.23*	-0.04	-0.56***	0.055
	[0.05]	[0.06]	[0.06]	[0.08]	[0.04]	[0.05]	[0.00]	[0.15]	[0.02]	[0.48]	
R_{SE}	-0.01	-0.11	-0.13	-0.25**	-0.07	-0.08	-0.04	-0.10	-0.21**	-0.69***	0.047
	[0.00]	[0.05]	[0.05]	[0.12]	[0.01]	[0.01]	[0.01]	[0.02]	[0.12]	[0.61]	
R_{US}	-0.06	-0.19*	-0.08	-0.20*	-0.20*	0.02	-0.07	0.09	-0.24***	-0.98***	0.069
	[0.00]	[0.06]	[0.01]	[0.05]	[0.05]	[0.00]	[0.01]	[0.01]	[0.10]	[0.71]	

This table reports beta estimates of regressing weekly JPM bond index excess returns (R) on the changes in surprise indices (SI) jointly. The SI changes are calculated in the 5 trading day window prior to the forecast day. Country returns and indices are coded by countries they represent: AU – Australia, CA – Canada, CH – Switzerland, DE – Germany, EU – Euro Zone, UK – United Kingdom, JP – Japan, NO – Norway, NZ – New Zealand, SE – Sweden, US – United States. For Australia, New Zealand, and Japan news indices of the European and North American are lagged by one day to take into account that macroeconomic news information is not available for the Australasian markets. Excess returns are calculated daily and accumulated for 5 days. Following Ludvigson and Ng (2009) we use Newey-West error with 8 lags to ensure the procedure fully corrects for the MA(5) error structure. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Values in the brackets under the regression coefficients show the fraction of R^2 they represent. R^2 is decomposed following method in Feldman (2005), see also Section 3.2.

compared. U.S. macroeconomic news has more than twice as much impact on bond returns as European news. The results of the R^2 decomposition confirm that U.S. news accounts for most of the explanatory power. The fraction varies from 32% for the U.K. up to 71% for the U.S. itself. U.S. news is always in the top 3 contributors. Local news also has a statistically significant relation with the local bond returns, confirming the results from Table 4.4. For 6 of the 8 markets local news is in the top 3 contributors to explanatory power. Interestingly U.S. news is the most important for each country, more important than local news. Existing studies also find that local economic news (except U.S.) is less important than U.S. economic news for Germany (Ehrmann and Fratzscher, 2005, and Andersson, Overby, and Sebestyén, 2009), Canada (Gravelle and Moessner, 2001), and Australia (Craine and Martin, 2008) government bond markets. Surprisingly, Japanese news is not important for any of the countries. On the other hand 71% of the relation between economic news and the U.S. bond market comes from local news. U.S. bond investors focus on the local news and largely seem to ignore international economic news. To summarize, our results show that economic news from the largest economies, the U.S. and the Euro Zone, is important for all countries, with a dominant role of U.S. news. Local news is also important for local bond returns.

4.4.3.2 Predictive power

Table 4.7 provides the results of a detailed analysis of the origin of the predictive power of news for bond prices illustrated in Section 4.4.2. For the excess bond returns of each country we estimate the predictive regression in equation (4.3) with changes in G10 news indices as predictors. The results suggest the predictive results are mainly driven by economic news from the Eurozone and Japan. News from the Eurozone and Japan predicts 7 and 6 bond markets, respectively. None of the news from other countries has such strong predictive power. The signs of the predictive direction are negative consistent with an initial under-reaction to the news.

The predictive R^2 is decomposed in the brackets under the predictive coefficients in Table 4.7. For all but U.K. market Eurozone news is among top 3 contributors to predictive power. Japanese and Swiss economic news is among top 3 largest contributors for 5 markets. News from the Eurozone, Japan and Switzerland is the main driver of the predictive power accounting for 39% (Japan) to 80% (New Zealand) of predictive power. For the U.S. 40% of the predictive power of global news comes from the Eurozone. Hence US bond investors on average react to European macroeconomic news with a lag.

Table 4.7. Decomposition of predictive power

Y	SI_{AU}	SI_{CA}	SI_{CH}	SI_{EU}	SI_{UK}	SI_{JP}	SI_{NO}	SI_{NZ}	SI_{SE}	SI_{US}	R^2
R_{AU}	0.10	-0.09	-0.14	-0.34***	0.13	-0.25*	-0.10	0.07	-0.06	-0.21*	0.027
	[0.04]	[0.06]	[0.12]	[0.38]	[0.07]	[0.13]	[0.06]	[0.02]	[0.02]	[0.11]	
R_{CA}	-0.02	-0.08	-0.24***	-0.30***	0.08	-0.25**	-0.11	-0.04	-0.14	-0.16	0.028
	[0.00]	[0.04]	[0.32]	[0.27]	[0.02]	[0.13]	[0.07]	[0.01]	[0.08]	[0.05]	
R_{DE}	0.09	-0.12	-0.16	-0.22**	0.11	-0.20	-0.13	-0.17	-0.09	-0.10	0.020
	[0.03]	[0.14]	[0.19]	[0.18]	[0.06]	[0.11]	[0.12]	[0.10]	[0.04]	[0.02]	
R_{UK}	0.10	-0.10	-0.19	-0.21	0.34**	-0.34**	-0.24*	-0.31*	-0.10	-0.22	0.025
	[0.02]	[0.04]	[0.12]	[0.07]	[0.23]	[0.13]	[0.18]	[0.14]	[0.02]	[0.05]	
R_{JP}	0.08	-0.01	-0.03	-0.10*	0.00	-0.06	-0.06	-0.05	-0.04	-0.07	0.010
	[0.20]	[0.01]	[0.06]	[0.27]	[0.00]	[0.06]	[0.18]	[0.08]	[0.06]	[0.08]	
R_{NZ}	0.11	-0.02	-0.14	-0.24***	0.07	-0.26**	-0.07	0.04	-0.05	-0.02	0.021
	[0.08]	[0.00]	[0.17]	[0.36]	[0.03]	[0.27]	[0.05]	[0.01]	[0.02]	[0.00]	
R_{SE}	0.08	-0.06	-0.20*	-0.24**	0.15	-0.25**	-0.07	-0.09	-0.05	-0.08	0.020
	[0.03]	[0.04]	[0.29]	[0.24]	[0.11]	[0.19]	[0.04]	[0.03]	[0.02]	[0.02]	
R_{US}	0.08	-0.13	-0.18**	-0.45***	0.08	-0.31**	-0.08	-0.06	-0.26**	-0.23*	0.037
	[0.01]	[0.07]	[0.11]	[0.40]	[0.02]	[0.12]	[0.03]	[0.01]	[0.17]	[0.07]	

Table reports beta estimates of regressing weekly JPM bond index excess returns (R) on past changes in CITI surprise indices (SI). The changes are calculated in the 5 trading day window prior to the first forecast day. Country returns and indices are coded by countries they represent: AU – Australia, CA – Canada, CH – Switzerland, DE- Germany, EU – Euro Zone, UK – United Kingdom, JP – Japan, NO – Norway, NZ – New Zealand, SE – Sweden, US – United States. For Australia, New Zealand, and Japan news indices of the European and North American are lagged by one day to account that macroeconomic news information is not available for the Australasian markets. Excess returns are calculated daily and accumulated for 5 days. We use Newey-West error with 8 lags to ensure the procedure fully corrects for the MA(5) error structure. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Values in the brackets under the regression coefficients show the fraction of R^2 they represent. R^2 is decomposed following method in Feldman (2005), see also Section 3.2.

4.4.4 How long does the predictive power last?

It is natural to choose a forecasting horizon that is a natural partition of calendar time: a day, week, month, quarter or year ahead. In the literature predictive power is often motivated by time-variation in the risk premium thus the choice of a medium (a month) to long horizon (a year). This chapter concerns economic news that according to EMH should be incorporated into prices as soon as it is available to market participants. In Table 4.8 we test this hypothesis in more detail than the fixed weekly periods analyzed so far. We

Table 4.8. How many days ahead do global indices forecast?

Y	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$	$t+6$	$t+7$	$t+8$	$t+9$	$t+10$
R_{AU}	-0.16**	-0.17***	-0.17**	-0.18***	-0.17***	-0.14**	-0.10	-0.05	-0.02	-0.04
R_{CA}	-0.16***	-0.17***	-0.12*	-0.16***	-0.15**	-0.11*	-0.10	-0.11*	-0.03	-0.03
R_{DE}	-0.16***	-0.11*	-0.09	-0.09	-0.04	-0.06	-0.05	-0.02	0.01	0.01
R_{UK}	-0.18**	-0.13	-0.07	-0.08	-0.04	-0.07	-0.07	-0.06	0.01	0.02
R_{JP}	-0.09***	-0.06**	-0.03	-0.03	-0.04	-0.02	0.00	-0.01	0.02	0.03
R_{NZ}	-0.13***	-0.09**	-0.10**	-0.09**	-0.07	-0.05	-0.07	-0.04	-0.04	-0.05
R_{SE}	-0.16***	-0.10*	-0.08	-0.08	-0.06	-0.11*	-0.09	-0.07	-0.05	-0.04
R_{US}	-0.24***	-0.23***	-0.17**	-0.22***	-0.24***	-0.14**	-0.12	-0.11	-0.08	-0.08

We regress daily excess bond index return on the 5-day change in global surprise indices lagged 1 (column "$t+1$") to 10 days (column "$t+10$"). To take into account that Australasian markets are closed during the announcement of European and North American macroeconomic news, we construct a separate index for Australasian markets where European and North American surprise indices are lagged 1 day. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Countries are coded as: AU – Australia, CA – Canada, CH – Switzerland, DE – Germany, UK – United Kingdom, JP – Japan, NO – Norway, NZ – New Zealand, SE – Sweden, US – United States.

regress daily excess return up to 10 days ahead into the future on the preceding weekly change in global surprise index. The results indicate that changes in surprise indices can predict bond returns up to 6 trading days ahead, including the U.S.

The results also point to a slow adjustment of bond prices to global news. First, the predictive significance starts on the first day. Second, the size of the predictive coefficient decays with the time, thus most information is being incorporated into asset prices on the first day and subsequently the older the news the less impact on bond markets. The Australian, Canadian and U.S. markets are the slowest to incorporate global economic news surprises into bond prices.

4.5 Limited attention explains inefficiencies?

In this part we investigate the origin of the predictive power documented in Section 4.4.2. First, we argue that due to the limited attention of investors the international news is not fully impounded into bond price immediately and fully. Second, we investigate a number of alternative explanations for the finding: local and global bond momentum, local and global news momentum.

4.5.1 Limited attention

The limited attention hypothesis states that news is impounded into asset prices with a delay. For example news from a related company is not impounded into the price of related companies due to limited attention (Ramnath, 2002, Cohen and Frazzini, 2008).

In this paper we argue that investor attention is affected by upcoming important scheduled announcements. Section 4.4.3.1 shows U.S. economic news is the key driver in international bond markets in the contemporaneous analysis, whereas non-U.S. economic news is less important. We therefore focus on the incorporation of non-U.S. economic news into bond prices. We consider two cases: One in which there is no important U.S. news within a day after the non-U.S. news. And one where there is important U.S. news following non-U.S. news. The literature[57] finds the following nine U.S. announcements the most important for bond markets: CPI, PPI, Durable Goods Orders, Employment report, ISM Manufacturing (NAPM), New Home Sales, Housing Starts, Retail Sales, and scheduled FOMC target rate decisions. The limited attention hypothesis contains two parts: (1) the lack of immediate reaction, and (2) presence of predictive power. We test both parts of limited attention.

***H_1*: The contemporaneous relation between global news and bond prices is weaker before important U.S. economic announcements.**

If H_1 holds then $\beta_{US\,news} > \beta_{no\,US\,news}$ in the regression

$$R_{t-4:t} = \alpha_k + \beta_{US\,news}\, dSI_{t-4:t} D_{t+1} + \beta_{no\,US\,news} dSI_{t-4:t}(1 - D_{t+1}) + \varepsilon_t, \quad (4.4)$$

where $R_{t-4:t}$ are weekly excess government bond returns starting four business days ago from day $t-4$ and ending on day t. $\Delta SI_{t-4:t}$ are weekly G10 surprise index changes in the interval that is considered contemporaneous. D_{t+1} is 1 if there is important U.S. economic announcement on day $t+1$, otherwise it is 0. Contemporaneously the relation between bond returns and economic news is negative. Thus a weaker relation indicates the news impact on bond prices is less negative.

[57] See Ederington and Lee (1993), Fleming and Remolona (1997), Fleming and Remolona (1999), Fleming and Remolona (2001), Bollerslev, Cai, and Song (2000), Balduzzi, Elton, and Green (2001), and Alessandro Beber and Brandt (2006).

H_2*: *Global economic news before important U.S. economic announcements has predictive power for bond returns.

In Section 4.4.3 we show that global economic news has predictive power for all international bond markets at least 1 day ahead. Therefore to test hypothesis H_2 we investigate if predictive power is concentrated to the days when important U.S. economic news is announced. If H_2 holds then in the regression

$$R_{t+1} = \alpha_k + \beta_{US\,news}\, dSI_{t-4:t} D_{t+1} + \beta_{no\,US\,news} dSI_{t-4:t}(1 - D_{t+1}) + \varepsilon_t \qquad (4.5)$$

only $\beta_{US\,news}$ is significant. In regression (4.5) R_{t+1} is the daily excess government bond return on day $t + 1$.

Table 4.9 gives the results for regressions (4.4) and (4.5). In Panel A we test the first part of the inattention hypothesis that global news has weaker immediate impact on bond prices when there is important U.S. news scheduled on the next day. News is a statistically significant driver of all bond markets both in the days before important U.S. economic announcements ($\beta_{US\,news}$) and when there is no important U.S. economic announcements ($\beta_{no\,US\,news}$). However in all markets except for Japan we find $\beta_{no\,US\,news}$>$\beta_{US\,news}$. The difference is statistically significant for 6 out of 8 bond markets.

Panel B of Table 4.9 tests hypothesis H_2 that predictive power is concentrated on important U.S. economic news days. Indeed for 7 out of 8 bond markets global news has significant predictive power for days when important U.S. announcements are made. In contrast for 6 out of 8 bond markets global news has no predictive power for the days when there are no important U.S. announcements.

The results in Panel A and B of Table 4.9 provide support for the limited attention hypothesis. Upcoming important U.S. news results in an insufficient immediate adjustment to global news, which in turn leads to predictability in international bond returns including U.S. bond returns.

Table 4.9. Importance of global news before important U.S. news announcement days

	Panel A. Contemporaneous				**Panel B.** Forecasting		
	$\beta_{US\ news}$	$\beta_{no\ US\ news}$	R^2	*p-value*	$\beta_{US\ news}$	$\beta_{no\ US\ news}$	R^2
Australia	-1.32***	-1.61***	0.047	0.25	-0.26**	-0.12	0.003
Canada	-1.09***	-1.74***	0.050	**0.01**	-0.40***	-0.05	0.005
Germany	-1.10***	-1.61***	0.042	**0.05**	-0.30***	-0.09	0.003
U.K.	-1.26***	-2.05***	0.033	**0.04**	-0.33**	-0.11	0.002
Japan	-0.68***	-0.67***	0.028	0.93	-0.11*	-0.08**	0.002
New Zealand	-0.92***	-1.29***	0.038	**0.10**	-0.12	-0.13**	0.003
Sweden	-1.23***	-1.67***	0.047	**0.10**	-0.28***	-0.11	0.003
U.S.	-1.55***	-2.15***	0.061	**0.03**	-0.54***	-0.1	0.007

The table displays regression results when regressing bond returns on the 5-day change in G10 economic surprise index conditioned upon important U.S. economic news. Panel A gives estimates of contemporaneous regression $R_{t-4:t} = \alpha_k + \beta_{US\ news}\ dSI_{t-4:t}D_{t+1} + \beta_{no\ US\ news} dSI_{t-4:t}(1 - D_{t+1}) + \varepsilon_t$, where $R_{t-4:t}$ are weekly excess government bond returns starting four business days ago from day t and ending on day t; $dSI_{t-4:t}$ is the 5-day change in the G10 economic surprise index starting $t-4$ and ending at t; D_{t+1} is 1 if there is important U.S. economic announcement on day $t+1$, otherwise it is 0. Panel B gives estimates for the predictive regression $R_{t+1} = \alpha_k + \beta_{US\ news}\ dSI_{t-4:t}D_{t+1} + \beta_{no\ US\ news} dSI_{t-4:t}(1 - D_{t+1}) + \varepsilon_t$, estimate. R_{t+1} is the daily excess bond return. The important announcement set includes nine U.S. announcements that the literature finds important: CPI, PPI, Durable Goods Orders, Employment report, ISM Manufacturing (NAPM), New Home Sales, Housing Starts, Retail Sales, and scheduled FOMC target rate decisions. The sample consists of 2912 observations of which 953 are important announcement days. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. The last column of Panel B gives p-values of the Wald test for the hypothesis $\beta_{US\ news} = \beta_{no\ US\ news}$.

4.5.2 Alternative hypotheses

In this section we look at alternative explanations for our finding that global news predicts excess bond returns. First, we test momentum in bond returns as a cause for predictability. A Ilmanen (1997), Yamada (1999), Luu and Yu (2012) and Moskowitz, Ooi, and Pedersen (2012) document that past bond returns predict future bond returns in developed country bond markets (Australia, Canada, Germany, Japan, U.S. and U.K.). Duyvesteyn and Martens (2014) document bond return momentum in emerging markets. Bond momentum means returns are positively autocorrelated. Hence it could be that global news that explains excess bond returns in week t, appears to predict excess bond returns in week $t+1$ as well.

However Table 4.3 shows that for all but one country excess bond returns are negatively autocorrelated at the weekly frequency. We nevertheless test the local momentum hypothesis in Panel A of Table 4.10. We first orthogonalize each local bond market return to its own past, i.e. we regress weekly bond returns on past weekly bond returns. We use the residuals to evaluate the predictive power of the G10 surprise index. Comparing the results in Table 4.10 to those in Table 4.5 we see that we still have strong predictability of past weekly changes in the global surprise index for future weekly bond returns. The only difference now is that we also find this result for the U.K. bond market.

Second, we test the hypothesis of news momentum. Changes in surprise indices are strongly connected to the bond returns contemporaneously (Table 4.4). Changes in news indices are also significantly positively autocorrelated (Table 4.1). Thus predictability

Table 4.10. Bond and news momentum

	Panel A. Local bond momentum		**Panel B.** Local news momentum		**Panel C.** Global news momentum	
	$\boldsymbol{\beta}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta}$	$\boldsymbol{R^2}$
$R_{AU}^{\perp}$	-0.93***	0.017	-0.83***	0.014	-0.60***	0.008
$R_{CA}^{\perp}$	-0.81***	0.013	-0.69***	0.010	-0.56***	0.007
$R_{DE}^{\perp}$	-0.58**	0.007	-0.46**	0.004	-0.31	0.002
$R_{UK}^{\perp}$	-0.68**	0.005	-0.41	0.002	-0.27	0.001
$R_{JP}^{\perp}$	-0.26**	0.004	-0.25**	0.004	-0.14	0.001
$R_{NZ}^{\perp}$	-0.40*	0.004	-0.46**	0.006	-0.29	0.002
$R_{SE}^{\perp}$	-0.56**	0.006	-0.45*	0.004	-0.28	0.002
$R_{US}^{\perp}$	-1.16***	0.021	-0.90***	0.013	-0.84***	0.012

We regress weekly excess bond returns ($R^{\perp}$) orthogonalized to past returns or past news on the contemporaneous changes in global (β) surprise indices. The global index is constructed as GDP-weighted average of G10 country local surprise indices. The changes are calculated over the five-day period prior to the forecast period. When computing global indices individual European and North American surprise indices are lagged one day to account that this information is not available for these markets. For all countries we use their local surprise indices except for Germany, where we use Eurozone surprise index. Excess returns are calculated daily and accumulated for 5 days. In Panel A bond returns are orthogonalized to the local bond return in the previous 5 business days before forecast period. In Panel B the returns are orthogonalized to the contemporaneous change in local news index. In Panel C the returns are orthogonalized to the contemporaneous change in the global surprise index. We use Newey-West error with 8 lags to ensure the procedure fully corrects for the MA(5) error structure. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. Countries are coded as: AU – Australia, CA – Canada, DE – Germany, UK – United Kingdom, JP – Japan, NZ – New Zealand, SE – Sweden, US – United States.

could be a result of predicting the changes in surprise index which in turn are contemporaneously connected to the bond returns.

We test two versions of the hypothesis. Changes in the global surprise index could predict changes in local surprise indices or changes in the global surprise index. We orthogonalize local excess bond returns to the contemporaneous changes in the corresponding local surprise index (Panel C); or we orthogonalize the returns to the contemporaneous changes in the global surprise index (Panel D). Panel C of Table 4.10 shows that the predictability result is not affected by the predictability of local news. Panel D of Table 4.10 however shows that the predictive power of G10 surprise changes is significantly reduced when returns are corrected for the contemporaneous news impact. The predictive power of the global surprise index only remains significant for Australia, Canada and U.S. Hence we have a second reason for the predictive ability of changes in global news indices for excess bond returns. Besides limited attention we find that also autocorrelation in changes in the global news indices can explain part of the predictive ability. In the next section we check whether the market is taking into account this autocorrelation.

4.5.3 Do bond markets account for predictability in the global surprise index?

The limited predictive power after controlling for contemporaneous G10 surprise index changes documented in Table 4.10 Panel D together with the strong contemporaneous relation between changes in G10 index and bond market returns documented in Table 4.4 suggests that market participants may also react to the predictable component of the global surprise index. We therefore test the hypothesis that market participants fail to adjust for predictability. First we split the changes in G10 surprise index into expected (predictable) and unexpected (unpredictable) components estimating regression

$$dSI_{t+1:t+5} = \alpha_k + \beta\, dSI_{t-4:t} + \varepsilon_t \qquad (4.6)$$

where $dSI_{t-4:t}$ ($dSI_{t+1:t+5}$) is 5-day change in G10 surprise index from day $t-4$ to day t (from $t+1$ to $t+5$). We then run regression

$$R_{t+1:t+5} = \alpha_k + \beta_{t,G}^{expected}\ \widehat{dSI}_{t+1:t+5} + \beta_{t,G}^{unexpected}\hat{\varepsilon}_t + \eta_t \qquad (4.7)$$

where $R_{t+1:t+5}$ 5-day excess bond return $t+1$ to day $t+5$; $\widehat{dSI}_{t+1:t+5}$ is fitted part from estimating regression (4.6), and $\hat{\varepsilon}_t$ is residual from regression (4.6).

Table 4.11 gives estimates of regression (4.7). Regression results show that all markets react significantly to the unpredictable change in G10 surprise index. However markets also react to the predictable part of the G10 surprise index change. This finding is contrary to the finding of Campbell and Sharpe (2009) who find markets react only to the unpredictable part of economic announcement. This could be explained by the complexity of the adjustment for predictability. Campbell and Sharpe (2009) require an adjustment that uses the previous value of the announcement. Adjusting the G10 surprise index is more complex and requires larger cognitive resources of investor to incorporate many pieces of global news.

Table 4.11. Bond reactions to changes in global surprise index

	$\boldsymbol{\beta_{t,G}^{expected}}$	$\boldsymbol{\beta_{t,G}^{unexpected}}$	$\boldsymbol{R^2}$
R_{AU}	-5.35***	-1.43***	0.054
R_{CA}	-4.77***	-1.17***	0.039
R_{DE}	-3.12**	-1.12***	0.028
R_{UK}	-3.16	-1.43***	0.022
R_{JP}	-1.58**	-0.66***	0.030
R_{NZ}	-3.01**	-1.14***	0.040
R_{SE}	-3.09**	-1.25***	0.035
R_{US}	-6.95***	-1.52***	0.055

We regress 5 trading day cumulative excess return of JPM bond indices on predictable ($\beta_{t,G}^{expected}$) and unpredictable ($\beta_{t,G}^{unexpected}$) 5-day changes in global surprise index. The global index is constructed as GDP-weighted average of G10 country local surprise indices. The predictable change in global index is the fitted part of autoregression (equation (4.6) in the text). The unpredictable change is residual from the same regression. Countries are coded as: AU – Australia, CA – Canada, DE – Germany, UK – United Kingdom, JP – Japan, NZ – New Zealand, SE – Sweden, US – United States. *, ** and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. We use Newey-West error with 8 lags to ensure the procedure fully corrects for the MA(5) error structure.

The combined results suggest that both market participants and economists forecasting economic figures fail to adjust for the predictability. In particular market participants fail to adjust for the predictability before important U.S. economic news announcements.

4.6 Conclusion

We investigate the efficiency of international government bond prices with regard to incorporating international macroeconomic news. Several significant findings emerge. First, we find U.S. economic news is the most important driver of bond prices contemporaneously. Second, contrary to the Efficient Market Hypothesis of Fama (1970) changes in global surprise indices predict international bond market returns up to 8 days ahead. Third, the predictive power arises from economic news in Eurozone, Japan and Switzerland.

We investigate several hypotheses for the existence of predictability. First, if the predictability exists due to limited attention of investors then economic news is not fully incorporated into bond prices before important economic announcements. This is indeed what we find. Reaction of bond markets to international news is weaker before important attention-grabbing (U.S.) announcements. Forecasting power is concentrated on the day of the attention-grabbing announcement.

Second, bond return momentum is finding in the literature that past bond returns predict future bond returns. If news drives these past bond returns, it will appear that the same old news is correlated with future bond returns. Controlling for the bond momentum does not change the predictability result.

Third, strong contemporaneous relationship between bond returns and changes in global surprise index combined with significant positive autocorrelation of global surprise index changes means that predictability might be due to predictable economic news. We find international bond markets react both to the predictable and unpredictable part of global economic news. In addition we find that Australian, Canadian and U.S. markets are predictable beyond simple predictability of the economic news.

To conclude, both the persistence in the changes in the global surprise index and investor inattention before important economic news leads to predictive power of changes in the global surprise index for international bond returns.

Chapter 5

Summary and discussion

5.1 Summary

Is there a link between asset prices and economic fundamentals? Many studies fail to find a convincing link and conclude that asset prices and economic fundamentals are disconnected. A famous example of the disconnect between exchange rates and macroeconomic fundamentals is presented in Meese and Rogoff (1983). The main success connecting asset prices to economic fundamentals is in very short periods immediately after macroeconomic announcements (e.g. Andersen et al., 2007). However, individual announcements are much less important in the medium term. The reason is that medium term returns are contaminated by other types of news (including economic news) unrelated to the news analyzed. Therefore simultaneously relating medium term asset returns to a large number of economic news announcements can provide a means of mitigating contamination. This thesis provides evidence of a strong medium term relation between asset prices and economic fundamentals by using news aggregation and novel methods. While the literature documents that the link between asset prices and economic fundamentals as measured by R-squared does not exceed eight percent, this thesis shows that R-squared can be as high as 27%.

The thesis investigates four aspects of a possible explanation for the apparent disconnect between fundamentals and asset prices in the medium term. First, a broad range of economic fundamentals might be driving asset prices. Instead of using a single fundamental to explain asset prices, a wide range of economic fundamentals is aggregated into a single measure of news. Second, it is important not only to consider surprises in economic announcements, but also to link it to the market reaction. Aggregating price reactions over multiple announcements and longer time periods is important to find a strong relation between fundamentals and prices. Third, the relationship between economic fundamentals and asset prices may be changing over time. For example, for equities good economic news is bad during economic expansions but good during recessions (McQueen and Roley, 1993, Boyd et al., 2005, Andersen et al., 2007). Finally, several studies find single announcements are incorporated into asset prices within minutes (Andersen et al., 2003). However the overall economic situation conveyed by a wide range of economic news might not be incorporated immediately and fully due to limited investor attention (Peng and Xiong, 2006).

The second chapter introduces a novel method to estimate the importance of economic news. Instead of using the indirect measure of economic surprises the method aggregates price moves in a short window around economic news. Applying this novel method to U.S. treasuries reveals that aggregated economic news can explain on average 20% of the total daily variation in bond returns. On days with announcements on the FOMC target rate, the employment report and the preliminary GDP the explanatory power increases to 55%, 46%, and 36%, respectively. The importance of news varies over time. In the period with low bond market volatility in 2004 the explanatory power of economic news increases to 51%. News is more important when the VIX is low or investor sentimental is negative. Also, news that is contrary to the direction of FED target rate changes is more important.

The third chapter introduces a method to divide aggregated economic news into sentimental and fundamental depending on the market reaction. Low-yield currencies predominantly react to macroeconomic news consistent with predictions from Taylor-rule models: Good U.S. news is good for the U.S. Dollar. But high-yield currencies also regularly react in the opposite (sentimental) way. Based on these opposite reactions a novel sentimental news index is constructed. Periods of negative surprises in news announcements combined with a sentimental response of high-yield currencies lead to currency carry losses. In periods where the sentimental responses dominate, the sentimental news index explains 27% (26%) of the variation in monthly carry (S&P500) returns. Hence the sentimental news index is a breakthrough in linking fundamentals to risky asset classes in the medium term.

The fourth chapter uses aggregated news indices to predict returns of international bond markets. Not all news is incorporated immediately and fully into government bond prices. Global news predicts local bond returns up to a week in the future. The predictability originates from economic news in Europe and Japan. While U.S. news alone accounts for up to 71% of the contemporaneous explanatory power of news for international bond returns, Europe and Japan account for up to 63% of the predictive power. This result can be attributed to the combination of the anchoring bias in economist consensus forecasts (Campbell and Sharpe, 2009) and limited attention of market participants. On the one hand economist consensus forecasts do not include all information because changes in aggregated news indices are predictable. On the other hand the predictability of European and Japanese news for international bond markets originates from days with important U.S. news announcements. This is evidence of the limited attention bias of market participants.

5.2 Further research

There are several potential directions for further research. First, theory proposes that only a few economic fundamentals drive asset prices. However, our empirical results show that only the aggregate of a broad range of economic fundamentals explains a significant part of changes in asset prices. In addition we show that the time-variation in the market interpretation of economic news is important in establishing the link between economic fundamentals and asset prices. Therefore, future research should focus on theoretical models that include a broader range of economic fundamentals or an aggregate summary of the economic fundamentals. In addition new models should account for the time-varying link between the economic fundamentals and asset prices.

Second, the novel returns-based measure of news importance can be used to review studies that do not find a significant relation between economic news and asset prices. The novel method challenges the traditional research agenda that so far was to look for better measures of news in announcements or a different source of the news (e.g. text analysis of news articles, Tetlock, 2007, or FOMC minutes, Boukus and Rosenberg, 2006). Searching for the relation between the proposed news measures is a difficult task not having a prior knowledge if the news moves the market. Therefore, we propose first using our novel methodology to identify events that move the market.

Third, the new method makes it easy to evaluate the importance of announcements that do not have forecast values. Forecasts are available for many U.S. macroeconomic figures. However, forecast data for other countries is scarce. Our methodology can be used in these cases to evaluate the importance of macroeconomic announcements. It also allows for the investigation of the importance of news that has no explicit expectation and thus a surprise component cannot be calculated. For example the importance of speeches of Federal Reserve officials for financial markets can now be evaluated.

Fourth, Chapters 2 and 3 use only U.S. macroeconomic announcements. The results in Chapter 4 show that asset prices are also driven by international macroeconomic news. Therefore including worldwide economic news can increase the explanatory power of economic news even further.

Finally, announcement surprises in the news indices presented in Chapter 2 are weighted independently using individual announcement regressions. Some announcements may provide similar information. For example CPI and CPI core announcements are related, thus assuming their independence in the news index, overweight their importance. To account for this the latent factor methodology of Aruoba, Diebold, and Scotti (2009) could be used.

Samenvatting (Summary in Dutch)

Is er een verband tussen de activa prijzen en economische fundamenten? Vele onderzoeken slagen er niet in een overtuigende link te vinden en concluderen dat de activa prijzen en economische fundamenten zijn losgekoppeld. Een bekend voorbeeld van de discrepantie tussen de wisselkoersen en de macro-economische fundamenten wordt gepresenteerd in Meese en Rogoff (1983). De voornaamste succes die activa prijzen aan de economische fundamenten koppelt is in de zeer korte perioden onmiddellijk na de macro-economische aankondigingen (bijv. Andersen et al., 2007). Echter, individuele aankondigingen zijn veel minder belangrijk op de middellange termijn. De reden is dat rendementen op de middellange termijn beïnvloed worden door andere vormen van nieuws (met inbegrip van economisch nieuws) ongerelateerd aan het geanalyseerde nieuws. Daarom kan het gelijktijdig relateren van rendementen op de middellange termijn met een groot aantal economische nieuwsberichten een voorziening bieden ter vermindering van de beïnvloeding. Dit proefschrift levert het bewijs van een sterke middellange termijn relatie tussen de activa prijzen en economische fundamenten met behulp nieuws aggregatie en nieuwe methoden. Terwijl de literatuur aantoont dat het verband tussen de activa prijzen en de economische fundamenten, zoals gemeten door de R-kwadraat niet boven de acht procent uitkomt laat dit proefschrift zien dat de R-kwadraat zo hoog als 27 procent kan zijn.

Bibliography

Almeida, A., C. Goodhart, and R. Payne. 1998. The Effects of Macroeconomic News on High Frequency Exchange Rate Behavior. *Journal of Financial and Quantitative Analysis* 33:383–408.

Altavilla, C., D. Giannone, and M. Modugno. 2014. Government Bond Yields Low Frequency Effects of Macroeconomic News on Government Bond Yields. Finance and Economics Discussion Series. Federal Reserve Board, Washington, D.C.

Andersen, T. G., and T. Bollerslev. 1998. Deutsche Mark-Dollar Volatility : Intraday Activity Patterns , Macroeconomic Announcements , and Longer Run Dependencies. *The Journal of Finance* 53:219–65.

Andersen, T. G., T. Bollerslev, F. X. Diebold, and C. Vega. 2003. Micro Effects of Macro Announcements: Real-Time Price Discovery in Foreign Exchange. *The American Economic Review* 93:38–62.

Andersen, T. G., T. Bollerslev, F. X. Diebold, and C. Vega. 2007. Real-Time Price Discovery in Stock, Bond and Foreign Exchange Markets. *Journal of International Economics* 73:251–77.

Andersson, M., L. J. Overby, and S. Sebestyén. 2009. Which News Moves the Euro Area Bond Market? *German Economic Review* 10:1–31.

Aruoba, S. B., F. X. Diebold, and C. Scotti. 2009. Real-Time Measurement of Business Conditions. *Journal of Business & Economic Statistics* 27:417–27.

Bacchetta, P., and E. Van Wincoop. 2004. A Scapegoat Model of Exchange Rate Fluctuations. *American Economic Review* 94:114–18.

Bailey, W., L. Zheng, and Y. Zhou. 2014. What Makes the VIX Tick? Unpublished manuscript, Cornell University, City College of New York, and Chinese University of Hong Kong

Baker, M., and J. Wurgler. 2006. Investor Sentiment and the Cross-Section of Stock Returns. *The Journal of Finance* 61:1645–80.

Baker, M., and J. Wurgler. 2007. Investor Sentiment in the Stock Market. *Journal of Economic Perspectives* 21:129–51.

Balduzzi, P., E. J. Elton, and T. C. Green. 2001. Economic News and Bond Prices: Evidence from the US Treasury Market. *Journal of Financial and Quantitative Analysis* 36:523–43.

Beber, A., and M. W. Brandt. 2009. When It Cannot Get Better or Worse: The Asymmetric Impact of Good and Bad News on Bond Returns in Expansions and Recessions. *Review of Finance* 14:119–55.

Beber, Al., and M. Brandt. 2006. The Effect of Macroeconomic News on Beliefs and Preferences: Evidence from the Options Market. *Journal of Monetary Economics* 53:1997–2039.

Bernanke, B. S., and K. Kuttner. 2005. What Explains the Stock Market's Reaction to Federal Reserve Policy? *The Journal of Finance* 60:1221–57.

Bollerslev, T., J. Cai, and F. M. Song. 2000. Intraday Periodicity, Long Memory Volatility, and Macroeconomic Announcement Effects in the US Treasury Bond Market. *Journal of Empirical Finance* 7:37–55.

Boukus, E., and J. V Rosenberg. 2006. The Information Content of FOMC Minutes. Working Paper. Federal Reserve Bank of New York.

Boyd, J. H., J. Hu, and R. Jagannathan. 2005. The Stock Market's Reaction to Unemployment News: Why Bad News Is Usually Good for Stocks. *The Journal of Finance* 60:649–72.

Brazys, J., and M. Martens. 2014. Does Aggregate Macroeconomic News Drive Carry Returns? Working Paper. Erasmus University Rotterdam.

Brenner, M., P. Pasquariello, and M. Subrahmanyam. 2009. On the Volatility and Comovement of U.S. Financial Markets around Macroeconomic News Announcements. *Journal of Financial and Quantitative Analysis* 44:1265–89.

Brunnermeier, M., S. Nagel, and L. Pedersen. 2009. Carry Trades and Currency Crashes. *NBER Macroeconomics Annual 2008* 23:313–47.

Campbell, S. D., and S. A. Sharpe. 2009. Anchoring Bias in Consensus Forecasts and Its Effect on Market Prices. *Journal of Financial and Quantitative Analysis* 44:369–90.

Chaboud, A. P., S. V. Chernenko, and J. H. Wright. 2008. Trading Activity and Macroeconomic Announcements in High-Frequency Exchange Rate Data. *Journal of the European Economic Association* 6:589–96.

Christiansen, C., A. Ranaldo, and P. Söderlind. 2011. The Time-Varying Systematic Risk of Carry Trade Strategies. *Journal of Financial and Quantitative Analysis* 46:1107–25.

Clarida, R., and D. Waldman. 2008. Is Bad News about Inflation Good News for the Exchange Rate ? *National Bureau of Economic Research: Asset Prices and Monetary Policy* :371–96.

Cochrane, J., and M. Piazzesi. 2005. Bond Risk Premia. *American Economic Review* 94:138–60.

Cohen, L., and A. Frazzini. 2008. Economic Links and Predictable Returns. *The Journal of Finance* 63:1977–2011.

Craine, R., and V. Martin. 2008. International Monetary Policy Surprise Spillovers. *Journal of International Economics* 75:180–96.

Cumby, R. E. 1988. Is It Risk? *Journal of Monetary Economics* 22:279–299.

D'Arcy, P., and E. Poole. 2010. Interpreting Market Responses to Economic Data. *Reserve Bank of Australia, Bulletin September Quarter 2010* :35–42.

Dahlquist, M., and H. Hasseltoft. 2013. International Bond Risk Premia. *Journal of International Economics* 90:17–32.

Dominguez, K. 2003. The Market Microstructure of Central Bank Intervention. *Journal of International Economics* 59:25–45.

Durbin, J., and S. J. Koopman. 2012. *Time Series Analysis by State Space Methods*. Oxford University Press.

Duyvesteyn, J., and M. Martens. 2014. Emerging Government Bond Market Timing. *The Journal of Fixed Income* 23:36–49.

Ederington, L. H., and J. H. Lee. 1993. How Markets Process Information: News Releases and Volatility. *The Journal of Finance* 48:1161–91.

Ederington, L. H., and J. H. Lee. 1995. The Short-Run Dynamics of the Price Adjustment to New Information. *The Journal of Financial and Quantitative Analysis* 30:117.

Edison, H. J. 1997. The Reaction of Exchange Rates and Interest Rates to News Releases. *International Journal of Finance and Economics* 2:87–100.

Ehrmann, M., and M. Fratzscher. 2005a. Equal Size, Equal Role? Interest Interdependence between the Euro Area and the United States. *The Economic Journal* 115:928–48.

Ehrmann, M., and M. Fratzscher. 2005b. Exchange Rates and Fundamentals: New Evidence from Real-Time Data. *Journal of International Money and Finance* 24:317–41.

Elder, J., H. Miao, and S. Ramchander. 2012. Impact of Macroeconomic News on Metal Futures. *Journal of Banking & Finance* 36:51–65.

Elder, J., H. Miao, and S. Ramchander. 2013. Jumps in Oil Prices: The Role of Economic News. *The Energy Journal* 34:217–38.

Engel, C., N. C. Mark, and K. West. 2007. Exchange Rate Models Are Not as Bad as You Think. *NBER Macroeconomics Annual 2007*.

Engel, C., and K. D. West. 2005. Exchange Rates and Fundamentals. *Journal of Political Economy* 113:485–517.

Evans, K. 2011. Intraday Jumps and US Macroeconomic News Announcements. *Journal of Banking & Finance*.

Evans, M., and R. Lyons. 2005. Do Currency Markets Absorb News Quickly? *Journal of International Money and Finance* 24:197–217.

Evans, M., and R. Lyons. 2008. How Is Macro News Transmitted to Exchange Rates? *Journal of Financial Economics* 88:26–50.

Fabozzi, F. 1997. *Selected Topics in Bond Portfolio Management*. Vol. 27. John Wiley & Sons, 1997.

Fama, E. 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. *The journal of Finance* 25:28–30.

Fama, E. 1990. Stock Returns, Expected Returns, and Real Activity. *The Journal of Finance* 45:1089–1108.

Fatum, R., M. Hutchison, and T. Wu. 2012. Asymmetries and State Dependence: The Impact of Macro Surprises on Intraday Exchange Rates. *Journal of the Japanese and International Economies* 26:542–60.

Faust, J., J. Rogers, S. Wang, and J. H. Wright. 2007. The High-Frequency Response of Exchange Rates and Interest Rates to Macroeconomic Announcements. *Journal of Monetary Economics* 54:1051–68.

Feldman, B. 2005. Relative Importance and Value. Unpublished manuscript.

Fleming, M., and E. Remolona. 1997. What Moves the Bond Market? *Economic Policy Review* :31–50.

Fleming, M., and E. Remolona. 1999. Price Formation and Liquidity in the US Treasury Market: The Response to Public Information. *The Journal of Finance* 54:1901–15.

Fleming, M., and E. Remolona. 2001. The Term Structure of Announcement Effects. Federal Reserve Bank of New York and Bank for International Settlements.

Fratzscher, M. 2009. What Explains Global Exchange Rate Movements during the Financial Crisis? *Journal of International Money and Finance* 28:1390–1407.

Froot, K., and R. Thaler. 1990. Anomalies: Foreign Exchange. *The Journal of Economic Perspectives* 4:179–92.

Goldberg, L., and C. Grisse. 2013. Time Variation in Asset Price Responses to Macro Announcements. *Federal Reserve Bank of New York Staff Reports*.

Gorain, S. Mac. 2011. Trading on Economic Data Releases : What Works? What Does Not? *JP Morgan* .

Gravelle, T., and R. Moessner. 2001. Reactions of Canadian Interest Rates to Macroeconomic Announcements: Implications for Monetary Policy Transparency.

Green, T. C. 2004. Economic News and the Impact of Trading on Bond Prices. *The Journal of Finance* 59:1201–34.

Gurkaynak, R. S., B. Sack, and E. Swanson. 2005a. The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models. *The American Economic Review* 95:425–36.

Gurkaynak, R. S., B. Sack, and E. Swanson. 2005b. Do Actions Speak Louder than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking* :55–93.

Hardouvelis, G. 1988. Economic News, Exchange Rates and Interest Rates. *Journal of International Money and Finance* 7:23–35.

Harju, K., and S. M. Hussain. 2011. Intraday Seasonalities and Macroeconomic News Announcements. *European Financial Management* 17:367–90.

Hellerstein, R. 2011. Global Bond Risk Premiums. *Federal Reserve Bank of New York Staff Reports* .

Hu, G. X., J. Pan, and J. Wang. 2013. Noise as Information for Illiquidity. *The Journal of Finance* 68:2341–82.

Hussain, S. M. 2010. Simultaneous Monetary Policy Announcements and International Stock Markets Response: An Intraday Analysis. *Journal of Banking & Finance* 35:752–64.

Hutchison, M., and V. Sushko. 2013. Impact of Macro-Economic Surprises on Carry Trade Activity. *Journal of Banking & Finance* 37:1133–47.

Ilmanen, A. 1997. Forecasting US Bond Returns. *The Journal of Fixed Income* 7:22–37.

Ilmanen, A. 2011. *Expected Returns. An Investor's Guide to Harvesting Market Rewards*. Chichester, West Sussex, UK: John Wiley & Sons, Ltd.

James, J., and K. Kasikov. 2008. Impact of Economic Data Surprises on Exchange Rates in the Inter-Dealer Market. *Quantitative Finance* 8:5–15.

Kilian, L., and C. Vega. 2011. Do Energy Prices Respond to US Macroeconomic News? A Test of the Hypothesis of Predetermined Energy Prices. *The Review of Economics and Statistics* 93:660–71.

Kim, S.-J. 1998. Do Australian and the US Macroeconomic News Announcements Affect the USD/AUD Exchange Rate? Some Evidence from E-GARCH Estimations. *Journal of Multinational Financial Management* 8:233–48.

Kim, S.-J., and J. Sheen. 2000. International Linkages and Macroeconomic News Effects on Interest Rate volatility—Australia and the US. *Pacific-Basin Finance Journal* .

Kuttner, K. 2001. Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. *Journal of Monetary Economics* 47:523–44.

Lucas, R. E. 1982. Interest Rates and Currency Prices in a Two-Country World. *Journal of Monetary Economics* 10:335–59.

Ludvigson, S. C., and S. Ng. 2009. Macro Factors in Bond Risk Premia. *Review of Financial Studies* 22:5027.

Lustig, H., N. Roussanov, and A. Verdelhan. 2011. Common Risk Factors in Currency Markets. *Review of Financial Studies* :3731–77.

Luu, B., and P. Yu. 2012. Momentum in Government-Bond Markets. *The Journal of Fixed Income* .

Mark, N. C. 1995. Exchange Rates and Fundamentals: Evidence on Long-Horizon Predictability. *The American Economic Review* 85:201–18.

McQueen, G., and V. V. Roley. 1993. Stock Prices, News, and Business Conditions. *The Review of Financial Studies* 6:683–707.

Meese, R. A., and K. Rogoff. 1983. Empirical Exchange Rate Models of the Seventies: Do They Fit out of Sample? *Journal of International Economics* 14:3–24.

Menkhoff, L., L. Sarno, M. Schmeling, and A. Schrimpf. 2012. Carry Trades and Global Foreign Exchange Volatility. *The Journal of Finance* 67:681–718.

Menzly, L., and O. Ozbas. 2010. Market Segmentation and Cross-Predictability of Returns. *The Journal of Finance* LXV.

Moskowitz, T. J., Y. H. Ooi, and L. H. Pedersen. 2012. Time Series Momentum. *Journal of Financial Economics* 104:228–50.

Peng, L. 2005. Learning with Information Capacity Constraints. *Journal of Financial and Quantitative Analysis* 40:307–29.

Peng, L., and W. Xiong. 2006. Investor Attention, Overconfidence and Category Learning. *Journal of Financial Economics* 80:563–602.

Ramnath, S. 2002. Investor and Analyst Reactions to Earnings Announcements of Related Firms: An Empirical Analysis. *Journal of Accounting Research* 40:1351–76.

Rizova, S. 2010. Predictable Trade Flows and Returns of Trade-Linked Countries. *SSRN Electronic Journal* .

Scotti, C. 2013. Surprise and Uncertainty Indexes: Real-Time Aggregation of Real-Activity Macro Surprises. Working paper. Board of Governors of the Federal Reserve System.

Shiller, R. 1981. Do Stock Prices Move Too Much to Be Justified by Subsequent Changes in Dividends? *The American Economic Review* 71:421–36.

Stock, J. H., and M. W. Watson. 2002. Macroeconomic Forecasting Using Diffusion Indexes. *Journal of Business & Economic Statistics* 20:147–62.

Tetlock, P. C. 2007. Giving Content to Investor Sentiment: The Role of Media in the Stock Market. *The Journal of Finance* 62:1139–68.

VanDijk, D., R. L. Lumsdaine, and M. van der Wel. 2014. Market Set-up in Advance of Federal Reserve Policy Decisions. *NBER Working Paper Series* .

Veronesi, P. 1999. Stock Market Overreaction to Bad News in Good Times: A Rational Expectations Equilibrium Model. *Review of Financial Studies* 12:975–1007.

Vrugt, E. B. 2009. Asymmetries in the Reaction of Treasury Bond Futures Returns to Macroeconomic News. Unpublished manuscript.

Yamada, S. 1999. Risk Premiums in the JGB Market and Application to Investment Strategies. *The Journal of Fixed Income* 9:20–41.

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AGGREGATED MACROECONOMIC NEWS AND PRICE DISCOVERY

Is there a link between asset prices and economic fundamentals? Many studies fail to find a convincing link and conclude that asset prices and economic fundamentals are disconnected. A famous example of the disconnect between exchange rates and macroeconomic fundamentals is presented in Meese and Rogoff (1983). The main success connecting asset prices to economic fundamentals is in very short periods immediately after macroeconomic announcements (e.g. Andersen et al., 2007). However, individual announcements are much less important in the medium term. The reason is that medium term returns are contaminated by other types of news (including economic news) unrelated to the news analyzed. Therefore simultaneously relating medium term asset returns to a large number of economic news announcements can provide means of mitigating contamination. This thesis provides evidence of a strong medium term relation between asset prices and economic fundamentals by using news aggregation and novel methods. While the literature documents that the link between asset prices and economic fundamentals, measured by R-squared, does not exceed eight percent, this thesis shows that the R-squared can be as high as 27 percent.

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