Macroeconomic news and price discovery in international bond markets

Justinas Brazys*, Johan Duyvesteyn†, and Martin Martens‡

Abstract

We find that government bond prices fail to immediately and fully incorporate global macroeconomic news. Global news can predict local bond returns up to a week in the future. The predictability originates from economic news in the Eurozone, Japan and Switzerland. While U.S. news alone accounts for up to 71% of the contemporaneous explanatory power, EU, Japan and Switzerland account for up to 80% of the predictive power. This finding can be attributed to persistence in global news and the limited attention hypothesis. Most of the predictability originates from non-U.S. news released closely before important U.S. news.

Keywords: International macroeconomic news; Government bonds; Limited attention.

JEL classification: G12, G14, G15.

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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[1]. 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 paper 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 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 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

[1] 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 (1999a), 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).

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[2]. 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 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 driven by limited attention and 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,

[2] 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 (2005) [Euro area], Craine and Martin (2008) [Australia], Andersson, Overby, and Sebestyén (2009) [Euro area, Germany, France, Italy, Spain, Belgium, and U.K.].

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 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.

2. Data and Sample Statistics

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[3]. 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

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

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.

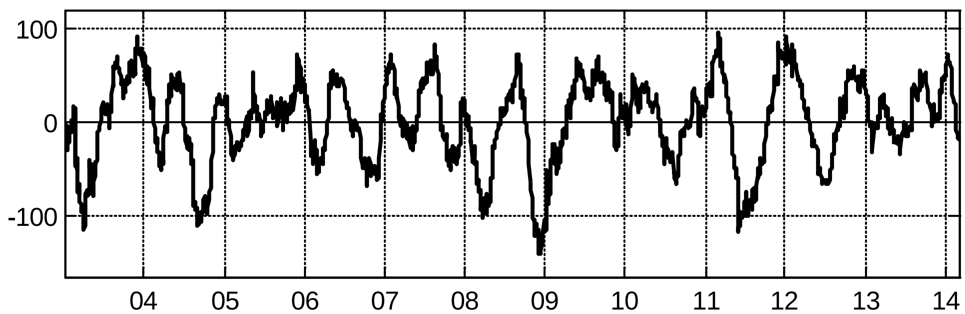
The economic surprise index at time t, SI_t, is weighed sum of standardized surprises $S_{k,\tau}$

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

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 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 1 illustrates the dynamics of the U.S. economic surprise index of Citigroup. The index oscillates between negative and positive values. In this paper 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.

Figure 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.

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 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[4] 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.

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

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 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.

Table 1 shows summary statistics of levels (Panel A) and changes (Panel B) for the individual country and G10 global indices. In this paper 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 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 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 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.

Table 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.

Bond returns

In this paper we use J.P. Morgan government bond indices 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 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 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.

Table 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

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[5] for all markets except News Zealand. Only the mean reversion in U.K. bond returns is statistically significant.

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

3. Methodology

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

$$R_{t-4:t} = \alpha_k + \beta' \Delta SI_{t-4:t} + \varepsilon_t, \tag{2}$$

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[6] 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 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, Bollerslev, and Dobrev (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

$$R_{t+1:t+5} = \alpha_k + \beta' \Delta SI_{t-4:t} + \varepsilon_t, \tag{3}$$

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 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. $\beta < 0$.

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

3.2 Decomposition of $\mathbf{R^2}$

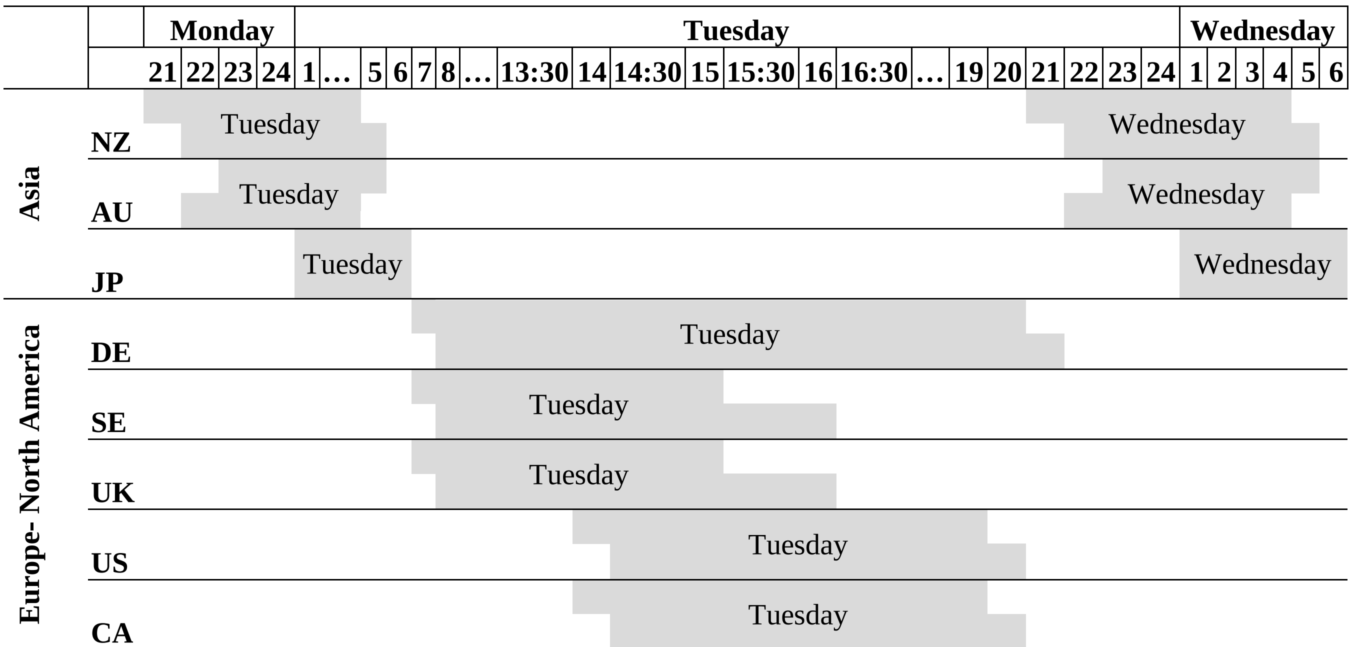
When analyzing the predictive or contemporaneous explanatory power in a multivariate regression it is important to understand the contribution of the economic surprise index of each country k ($\Delta SI_{t,k}$ in the vector ΔSI_t). We use Feldman's (2005) proportional marginal variance decomposition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

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 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 (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 (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.

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.

Figure 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).

4. Results and Analysis

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 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 we give estimates of regression (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 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.

Table 4. Contemporaneous relationship between bond returns and macroeconomic news

	$\boldsymbol{\beta_{t,L}}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta_{t,G}}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta_{t,L}}$	$\boldsymbol{\beta_{t,GxL}}$	$\boldsymbol{R^2}$
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.

4.2 Predictability

If news is incorporated into bond prices efficiently news cannot have predictive power. Table 5, however, provides initial evidence for predictive power of macroeconomic news for bond markets. Table 5 provides the results for the regression in equation (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.

Table 5. Forecasting: Global vs. Local

	$\boldsymbol{\beta_{t,L}}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta_{t,G}}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta_{t,L}}$	$\boldsymbol{\beta_{t,GxL}}$	$\boldsymbol{R^2}$
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.

4.3 Which countries contribute to the explanatory and predictive power?

Contemporaneous

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 6 gives results of regression (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 1 Panel B), thus the news impact coefficients in Table 6 can be 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. 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.

Table 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.

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.

Predictive

Table 7 provides the results of a detailed analysis of the origin of the predictive power of news for bond prices illustrated in Section 4.2. For the excess bond returns of each country we estimate the predictive regression in equation (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 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 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 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). Our paper concerns economic news that according to EMH should be incorporated into prices as soon as it is available to market participants. In Table 8 we test this hypothesis in more detail than the fixed weekly periods analyzed so far. We 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.

Table 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.

5. Limited attention explains inefficiencies?

In this part we investigate the origin of the predictive power documented in Section 4.2. First, we argue that due to the limited attention of investors the international news are 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.

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 4.3 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[7] 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

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

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

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.

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

In Section 4.3 we show that global economic news have 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

$$R_{t+1} = \alpha_k + \beta_{US\ news}\ dSI_{t-4:t}D_{t+1} + \beta_{no\ US\ news}dSI_{t-4:t}(1 - D_{t+1}) + \varepsilon_t, \qquad (5)$$

only $\beta_{US\ news}$ is significant. In regression (5) R_{t+1} is the daily excess government bond return on day $t + 1$.

Table 9 gives the results for regressions (4) and (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 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 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 9. Importance of global news before important U.S. news announcement days

	Panel A. Contemporaneous				**Panel B.** Forecasting		
	$\boldsymbol{\beta_{US\ news}}$	$\boldsymbol{\beta_{no\ US\ news}}$	$\boldsymbol{R^2}$	$\boldsymbol{\beta_{news} = \beta_{no\ US\ news}}$	$\boldsymbol{\beta_{US\ news}}$	$\boldsymbol{\beta_{no\ US\ news}}$	$\boldsymbol{R^2}$
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 $\beta_{US\ news} = \beta_{no\ US\ news}$.

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 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 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 10 to those in Table 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.

Table 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.

Second, we test the hypothesis of news momentum. Changes in surprise indices are strongly connected to the bond returns contemporaneously (Table 4). Changes in news indices are also significantly positively autocorrelated (Table 1). Thus predictability 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 10 shows that the predictability result is not affected by the predictability of local news. Panel D of Table 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.

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 10 Panel D together with the strong contemporaneous relation between changes in G10 index and bond market returns documented in Table 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

$$dSI_{t+1:t+5} = \alpha_k + \beta\, dSI_{t-4:t} + \varepsilon_t, \tag{6}$$

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

$$R_{t+1:t+5} = \alpha_k + \beta_{t,G}^{expected}\ \widehat{dSI}_{t+1:t+5} + \beta_{t,G}^{unexpected}\hat{\varepsilon}_t + \eta_t, \tag{7}$$

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 (6), and $\hat{\varepsilon}_t$ is residual from regression (6).

Table 11 gives estimates of regression (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 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 (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.

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.

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