The US, Economic News, and the Global Financial Cycle*

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Abstract

We provide evidence for a causal link between the US economy and the global financial cycle as defined in Rey (2013). Using intraday data, we show that US macroeconomic news releases have a strong, significant, and synchronous effect on global risky asset prices. Stock indexes of 27 countries, commodity prices, and the VIX all jump instantaneously upon news releases. These effects are large and persistent. US macroeconomic news explain up to 22% of quarterly variation in foreign stock markets. For some countries the share of explained variation is larger than that of the S&P 500. We also show that stock markets of more financially integrated countries respond systematically stronger to US macroeconomic releases. Our findings show that a byproduct of the United States' central position in the global financial system is that its business cycle has a disproportionately large effect on global financial conditions.

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1 Introduction

The global financial cycle appears in co-movements of gross flows, asset prices, leverage, and credit creation, which are all closely linked to fluctuations in the VIX. But what are its drivers?

— Rey (2013)

In an influential speech at the Jackson Hole Symposium in 2013, Rey (2013) provides evidence for the global co-movement of capital flows, risky asset prices, credit growth, and leverage. This phenomenon, which Rey calls the *global financial cycle*, constitutes an external source of financial and macroeconomic volatility for countries with open capital accounts. In episodes of favorable international financial conditions, these countries experience capital inflows, buildups of credit and leverage, and appreciations in risky asset prices, ultimately resulting in macroeconomic expansion. In episodes of retrenchment, however, capital flows reverse, credit and leverage contract, and risky asset prices plummet. Historically, these episodes of retrenchment are often associated with severe crises.

A largely open question to this point is what the drivers of the global financial cycle (GFC) are. The only exception, to the best of our knowledge, is that US monetary policy shocks cause movements in the GFC (Miranda-Agrippino and Rey, 2020). From the domestic literature on monetary policy, however, it is known that monetary policy shocks account for only a small fraction of the business cycle variation (Coibion, 2012; Ramey, 2016). To the extent that this point applies in the international context as well, a sizable chunk of the variation in the GFC therefore remains unexplained. Since identifying the driving forces of the GFC is critical both for understanding the international transmission of shocks through the financial system and designing appropriate policy responses, this paper aims to make progress on this question.

Establishing a causal link between any potential driving force and the GFC is econometrically challenging. By its very nature, the GFC is characterized by fast-moving financial variables such as risky asset prices or the VIX.[1] At this point, it is well understood that identification strategies based on monthly or quarterly data, which do not take this simultaneity problem into account are unlikely to be successful at isolating the underlying sources of fluctuations (Gertler and Karadi, 2015; Ludvigson, Ma, and Ng, 2015).[2]

In this paper we resolve this identification problem by employing a high-frequency event

[1] The VIX is the 30-day option-implied volatility index of the S&P 500 index.

[2] Miranda-Agrippino and Rey (2020) resolve this simultaneity problem by identifying monetary policy shocks from high-frequency asset price responses around Federal Reserve monetary policy releases.

study using a narrow window around information releases (Gürkaynak and Wright, 2013). In particular, we study the effect of US macroeconomic news releases on the GFC. The focus on US macro news is motivated by two key insights from prior work. First, various papers show how the US as the center country of the international monetary and financial system plays a special role in multiple dimensions (Gourinchas, Rey, and Sauzet, 2019). It is therefore plausible *ex-ante* that news about the US economy affect international financial conditions. Second, a large literature documents how scheduled macroeconomic announcements are a unique source of variation to study asset price movements (Faust et al., 2007). Hence, we see studying the effect of US macroeconomic releases on the GFC as a natural starting point to better understand its potential drivers and the role of the US economy.

In the first part of the paper, we establish a causal link between the US economy and a large set of risky asset prices—a defining feature of the GFC. We begin with studying the effects on major stock indexes of 27 countries from 1997 to 2019. Within a 30-minute window, these stock indexes show a statistically significant response and react overwhelmingly symmetrically across countries. For instance, a positive surprise about nonfarm payroll employment generates a statistically significant increase in stock prices in all but one of the countries in our sample. We confirm analogous findings for the VIX, a close proxy for the GFC, and commodity prices, which are often interpreted as indicators of risk appetite (Miranda-Agrippino and Rey, 2020).

High-frequency analyses often face the limitation that it is difficult to assess the economic importance of the identified relationship. We address this concern and demonstrate that the effects of US macroeconomic news on risky asset prices are both large and an important driving force. The effects are large in the sense that international stock prices respond by a similar magnitude as the US stock market. Using the method by Altavilla, Giannone, and Modugno (2017), we further show that US macro news explain a sizable fraction of the variation in countries' stock markets at lower frequencies. For many economies, US news explain more than 15 percent of the quarterly variation in these markets. This magnitude is comparable with their explanatory power for the S&P 500 and exceeds the explanatory power of US monetary policy shocks by far. US macroeconomic news further explain around 12 percent of the quarterly variation in the VIX. The concern that effects identified with high-frequency methods dissipate quickly does therefore not apply in our context. To the contrary, we show that the explanatory power increases when we aggregate the effects to the monthly and quarterly frequency.

In the last part of the paper, we extend the analysis to shed light on the underlying mechanism. First, we provide a simple framework to clarify the role between the measured surprises, the observed asset price responses, and the true underlying structural shocks. Second, we exploit the cross-country variation of our sample to investigate the role of financial linkages to the global markets. We find that stock markets of more financially integrated countries respond systematically stronger to US macroeconomic releases about the real economy. For price-related news less financially integrated countries respond stronger. Third, using 10-year government bond yields we study the stock-bond correlation conditional on news releases (Andersen et al., 2007). We find a positive correlation for most releases consistent with a dominant cash flow channel. As before, price-related news releases produce a different pattern. They induce a negative stock-bond correlation consistent with a dominant discount channel.

Related literature Our paper relates to various strands in international finance and macroeconomics. Following Rey (2013), who establishes the existence of the GFC, several other papers emphasize the increased global financial synchronization over the recent decades (e.g., Bruno and Shin, 2015b; Obstfeld, 2015; Jordà et al., 2019).[3] This literature also shows that US monetary policy is a key driver of global financial conditions. Bruno and Shin (2015a) find evidence that US monetary policy affects the risk-taking behavior of international banks. Miranda-Agrippino and Rey (2020) demonstrate that contractionary US monetary policy shocks worsen global financial conditions by affecting risky asset prices, leverage of global financial intermediaries, and international credit flows. Jordà et al. (2019) also provide evidence that US monetary policy drives global risk appetite and equity prices. We show that US macroeconomic news are a second causal driver of the global financial cycle, and that they explain more variation in risky asset prices than monetary policy shocks.[4]

More broadly, our paper also relates to work studying the central role of the US in the international monetary and financial system.[5] Gourinchas and Rey (2007) emphasizes the role of the US as world banker, Maggiori, Neiman, and Schreger (2020) document a significant dollar bias of international investors, and Goldberg and Tille (2009), Gopinath (2015), and Gopinath et al. (2020) document and study the importance of the US dollar as

[3]Compared to other papers, Cerutti, Claessens, and Rose (2019) find evidence consistent with a less important role of the GFC. Monnet and Puy (2019) study a broad sample of countries since 1950 and find that co-movement of macroeconomic and financial variables exists, but that it has not increased substantially over time. They also study the effects of U.S. monetary, fiscal, uncertainty, productivity shocks on the global financial cycle—with mixed results.

[4]Our finding that US monetary policy is relatively less important for the GFC is somewhat in line with Bekaert, Hoerova, and Xu (2020) who find no evidence of US monetary policy shocks affecting financial risk factors of international markets.

[5]See Gourinchas, Rey, and Sauzet (2019) for a broad coverage on the international monetary and financial system.

the dominant currency of trade invoicing. Our results show that an additional byproduct of the US being the hegemon of the global financial system is that US macroeconomic news have a large—and potentially disproportionately large—effect on global financial conditions.

Our paper also relates to the literature studying the high-frequency, i.e. daily or intraday, effects of macroeconomic news releases on asset prices.[6] A large set of papers study the effect of US macroeconomic releases on domestic financial markets (McQueen and Roley, 1993; Balduzzi, Elton, and Green, 2001; Andersen et al., 2003; Gürkaynak, Sack, and Swanson, 2005; Boyd, Hu, and Jagannathan, 2005; Rigobon and Sack, 2008; Beechey and Wright, 2009; Swanson and Williams, 2014; Gilbert et al., 2017; Gürkaynak, Kısacıkoğlu, and Wright, 2018). Several papers study the effect of US macroeconomics news releases on international financial markets. Andersen et al. (2007) and Faust et al. (2007) use news surprises and analyze the transmission to financial markets in Germany and the United Kingdom. Ehrmann, Fratzscher, and Rigobon (2011) identify shocks through heteroscedasticity and study the interdependence of asset markets between the US and the Euro Area for multiple assets. We contribute to this literature in multiple ways. First, our sample contains a broader set of countries including developing countries while using intraday variation in asset prices. Second, we document the synchronized nature of foreign stock price responses in this large sample of countries and thereby establish a link between the U.S. economy and the global financial cycle. Third, we present a framework to clarify the role of the underlying structural drivers of the news releases. We show, for instance, that common global shocks could principally drive US macroeconomic news.

Lastly, our work is related to papers investigating the role of macroeconomic shocks in explaining asset prices at business cycle frequency. Multiple papers emphasize the importance of macroeconomic shocks for explaining monthly bond yield movements (Ang and Piazzesi, 2003; Diebold, Rudebusch, and Aruoba, 2006; Coroneo, Giannone, and Modugno, 2016). Altavilla, Giannone, and Modugno (2017) show that the explanatory power of macroeconomic news for stocks and bonds rises at lower frequency, since these news have more persistent effects compared to other factors. We build on their work and show that their results also hold true for international effects of US macroeconomic news. In some cases, they can even explain a larger share of variation in foreign markets than in the US.

Roadmap The remainder of the paper is structured as follows. Section 2 presents the data. We present the high-frequency effects of US news on foreign asset prices in Section 3. In

[6]See Gürkaynak and Wright (2013) for a survey on high-frequency event studies in macroeconomics.

Section 4 we demonstrate that these effects are persistent and explain a sizable fraction of the quarterly variation. We discuss multiple aspects of the underlying mechanism in Section 5. Section 6 concludes.

2 Data

2.1 US Macroeconomic News

The data on macroeconomic news come from Bloomberg's US Economic Calendar. For each macroeconomic release, Bloomberg reports, among other things, release date and time, released value, and the median market expectation prior to the release. Table 1 provides an overview on 12 of the most important macroeconomic news series we focus on in Sections 3 and 5. This selection is inspired by previous studies in the literature (Faust et al., 2007; Rigobon and Sack, 2008; Gürkaynak, Kısacıkoğlu, and Wright, 2018). Following Beechey and Wright (2009), we also distinguish news on real economic activity and news on prices.

Table 1: US Macroeconomic News

	Release Time	Frequency	Category	Observations
Capacity Utilization	9:15 am	Monthly	Real Activity	268
CB Consumer Confidence	10:00 am	Monthly	Real Activity	268
Core CPI	8:30 am	Monthly	Price	269
Core PPI	8:30 am	Monthly	Price	269
Durable Goods Orders	8:30 am	Monthly	Real Activity	260
GDP A	8:30 am	Quarterly	Real Activity	89
Initial Jobless Claims	8:30 am	Weekly	Real Activity	1140
ISM Mfg Index	10:00 am	Monthly	Real Activity	271
New Home Sales	10:00 am	Monthly	Real Activity	261
Nonfarm Payrolls	8:30 am	Monthly	Real Activity	268
Retail Sales	8:30 am	Monthly	Real Activity	270
UM Consumer Sentiment P	10:00 am	Monthly	Real Activity	241

Notes: This table displays the 12 major macroeconomic series we focus on throughout most of the paper. The sample ranges from November 1996 to June 2019. Appendix Table A1 shows all release series considered in the analysis. *Frequency* refers to the frequency of the data releases, *Observations* to the number of observations (surprises) of a macroeconomic series in our sample. *Category* specifies if the news release is more concerned about the real or nominal side of the economy. Abbreviations: A — advanced; P — preliminary; Mfg — Manufacturing; CB — Chicago Board; UM — University of Michigan; ISM — Institute for Supply Management.

When studying the explanatory power of US macroeconomic news in Section 4 we use *all* available US macroeconomic news series. These are listed in Appendix Table A1. As discussed below we will also use this broader set of announcements as controls. Following prior work, we treat different releases for the same macroeconomic variable—for instance, the advanced, second, and third release of GDP—as separate news series.

We construct surprises by subtracting from a given US macroeconomic series its forecast,

$$s^{y}_{US,t} = \frac{y_{US,t} - E\left[y_{US,t}|\mathcal{I}_{t-\Delta^{-}}\right]}{\hat{\sigma}^{y}_{US}}, \tag{1}$$

where $y_{US,t}$ is the released value and $E\left[y_{US,t}|\mathcal{I}_{t-\Delta^{-}}\right]$ is the median market expectation of the release.[7] To make the magnitude of surprises comparable across series, we also divide by the sample standard deviation of $y_{US,t} - E\left[y_{US,t}|\mathcal{I}_{t-\Delta^{-}}\right]$, denoted by $\hat{\sigma}^{y}_{US}$. For the ease of interpretation, we flip the sign of Initial Jobless Claims surprises such that an positive sign corresponds to positive news about real economic activity consistent with the other releases.

Appendix Figure A1 shows the resulting time series of standardized surprises for each macroeconomic variable. Reassuringly, all series of surprises are centered at zero. Further, there is no discernible pattern of autocorrelation, and there is no systematic trend in the standard deviation of surprises. Some series such as Initial Jobless Claims and Retail Sales appear to have somewhat higher volatility during recessions. In contrast, other series such as Core PPI and New Home Sales, appear to have lower volatility during downturns. Overall, there is no indication that using these surprises as our identifying variation is econometrically problematic.

2.2 Financial Data

The data on asset prices comes from the *Thomson Reuters Tick History* dateset and is obtained via *Refinitiv*. We employ intraday data throughout the analysis allowing us to construct a narrow window around each news release. As shown by the previous event studies literature, moving from daily to intraday data leads to increased precision by mitigating noise, and a reduction in the influence of other news releases. However, these studies mostly focused on the effects of US news releases on US markets. We believe that intraday data is even more important for our purposes. A country's stock market is driven by domestic *and* foreign news, making US news releases just one among many other sources of information throughout a trading day.

Our primary dataset consists of minute-by-minute series of 27 countries' major stock index. Table 2 provides an overview of these, and indicating the sample periods over which

[7] Since Bloomberg allows forecasters to update their prediction up until the release time, these forecasts should reflect all publicly available information at the time.

these indexes are available to us. For Canada and Italy, the stock indexes change their ticker symbols during our sample. In both cases, we merge the series with its predecessors in a consistent fashion (see the notes of Table 2 for details). Lastly, we inspect each data series for potential misquotes, and remove them if necessary. Throughout the paper, we use a country's 3-digit ISO code to refer to its stock index (e.g. DEU stands for the DAX).

Table 2: Overview of Intraday Financial Data

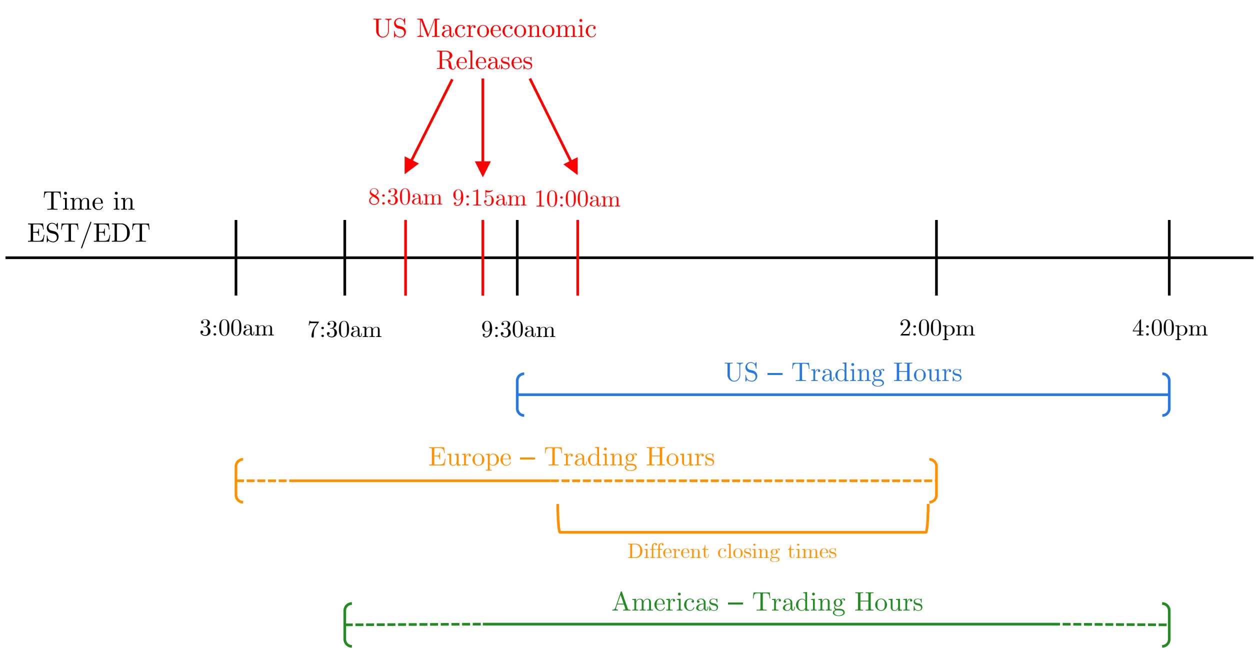
Name	Ticker	Sample	Country	ISO
International Stock Indexes				
MERVAL	.MERV	1996–2019	Argentina	ARG
ATX	.ATX	1996–2019	Austria	AUT
BEL 20	.BFX	1996–2019	Belgium	BEL
Bovespa	.BVSP	1996–2019	Brazil	BRA
S&P/TSX	.GSPTSE*	2000–2019	Canada	CAN
SMI	.SSMI	1996–2019	Switzerland	CHE
IPSA	.IPSA	1996–2019	Chile	CHL
PX	.PX	1999–2019	Czech Republic	CZE
DAX	.GDAXI	1996–2019	Germany	DEU
OMX Copenhagen 20	.OMXCXC20PI	2000–2019	Denmark	DNK
IBEX 35	.IBEX	1996–2019	Spain	ESP
OMX Helsinki 25	.OMXH25	2001–2019	Finland	FIN
CAC 40	.FCHI	1996–2019	France	FRA
FTSE 100	.FTSE	1996–2019	United Kingdom	GBR
FTSE/Athex Large Cap	.ATF	1997–2019	Greece	GRC
BUX	.BUX	1997–2019	Hungary	HUN
ISEQ	.ISEQ	1996–2019	Ireland	IRL
FTSE MIB	.FTMIB*	1996–2019	Italy	ITA
S&P/BMV IPC	.MXX	1996–2019	Mexico	MEX
AEX	.AEX	1996–2019	Netherlands	NLD
OBX	.OBX	1996–2019	Norway	NOR
WIG20	.WIG20	1997–2019	Poland	POL
PSI-20	.PSI20	1996–2019	Portugal	PRT
MOEX Russia	.IMOEX	2001–2019	Russia	RUS
OMX Stockholm 30	.OMXS30	1996–2019	Sweden	SWE
BIST 30	.XU030 30	1997–2019	Turkey	TUR
FTSE/JSE Top 40	.JTOPI	2002–2019	South Africa	ZAF
Other Risky Asset Prices				
E-mini S&P 500 Futures	ESc1	1997–2019		
VIX	.VIX	1996–2019		
VIX Futures	VXc1	2011–2019		
S&P GSCI Agriculture	.SPGSAG	2007–2019		
S&P GSCI Energy	.SPGSEN	2007–2019		
S&P GSCI Industrial Metals	.SPGSINTR	2007–2019		

Notes: This table gives an overview of the primary intraday data from *Thomson Reuters Tick History*. The top panel shows information on various financial instruments. For all series, the sample period ends in June 2019. *For Canada and Italy, we incorporate date from the predecessor indexes, i.e. the TSE 300 index (.TSE300) for Canada, and the MIB-30 (.MIB30) and the S&P/MIB (.SPMIB) for Italy. Further, *Ticker* refers to the Reuters Instrument Code (RIC), and *ISO* denotes the 3-digit ISO country code.

Besides the data on international stock markets, we also employ other risky asset prices such as E-mini S&P 500 Futures, the VIX, VIX Futures, and several S&P commodity indexes. We defer a more detailed discussion of each of them to the relevant subsequent sections.

The study of international equity markets and the use of intraday data requires a careful consideration of the timing of the US news releases, and the trading hours of a particular market. The country composition of our sample reflects this. Our intraday analysis requires that the time window around a particular news release lies within the trading hours of the respective stock market. For instance, Asian and Australian equity markets are closed during almost all release times of US macroeconomic releases and are thus not included in our sample. Figure 1 visualizes the timing of the news releases, and the trading hours for the stock markets in our sample. Further, Appendix Table A3 summarizes which countries' equity markets in our sample are open for each of the 12 main announcements.

Figure 1: US Macroeconomic Releases and International Stock Market Trading Hours



Notes: This figure provides an overview of release times and trading hours of stock markets in our sample. Note that the trading hours of South Africa, and Turkey are represented by the European trading hours.

3 High-Frequency Effects of US Macro News on the Global Financial Cycle

In this section, we employ a high-frequency event study approach to estimate the effect of US macroeconomic releases on risky asset prices. Following the previous literature on the GFC, we are interested in the effects on various international stock indexes, the VIX, and commodity prices. We document two key findings. First, and consistent with the view that positive news lead to increased risk-taking capacity, we show that international asset prices increase after positive news. Second, US news releases induce a *synchronous* effect on international markets, thereby generating co-movement.

3.1 International Stock Markets

3.1.1 Pooled Effects

We begin our empirical analysis with demonstrating that international stock indexes respond to the release of news about the US economy. We estimate pooled regressions of the form

$$\Delta q_{i,t} = \alpha_i + \gamma^y s^y_{US,t} + \sum_{k \neq y} \gamma^k s^k_{US,t} + \varepsilon_{i,t}, \tag{2}$$

where $\Delta q_{i,t} = q_{i,t+20} - q_{i,t-10}$ is the 30-min log-change of country i's stock market index.[8] In equation (2), $s^y_{US,t}$ is the surprise of interest and $\varepsilon_{i,t}$ captures the effect of unmeasured news. We include other surprises about US macroeconomic variables, $s^k_{US,t}$, which are published within the time window we study, as controls.[9] For instance, the Bureau of Labor Statistics publishes Nonfarm Payrolls together with the Unemployment Rate (and other macroeconomic variables) as part of a news release about the Employment Situation. Attributing asset price changes solely to the surprise about the change in payroll employment could be misleading.

The identification assumption for the consistent estimation of γ^y holds that, conditional on controls, error $\varepsilon_{i,t}$ is uncorrelated with the surprise $s^y_{US,t}$. To account for the fact that surprises on the right hand side are US-specific and thus perfectly correlated across foreign countries, we cluster standard errors by announcement (and country).

Table 3 shows the estimates of γ^y for the 12 major macroeconomic releases. Two key

[8] Technically, we calculate them as 10-minute averages, i.e. $q_{i,t+20} = (q_{i,t+15} + ... + q_{i,t+25})/11$ and $q_{i,t-10} = (q_{i,t-15} + ... + q_{i,t-5})/11$.

[9] Note that we consider all 66 announcements as listed in Appendix Table A1 as controls.

results emerge from the table. First, all announcements have a significant effect at the one-percent level with the exception of the Capacity Utilization announcement which is significant at the five-percent level. Second, positive news about US real activity lead to an increase in the stock prices. This effect is consistent with increased risk-taking of international investors and suggests that the cash flow channel dominates the discount channel. In contrast, surprise inflation as captured by positive surprises in the Core CPI and Core PPI lead to a decrease in stock prices. This effect suggests that after these surprises the discount channel dominates. We will return to this discussion in Section 5, where we provide evidence for the responses of bond yields as well.

Table 3: Pooled Effect by Announcement

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	4.98**	12.60***	-8.80***	-4.26***	6.14***	19.04***
	(2.31)	(2.07)	(1.85)	(1.39)	(1.71)	(3.78)
R^2	0.06	0.12	0.08	0.02	0.06	0.17
Observations	5907	5903	5576	5686	5468	1864

	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	4.98***	11.72***	3.93***	16.93***	10.26***	5.68***
	(0.78)	(2.23)	(1.35)	(2.88)	(2.40)	(1.60)
R^2	0.03	0.10	0.03	0.12	0.10	0.04
Observations	23741	5393	5743	5556	5672	5562

Notes: This table presents estimates of γ^y of equation (2) for each of the 12 macroeconomic announcements. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level.

A number of previous papers have documented that some asset prices drift prior to certain announcements (Lucca and Moench, 2015; Kurov et al., 2019). Such drifts may reflect information leakage or superior forecasting ability relative to the median forecast and cast doubt on market efficiency—which our analysis relies on. As Appendix Figure A2 shows, international equity prices do not drift prior to the four news releases, in line with earlier work studying pre-announcement drifts of US macroeconomic news.

3.1.2 Cross-country Heterogeneity

The results in Table 3 are informative about the *average* effect on international stock markets. These estimates, however, mask potential heterogeneity in the responses of the 27 stock indexes in our sample. We next study country-specific effects and show that US macroeconomic news induce co-movement across markets. In particular, we estimate

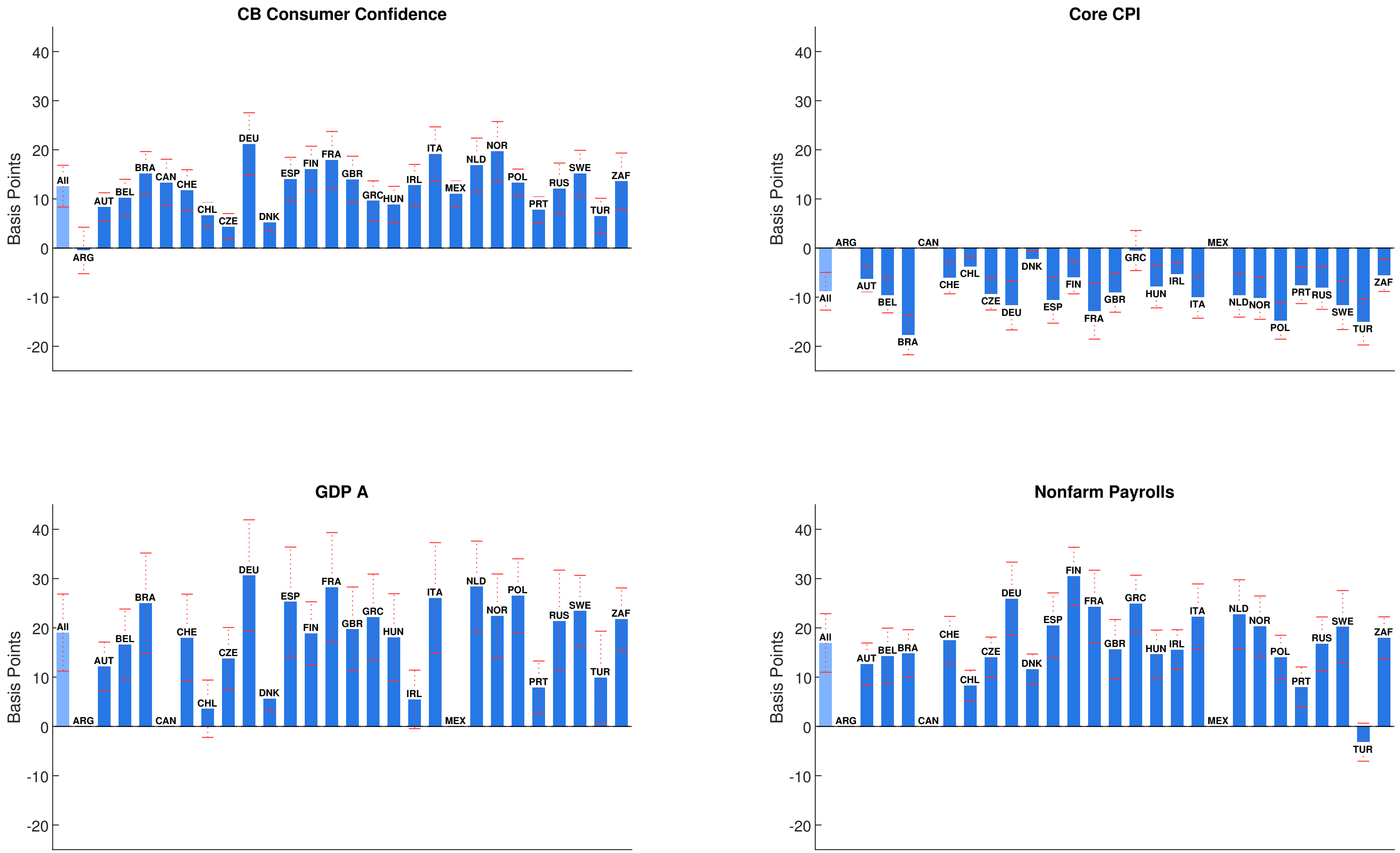
$$\Delta q_{i,t} = \alpha_i + \gamma_i^y s_{US,t}^y + \sum_{k \neq y} \gamma_i^k s_{US,t}^k + \varepsilon_{i,t}, \tag{3}$$

where $\Delta q_{i,t} = q_{i,t+20} - q_{i,t-10}$. Different from equation (2), the coefficients γ_i^y are now specific to each country.

Figure 2 illustrates countries' stock index responses for four of the 12 announcements. Strikingly, for a given announcement the sign of the response is identical for all countries whenever statistically significant. That is, the US macroeconomic releases do not only affect international stock markets but they also lead to *correlated* asset price responses. This co-movement of risky asset prices is a defining feature of the GFC (Rey, 2013).

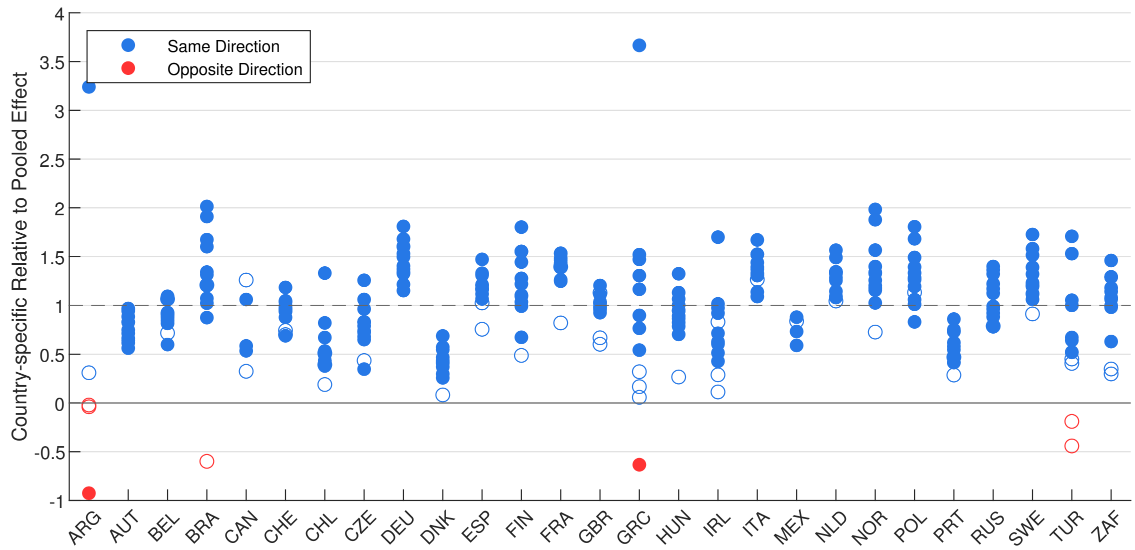
Figure 3 summarizes this finding for all 12 announcements by plotting the country-specific effect relative to the pooled effect. Circles above zero indicate cases in which the country-specific effect has the same sign as the pooled effect (γ^y in equation (2)). The fact that almost all circles are positive confirms the results of Figure 2. Figure 3 also illustrates systematic heterogeneity in responsiveness across countries. While Germany responds stronger than the average for 11 out of 12 announcements, Denmark always responds less than the average. We return to this point in Section 5 where we show that countries' responsiveness co-varies with their financial openness.

Figure 2: Response of Stock Indexes for Selected Announcements



Notes: This figure shows the stock index responses for four selected announcements. The light blue bar shows the pooled effect, i.e. common coefficient γ^y of equation (2), while the dark blue bars show the country-specific effect, i.e. γ_i^y obtained from estimating equation (3). Missing country bars depict cases in which the country is dropped because it had less than 24 observations for a given announcement. The red error bands depict 95 percent confidence intervals, where standard errors are clustered at the announcement- and country-level. The bar charts for all news releases are shown in Appendix Figure A3.

Figure 3: Direction of Country's Stock Index Response Relative to World Response



Notes: This figure plots the country-specific stock index response of all 12 announcements relative to the pooled response, i.e. γ_i^y/γ^y obtained from estimating equation (2) and (3). Blue (red) circles indicate that the country response is in the same (opposite) direction as the pooled effect. A filled circle indicates significance at the 5 percent level while an empty circle indicates an insignificant effect. For a given announcement, country-specific estimates obtained for countries with less than 24 observations are dropped.

3.1.3 Assessing the Magnitude

While our high-frequency event study above allows us to establish a causal relationship between US news and foreign stock markets, it comes at the cost that the economic significance of this finding is not immediately obvious. To shed light on this question, we next assess the effect size by comparing it to a benchmark. In particular, we compare the foreign stock price response to the response of the S&P 500.

We estimate the following specification

$$\Delta q_{US,t} - \Delta q_{i,t} = \widetilde{\alpha}_i + \widetilde{\gamma}^y s^y_{US,t} + \sum_{k \neq y} \widetilde{\gamma}^k s^k_{US,t} + \widetilde{\varepsilon}_{i,t}, \tag{4}$$

where $\Delta q_{i,t}$ is the 30-min log-change of country i's stock market index as above, and $\Delta q_{US,t}$ is the 30-min log-change in E-mini S&P 500 Futures. We follow earlier studies and use E-mini S&P 500 Futures for this analysis (e.g., Hasbrouck, 2003). These futures are highly liquid, traded outside of regular hours, and thus available for all announcements. A positive coefficient $\widetilde{\gamma}^y$ in equation (4) implies that the response of the S&P 500 is greater than the response of the foreign stock price index.

Table 4 shows the estimates of equation (4). Strikingly, only in 3 of the 12 announcements, we find evidence that the US stock market responds differently from foreign stock markets. The US response is greater in magnitude for the CB Consumer Confidence, the Core CPI, and the ISM Manufacturing Index. (Recall that stock markets respond negatively to Core CPI announcements.) In the remaining cases, we cannot reject the null hypothesis of equally sized responses. Hence, foreign stock price responses are often comparable in magnitude to US stock price responses after the release of US news.

Table 4: Pooled Relative Effect by Announcement

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index Diff. (bp)						
News	-0.47	3.28**	-4.71***	-0.78	-1.05	-0.69
	(1.14)	(1.33)	(1.21)	(0.81)	(0.88)	(2.04)
R^2	0.01	0.02	0.04	0.01	0.01	0.02
Observations	5389	5815	5434	5526	5468	1824
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index Diff. (bp)						
News	0.63	3.61*	-0.85	3.42	-1.15	-1.79
	(0.45)	(1.83)	(0.87)	(2.24)	(1.08)	(1.14)
R^2	0.00	0.02	0.01	0.02	0.01	0.02
Observations	23529	5277	5728	5446	5479	4924

Notes: This table presents estimates of $\widetilde{\gamma}^y$ of equation (4) for each of the 12 macroeconomic announcements. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level.

3.2 Other Risky Asset Prices

In this section we estimate the effects of US macro news on the VIX, a measure of risk aversion and uncertainty. Declines in the VIX are typically interpreted as signalling increasing willingness of investors to take risk. Various papers highlight the VIX' important role for international financial markets. Rey (2013) shows that the VIX is a close proxy for the Global Financial Cycle. Other studies emphasize the VIX' explanatory power for international capital flows (Forbes and Warnock, 2012), and its link to global banks' leverage (Bruno and Shin, 2015a).

For each of the 12 macroeconomic announcements, we re-run our event-study regression with 30-min changes of the VIX on the left-hand side. If the stock market is not open at the announcement time, we instead use changes in the current month VIX futures contract.[10] Since these data are available for the relevant trading hours only since 2011, the sample sizes are often smaller than before (see Table A2).

Table 5 reports the estimates of these regressions. Almost all announcements show a highly significant effect on the VIX. The signs of the responses are consistent with the view that positive news about real economic activity lead to a reduction in the VIX, thus increasing investors' risk-taking capacity. These results confirm that US macroeconomic news drive the GFC. Comparing the results with the ones in Table 3, we see that almost all announcements induce an negative co-movement of stock prices and the VIX. The only exception here is the Core PPI release although the estimate for the VIX is comparatively noisy.

Following Miranda-Agrippino and Rey (2020), we also study the effect on commodity prices as additional measures of risky asset prices. Gorton and Rouwenhorst (2006) show that commodities and equities have similar return profiles. Bastourre et al. (2012) and Etula (2013) emphasize the relationship of commodity prices and risk appetite. In our analysis, we focus on three commodity classes: energy, agriculture, and industrial metals and measure them using the corresponding S&P GS commodity sector indexes.[11] Appendix Table A5 shows the underlying commodity prices and the associated weights for all three indexes.

As documented by prior research (Pindyck and Rotemberg, 1990; Byrne, Fazio, and Fiess, 2013; Alquist, Bhattarai, and Coibion, 2019), commodity prices co-move over time, and can be summarized by common factors. Bastourre et al. (2012) find that such a commodity factor is also informative about global risk taking capacity. We follow this literature and employ a principal component analysis of the 30-minute changes in the commodity indexes around the 12 macroeconomic announcements of interest.

Table A4 summarizes the principal components analysis. The first common factor (Factor 1) explains around 55% of the variation, and it loads with the same sign on all three commodity indexes. Hence, this factor captures the co-movement of commodity prices. The second factor, which explains 29% of the variation, loads positively on agricultural commodities, and negatively on energy commodities and industrial metals. Further, this factor primarily explains variation of the agricultural index and is relatively unimportant for energy and industrial metals.

Based on the results in Table A4, we proceed with studying the effects of U.S. news on

[10] Over our sample period, the correlation of the daily returns of the VIX and current month VIX futures contract is 80%.

[11] Following the previous literature, we exclude precious metals as they behave differently than to other commodities, e.g. due to their use in hedging risk (Chinn and Coibion, 2014). We also exclude livestock commodities since intraday data is not available to us for early-morning (8:30 ET) announcements from 2014 onwards.

the first common factor within a 30-minute window of the release. Table 5 shows the results of this analysis. For the majority of news releases, we find a significant effect on the factor. Further, the coefficient signs are as expected. Positive (negative) news about real activity lead to an increase (decrease) in commodity prices. Our results are in line with Kurov and Stan (2018), and somewhat in contrast to Kilian and Vega (2011). The former paper finds significant effects of macroeconomic news on energy prices using intraday data similar to us, whereas the latter—and employing daily data—does not find significant effects.

Table 5: Effect on VIX and Commodity Prices by Announcement

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
VIX (bp)						
News	-13.75	-65.82***	41.47***	-18.74*	-7.39	-51.83***
	(12.75)	(12.30)	(12.78)	(9.61)	(6.24)	(15.21)
R^2	0.05	0.11	0.14	0.02	0.02	0.21
Observations	102	265	99	102	102	34
Commodity Factor (bp)						
News	0.65	18.62***	-2.82	-0.13	5.27	24.92*
	(4.00)	(4.87)	(3.82)	(3.15)	(3.19)	(12.64)
R^2	0.11	0.13	0.04	0.02	0.03	0.14
Observations	146	146	145	146	145	48
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
VIX (bp)						
News	-15.87***	-57.69***	-23.23*	-119.33***	-79.99***	-38.62**
	(5.95)	(17.14)	(12.39)	(22.61)	(20.29)	(14.98)
R^2	0.03	0.07	0.06	0.25	0.14	0.05
Observations	438	264	258	101	100	224
Commodity Factor (bp)						
News	6.74***	15.86***	11.58**	35.68***	18.31***	0.15
	(1.70)	(4.32)	(4.72)	(8.26)	(4.36)	(4.27)
R^2	0.04	0.17	0.05	0.18	0.22	0.01
Observations	632	145	145	142	145	146

Notes: For all 12 announcements, this table shows estimates of γ^y obtained from the following specificaton:

$$\Delta q_t = \alpha + \gamma^y s^y_{US,t} + \sum_{k \neq y} \gamma^k s^k_{US,t} + \varepsilon_t,$$

where $s^y_{US,t}$ is the announcement surprise of interest, $s^k_{US,t}$ other surprises at the same time, and $\Delta q_t = q_{t+20} - q_{t-10}$ is the 30-min log-change in the current month VIX futures contract, or the commodity factor estimated from 30-min changes in the energy, industrial metals, and agriculture commodities. See text and Table A4 for details on the construction of the factor. For CB Consumer Confidence, UM Consumer Sentiment P, ISM Mfg Index, and New Home Sales, we are able to use the VIX due to the later announcement time. Standard errors are clustered by announcement, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level.

4 Low Frequency Effects and Explanatory Power of US Macro News

In this section we demonstrate that the effects of U.S. news on international stock markets are persistent and explain a sizable share of their variation. We also show that their explanatory power is greater than that of US monetary policy shocks—the only other known driver of the GFC.

Following Altavilla, Giannone, and Modugno's (2017) method, we switch from our earlier intraday event study approach in the previous section to a daily time series analysis. In a first step, we estimate the specification

$$\Delta q_{i,d} = \alpha_i + \sum_k \beta_i^k s_{US,d}^k + \varepsilon_{i,d}. \tag{5}$$

Here, d indexes time in days and $\Delta q_{i,d}$ is the daily log return of the stock index price q of country i as measured by the difference from market closing to market closing. The sum on the right hand side now includes *all* available announcements as listed in Appendix Table A1.[12] Note that all coefficients are country-specific. A surprise $s_{US,d}^k$ takes the value 0 if no news are released on a given day. Since the coverage of news releases is incomplete in the late 1990s, the sample period now ranges from January 1, 2000 to June 28, 2019.

Next, we define the daily news index as the fitted value $nix_{i,d}^q := \widehat{\Delta q_{i,d}}$ from equation (5), and aggregate this predicted value to the desired time horizon h (in days), $nix_{i,d,h}^q = \sum_{j=0}^{h-1} nix_{i,d-j}^q$. Letting $\Delta_h q_{i,d} = q_{i,d} - q_{i,d-h} = \sum_{j=0}^{h-1} \Delta q_{i,d-j}$ be the h-day log return in stock index q_i, we estimate in a second step the specification

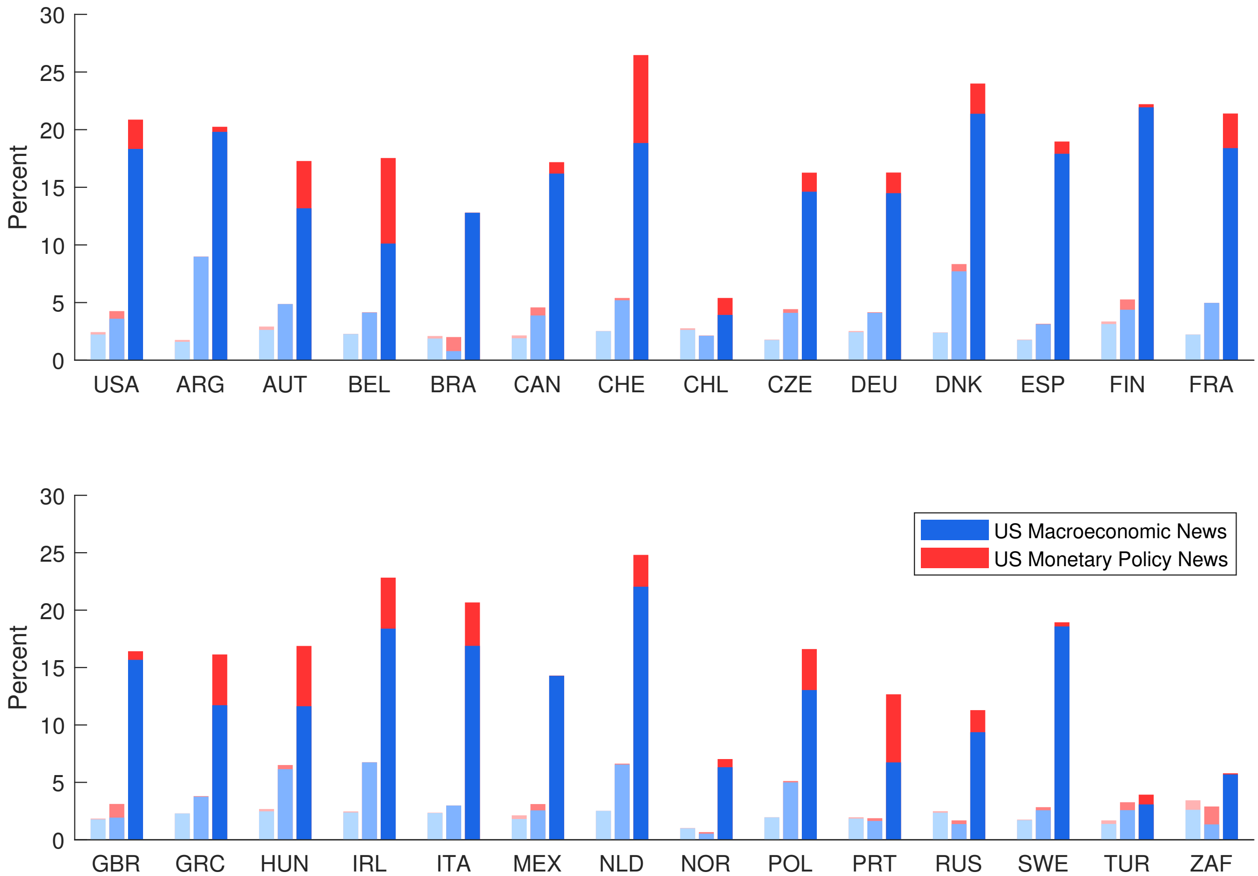
$$\Delta_h q_{i,d} = \alpha_{i,h} + \beta_i^{q,h} nix_{i,d,h}^q + \varepsilon_{i,d,h}. \tag{6}$$

The statistic of primary interest is the R-squared of regression (6). It measures the explanatory power of the US macroeconomic news releases at horizon h and is therefore informative about how persistent the effects of macroeconomic news are relative to residual factors. Additionally, if the coefficient $\beta_i^{q,h}$ is greater (smaller) than one, macroeconomic news exert a delayed (mean-reverting) effect. As do Altavilla, Giannone, and Modugno (2017), we consider aggregation to the monthly and quarterly frequency.

[12] By focusing on daily log returns, we circumvent the problem that some foreign markets are closed for some announcements. Hence, the set of US news that drive foreign asset prices in specification (5) are identical for all countries. Relative to Altavilla, Giannone, and Modugno (2017), our set of announcements includes more macroeconomic news releases. However, we exclude news about monetary policy.

Figure 4 shows the daily, monthly, and quarterly R-squared for the stock indexes by country. For comparison, we also separately estimate specifications (5) and (6) over the same sample using US monetary policy news instead of macroeconomic news. Our construction of monetary shocks follows Nakamura and Steinsson (2018).[13] Figure 4 displays the R-squared of the US macroeconomic and US monetary news in blue and red, respectively.

Figure 4: Daily, Monthly, and Quarterly R-Squared for Stock Indexes



Notes: For each country's stock index, this figure plots the R-squared of equation (5) for the daily frequency, and the R-squared of equation (6) for the monthly and quarterly frequency. The left, middle, and right bar indicate the R-squared of the daily, monthly, and quarterly regression, respectively. For a given frequency, the blue (red) bar stands for the R-squared of US macroeconomic (monetary policy) news. The sample runs from January 1, 2000 to June 28, 2019.

As Figure 4 shows, the explanatory power of US news for foreign stock indexes increases at lower frequencies. In an overwhelming number of cases, the R-squared at the quarterly frequency exceeds the R-squared at the monthly frequency, which in turn, exceeds the R-

[13]For details on the construction, see Nakamura and Steinsson (2018). For the overlapping period, the correlation of our shock measure with the original one is over 99%.

squared at the daily frequency. Hence, relative to other driving forces of foreign stock markets, the effects of US news are persistent. At the quarterly frequency, the explanatory power of US news is sizable, often explaining between 15 and 22 percent of the variation. For comparison, we repeat the analysis for the S&P 500, and report the R-squared first in the figure. For a number of countries, US macroeconomic news explain an even larger fraction of stock price movements than they do in the US.

Although the explanatory power of US monetary policy shocks also increases at lower frequencies, the R-squared is lower than that for macroeconomic news. For some countries, the contribution of US monetary policy shocks is almost negligible. These results echo findings of the domestic literature on US monetary policy. The historical contribution of monetary policy shocks since the 1990s is typically estimated to be relatively small (Coibion, 2012; Ramey, 2016).

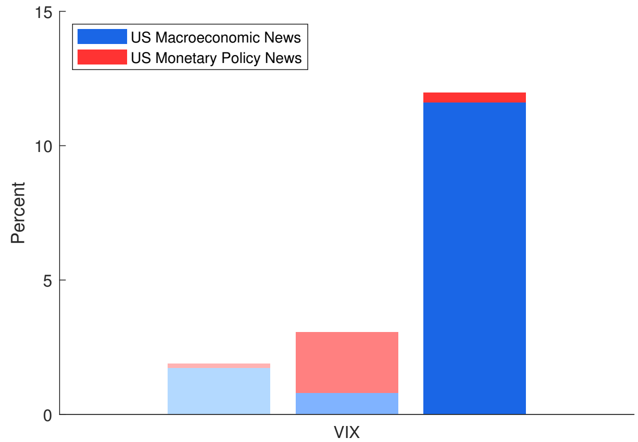
The increased R-squared at lower frequencies imply that the effect of macroeconomic news is more persistent than the effect of the residual factors. Appendix Table A6 reports the daily, monthly and quarterly estimates of $\beta_i^{q,h}$, and shows that at least part of this is due to delayed effects of the macroeconomic news. For several countries we can reject the null hypothesis that $\beta_i^{q,h} = 1$.

Overall, the explanatory power on international stock markets at lower frequencies is striking. Reassuringly, our estimates for the US are in line with the ones by Altavilla, Giannone, and Modugno (2017).[14] We also repeat our exercise for US dollar exchange rates. The results shown in Appendix Figure A4 make clear that the methodology does not mechanically lead to an increase in the R-squared at lower frequencies.

Lastly, we repeat the analysis for the VIX. To do so, we simply replace $q_{i,d}$ in equations (5) and (6) with the VIX. Figure 5 shows the resulting daily, monthly, and quarterly R-squared. Similar to the stock indexes, the explanatory power increases at lower frequencies. At the quarterly frequency, US macroeconomic news explain approximately 12 percent of the variation of the VIX—substantially more than US monetary policy shocks.

[14] Our R-squared is slightly higher since we are using a larger set of macroeconomic news announcements than Altavilla, Giannone, and Modugno (2017).

Figure 5: Daily, Monthly, and Quarterly R-Squared for VIX



Notes: This figure plots the R-squared of equation

$$\Delta VIX_d = \alpha + \sum_k \beta^k s^k_{US,d} + \varepsilon_d$$

for the daily frequency, and the R-squared of equation

$$\Delta_h VIX_d = \alpha_h + \beta^{VIX,h} nix^{VIX}_{d,h} + \varepsilon_{d,h}$$

for the monthly and quarterly frequency. ΔVIX_d and $\Delta_h VIX_d$ refer to the log-returns of the VIX, and $nix^{VIX}_{d,h} = \sum_{j=0}^{h-1} nix^{VIX}_{d-j}$ and $nix^{VIX}_d := \widehat{\Delta VIX}_d$ stand for the news indexes calculated from the fitted values. The left, middle, and right bar indicate the R-squared of the daily, monthly, and quarterly regression, respectively. For a given frequency, the blue (red) bar stands for the R-squared of US macroeconomic (monetary policy) news. The sample runs from January 1, 2000 to June 28, 2019.

5 Inspecting the Mechanism

5.1 Structural Interpretation of News Releases

We next provide a simple framework to clarify the role between the measured surprises, the observed asset price responses, and the true underlying structural shocks.

In Section 3, we estimate the relationship

$$\Delta q_{i,t} = \gamma^y_i s^y_{US,t} + \varepsilon_{i,t}, \tag{7}$$

where we omit the constant and controls for simplicity. Recap that q_i denotes the asset of interest in country i, and y is a particular US macroeconomic variable for which market participants observe the surprise. We next discuss the structural interpretation of the effect of news releases on asset prices as captured by the coefficient γ^y_i. We relegate all technical details into Appendix B. Our main assumptions are that the multi-country economy is log-linear and has a unique equilibrium. We make no assumptions about economic behavior.

We demonstrate in the appendix that the coefficient γ_i^y in the estimation equation (7) can be decomposed as follows,

$$\gamma_i^y = \underbrace{a_{i,US}^q \beta_{US}^y}_{\text{(a)}} + \underbrace{a_{i,i}^q \beta_i^y}_{\text{(b)}} + \underbrace{\sum_{j \neq US,i} a_{i,j}^q \beta_k^y}_{\text{(c)}} + \underbrace{a_{i,glob}^q \beta_{glob}^y}_{\text{(d)}}. \tag{8}$$

In this expression, the coefficients $a_{i,j}^q$ capture the dependence of country i's asset price q_i on a vector x_j of state variables. We distinguish country-specific state variables and common global state variables. For instance, $a_{i,US}^q$ captures the dependence of county i's asset price on US-specific state variables (x_{US}) and $a_{i,glob}^q$ captures its dependence on global state variables (x_{glob}).

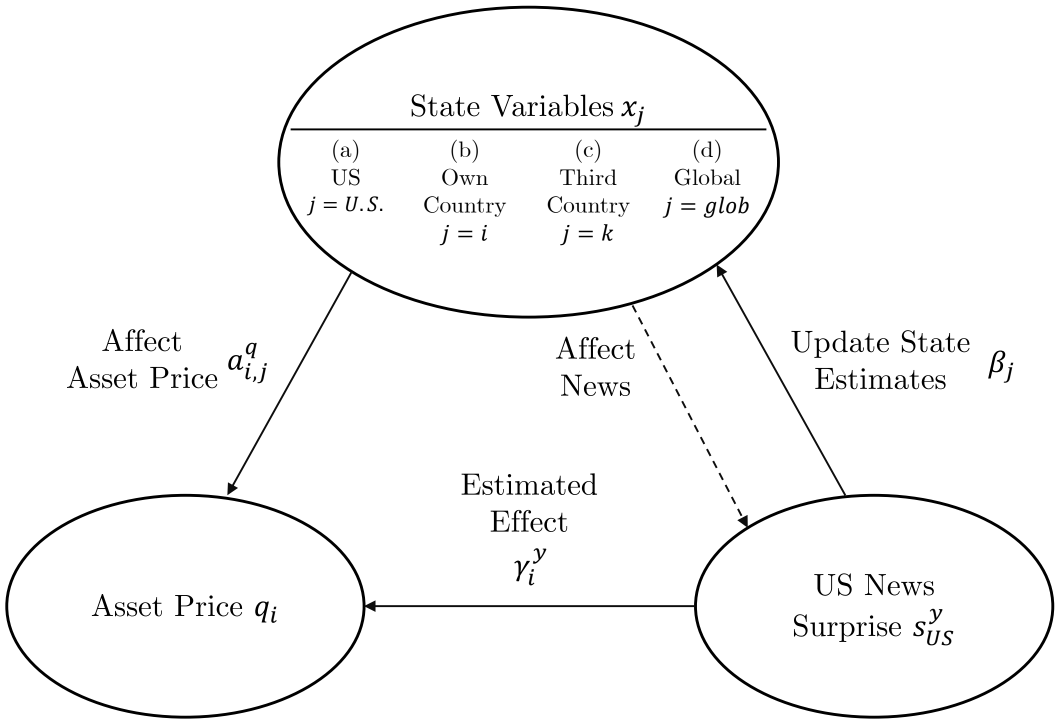
Shocks to these state variables drive the business cycle, asset prices, and also the variation in US macroeconomic news. Upon observing these news, market participants attempt to infer which state variables have changed. They could, for instance, use the Kalman filter to estimate the state, but we do not impose this assumption. We only assume that vectors β_j^y capture how market participants update state vector x_j after observing news about the macroeconomic variable y. As equation (8) illustrates, both updates of the estimated state vectors and the state vectors' effects on the asset price determine the value of γ_i^y.

Equation (8) also highlights, that the disturbances, which drive US macroeconomic news and asset prices, need not originate in the US. Without imposing further structure, the underlying shocks could also originate in other countries or they could be common to all countries (the global state x_{glob}). Figure 6 visualizes the relationship between state variables, macroeconomic news, and asset prices. We continue with a more detailed discussion of the possible origins of fluctuations and their interpretation.

Term (a) in equation (8) and Figure 6 captures economic disturbances originating in the US. If, for instance, a change in US TFP affects US macroeconomic variable $y_{US,\tau}$, market participants who observe the surprise $s_{US,t}^y$ may update their estimate of US TFP. This would be captured by a nonzero element in vector β_{US}. At the same time the change in US TFP may affect foreign asset price $q_{i,t}$—as captured by a nonzero entry in vector $a_{i,US}^q$. The asset price in country i only responds to an observed surprise if both market participants update their expectation of US TFP *and* US TFP indeed affects the asset price in country i. More generally, term (a) captures this logic for all US state variables and thus reflects country i's asset price responses to disturbances originating in the US.

Term (b) reflects changes in state variables, which originate in country i. In order for an

Figure 6: Structural Interpretation of Effect of US Macroeconomic News on Country's i Asset Price



Notes: This Figure illustrates the discussion in 5.1. Solid arrows display relationships at the time of the news release, whereas dashed arrows represent relationships predetermined at the time of the release.

innovation to the state in country i to affect i's own asset price *through the US macroeconomic surprise*, it would have to be the case that market participants learn about i's state by studying US macroeconomic news. Similarly, term (c) captures disturbances, which originate in a third country j, and affect both US macro news as well as the asset price in country i. Lastly, term (d) reflects changes in the global state vector. Such disturbances could affect US macroeconomic surprises, and market participants may use these surprises to estimate these global state variables.

A reasonable assumption in the context of our analysis is that surprises in US macroeconomic variables are not used to update state variables that are specific to countries other than the US. That is, $\beta^y_j = 0$ for $j \notin \{US, glob\}$. This assumption implies for instance, that market participants do not use US payroll employment to forecast the country-specific component of Belgian TFP. For commonly used state estimation frameworks (Kalman filter), a sufficient condition for this assumption to hold is that countries other than the US are *small*. Continuing with the earlier example, a change in Belgian TFP has no impact on US macroeconomic variables, and hence, the forecaster would find no useful correlation to predict Belgian TFP when new information about the US macroeconomy becomes available.

Under this assumption, equation (8) becomes

$$\Delta q_{i,t} = \left(\underbrace{a^q_{i,US}\beta^y_{US}}_{\text{transmission from US}} + \underbrace{a^q_{i,glob}\beta^y_{glob}}_{\text{common shock}} \right) s^y_{US,t} + \varepsilon_{i,t}, \tag{9}$$

The first term in parentheses reflects the *transmission* of macroeconomic shocks from the US to country i. The second term captures the possibility of *common shocks*.

This discussion helps interpret our estimates in Section 3. While foreign stock prices strongly respond to the release of US macroeconomic news, this does not necessarily imply the transmission of US shocks to foreign countries. It is also possible that the US and other countries are subject to common shocks. These common shocks affect US macroeconomic outcomes and are therefore reflected in the measured surprises. Foreign stock markets respond to these surprises, because they reveal information about the common state vector. Importantly, even if our estimates reflect common shocks, the fact that the effects of these shocks are routed through the US highlights its central importance in the global economy.[15]

Lastly, it follows from equation (9) that heterogeneity in countries' asset price responses to US macroeconomic news, reflects heterogeneity in how US country-specific shocks affect country i (as captured by $a^q_{i,US}$), or how country i responds to global shocks (as captured by $a^q_{i,glob}$). We will return to this discussion next.

5.2 The Role of Financial Integration

Figure 3 in Section 3 showed systematic differences in countries' stock market responsiveness to US macroeconomic news. For 11 of the 12 announcements depicted in the figure Germany responds more than the average, as indicated by a circle above one. Denmark, on the other hand responds less than the average for all 12 announcements. In this section we link this heterogeneity to observables. In particular, we show that stock markets of more financially integrated countries respond more to U.S. macroeconomic news. This finding aligns well with earlier work, which has emphasized the role of global financial intermediaries for the global financial cycle.

To study how the responsiveness correlates with financial integration, we estimate the

[15]For further discussion of common shocks, see, e.g., Canova and Marrinan (1998) and Canova (2005).

specification

$$\Delta q_{i,t} = \alpha_i + \gamma^y s^y_{US,t} + \delta^y \left(s^y_{US,t} \times \text{finInt}_{i,t-} \right) + \sum_{k \neq y} \gamma^k s^k_{US,t} + \sum_{k \neq y} \delta^k \left(s^k_{US,t} \times \text{fintInt}_{i,t-} \right) + \zeta \, \text{finInt}_{i,t-} + \varepsilon_{i,t}, \tag{10}$$

where $\text{finInt}_{i,t-}$ is the measure of integration and the subscript $t-$ indicates that the measure is predetermined. We use the calendar year prior to the announcement. For ease of interpretation, we standardize the measures of integration by first subtracting the sample mean and then by dividing by the sample standard deviation. Hence, the main effect γ^y in equation (10) captures the average response and δ^y captures the differential response of a country with a one standard deviation greater-than-average degree of financial integration.

As is common in the literature, we measure financial integration of country i in year τ as

$$\text{finInt}_{i,\tau} = \frac{\text{FA}_{i,\tau} + \text{FL}_{i,\tau}}{\text{GDP}_{i,\tau}}, \tag{11}$$

where $\text{FA}_{i,\tau}$ and $\text{FL}_{i,\tau}$ denote the stock of foreign assets and liabilities, respectively. All series are measured in current US dollars, and the data are taken from Lane and Milesi-Ferretti (2007, 2017).[16]

As we document in Appendix Figure A5, a handful of countries experience an enormous growth in financial integration, most notably Ireland (IRL). While we report results for all countries in Appendix A, we prefer a set of baseline results that excludes these countries (Ireland (IRL), Switzerland (CHE), the Netherlands (NLD), the United Kingdom (GBR), and Belgium (BEL)), since they may unduely drive the results.

Table 6 shows the estimates of equation (10) for stock market indexes on the left hand side, and using financial openness as the measure of integration. For 6 out of 12 news releases, the interaction term has a significant coefficient. For news about the real economy the interaction term has the same sign as the main effect, indicating that countries with greater financial integration are more affected by news about the US economy. For news on prices, the interaction term has the opposite sign as the main effect, implying that countries with greater financial integration are less affected.

The size of the interaction term is often large. For instance, in response to surprises about Nonfarm Payrolls, a country with 1.5 standard deviations of greater-than-average financial

[16] Theory does not make clear predictions as to whether these measures should be constructed at the bilateral level, i.e. between country i and the US, or at the multilateral level as equation (11). In our baseline analysis we use multilateral measures.

Table 6: Role of Financial Linkages

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	5.82**	13.63***	-9.11***	-4.37**	6.78***	20.26***
	(2.44)	(2.31)	(2.05)	(1.54)	(1.82)	(3.97)
Fin. Integration × News	1.43	1.20	2.76**	2.78***	0.12	-1.20
	(1.17)	(1.05)	(1.23)	(0.78)	(0.89)	(2.03)
R^2	0.07	0.13	0.09	0.04	0.06	0.17
Observations	4037	3998	3767	3824	3676	1253
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	5.42***	12.33***	4.36***	21.21***	11.12***	5.85***
	(0.90)	(2.55)	(1.49)	(3.35)	(2.43)	(1.76)
Fin. Integration × News	1.18**	4.32**	0.82	14.02***	3.50***	0.49
	(0.56)	(1.69)	(0.89)	(2.88)	(1.07)	(0.85)
R^2	0.03	0.11	0.03	0.17	0.11	0.05
Observations	15941	3673	3888	3725	3846	3788

Notes: This table presents estimates of γ^y and δ^y of equation (10) for each of the 12 macroeconomic announcements. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level. Appendix Table A7 shows the regression results including all countries, and Appendix Table A8 shows results controlling for trade integration and sectoral dissimilarity.

openness responds twice as much as the average country. Further, financial integration is associated with larger effects for announcements on the real economy and with smaller effects for news on prices.

When interpreting these results, it is important to note the following. While we argue that asset prices *causally* respond to US news releases, a significant interaction term does *not* necessarily imply that greater financial integration *causes* these responses to be greater. It is likely, for instance, that other measures of integration correlate with financial openness and ultimately drive the estimate on the interaction term. To mitigate this concern somewhat, we also re-estimate equation (10) including a measure of trade integration and a industry dissimilarity. The results are shown in Appendix Table A8. Reassuringly, the results are largely unaffected.

5.3 Discount vs. Cash Flow Channel

Lastly, we extend the analysis to government bond markets, and investigate the bond-stock correlation conditional on news releases as done by prior work (e.g., Andersen et al., 2007). Macroeconomic news affect bond prices only through a change in discount rates. Stock prices, in contrast, respond also because market participants expect a change in dividends. For example, an observed increase in stock prices could result from decreased discount rates or increased expected dividends. In the following, we refer to the former mechanism as the *discount channel* and the latter the *cash flow channel*.

To inform the relative strength of these to channels, we study the effect of macroeconomic news on longer-term government bond yields. We focus on 10-year government bonds compared to other maturities for two reasons. First, the 10-year rate is a standard measure of long-term interest rates and commonly used in the literature. Second, data for this maturity is available for all countries in our sample.[17] We exclude bond market data during sovereign debt crisis, e.g. in Argentina and Greece.

Yield changes within the 30-min window of the announcement isolate the effect of macroeconomic news on the discount rate. We re-estimate the pooled regression (2), where $\Delta q_{i,t} = q_{i,t+20} - q_{i,t-10}$ is now the 30-min change of country i's 10-year government bond yield. Table 7 reports the results of this exercise, and contrasts them with the previously obtained estimates for stock indexes from Table 3.

The results show that for all 12 announcements the bond yields are responding significantly at the 1-percent level. More importantly, news about real activity induce a positive co-movement of stock prices and bond yields, while price news, i.e. Core CPI and Core PPI, lead to negative co-movement. These results suggest a dominant cash flow channel news about real activity and dominant discount channel for news about prices.

6 Conclusion

In this paper we establish a causal link between the US economy and a large set of global risky asset prices. US macroeconomic news have strong and synchronous effects on foreign stock markets, commodity prices, and the VIX. Further, these effects are large, persistent, and explain a sizable fraction of the quarterly variation. Since the co-movement of risky

[17] We are relying on yields calculated by *Thomson Reuters*, which are based on bond prices from external sources. This ensures consistency in the yield calculations across countries. The corresponding identifiers are ending with $=RR$, e.g. $AR10YT = RR$ for the Argentinian 10-year government bond yield. Appendix Table A2 provides an overview of the employed instruments.

Table 7: Pooled Effect of International Stock and Bond Markets

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	4.98**	12.60***	-8.80***	-4.26***	6.14***	19.04***
	(2.31)	(2.07)	(1.85)	(1.39)	(1.71)	(3.78)
R^2	0.06	0.12	0.08	0.02	0.06	0.17
Observations	5907	5903	5576	5686	5468	1864
10-Year Bond Yield (bp)						
News	0.21**	0.58***	0.68***	0.45***	0.33***	0.86***
	(0.08)	(0.08)	(0.13)	(0.09)	(0.10)	(0.17)
R^2	0.02	0.08	0.04	0.06	0.02	0.14
Observations	4424	4214	4345	4452	4260	1386

	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	4.98***	11.72***	3.93***	16.93***	10.26***	5.68***
	(0.78)	(2.23)	(1.35)	(2.88)	(2.40)	(1.60)
R^2	0.03	0.10	0.03	0.12	0.10	0.04
Observations	23741	5393	5743	5556	5672	5562
10-Year Bond Yield (bp)						
News	0.30***	0.89***	0.30***	1.53***	0.50***	0.29***
	(0.04)	(0.10)	(0.06)	(0.21)	(0.10)	(0.06)
R^2	0.01	0.16	0.03	0.16	0.07	0.03
Observations	18753	3956	4128	4378	4431	3985

Notes: This table presents results of the pooled regression for the stock indexes, as shown in Table 3, and the 10-year govt. bond yields, i.e. estimates of γ^y of equation (2) where the left-hand variable is now the 30-min change of country i's 10-year govt. bond yield. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level.

asset prices is a defining feature of the GFC, we interpret these findings as evidence for a connection between the US economy and the GFC. US macroeconomic news are a more important driving source than US monetary policy shocks – the only other known driver of the GFC.

While it is likely that a sizable chunk of the variation in US news is driven by US-specific shocks, it is possible that part of the variation originates outside the US. Global common shocks and to a limited extent country-specific foreign shocks could also affect US macroeconomic variables and therefore measured surprises. However, our evidence implies that these shocks affect risky asset prices *through their effects on US macroeconomic aggregates*. Hence, whether these shocks originate in the US or not, news about the US economy are of central importance for shaping global financial conditions.

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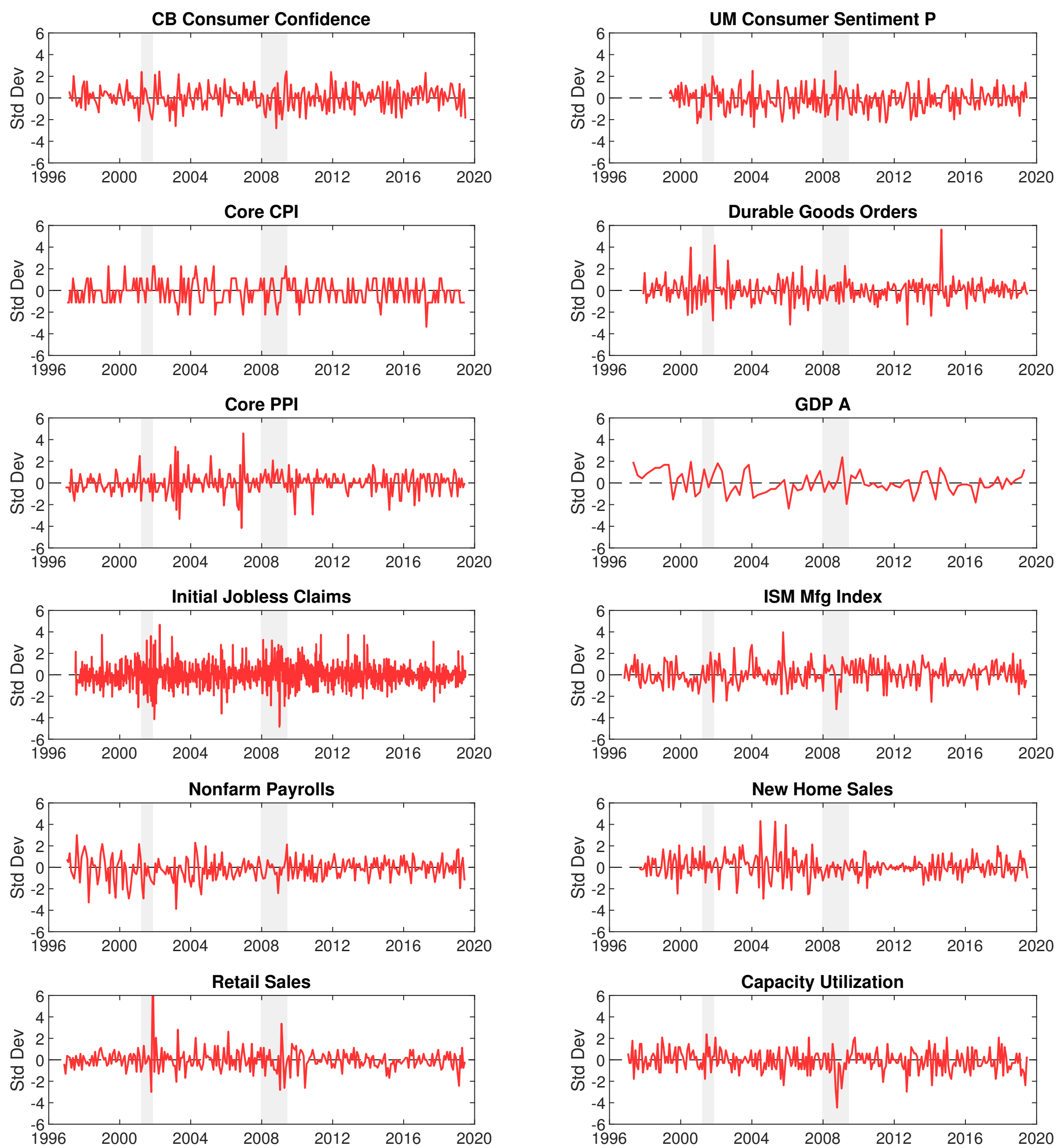
A Additional Tables and Figures

Table A1: U.S. Macroeconomic News

Name	Relevance	Frequency	Observations	Name	Relevance	Frequency	Observations
ADP Employment	87	Monthly	154	Import Price Index	79	Monthly	247
Average Hourly Earnings	31	Monthly	252	Initial Jobless Claims	98	Weekly	1140
Chicago Fed Nat Activity Index	63	Monthly	101	Continuing Claims	69	Weekly	839
Capital Goods Orders	60	Monthly	106	Industrial Production	89	Monthly	271
Capital Goods Shipments	59	Monthly	89	CB Leading Economic Index	83	Monthly	266
ISM Chicago Index	82	Monthly	269	Business Inventories	39	Monthly	263
Consumer Credit	39	Monthly	271	Wholesale Inventories	81	Monthly	264
Construction Spending	80	Monthly	246	ISM Non-Mfg Index	78	Monthly	245
CB Consumer Confidence	94	Monthly	268	ISM Mfg Index	95	Monthly	271
UM Consumer Sentiment F	94	Monthly	242	ISM Prices Paid	73	Monthly	228
UM Consumer Sentiment P	94	Monthly	241	Private Payrolls	31	Monthly	110
Unit Labor Costs F	38	Quarterly	79	Nonfarm Payrolls	99	Monthly	268
Unit Labor Costs P	38	Quarterly	79	New Home Sales	91	Monthly	261
CPI	96	Monthly	271	Building Permits	63	Monthly	202
Capacity Utilization	62	Monthly	268	Housing Starts	90	Monthly	254
Core CPI	77	Monthly	269	Philly Fed Business Outlook	80	Monthly	267
Dallas Fed Mfg Index	64	Monthly	125	Core PCE Price Index	60	Monthly	168
Durable Goods Orders	93	Monthly	260	Personal Consumption Expenditure	85	Monthly	267
Durables Ex Transportation	74	Monthly	211	Personal Income	85	Monthly	271
Employment Cost Index	75	Quarterly	89	Nonfarm Productivity F	43	Quarterly	84
NY Fed Mfg Index	83	Monthly	200	Nonfarm Productivity P	43	Quarterly	85
Existing Home Sales	88	Monthly	172	Richmond Fed Mfg Index	72	Monthly	164
Government Budget Balance	76	Monthly	270	Retail Sales	92	Monthly	270
PPI	87	Monthly	257	Retail Sales Ex Auto	64	Monthly	264
Core PPI	67	Monthly	269	Total Vehicle Sales	44	Monthly	82
Net Long-term TIC Flows	74	Monthly	117	NFIB Small Business Optimism	62	Monthly	112
GDP A	97	Quarterly	89	Factory Orders	86	Monthly	271
GDP S	97	Quarterly	88	Current Account Balance	72	Quarterly	85
GDP T	97	Quarterly	89	NFIB Small Business Optimism	62	Monthly	112
GDP Price Index A	77	Quarterly	85	Mfg Payrolls	69	Monthly	246
GDP Price Index S	77	Quarterly	85	Pending Home Sales	77	Monthly	170
GDP Price Index T	77	Quarterly	84	Trade Balance	84	Monthly	271
FHFA House Price Index	69	Monthly	133	Unemployment Rate	89	Monthly	267

Notes: This table displays the entirety of macroeconomic series analyzed in the paper. The sample ranges from November 1996 to June 2019. *Relevance* indicates the percentage of alerts set for the particular release to total alerts. *Observations* refers to number of observations (surprises) of a macroeconomic series in the sample, *Frequency* to the frequency of the data releases. Abbreviations: A — advanced; S — second; T — third; P — preliminary; F — final; MFG — Manufacturing; ADP — Automatic Data Processing Inc; CB — Chicago Board; ISM — Institute for Supply Management; UM — University of Michigan; NFIB — National Federation of Independent Business; NAHB — National Association of Home Builders.

Figure A1: Time Series of Standardized Surprises



Notes: This figure shows the standardized surprises for the 12 major macroeconomic series over the sample period. The construction follows equation (1) in the text. Gray bars indicate NBER recession periods.

Table A2: Overview of Intraday Financial Data

Name	Ticker	Sample
E-mini S&P 500 Futures	ESc1	1997–2019
VIX	.VIX	1996–2019
VIX Futures	VXc1	2011–2019
S&P GSCI Agriculture	.SPGSAG	2007–2019
S&P GSCI Energy	.SPGSEN	2007–2019
S&P GSCI Industrial Metals	.SPGSINTR	2007–2019

Country	ISO	Stock Index		Dollar Exchange Rate		10-Year Govt. Bond	
		Ticker	Sample	Ticker	Sample	Ticker	Sample
Argentina	ARG	.MERV	1996–2019	ARS=	1996–2019	AR10YT=RR	1999–2017
Brazil	BRA	.BVSP	1996–2019	BRL=	1996–2019	BR10YT=RR	1998–2019
Canada	CAN	.GSPTSE	2000–2019	CAD=	1996–2019	CA10YT=RR	1996–2019
Switzerland	CHE	.SSMI	1996–2019	CHF=	1996–2019	CH10YT=RR	1996–2019
Chile	CHL	.IPSA	1996–2019	CLP=	1996–2019	CL10YT=RR	2007–2019
Czech Republic	CZE	.PX	1999–2019	CZE=	1996–2019	CZ10YT=RR	2000–2019
Denmark	DNK	.OMXCXC20PI	2000–2019			DK10YT=RR	1996–2019
United Kingdom	GBR	.FTSE	1996–2019	GBP=	1996–2019	GB10YT=RR	1996–2019
Hungary	HUN	.BUX	1997–2019	HUF=	1996–2019	HU10YT=RR	1999–2019
Mexico	MEX	.MXX	1996–2019	MXN=	1996–2019	MX10YT=RR	2002–2019
Norway	NOR	.OBX	1996–2019	NOK=	1996–2019	NO10YT=RR	1996–2019
Poland	POL	.WIG20	1997–2019	PLN=	1996–2019	PL10YT=RR	1999–2019
Russia	RUS	.IMOEX	2001–2019	RUB=	1998–2019	RU10YT=RR	2003–2019
Sweden	SWE	.OMXS30	1996–2019	SEK=	1996–2019	SE10YT=RR	1996–2019
Turkey	TUR	.XU030 30	1997–2019	TRY=	2004–2019	TR10YT=RR	2010–2019
South Africa	ZAF	.JTOPI	2002–2019	ZAR=	1996–2019	ZA10YT=RR	1997–2019
Euro Area	EUR			EUR=	1999–2019		
Austria	AUT	.ATX	1996–2019			AT10YT=RR	1996–2019
Belgium	BEL	.BFX	1996–2019			BE10YT=RR	1996–2019
Germany	DEU	.GDAXI	1996–2019			DE10YT=RR	1996–2019
Spain	ESP	.IBEX	1996–2019			ES10YT=RR	1996–2019
Finland	FIN	.OMXH25	2001–2019			FI10YT=RR	1996–2019
France	FRA	.FCHI	1996–2019			FR10YT=RR	1996–2019
Greece	GRC	.ATF	1997–2019			GR10YT=RR	1998–2019
Ireland	IRL	.ISEQ	1996–2019			IE10YT=RR	1998–2019
Italy	ITA	.FTMIB	1996–2019			IT10YT=RR	1996–2019
Netherlands	NLD	.AEX	1996–2019			NL10YT=RR	1996–2019
Portugal	PRT	.PSI20	1996–2019			PT10YT=RR	1996–2019

Notes: This table gives an overview of the intraday data from *Thomson Reuters Tick History*. The top panel shows information on various financial instruments. The bottom panel provides information on the cross-country data. For all series, the sample period ends in June 2019. Further, *Ticker* refers to the Reuters Instrument Code (RIC). For a given country, the table shows details of the major stock index, US exchange rate, and 10-year government bond yield with the respective data samples. For members of the Euro Area, we do not use country-specific exchange rates prior to the currency union due to the small sample. For exchange rates, we do not use the Danish Krone since its currency is tightly and credibly pegged to the Euro. Abbreviations: ISO — 3 digit ISO country code.

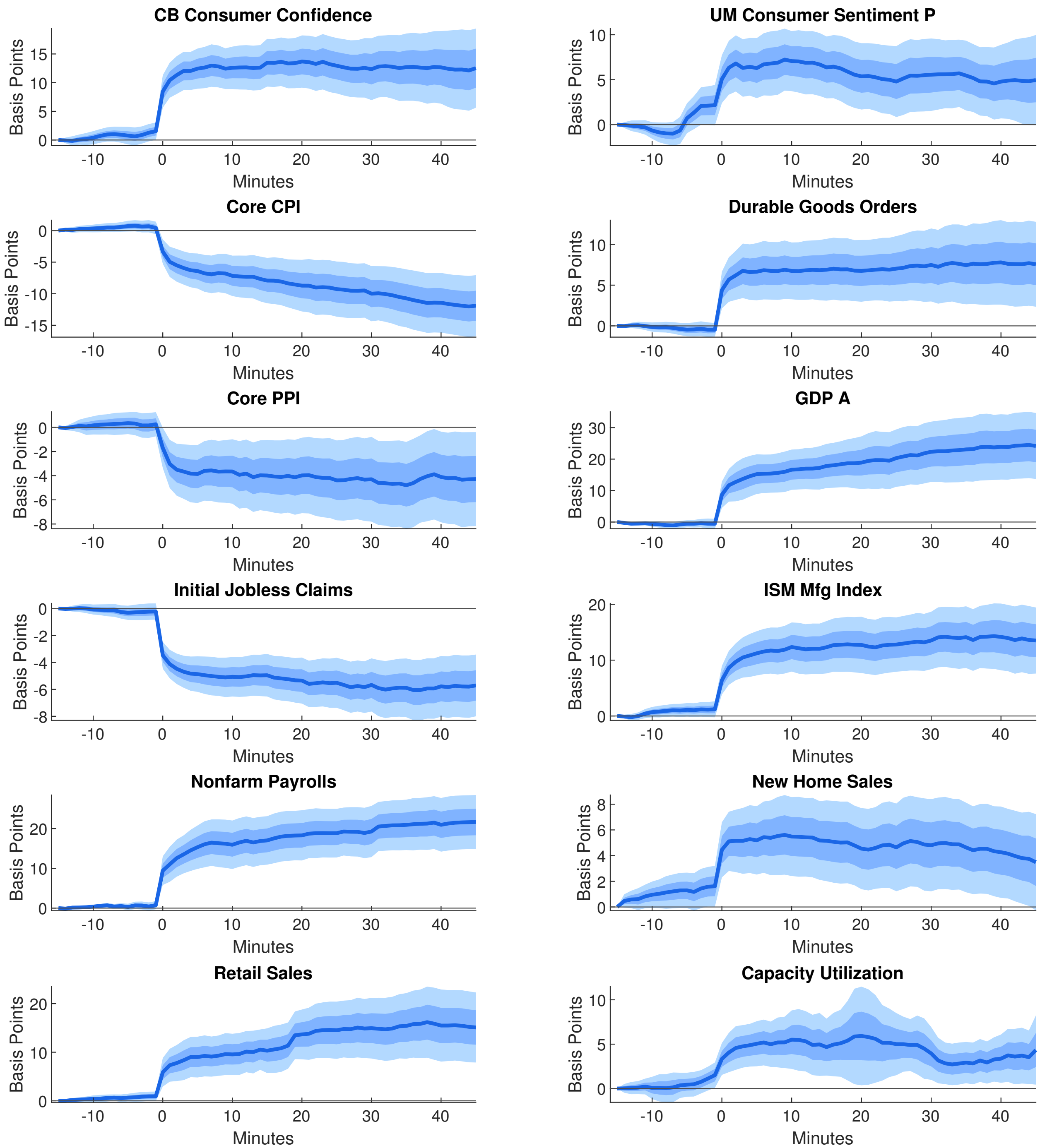
Table A3: Overview of Open/Closed Equity Markets during U.S. Macroeconomic News Announcements

Event	ARG	AUT	BEL	BRA	CAN	CHE	CHL	CZE	DEU	DNK	ESP	FIN	FRA	GBR
Capacity Utilization	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
CB Consumer Confidence	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Core CPI	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
Core PPI	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
Durable Goods Orders	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
GDP A	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
Initial Jobless Claims	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
ISM Mfg Index	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
New Home Sales	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Nonfarm Payrolls	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
Retail Sales	Closed	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open	Open
UM Consumer Sentiment P	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

	GRC	HUN	IRL	ITA	MEX	NLD	NOR	POL	PRT	RUS	SWE	TUR	ZAF
Capacity Utilization	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
CB Consumer Confidence	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Core CPI	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
Core PPI	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
Durable Goods Orders	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
GDP A	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
Initial Jobless Claims	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
ISM Mfg Index	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
New Home Sales	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Nonfarm Payrolls	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
Retail Sales	Open	Open	Open	Open	Closed	Open	Open	Open	Open	Open	Open	Open	Open
UM Consumer Sentiment P	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

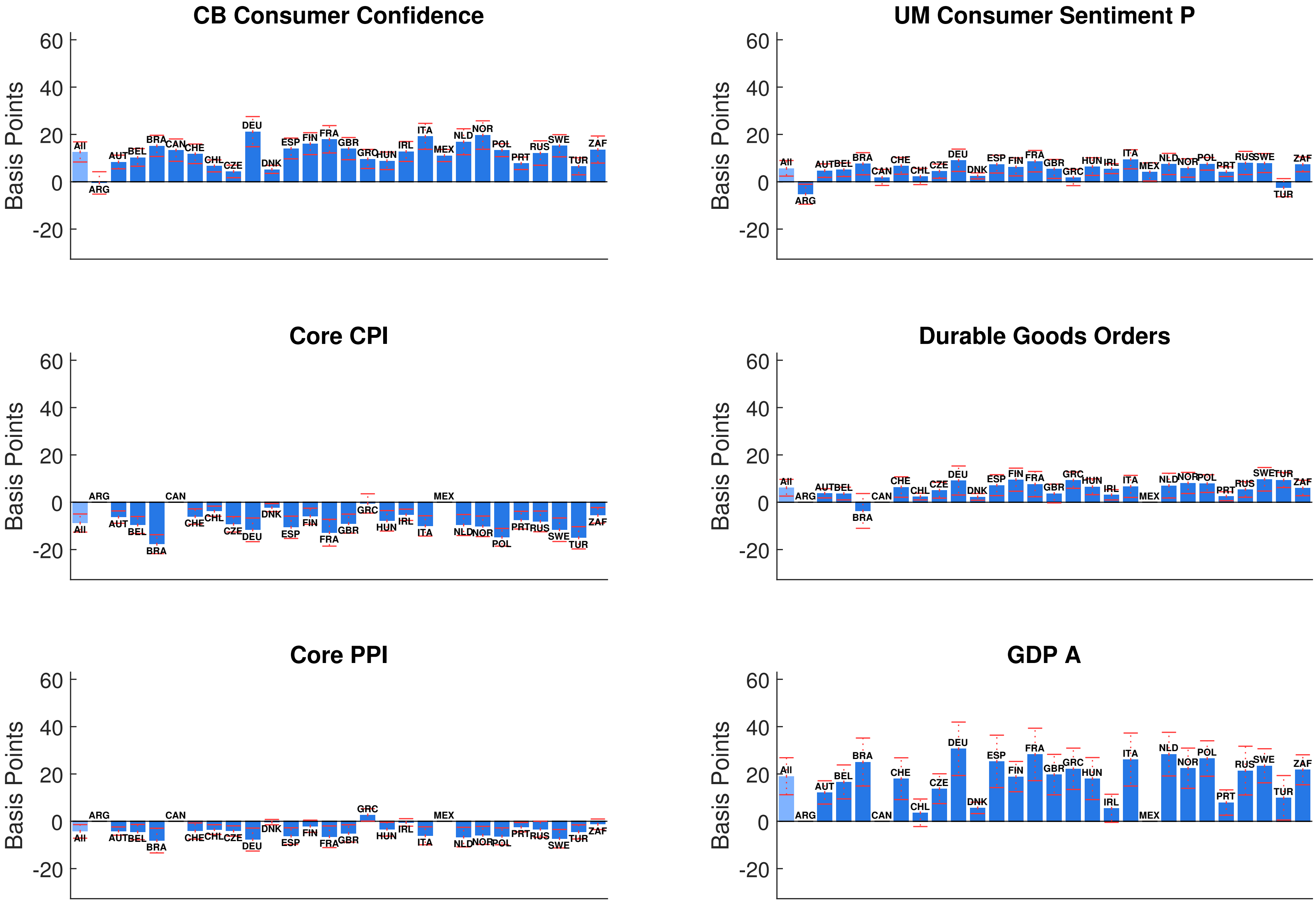
Notes: *Green* indicates that the corresponding equity market is usually open at the time of the news release. *Orange* indicates that the equity market is usually open but that the news release is around market opening or closing. In the case of Brazil, it indicates that the news release moves outside the trading hours during the U.S. daylight saving time since Sao Paulo, the location of the Brazilian stock market, does not observe daylight saving time. *Red* indicates indicates that the equity market is usually closed at the release time.

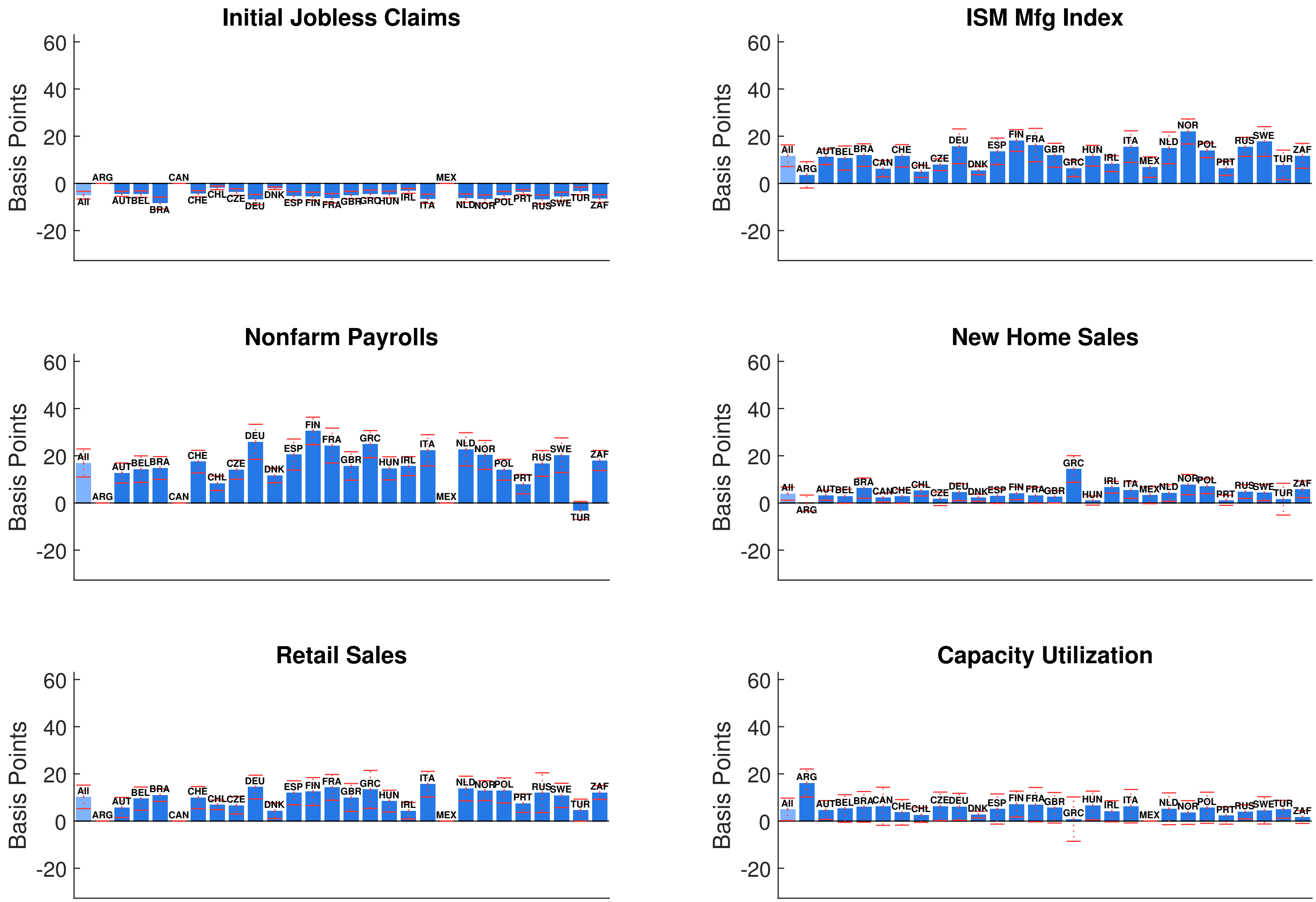
Figure A2: Average Paths within 60-minute Window for Selected Announcements



Notes: This figure displays the average path for stock indexes within a 60 minute window for a given news release. The units are expressed in basis points. The changes are relative to the level 15 minutes prior to each release. The dark and light blue bands display the 68 percent and 95 percent confidence bands, respectively. Standard errors are clustered at event- and country-level.

Figure A3: Response of Equity Markets for All Announcements





This figure shows the equity market responses for all releases. The light blue bar shows the pooled effect, i.e. common coefficient γ^y of equation (2), while the dark blue bars show the country-specific effect, i.e. γ_i^y obtained from estimating equation (3). Missing country bars depict cases in which the country is dropped because it had less than 24 observations for a given announcement. The red error bands depict 95 percent confidence intervals, where standard errors are clustered at the event- and country-level.

Table A4: Results of Principal Component Analysis

	Loadings		Explained Variance		
	Factor 1	Factor 2	Factor 1	Factor 2	Total
Energy	0.65	-0.27	0.71	0.06	0.77
Industrial Metals	0.65	-0.28	0.70	0.07	0.77
Agriculture	0.39	0.92	0.25	0.75	1.00
Total			0.55	0.29	0.85

Notes: This table shows the loadings and explained variance of the first two factors of the commodity data. They are estimated using principal components on 30-minute changes of the S&P GS energy, industrial metals, and agriculture commodity index around the 12 macroeconomic announcements.

Table A5: Compositions of Commodity Indexes

Energy		Industrial Metals		Agriculture	
WTI Crude Oil	0.41	LME Aluminium	0.35	Chicago Wheat	0.18
Brent Crude Oil	0.30	LME Cooper	0.41	Kansas Wheat	0.08
RBOB Gasoline	0.07	LME Lead	0.06	Corn	0.31
Heating Oil	0.07	LME Nickel	0.08	Soybeans	0.20
Gasoil	0.10	LME Zinc	0.11	Cotton	0.08
Natural Gas	0.05			Sugar	0.10
				Coffee	0.04
				Cocoa	0.02

Notes: This table shows the underlying commodity prices and corresponding weights for each of the three S&P GS commodity indexes.

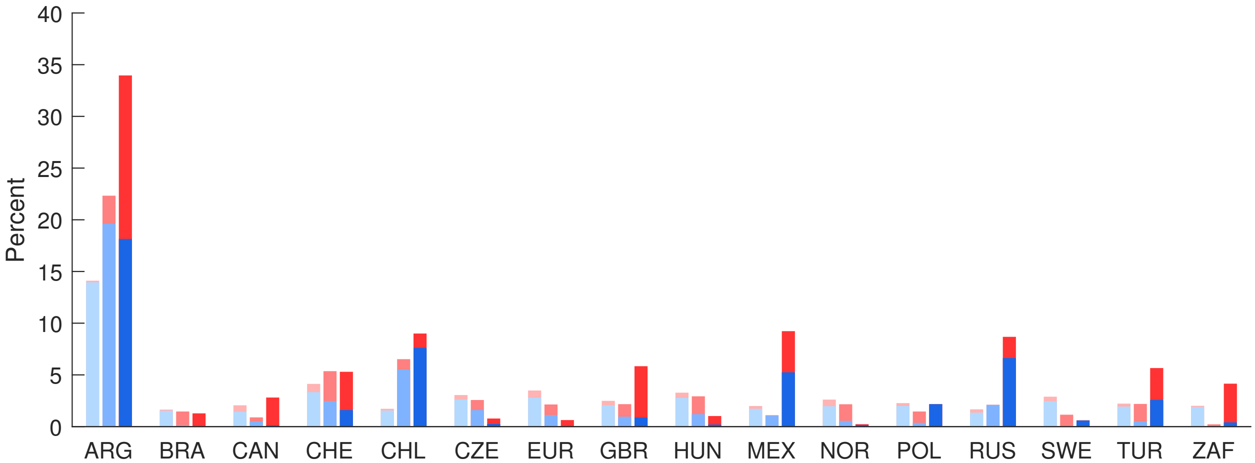
Table A6: Low Frequency Analysis — Stock Indexes

	USA	ARG	AUT	BEL	BRA	CAN	CHE	CHL	CZE	DEU	DNK	ESP	FIN	FRA
R-squared														
1-day	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02
1-month	0.04	0.09	0.05	0.04	0.01	0.04	0.05	0.02	0.04	0.04	0.08	0.03	0.04	0.05
1-quarter	0.18	0.20	0.13	0.10	0.13	0.16	0.19	0.04	0.15	0.14	0.21	0.18	0.22	0.18
Coefficient														
1-month	1.05	2.57	1.31	1.15	0.66	1.22	0.95	0.81	1.61	1.11	2.18	1.14	0.93	1.11
	(0.39)	(0.43)	(0.67)	(0.83)	(0.38)	(0.46)	(0.38)	(0.45)	(0.63)	(0.37)	(1.04)	(0.57)	(0.35)	(0.44)
1-quarter	2.20	3.63	2.40	1.83	2.79	2.37	1.58	0.97	2.91	2.04	4.01	2.47	2.05	2.08
	(0.64)	(0.55)	(0.96)	(1.05)	(0.69)	(0.82)	(0.47)	(0.52)	(0.95)	(0.72)	(1.70)	(0.82)	(0.51)	(0.65)

	GBR	GRC	HUN	IRL	ITA	MEX	NLD	NOR	POL	PRT	RUS	SWE	TUR	ZAF
R-squared														
1-day	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.01	0.02	0.02	0.02	0.02	0.01	0.03
1-month	0.02	0.04	0.06	0.07	0.03	0.03	0.07	0.01	0.05	0.02	0.01	0.03	0.03	0.01
1-quarter	0.16	0.12	0.12	0.18	0.17	0.14	0.22	0.06	0.13	0.07	0.09	0.19	0.03	0.06
Coefficient														
1-month	0.74	1.37	1.52	1.44	0.96	1.13	1.30	0.64	1.65	0.99	0.61	0.96	1.41	0.56
	(0.47)	(0.54)	(0.62)	(0.79)	(0.55)	(0.44)	(0.50)	(0.58)	(0.47)	(0.74)	(0.35)	(0.42)	(0.64)	(0.37)
1-quarter	1.93	2.48	2.04	2.64	2.05	2.57	2.21	1.94	2.50	2.39	1.55	2.39	1.27	1.00
	(0.56)	(0.62)	(1.03)	(1.05)	(0.72)	(0.90)	(0.60)	(0.57)	(0.68)	(1.36)	(0.46)	(0.78)	(0.83)	(0.51)

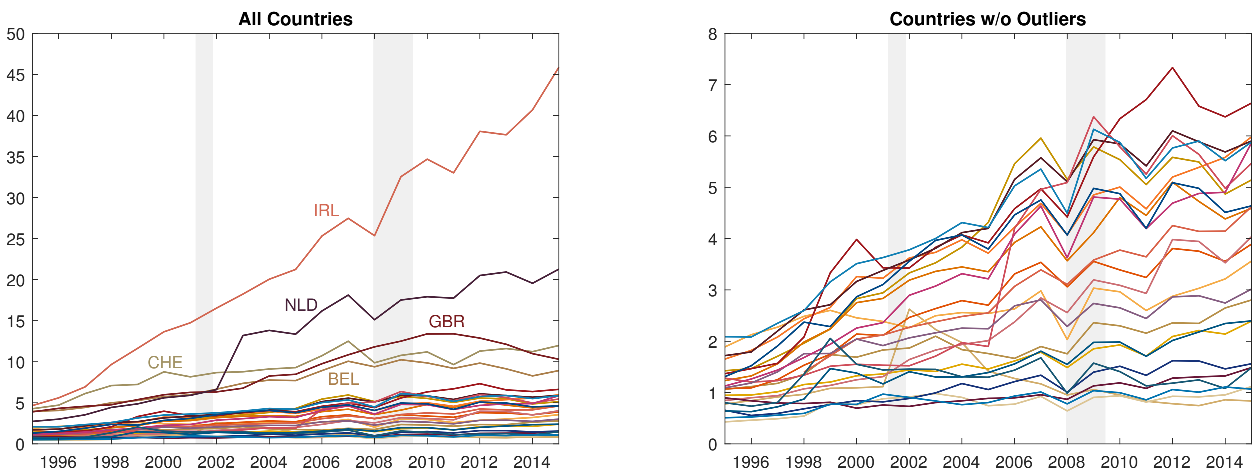
Notes: This table reports, country-by-country, the R-squared values of equation (5) (daily) and, R-squared and coefficient values of equation (6) (monthly and quarterly) for stock indexes. The sample runs from January 1, 2000 to June 28, 2019 and Newey-West standard errors are used. For the US, we use the S&P 500 where we obtain daily data from the Center of Research in Security Prices (CRSP).

Figure A4: Daily, Monthly, and Quarterly R-Squared for U.S. Dollar Exchange Rates



Notes: For each country's U.S. dollar exchange rate, this figure plots the R-squared of equation (5) for the daily frequency, and the R-squared of equation (6) for the monthly and quarterly frequency. The left, middle, and right bar indicate the R-squared of the daily, monthly, and quarterly regression, respectively. For a given frequency, the blue (red) bar stands for the R-squared of U.S. macroeconomic (monetary policy) news. The sample runs from January 1, 2000 to June 28, 2019.

Figure A5: Time Series of Financial Integration by Country



Notes: This figure shows the time series of financial integration from 1995 to 2015. The construction of the measure follows equation (11). The left hand side graph depicts the time series for all countries in the sample. The right hand side excludes the time series for the five outliers, i.e. Belgian, Ireland, Netherlands, Switzerland, and the United Kingdom. Note that the Euro Area is a separate line in both graphs.

Table A7: Role of Financial Linkages — All Countries

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	5.74**	13.74***	-8.89***	-4.60***	6.32***	19.72***
	(2.60)	(2.26)	(1.93)	(1.48)	(1.76)	(3.87)
Fin. Integration × News	0.80	1.00	1.40	1.64**	-0.63*	-1.45
	(0.88)	(0.64)	(0.98)	(0.60)	(0.37)	(1.32)
R^2	0.07	0.14	0.08	0.03	0.06	0.18
Observations	5205	5149	4929	5010	4794	1640
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	5.26***	12.13***	4.27***	18.78***	10.27***	5.89***
	(0.84)	(2.48)	(1.47)	(3.37)	(2.50)	(1.72)
Fin. Integration × News	0.37	2.11	1.02**	8.15**	1.19	0.29
	(0.55)	(1.42)	(0.38)	(3.77)	(1.42)	(0.43)
R^2	0.03	0.10	0.03	0.14	0.10	0.05
Observations	20835	4738	4992	4887	5030	4819

Notes: This table presents estimates of γ^y and δ^y of equation (10) for each of the 12 macroeconomic announcements, and including all countries. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level.

Table A8: Role of Financial Linkages — Trade Integration and Industry Dissimilarity

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	6.52**	15.40***	-9.19***	-4.23**	7.07***	21.85***
	(2.67)	(2.35)	(2.23)	(1.56)	(2.07)	(3.88)
Fin. Integration × News	1.45	0.43	3.60	3.94**	0.39	-3.98
	(1.69)	(1.55)	(2.15)	(1.46)	(1.67)	(3.13)
Trade Integration × News	-0.61	-2.79***	0.53	0.00	-0.11	-2.84**
	(1.11)	(0.94)	(0.48)	(0.48)	(0.44)	(1.31)
Industry Dissimilarity × News	0.80	-1.28	1.91	2.49*	0.59	-3.35
	(1.47)	(1.28)	(1.83)	(1.28)	(1.47)	(3.09)
R^2	0.09	0.18	0.09	0.04	0.07	0.22
Observations	3449	3325	3272	3314	3262	1095
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	5.28***	13.97***	4.73***	23.27***	11.43***	6.73***
	(0.98)	(2.66)	(1.52)	(3.50)	(2.50)	(1.76)
Fin. Integration × News	2.19**	4.61**	2.20	15.41***	4.89***	-0.17
	(0.79)	(2.16)	(1.45)	(3.03)	(1.49)	(1.23)
Trade Integration × News	-0.99	-2.59**	-2.24**	-3.69	-1.87*	-0.97
	(0.61)	(1.11)	(1.00)	(2.48)	(0.94)	(0.63)
Industry Dissimilarity × News	1.01	2.25	2.05*	4.75*	1.74	-0.49
	(0.82)	(1.63)	(0.97)	(2.66)	(1.26)	(1.16)
R^2	0.04	0.15	0.04	0.21	0.13	0.06
Observations	14045	3044	3268	3240	3329	3270

Notes: This table presents estimates of γ^y and δ^y of an adapted version of equation (10), where all financial integration and industry dissimilarity are all included at the same time, for each of the 12 macroeconomic announcements. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * refer to significance at the 1, 5, and 10 percent level. Trade integration (or openness) is calculated for country i and year τ as

$$\text{tradeInt}_{i,\tau} = \frac{\text{Imports}_{i,\tau} + \text{Exports}_{i,\tau}}{\text{GDP}_{i,\tau}}.$$

Country i dissimilarity measure is calculated as

$$\text{dissim}_{i,\tau} = \sum_k |s_{i,k,\tau} - s_{US,k,\tau}|,$$

where $s_{i,k,\tau}$ is country i's share of gross output in sector k and in year τ.

B A Structural Framework to Interpret Results

The following exposition extends the framework in Faust et al. (2007) to the international setting.

Setup We adopt the high-frequency setup from Section 3, and denote by t the release time. The time window around the release is $[t-\Delta^-, t+\Delta^+]$, where Δ^- and Δ^+ are short time periods. We are interested in the effect of news about a U.S. macroeconomic variable $y_{US,\tau}$ on an asset price q_i in country i. τ is a generic time index.

Letting $\mathcal{I}_{t-\Delta^-}$ denote agents' (common) information set prior to the news release, the *surprise* about the US macroeconomic variable is $s^y_{US,t} = y_{US,t} - E\left[y_{US,t}|\mathcal{I}_{t-\Delta^-}\right]$, where $E\left[\cdot|\mathcal{I}_{t-\Delta^-}\right]$ denotes the expectation conditional on information set $\mathcal{I}_{t-\Delta^-}$. Consistent with recent evidence (Gürkaynak, Kısacıkoğlu, and Wright, 2018), we assume that $s^y_{US,t}$ is measured without error. We denote the set of news that become available in the time window we study by $\mathcal{N}_{[t-\Delta^-,t+\Delta^+]}$. It includes, in particular, news on the macroeconomic variable $y_{US,t}$, but also other news. Asset prices at time $t+\Delta^+$ are then based on the information set $\mathcal{I}_{t+\Delta^+} = \mathcal{I}_{t-\Delta^-} \cup \mathcal{N}_{[t-\Delta^-,t+\Delta^+]}$.

We assume a log-linear multi-country world with a unique equilibrium. Countries are indexed by i, j, and k, and $\mathcal{C}$ denotes the set of countries. The state variables of the economy are elements of the *vectors* $x_{j,\tau}$ and $x_{glob,\tau}$. State variables specific to country $j \in \mathcal{C}$ are included in the vector $x_{j,\tau}$ and global state variables are included in the vector $x_{glob,\tau}$. For instance, a component of total factor productivity (TFP) specific to the US is part of vector $x_{US,\tau}$, while the global TFP component is included in $x_{glob,\tau}$. We are agnostic as to which state variables drive the business cycle and explicitly allow for news shocks in the spirit of Beaudry and Portier (2006). All structural shocks are uncorrelated.

The price of an asset of interest in country i can then be written as

$$q_{i,\tau} = E\left[\sum_{j\in\mathcal{C}} a^q_{i,j} x_{j,\tau} + a^q_{i,glob}\, x_{glob,\tau}|\mathcal{I}_\tau\right],$$

where $a^q_{i,j}, j \in \mathcal{C}$ and $a_{glob,i}$ are coefficient vectors that depend on the specification of the model. They capture, respectively, how the asset price $q_{i,\tau}$ is affected by the country-specific state variables in $x_{j,\tau}$ and the global state variables in $x_{glob,\tau}$. Similarly, we can express the US macroeconomic variable of interest as

$$y_{US,\tau} = \sum_{j\in\mathcal{C}} a^y_{US,j} x_{j,\tau} + a^y_{US,glob}\, x_{glob,\tau}.$$

Under the assumption that $x_{j,t+\Delta^+} = x_{j,t-\Delta^-}$ for all j and $x_{glob,t+\Delta^+} = x_{glob,t-\Delta^-}$ for small Δ^-, Δ^+, we can write the change in asset price $q_{i,\tau}$ over the window we study as

$$\begin{aligned} \Delta q_{i,t} &= q_{i,t+\Delta^+} - q_{i,t-\Delta^-} \\ &= \sum_{j\in\mathcal{C}} a^q_{i,j}\left(E\left[x_{j,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{j,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right]\right) \\ &\qquad + a^q_{i,glob}\left(E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right]\right). \end{aligned} \tag{B1}$$

In words, when new information becomes available, market participants change their expectations about the state of the economy, which in turn, changes asset price $q_{i,t}$.

We next use the fact that $\mathcal{I}_{t+\Delta^+} = I_{t-\Delta^-} \cup \mathcal{N}_{[t-\Delta^-,t+\Delta^+]}$, and parameterize the conditional expectations in equation (B1),

$$
\begin{aligned}
E\left[x_{j,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{j,t+\Delta^+}|I_{t-\Delta^-}\right] &= \beta_j s^y_{US,t} + u_{j,t}, \qquad \text{for } j \in \mathcal{C}, && \text{(B2)}\\
E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{glob,t+\Delta^+}|I_{t-\Delta^-}\right] &= \beta_{glob} s^y_{US,t} + u_{glob,t}. && \text{(B3)}
\end{aligned}
$$

These expressions make explicit that market participants use the surprise about US macroeconomic news, as well as other information that becomes available within the time window (as captured by $u_{j,t}$ and $u_{glob,t}$), to update their expectations about the state of the world economy. To the extent that the US macroeconomic news release is informative about the state, the *vectors* β_j and β_{glob} contain nonzero elements. For instance, higher-than-expected US Nonfarm Payrolls may lead market participants to update their expectation of the US-specific component of TFP. In this case, the relevant element in β_{US} is nonzero. If the surprise is not useful for estimating particular state variables, then the relevant entries in β_j and β_{glob} are zero.

Plugging equations (B2) into equation (B1) gives

$$
\Delta q_{i,t} = \left(\sum_{j \in \mathcal{C}} a^q_{i,j} \beta_j + a^q_{i,glob} \beta_{glob} \right) s^y_{US,t} + \varepsilon_{i,t}, \tag{B4}
$$

where $\varepsilon_{i,t} = \sum_{j\in\mathcal{C}} a^q_{i,j} u_{j,t} + a^q_{i,glob} u_{glob,t}$. Letting $\gamma_i := \sum_{j\in\mathcal{C}} a^q_{i,j}\beta_j + a^q_{i,glob}\beta_{glob}$, delivers our estimating equation (3).

Discussion For a given asset q and surprise $s^y_{US,t}$, equation (B4) highlights that a country's response reflects two components. First, the response reflects the asset price's dependence on the true unobserved state, as captured by $a^q_{i,j}$ and $a^q_{i,glob}$. Second, the response reflects market participant's updates about the state of the world, as measured by vectors β_j and β_{glob}. If market participants use the newly available information to update only some state variables, and country i's asset price does not depend on the state variables being updated, then the asset price should not systematically respond to the surprise. The nonzero responses that we identified in Section 3 thus imply that market participants update their belief about states, which country i's asset price depends on.

We next split the asset price response in equation (B4) by country into four different components,

$$
\Delta q_{i,t} = \left(\underbrace{a^q_{i,US}\beta_{US}}_{\text{(a)}} + \underbrace{a^q_{i,i}\beta_i}_{\text{(b)}} + \underbrace{\sum_{j\neq US,i} a^q_{i,j}\beta_j}_{\text{(c)}} + \underbrace{a^q_{i,glob}\beta_{glob}}_{\text{(d)}} \right) s^y_{US,t} + \varepsilon_{i,t}.
$$

This breakdown reflects the origins of disturbances. Term (a) captures economic disturbances originating in the US. If, for instance, the change in US TFP affects US macroeconomic variable $y_{US,\tau}$, market participants who observe the surprise $s^y_{US,t}$ may update their estimate of US TFP. This would be captured by a nonzero element in vector β_{US}. At the same time the change in US TFP may affect foreign asset price $q_{i,t}$—as captured by a nonzero entry in vector $a^q_{i,US}$. The asset price in country i only responds to a change in US TFP if both market participants update their expectation of US TFP *and* US TFP indeed affects the asset price in country i. More generally, term (a) captures this logic for all US state variables and thus reflects country i's asset price responses to disturbances originating in the US.

Term (b) in the above expression reflects changes in state variables, which originate in country i. In order for an innovation to the state in country i to affect i's own asset price *through the US macroeconomic surprise*, it would have to the case that market participants learn about i's state by studying US macroeconomic news. Similarly, term (c) captures disturbances, which originate in a third country j, and affect both US macro news as well as the asset price in country i. Lastly, term (d) reflects changes in the global state vector. Such disturbances may affect US macroeconomic surprises, and as a result market participants may use these surprises to estimate these global state variables.

A reasonable assumption in the context of our analysis is that surprises in US macroeconomic variables are not used to update state variables that are specific to countries other than the US. That is, $\beta_j = 0$ for $j \neq US$. This assumption implies that it is not the case that market participants use US payroll employment to forecast the country-specific component of Belgian TFP. For commonly used state estimation frameworks (Kalman filter), a sufficient condition for this assumption to hold is that countries other than the US are *small*. Continuing with the earlier example, a change in Belgian TFP has no impact on US macroeconomic variables, and hence, the forecaster would find no useful correlation to predict Belgian TFP when new information about the US macroeconomy becomes available.

Under this assumption, equation (B4) becomes

$$\Delta q_{i,t} = \left(\underbrace{a^q_{i,US}\beta_{US}}_{\text{transmission from US}} + \underbrace{a^q_{i,glob}\beta_{glob}}_{\text{common shock}} \right) s^y_{US,t} + \varepsilon_{i,t}. \tag{B5}$$

This estimating equation makes clear that a significant coefficient on the US macroeconomic surprise reflects two different components. First, if the surprise leads to an update of market participants' expectations on US state variables (as captured by nonzero elements in the vector β_{US}), and if changes in US state variables impact the foreign asset price (the vector $a^q_{i,US}$ contains nonzero elements), then the inner product $a^q_{i,US}\beta_{US}$ can be different from zero. This component thus reflects *transmission* of macroeconomic shocks from the US to country i. Second, the surprise $s^y_{US,t}$ may be useful to forecast global state variables (β_{glob} contains nonzero elements). In this case, a significant coefficient on the surprise reflects that country i is impacted by a *common shock*.

This discussion helps interpret our estimates in Section 3. While foreign stock prices strongly respond to the release of US macroeconomic news, this does not necessarily imply the transmission of US shocks to foreign countries. It is also possible that the US and other countries are subject to common shocks. These common shocks affect US macroeconomic outcomes and are therefore reflected in the measured surprises. Foreign stock markets respond to these surprises, because they reveal information about the common state vector.

It also follows from equation (B5) that heterogeneity in countries' asset price responses to US macroeconomic news, reflects heterogeneity in how US country-specific shocks affect country i (as captured by $a^q_{i,US}$), or how country i responds to global shocks (as captured by $a^q_{i,glob}$).