RESEARCH SEMINAR IN INTERNATIONAL ECONOMICS

Gerald R. Ford School of Public Policy
The University of Michigan
Ann Arbor, Michigan 48109-3091

Discussion Paper No. 677

The US, Economic News, and the Global Financial Cycle

Christoph E. Boehm
UT Austin

T. Niklas Kroner
UT Austin

September 4, 2020

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

Christoph E. Boehm and T. Niklas Kroner

UT Austin

This draft: September 4, 2020
First draft: January 10, 2020

Abstract

We provide evidence for a causal link between the US economy and the global financial cycle. Using a unique intraday dataset, we show that US macroeconomic news releases have large and significant effects on global risky asset prices. Stock price indexes of 27 countries, commodity prices, and the VIX all jump instantaneously upon news releases. The responses of stock indexes co-move across countries and are large—often comparable in size to the response of the S&P 500. Further, these effects are persistent. US macroeconomic news explain up to 22% of the quarterly variation in foreign stock markets. The joint behavior of stock prices and long-term bond yields suggests that systematic monetary policy responses to news play a limited role for explaining the behavior of international stock markets. Instead, the evidence is consistent with a direct effect on investors' risk-taking capacity. Overall, our findings show that a byproduct of the United States' central position in the global financial system is that news about its business cycle have large effects on global financial conditions.

JEL Codes: E44, E52, F40, G12, G14, G15,

Keywords: Global Financial Cycle; Macroeconomic announcements; International spillovers; Stock returns; VIX; Commodity prices; High-frequency event study

*We thank Olivier Coibion, Andrei Levchenko, Nitya Pandalai-Nayar, and seminar participants at UT Austin for helpful comments. We thank Olivier Coibion, Stefano Eusepi, Nitya Pandalai-Nayar, Aysegul Sahin, and the UT Austin Department of Economics for financial support to purchase the proprietary data used in this paper. We also thank Gregory Weitzner for helping us with accessing parts of the data. A previous version of this paper was circulated under the title "What does high frequency identification tell us about the transmission and synchronization of business cycles?"
Email: `chris.e.boehm@gmail.com` and `tnkroner@utexas.edu`.

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 business cycle variation, in particular in recent decades (Coibion, 2012; Ramey, 2016). If this point applies in the international context as well, a sizable chunk of the variation in the GFC 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.

To do so, we study the relationship between the US economy and the GFC with a particular emphasis on drivers beyond monetary policy. Our focus on the US economy is motivated by its dominant position in the international monetary and financial system (e.g. Gourinchas, Rey, and Sauzet, 2019). This position makes it plausible *ex-ante* that shocks which affect US macroeconomic aggregates also drive international financial conditions. For instance, conventional accounts of the Great Recession highlight the US housing sector as the origin of a shock whose repercussions were felt worldwide.

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 and capital flows. At this point, it is well understood that identification strategies based on monthly or quarterly data, which do not take the simultaneity of financial variables into account, are unlikely to be successful at isolating the true underlying disturbances (Gertler and Karadi, 2015; Ludvigson, Ma, and Ng, 2015).[1] In this paper, we resolve this identification problem by implementing a high-frequency event study. In particular, we study the intraday effects of US macroeconomic news releases on risky asset prices such as international stocks, commodities, and the VIX.[2] This approach follows a large literature, which has established that scheduled macroeconomic announcements are a unique source of variation to study asset price movements (e.g., Faust et al., 2007). While this research design limits us to study asset prices as outcomes, the co-movement of risky asset prices is a defining feature of the GFC (Miranda-Agrippino and Rey, 2020). We therefore view our approach as natural step to better understand the drivers of the GFC 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. 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 strongly co-move 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 also document significant effects on the VIX, a close proxy for the GFC, and commodity prices, which are often interpreted as indicators of risk appetite (Etula, 2013; 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 constitute 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 at lower frequencies. For many economies, US news explain more than 15 percent of the quarterly variation in equity prices. 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 and 19 percent of the quarterly variation in the VIX and commodity prices, respectively. The

[1] 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.

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

concern that effects identified with high-frequency methods dissipate quickly does therefore not apply in our context.

The remainder of the paper interprets these findings and sheds light on the underlying mechanisms. We first provide a structural interpretation of the estimated coefficients. Clearly, surprises about US macroeconomic variables are not structural shocks. To clarify the relationship between the measured surprises, the observed asset price responses, and the true unobserved structural shocks we present a simple framework. The framework suggests that the estimated coefficients reflect the transmission of US-specific shocks to foreign stock markets, global common shocks to macroeconomic and financial variables, or both.

Second, we propose a test for the presence of global common shocks based on this framework. Intuitively, if global common shocks drove international business cycles and stock markets, news releases in other countries should be informative about the global state. Consequently, market participants should observe foreign macroeconomic news releases, and the US stock market should respond to these news. Our analysis shows that this is not the case. The S&P 500 does essentially not respond to foreign news releases. The evidence thus suggests a limited role of global common shocks and instead points to the transmission of US-specific shocks. This finding partially addresses Bernanke's (2017) observation that the GFC could be driven by global common shocks. If so, the global co-movement characterizing the GFC could have a more benign interpretation than suggested by authors who associate the GFC with financial stability concerns. While US news have strong effects on foreign stock markets, foreign news have essentially no effect on the US. This striking asymmetry highlights the unique position of the US economy in the global financial system.

Third, following Boyd, Hu, and Jagannathan (2005), we decompose the foreign stock price response into a component resulting from interest rate changes, and a component resulting from changes in expected future cash flows and the risk premium. While foreign 10-year bond yields do respond to US macroeconomic news, these responses can—in large part—*not* explain the observed changes in foreign stock prices. Instead, the evidence suggests that US news affect foreign stock prices predominantly through an effect on cash flows or the risk premium. This fact is consistent with a direct effect of US news on the risk-taking behavior of international investors, and suggests a limited role for US monetary policy. In particular, a systematic US monetary policy response to news—as implied by a Taylor-type reaction function—can, for the most part, *not* explain the observed stock price responses.

Fourth, we document that countries' exposure to international financial conditions correlates with their stock market responses to US macroeconomic news. In particular, we show that stock markets of more financially integrated countries respond systematically more strongly to US macroeconomic releases about the real economy. We interpret this evidence as consistent with prior work emphasizing the role of financial market frictions for explaining the GFC (Rey, 2016). Lastly, we show that the mechanism proposed by Bruno and Shin (2015b), which links global liquidity to US dollar exchange rate movements, cannot explain our findings.

Related literature Our paper relates to various topics in international finance and macroeconomics. First, our paper relates to work studying the GFC. Important antecedents of Rey's (2013) seminal work include Diaz-Alejandro (1983, 1984), Calvo, Leiderman, and Reinhart (1993, 1996), Reinhart and Reinhart (2008) and many others. These papers suggest a role for external and/or common drivers of countries' financial conditions. Following Rey (2013), several papers emphasize increased financial synchronization over recent decades, and discuss their implications (e.g., Bruno and Shin, 2015b; Obstfeld, 2015; Jordà et al., 2019).[3] Prior work has also shown that US monetary policy shocks affect global financial conditions. Bruno and Shin (2015a) provide evidence that US monetary policy affects the risk-taking behavior of international banks, Jordà et al. (2019) argue that US monetary policy drives global risk appetite and equity prices, and 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. 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 relates to work studying the central role of the US in the international monetary and financial system.[5] Gourinchas and Rey (2007) emphasize the role of the US as world banker (or venture capitalist), Maggiori, Neiman, and Schreger (2020) document a dollar bias of international investors, and Goldberg and Tille (2008), Gopinath (2015), and Gopinath et al. (2020) document and study the importance of the US dollar as the dominant currency of trade invoicing. Our results show that an additional byproduct of

[3] Cerutti, Claessens, and Rose (2019) argue that common factors explain a relatively small fraction of the variation in international capital flows. Monnet and Puy (2019) study a broad sample of countries since 1950 and find that co-movement has increased for asset prices, but not for credit. They also study the effects of U.S. monetary, fiscal, uncertainty, productivity shocks on the global financial cycle—with mixed results.

[4] This finding echoes conclusions by Bekaert, Hoerova, and Xu (2020), who argue that US monetary policy shocks have limited effects on financial risk factors of international markets.

[5] See Gourinchas, Rey, and Sauzet (2019) for a broad discussion.

the US' central position in the global financial system is that US macroeconomic news have large and persistent effects on global financial conditions while other countries' macro news have, if any, much smaller effects.

Lastly, our paper relates to prior work studying the high-frequency effects of US macroeconomic news releases on international financial markets.[6] Andersen et al. (2007) and Faust et al. (2007) analyze the effects of US news on 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 US economy and the global financial cycle. Third, building on Altavilla, Giannone, and Modugno (2017), we show that US macroeconomic news have persistent effects on international stock markets and explain a sizable fraction of their quarterly variation. Fourth, we present a framework to clarify the role of the underlying structural drivers of US news releases and document new properties of the transmission mechanism of US news to foreign markets.

Roadmap The remainder of the paper is structured as follows. Section 2 introduces the data. We analyze the high-frequency effects of US news on international asset markets in Section 3. In this section, we also present a framework which helps interpret the relationship between the measured surprises, the observed asset price responses, and the unobserved structural shocks. In Section 4, we demonstrate that the effects of US news on international asset prices are persistent and explain a sizable fraction of their quarterly variation. We discuss multiple aspects of the underlying mechanism in Section 5. Section 6 concludes.

[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; 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; Law, Song, and Yaron, 2018; Gürkaynak, Kısacıkoğlu, and Wright, 2018). See Gürkaynak and Wright (2013) for a survey on high-frequency event studies in macroeconomics.

2 Data

2.1 US Macroeconomic News

The data on macroeconomic news releases 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 of the 12 important macroeconomic news series we focus on in Sections 3 and 5. This selection is inspired by previous studies in the literature (e.g., Faust et al., 2007; Rigobon and Sack, 2008; Gürkaynak, Kısacıkoğlu, and Wright, 2018). We treat different releases for the same macroeconomic variable—for instance, the advanced, second, and third release of GDP—as separate news series. For the interpretation of our results it is often instructive to group these 12 series into those providing information on US real economic activity and those providing information on prices (Beechey and Wright, 2009).

Table 1: Overview of Major 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 predominantly informative about real activity or prices. 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.

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

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

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 ease of interpretation, we flip the sign of Initial Jobless Claims surprises such that a 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 display somewhat higher volatility during recessions. In contrast, other series such as Core PPI and New Home Sales, 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 come from the *Thomson Reuters Tick History* dataset and are obtained via *Refinitiv*. We use intraday data for most analyses. As shown by prior work—mostly in a domestic context—moving from daily to intraday data leads to lower risk of confounding by other news releases, and to increased precision by mitigating noise. Using intraday data is likely even more important when studying the effects on international markets. A country's stock market is driven by domestic *and* foreign news, making US news releases just one among many sources of information throughout the trading day.

Our primary outcomes of interest are minute-by-minute series of 27 countries' major stock indexes. Table 2 provides an overview of these. The table also shows the sample periods over which these indexes are available to us. For Canada and Italy, the stock indexes change their ticker symbols during the sample period. In both cases, we merge the series with its predecessors in a consistent fashion (see notes of Table 2 for details). 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).

[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.

Table 2: Overview of Intraday Financial Data

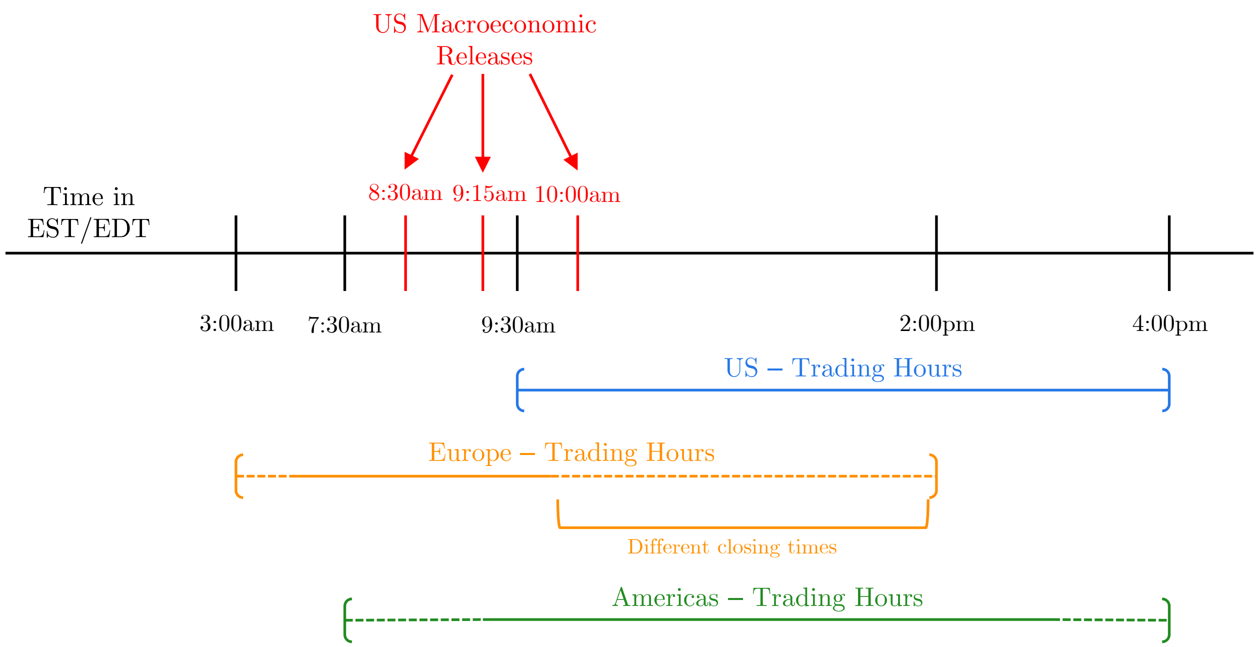
Name	Ticker	Sample	Country	ISO
International Stock Indexes				
MERVAL	.MERV	1996–2019	Argentina	ARG
ATX	.ATX	1996–2019	Austria	AUT
BEL 20	.BFX	1996–2019	Belgium	BEL
Bovespa	.BVSP	1996–2019	Brazil	BRA
S&P/TSX	.GSPTSE*	2000–2019	Canada	CAN
SMI	.SSMI	1996–2019	Switzerland	CHE
IPSA	.IPSA	1996–2019	Chile	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: All data are 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 data from predecessor indexes, i.e. the TSE 300 index (.TSE300) for Canada, and the MIB-30 (.MIB30) and the S&P/MIB (.SPMIB) for Italy. *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 use data on 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 to the relevant sections below.

Our intraday analysis of international equity markets requires that the time window around a particular news release lies within the trading hours of the respective foreign stock market. The country composition of our sample reflects this constraint. For instance, Asian and Australian equity markets are closed during almost all release times and are thus not included in our sample. When comparing US and foreign stock price responses, we rely on E-mini S&P 500 Futures data, which are traded outside of regular hours. Hence, we do not need to limit our analysis to announcements for which US markets are open. Figure 1 visualizes the timing of news releases and trading hours for the stock markets in our sample. Further, Appendix Table A3 summarizes which countries' equity markets 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 implement a high-frequency event study and estimate the effect of US macroeconomic releases on risky asset prices. Due to their importance for the GFC, we are interested in the effects on international stock indexes, the VIX, and commodity prices. We document two key findings. First, we show that international asset prices strongly respond to US news. Second, US news releases induce co-movement of international equity markets.

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-minute 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 effects of unmeasured news and/or noise. 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 Nonfarm Payrolls could therefore 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 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 stock prices. As we will discuss in Section 5 below, this effect is consistent with increased risk-taking of international investors and/or higher expected future dividends after such

[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, except those which are always part of the same release and by construction highly correlated with the release series of interest. Including such announcements as controls would make our coefficients difficult to interpret due to collinearity problems. For Capacity Utilization, we exclude Industrial Production. For Core CPI and Core PPI, we exclude CPI and PPI, respectively. For Durable Goods Orders, we exclude Durable Goods Orders Excluding Transportation (Durable Ex Transportation). For Nonfarm Payrolls, we exclude Private and Manufacturing Nonfarm Payrolls (Private and Mfg Payrolls). For Retail Sales, we exclude Retail Sales Excluding Autos (Retail Sales Ex Auto).

surprises. In contrast, inflation surprises—as captured by positive surprises in the Core CPI and Core PPI—lead to a decrease in stock prices. We show in Section 5 that this result is at least in part driven by higher interest rates.

Table 3: Effect of US News on International Stock Markets

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	4.98**	12.61***	-9.06***	-4.58***	5.63***	17.81***
	(2.30)	(2.07)	(1.86)	(1.37)	(1.61)	(3.43)
R^2	0.06	0.13	0.11	0.15	0.10	0.26
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	4.86***	11.36***	4.23***	17.24***	10.14***	5.71***
	(0.74)	(2.28)	(1.47)	(3.02)	(2.28)	(1.57)
R^2	0.09	0.12	0.03	0.13	0.15	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 * indicate 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 B1 shows, international equity prices do not drift prior to the news releases we study, in line with earlier work studying pre-announcement drifts of US macroeconomic news.

3.1.2 Cross-country Heterogeneity

The estimates in Table 3 are informative about the *average* effect on international stock markets. They mask, however, 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

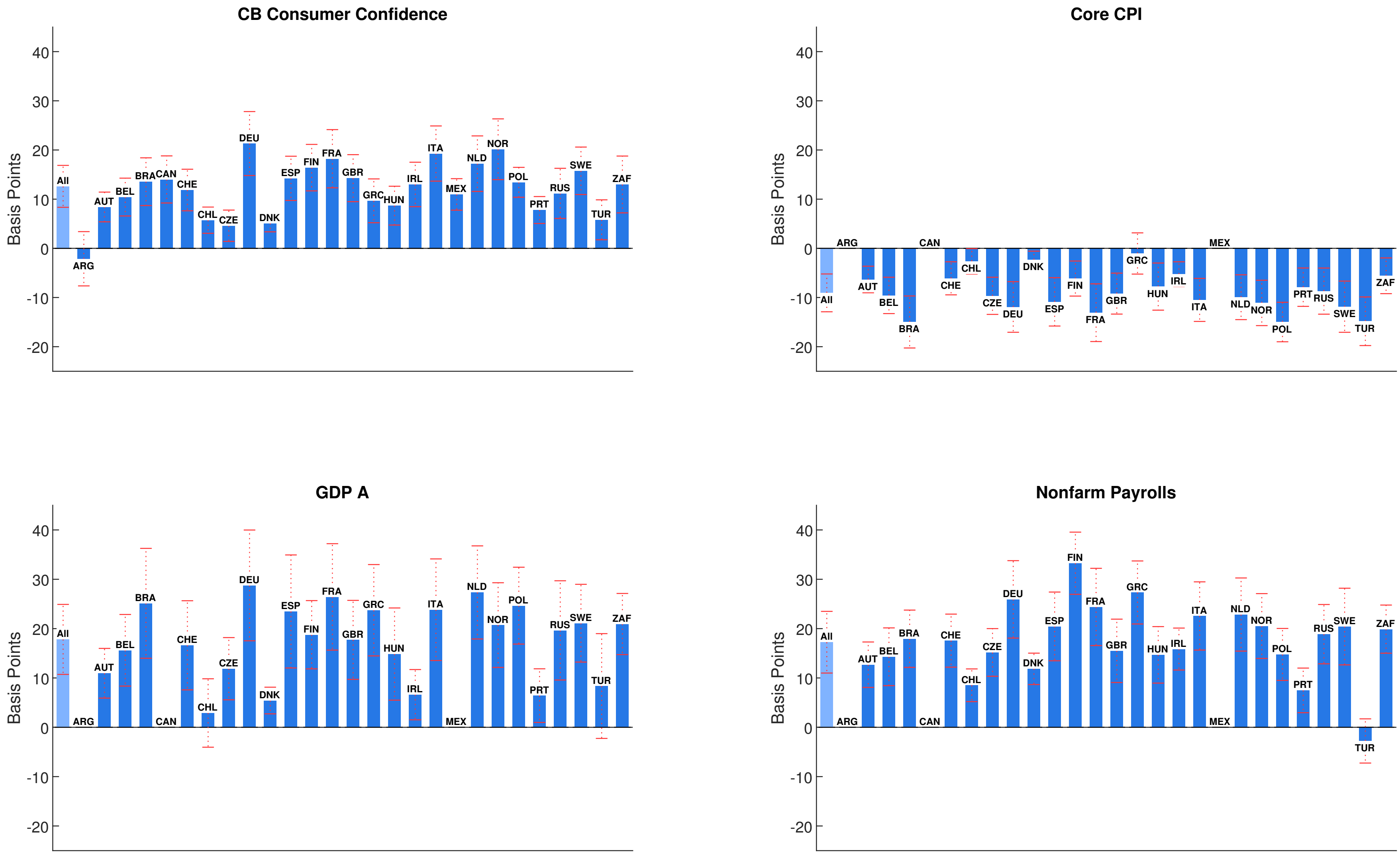
$$\Delta q_{i,t} = \alpha_i + \gamma_i^y s_{US,t}^y + \sum_{k \neq y} \gamma_i^k s_{US,t}^k + \varepsilon_{i,t}, \tag{3}$$

where $\Delta q_{i,t} = q_{i,t+20} - q_{i,t-10}$. Different from equation (2), the coefficients γ_i^y and γ_i^k 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, US macroeconomic news 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 (Miranda-Agrippino and Rey, 2020).

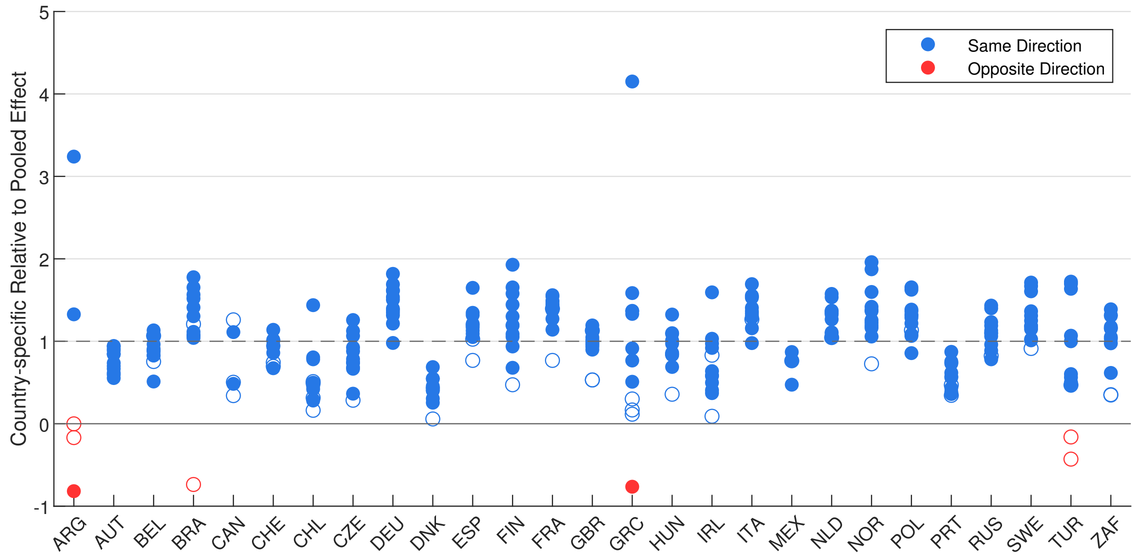
Figure 3 summarizes this finding for all 12 announcements by plotting the country-specific effect relative to the pooled effect. Circles above zero indicate cases in which the country-specific effect has the same sign as the pooled effect ($\hat{\gamma}^y$, estimated from equation (2)). The fact that almost all circles are positive confirms the results of Figure 2. Figure 3 also illustrates systematic heterogeneity in responsiveness across countries. While the Netherlands, for example, responds more strongly than the average for all 12 announcements, countries such as Austria, Denmark, and Portugal always responds less than the average. We return to this point in Section 5 where we show that countries' responsiveness co-varies with a measure of financial openness.

Figure 2: Effect of US News on International Stock Markets by Country



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. Analogous bar charts for all news releases are shown in Appendix Figure B2.

Figure 3: Country's Stock Market Response Relative to Pooled Response



Notes: The figure plots the country-specific stock index responses relative to the pooled response for all 12 announcements, or formally, $\hat{\gamma}_i^y/\hat{\gamma}^y$, where the estimates are obtained from estimating equations (2) and (3). Blue (red) circles indicate that the country's response has the same (opposite) sign as the pooled effect. Filled circles indicate significance at the 5 percent level while an empty circle indicates an insignificant effect. For a given announcement, country-specific estimates obtained from fewer 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

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

where $\Delta q_{US,t}$ is the 30-minute log-change in E-mini S&P 500 futures, and $\Delta q_{i,t}$ is the 30-minute log-change of country i's stock market index as above. 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) indicates 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, we find evidence that the US stock market responds differently from foreign stock markets for only 3 out of 12 announcements. In absolute terms, the US response is greater 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 can neither reject the null hypothesis of equally-sized responses, nor do the insignificant point estimates suggest a greater response of the S&P 500. For news about real activity, the insignificant point estimates are often negative, if at all hinting at greater responses of foreign equity markets. In sum, foreign stock price responses to US news are often comparable in magnitude to the response of US stock prices.

Table 4: Effect on US Stock Market Relative to International Markets

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index Diff. (bp)						
News	-0.47	3.44**	-4.78***	-0.89	-0.97	-1.05
	(1.13)	(1.37)	(1.23)	(0.84)	(0.87)	(2.02)
R^2	0.01	0.04	0.05	0.02	0.03	0.05
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	0.64	3.93**	-0.82	3.00	-1.60	-1.73
	(0.45)	(1.89)	(0.95)	(2.28)	(1.05)	(1.17)
R^2	0.01	0.06	0.01	0.03	0.03	0.01
Observations	23529	5277	5728	5446	5479	4924

Notes: This table presents estimates of $\widetilde{\gamma}^y$ as defined in 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 * indicate significance at the 1, 5, and 10 percent level.

3.2 Other Risky Asset Prices

The VIX 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's important role for international financial markets. Rey (2013) shows that the VIX is a close proxy of the GFC, Forbes and Warnock (2012) emphasize the correlation of the VIX with international capital flows, and Bruno and Shin (2015a) link it to global banks' leverage.

Analogous to specification (2), we estimate the effect of US news on the 30-minute log-change in the VIX. 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. 9 out of 12 announcements show a strong and significant effect on the VIX. Positive news about real economic activity lead to a reduction in the VIX, consistent with the view that they increase investors' risk-taking capacity, and confirming that US macroeconomic news drive the GFC. A comparison to the estimates to those in Table 3 makes clear that after most announcements stock prices co-move negatively with the VIX. As we will discuss in Section 5 below, this negative co-movement suggests that changes in the equity risk premium drive part of the stock price response.

Commodity Prices To ensure that our results hold for a large set of risky asset prices, we next turn to the effect of US news on commodity 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 B1 provides additional information on the three indexes.

As documented by prior research, commodity prices co-move over time, and can be summarized by common factors (Pindyck and Rotemberg, 1990; Byrne, Fazio, and Fiess, 2013; Alquist, Bhattarai, and Coibion, 2019). Bastourre et al. (2012) find that such a commodity factor is also informative about global risk taking capacity. We follow this literature and use principal component analysis on the 30-minute log-changes in the commodity indexes around the 12 macroeconomic announcements of interest. Table B2 summarizes the results. The first common factor explains around 55 percent of the variation, and 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 percent of the variation, loads positively on agricultural commodities, and negatively on energy commodities and industrial

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

[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.

Table 5: Effect of US News on VIX and Commodity Prices

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
VIX (bp)						
News	-13.75	-64.43***	43.27***	-7.97	-4.42	-51.40***
	(12.75)	(12.79)	(15.92)	(8.63)	(5.61)	(18.27)
R^2	0.05	0.14	0.24	0.43	0.27	0.37
Observations	102	265	99	102	102	34
Commodity Factor (bp)						
News	0.65	18.24***	-3.16	-1.34	6.78*	24.12**
	(4.00)	(5.12)	(3.97)	(3.29)	(3.63)	(11.19)
R^2	0.11	0.15	0.15	0.13	0.18	0.31
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	-15.40**	-60.07***	-25.08*	-114.08***	-92.44***	-41.66***
	(6.57)	(18.01)	(14.29)	(28.69)	(25.11)	(15.20)
R^2	0.14	0.12	0.05	0.31	0.33	0.05
Observations	438	264	258	101	100	224
Commodity Factor (bp)						
News	7.44***	15.96***	12.36**	40.00***	17.52***	-0.25
	(1.76)	(4.48)	(5.09)	(8.81)	(3.93)	(4.23)
R^2	0.11	0.23	0.12	0.26	0.25	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, $s^k_{US,t}$ are other surprises released in the same time window, and $\Delta q_t = q_{t+20} - q_{t-10}$ is the 30-minute log-change in the current-month VIX futures contract, or the commodity factor estimated from 30-minute changes in the energy, industrial metals, and agriculture commodities. See text and Appendix Table B2 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 late announcement time. Standard errors are clustered by announcement, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

metals. This factor primarily explains variation of the agricultural index and is relatively unimportant for energy and industrial metals.

We proceed with studying the effects of US news on the first common factor within a 30-minute window of the release. Table 5 shows the results. For the majority of news releases, we find a significant effect on the factor. Further, the signs are as expected. Positive (negative) news about real activity lead to an increase (decrease) in commodity prices.[12]

[12] Our results are in line with Kurov and Stan (2018), but differ somewhat from Kilian and Vega (2011). The

3.3 A Note on the Structural Interpretation of News Releases

While surprises about macroeconomic variables are useful to study causal effects on asset prices, they are not structural shocks. Our research design therefore differs from common macroeconometric approaches, which attempt to directly identify structural disturbances. We next present a simple framework with the primary objective of clarifying the relationship between the measured surprises, the observed asset price responses, and the true underlying structural shocks. The framework also helps understand the broader implications of our estimates for the dependence of foreign asset prices on the US business cycle.

The framework makes clear that the underlying structural shocks, which drive the measured surprises, need not originate in—or be specific to—the US. It is possible that these shocks are at least in part global in nature and affect all countries simultaneously. Together with the evidence above, the framework further implies that foreign asset prices depend *with nonzero coefficients* on (expectations of) US and/or global state variables. Unmeasured news about the US economy should therefore affect foreign asset prices in a similar fashion as our measured surprises. This implies, for instance, that we will systematically underestimate the explanatory power of US macroeconomic conditions for foreign asset prices in Section 4.

Framework Above we estimated the relationship

$$\Delta q_{i,t} = \gamma_i^y s_{US,t}^y + \varepsilon_{i,t}, \tag{5}$$

where we omit the constant and controls for simplicity. Recall that $q_{i,t}$ denotes the asset price of interest in country i, y is a particular US macroeconomic variable for which market participants observe the surprise, t is the announcement time, and Δ refers to a change in a 30-minute window around the announcement. We next discuss the structural interpretation of the effect of news releases on asset prices as captured by the coefficient γ_i^y. We relegate all technical details to Appendix C, where we derive the above relationship. Our main assumptions are that the multi-country economy is log-linear and has a unique equilibrium. For this derivation, we make minimal assumptions about economic behavior.

We demonstrate in the appendix that the coefficient γ_i^y in the estimation equation (5)

former paper finds significant effects of macroeconomic news on energy prices using intraday data similar to us, whereas the latter, employing daily data, does not find significant effects.

can be decomposed as follows,

$$\gamma_i^y = \underbrace{a_{i,US}^q b_{US}^y}_{\text{(a)}} + \underbrace{a_{i,i}^q b_i^y}_{\text{(b)}} + \underbrace{\sum_{k \neq US,i} a_{i,k}^q b_k^y}_{\text{(c)}} + \underbrace{a_{i,glob}^q b_{glob}^y}_{\text{(d)}}. \tag{6}$$

In this expression, the coefficients $a_{i,j}^q$ capture the dependence of country i's asset price $q_{i,\tau}$ on a vector $x_{j,\tau}$ of state variables (τ is a generic time subscript). 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 ($x_{US,\tau}$), and $a_{i,glob}^q$ captures its dependence on global state variables ($x_{glob,\tau}$).

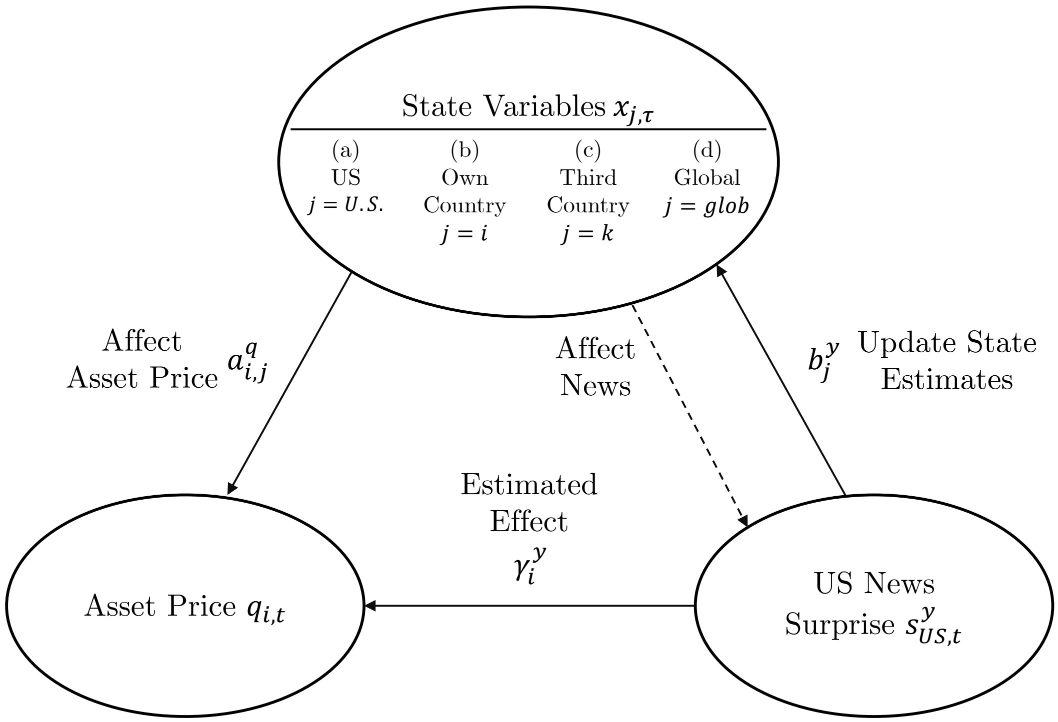
Shocks to these state variables drive the business cycle, asset prices, and also the variation in US macroeconomic news. Upon observing these news, market participants attempt to infer which state variables have changed. They could, for instance, use the Kalman filter to estimate the state, but we do not impose this assumption. We only assume that, for a given j, vector b_j^y captures how market participants update their expectations about state vector $x_{j,\tau}$ after observing news about the macroeconomic variable y. As equation (6) illustrates, both updates of the estimated state vectors (b_j^y) and the state vectors' effects on the asset price ($a_{i,j}^q$) determine the value of γ_i^y.

Equation (6) 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 $x_{glob,\tau}$). Figure 4 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 (6) and Figure 4 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 b_{US}^y. 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 4: Structural Interpretation of Country's i Asset Price Response to US News



Notes: This Figure illustrates the discussion in the text. Solid arrows display relevant relationships at the time of the news release, as captured by equation (6). The dashed error indicates that the relationship is 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.

Implications 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, $b_j^y = 0$ 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 (5) becomes

$$\Delta q_{i,t} = \left(\underbrace{a^q_{i,US} b^y_{US}}_{\text{transmission from US}} + \underbrace{a^q_{i,glob} b^y_{glob}}_{\text{common shock}} \right) s^y_{US,t} + \varepsilon_{i,t}, \tag{7}$$

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*.

Equation (7) helps interpret our estimates above. First, 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.

Prior work has acknowledged that global common shocks could drive business cycle comovement (e.g., Canova and Marrinan, 1998; Canova, 2005). Further, Bernanke (2017, p.23) notes that common shocks could drive the GFC. Based on this framework, we propose a test for the presence of common shocks in Section 5. This test suggests that global common shocks are unimportant in our context, and that the estimated effects capture the transmission of shocks from the US.

Second, our estimates of $\gamma^y_i \neq 0$ imply that $a^q_{i,US} \neq 0$ and/or $a^q_{i,glob} \neq 0$. In words, foreign asset prices depend on (expectations of) US-specific and/or global state variables *with nonzero coefficients*. This fact implies that other news, which are not included in our measured surprises, but are informative about US and global state variables, also affect foreign asset prices. In this sense our estimates are informative about the structural linkages between the US and foreign economies. One implication of this finding is that we will underestimate the explanatory power of US macroeconomic conditions for foreign asset prices in the next section. Since we estimate the explanatory power based on measured headline news only, our approach will not capture the explanatory power of unmeasured news about the macroeconomic series we consider.[13]

[13] Gürkaynak, Kısacıkoğlu, and Wright (2018) highlight the importance of non-headline news, which are released jointly with the measured surprise. Our framework implies that news about the macroeconomic series we consider, which are unobservable to the econometrician, and can be released at any time, should affect foreign asset prices in

4 Explanatory Power of US Macro News at Lower Frequencies

In this section we demonstrate that the effects of US 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.[14]

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

$$\Delta q_{i,d} = \alpha_i + \sum_k \beta_i^k s_{US,d}^k + \varepsilon_{i,d}. \tag{8}$$

Here, d indexes time in days and $\Delta q_{i,d}$ is the daily return of the stock index price q of country i as measured by the log-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. 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 (8) are identical for all countries.[15] 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 (8), 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

$$\Delta_h q_{i,d} = \alpha_{i,h} + \beta_i^{q,h} nix_{i,d,h}^q + \varepsilon_{i,d,h}. \tag{9}$$

The statistic of primary interest is the R-squared of regression (9). 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

the same way as our measured surprises. See Appendix C for details.

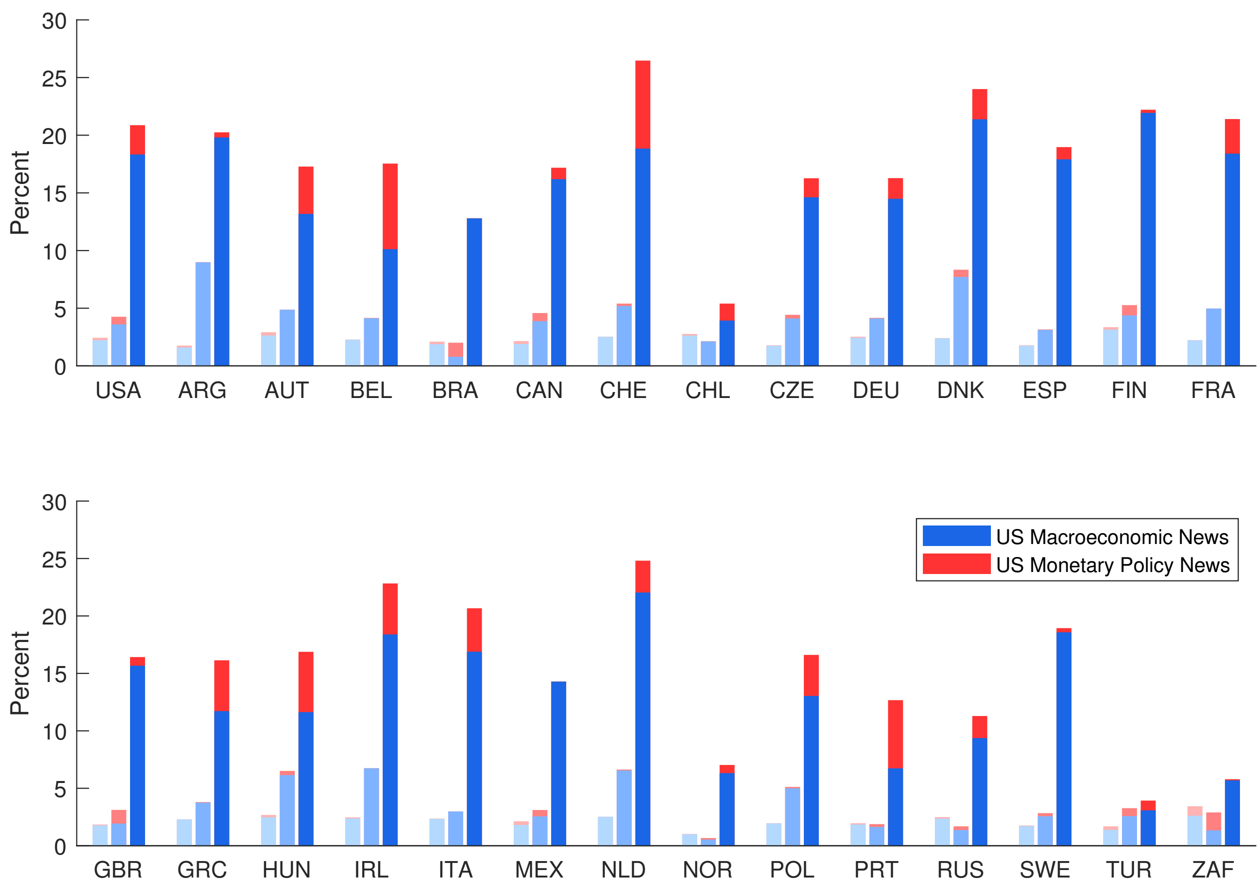
[14]Without identifying the source of the origin of the shock, Acalin and Rebucci (2020) document that global financial shocks have sizable explanatory power for equity returns.

[15]Relative to Altavilla, Giannone, and Modugno (2017), our set of announcements includes more macroeconomic news releases. However, we exclude news about monetary policy.

delayed (mean-reverting) effect. As in Altavilla, Giannone, and Modugno (2017), we consider aggregation to the monthly and quarterly frequency.

Figure 5 shows the daily, monthly, and quarterly R-squared for the stock indexes by country. For comparison, we also separately estimate specifications (8) and (9) over the same sample using US monetary policy news instead of macroeconomic news. Our construction of monetary shocks follows Nakamura and Steinsson (2018).[16] Figure 5 displays the R-squared of US macroeconomic news (in blue) and of US monetary shocks (in red).

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



Notes: For each country's stock index, this figure plots the R-squared of equation (8) for the daily frequency, and the R-squared of equation (9) 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 country and frequency, the blue bar represents the R-squared of US macroeconomic news and the red bar the R-squared of US monetary policy shocks. The sample runs from January 1, 2000 to June 28, 2019.

As Figure 5 shows, the explanatory power of US news for foreign stock indexes increases

[16] 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 percent.

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-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 (e.g., Coibion, 2012). Ramey (2016) shows that monetary policy shocks explain less than 3 percent of the forecast error variance in industrial production at the 2-year horizon for samples ending in 2007.

The increased R-squared at lower frequencies imply that the effects of US macroeconomic news are more persistent than the effects of residual factors. Appendix Table B3 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 of US macro news for international stock markets at lower frequencies is striking. Reassuringly, our estimates for the US market are in line with those by Altavilla, Giannone, and Modugno (2017).[17] We also repeat this exercise for US dollar-denominated foreign exchange rates. The results, shown in Appendix Figure B3, make clear that the methodology does not mechanically lead to an increase in the R-squared at lower frequencies. The explanatory power for exchange rates is typically very small.[18]

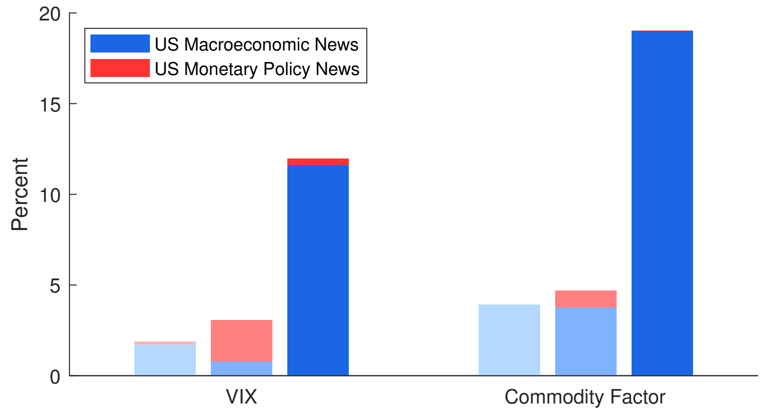
Lastly, we repeat the analysis for the VIX and the commodity factor (constructed as in Section 3). To do so, we simply replace $q_{i,d}$ in equations (8) and (9) with the VIX and the commodity factor. Figure 6 shows the resulting daily, monthly, and quarterly R-squared. Similar to the stock indexes, the explanatory power increases at lower frequencies.

[17] Our R-squared is slightly higher since we use a greater set of macroeconomic news announcements than Altavilla, Giannone, and Modugno (2017).

[18] Also note that we have sufficiently many observations for all news releases that overfitting concerns should not apply when estimating equation (8). Observation counts for all announcements are shown in Appendix Table A1.

At the quarterly frequency, US macroeconomic news explain approximately 12 percent of the variation in the VIX and 19 percent of commodity prices—substantially more than US monetary policy shocks.

Figure 6: Daily, Monthly, and Quarterly R-Squared for VIX and Commodity Prices



Notes: This figure plots the R-squared of equation (8) for the daily frequency, and the R-squared of equation (9) for the monthly and quarterly frequency, where we now use log-returns of the VIX or the commodity factor instead of country's i stock index. The left, middle, and right bar indicate the R-squared of the daily, monthly, and quarterly regression, respectively. For a given country and frequency, the blue bar represents the R-squared of US macroeconomic news and the red bar for US monetary policy shocks. The sample runs from January 1, 2000 to June 28, 2019 for the VIX, and from May 7, 2007 to June 28, 2019 for the commodity factor.

5 Inspecting the Mechanism

This section provides additional evidence and discussion to interpret the observed foreign stock price responses to US macro news.

First, as we discuss in Section 3.3, shocks to global common state variables could principally drive the observed responses of foreign equity markets. If this was the case, US macro news releases would not impact foreign markets by transmitting US-specific shocks, but by revealing information about the global common state. We begin this section with providing evidence for a limited role for common shocks.

Second, we decompose the pooled stock price response into an interest rate and a combined cash flow and risk premium component. Using data on foreign 10-year government bond yields, we show that changes in cash flows and/or risk premia drive international stock price responses while changes in interest rates are relatively unimportant. These findings are consistent with a direct effect of US news on the risk-taking behavior of international investors and suggest that systematic US monetary policy responses to news releases do not play an important role.

Third, using the cross-sectional dimension of our data, we explore the heterogeneity of responses documented in Section 3.1. As Figure 3 illustrated, some countries, including Germany, France, Italy, and the Netherlands respond systematically stronger to US macroeconomic news than countries such as Austria, Denmark or Portugal. It is therefore natural to ask whether countries' responsiveness to news is correlated with observables. We demonstrate that countries with greater financial openness tend to respond more strongly—which we interpret as consistent with theoretical explanations of the GFC as discussed in (as discussed in Rey, 2016). We lastly explore the role of exchange rates.

5.1 Common Shocks versus Transmission

As noted in Section 3.3, the estimated effects of US news on foreign asset prices reflect two components. First, they reflect an updating component. Upon observing US news, market participants update their expectations of the unobserved state vector. Second, they reflect the structural dependence of asset prices on these state variables. Asset prices respond to news because market participants change their estimate of states variables, which drive these asset prices (see Appendix C for details).

This structural interpretation helps devise a test for whether common shocks drive our estimated foreign stock prices responses to US news. If these responses were to an important degree driven by common shocks, market participants should study *other* countries' news releases to learn about the global state vector. Since these shocks affect all countries, macroeconomic news releases outside the US should generally be informative about the common global state. Further, this information should be valuable since changes in global state variables cause changes in asset prices of all countries.

To test for the presence of common shocks, we study the effect of foreign news releases on the US stock market. In particular, we regress the log-change in the S&P 500 on foreign macroeconomic surprises. Analogous to Section 3.3, it is possible to obtain a structural interpretation of the estimated coefficient. Denoting the coefficient on country i's macroeconomic surprise by ζ_i^y, we can write

$$\zeta_i^y = a^q_{US,US} b^y_{US,i} + a^q_{US,i} b^y_{i,i} + \sum_{k \neq US,i} a^q_{US,k} b^y_{k,i} + a^q_{US,glob} b^y_{glob,i}, \tag{10}$$

where the vectors $b^y_{j,i}$ ($b^y_{glob,i}$) are now specific to country i, and capture how market participants update their estimate of country j's state $x_{j,t}$ (the global state $x_{glob,t}$) upon observing these news. Further, vectors $a^q_{US,k}$ ($a^q_{US,glob}$) capture how country k's (the global) state affects the US stock market.

Studying the effects of foreign news on the US stock market—rather than on a third country—has a key advantage. Since most countries are small relative to the US, the interpretation of coefficient (10) simplifies considerably. In particular, under the assumptions that (i) country i is small relative to the US so that $a^q_{US,i} = 0$, and (ii) country i's news do not affect the US stock market through third countries ($a^q_{US,k} b^y_{k,i} = 0$ for all k),[19] the estimated coefficient simplifies to

$$\zeta^y_i = \underbrace{a^q_{US,US} b^y_{US,i}}_{\text{(a)}} + \underbrace{a^q_{US,glob} b^y_{glob,i}}_{\text{(b)}}. \tag{11}$$

These remaining two terms reflect the following intuition. First, term (a) reflects the possibility that market participants learn about the US state vector by observing foreign macroeconomic news. Since the US is large relative to country i, shocks in the US are likely to have an effect on country i's macroeconomic outcomes. As a result, country i's surprises could be informative about US-specific shocks. While this possibility cannot be ruled out *a priori*, we don't view it as particularly plausible either. Since US shocks presumably affect foreign macroeconomic outcomes with a lag and many indicators of US macroeconomic performance become available in a timely fashion, it is rather unlikely that this indirect channel of learning about the US state is active in practice.

Second, term (b) reflects the presence of common shocks. As noted earlier, if countries' macroeconomic and financial variables were driven by common global state variables, other countries' macroeconomic releases should generally be informative about it. Further, this state should drive international asset prices, including the S&P 500.

The above reasoning makes the implicit assumption that the measurement quality of macroeconomic series in other countries is high. If this was not the case, measured foreign aggregates would be of questionable use to learn about *any* state variable. We therefore consider major macroeconomic news releases in the non-US G7 countries (i.e. Canada, France, Germany, Italy, Japan, and the United Kingdom). Since we also required the assumption that country i is small relative to the US to arrive at equation (11), we study these countries with the understanding that the smaller three (Canada, Italy, and France) offer a sharper test. We estimate specifications analogous to equation (2), now with the 30-minute log-

[19] The second assumption is satisfied if third countries are small relative to the US so that $a^q_{US,k} = 0$ or if market participants do not update their estimate of country k's state vector upon observing country i's macroeconomic news ($b^y_{k,i} = 0$).

change in the S&P 500 on the left-hand side (as measured by the E-mini S&P 500 futures) and the foreign macroeconomic surprise on the right-hand side. We control for other surprises released within the same time window, including releases of US news. As before, the surprises are standardized, so that the coefficients measure the effect size of a one standard deviation surprise. Appendix Table A4 provides details on the foreign news releases we consider.

The results in Table 6 reveal a striking asymmetry. Foreign news releases have essentially no effect on the US stock market. For France and Italy, *no* news release has a statistically significant effect on the S&P 500. For Canada, only the Core CPI release has a significant effect, and the sign is flipped relative to the effect of the US Core CPI release on foreign markets (see Table 3 and Figure 2). For the larger non-US G7 countries, it is possible to detect significant effects on the US stock market. For both Germany and Japan, one news release has a significant effect on the S&P 500, and for the United Kingdom, two releases have significant effects. However, the magnitudes are approximately an order of magnitude smaller than the effect size of US news on these two markets (see Figure 2). Further, it is likely that these effects reflect the transmission of shocks since we observe significant coefficients with expected signs only for the largest three non-US G7 countries. Taken together, these results suggest a very limited role of global common shocks.[20] They further highlight the unique position of the US economy in the global financial system.

Lastly, note that our findings above do *not generally* rule out the presence of common shocks as drivers of international financial and/or macroeconomic variables. Our findings only suggest that the effects of US news on foreign markets predominantly reflect US-specific shocks, rather than shocks common to all countries.

[20]More precisely, we interpret these estimates as indicating that it is neither the case that common shocks drive our estimates in Section 3, nor that market participants use foreign macroeconomic news to update their estimates of the US state. Put differently, terms (a) and (b) are both zero in equation (11). In principle, it is also possible that these effects somehow offset one another, but we do not view such an interpretation as particularly plausible.

Table 6: Effect of Foreign News on US Stock Market

S&P 500 (bp)	Consumer Confidence	CPI	GDP	Industrial Production	PPI	Retail Sales	Unemployment Rate
Canada							
News		1.84**	-1.17		1.24	0.34	-0.99
		(0.89)	(1.12)		(1.14)	(0.97)	(1.01)
Observations		192	79		246	255	257
France							
News	-0.03	1.62	0.20	-0.87	2.99		0.52
	(0.73)	(1.09)	(1.03)	(1.16)	(3.70)		(0.82)
Observations	222	225	83	239	155		147
Germany							
News	0.93	-0.28	3.54**	2.10	1.27	0.58	-0.12
	(0.73)	(0.38)	(1.52)	(1.33)	(0.92)	(0.78)	(0.68)
Observations	152	196	75	249	229	222	254
Italy							
News	-0.42	-0.25	0.99	0.73	-0.28	0.79	-0.51
	(1.07)	(0.65)	(1.20)	(0.90)	(1.52)	(0.83)	(0.94)
Observations	210	234	66	229	175	169	134
Japan							
News	-0.27	-0.23	2.45*	0.20	-1.18	0.02	0.17
	(0.51)	(0.39)	(1.37)	(0.45)	(0.84)	(0.68)	(0.46)
Observations	143	196	69	222	184	187	216
United Kingdom							
News	-0.01	1.10	5.10***	-0.33	-0.46	1.94**	-1.19
	(0.55)	(0.97)	(1.80)	(0.97)	(0.96)	(0.78)	(0.93)
Observations	197	164	79	249	153	110	203

Notes: The table presents the response of the S&P 500 to foreign macroeconomic news releases. For each non-US G7 country, this table shows estimates of ζ^y obtained from specification

$$\Delta q_{US,t} = \alpha_i + \zeta_i^y s_{i,t}^y + \sum_{k \neq y} \zeta_i^k s_{i,t}^k + \sum_w \zeta_{US}^w s_{US,t}^w + \varepsilon_{i,t},$$

where $s_{i,t}^y$ is the surprise of interest, $s_{i,t}^k$ and $s_{US,t}^w$ are other surprises of country i and the US released in the same time window, and $\Delta q_{US,t}$ is the 30-minute log-change of the E-mini S&P 500 futures contract. Appendix Table A4 provides details on the foreign news releases. Note that the observations reported in Appendix Table A4 can differ from those reported above, because the E-mini S&P 500 futures data is not always available. The units are expressed in basis points. Standard errors are clustered by announcement, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

5.2 The Interest Rate, Risk Premium, and Cash Flow Channels

Decomposition Prior work has shown that stock price changes can be decomposed into three components: an interest rate, a risk premium, and a cash flow component.[21] Following Boyd, Hu, and Jagannathan (2005), we write

$$\Delta q_{i,t} \approx c_i \left[\left(\underbrace{\Delta g_{i,t}}_{\text{cash flow}} - \underbrace{\Delta ep_{i,t}}_{\text{risk premium}} \right) - \underbrace{\Delta r_{i,t}}_{\text{interest rate}} \right], \tag{12}$$

where $\Delta q_{i,t}$ is the observed change in the stock index, $\Delta g_{i,t}$ is the change in the weighted average of expected future growth rates of cash flows, $\Delta ep_{i,t}$ is the change of the equity risk premium, $\Delta r_{i,t}$ is the change in the interest rate on long-term risk-free claims, and c_i is a positive constant (the price-dividend ratio). As will become clear momentarily, it is convenient to group $\Delta g_{i,t}$ and $\Delta ep_{i,t}$ together; we will call $\Delta g_{i,t} - \Delta ep_{i,t}$ the *combined cash flow and risk premium channel*.

We next express all variables in equation (12) as functions of the surprise, so that

$$\Delta q_{i,t} = \alpha_i^q + \gamma^{y,q} s_{US,t}^y + \varepsilon_{i,t}^q, \tag{13}$$

$$(\Delta g_{i,t} - \Delta ep_{i,t}) = \alpha_i^c + \gamma^{y,c} s_{US,t}^y + \varepsilon_{i,t}^c, \tag{14}$$

$$\Delta r_{i,t} = \alpha_i^r + \gamma^{y,r} s_{US,t}^y + \varepsilon_{i,t}^r, \tag{15}$$

where we omit controls for clarity. Equation (13) is a restatement of estimating equation (2) from Section 3. Equations (14) and (15) provide a breakdown into the combined cash flow and risk premium channel and the interest rate channel, respectively. The coefficients $\gamma^{y,q}$, $\gamma^{y,r}$, and $\gamma^{y,c}$ capture the effects of surprises about macroeconomic variable y. It is clear from equation (12) that $\gamma^{y,q} = c_i \left(\gamma^{y,c} - \gamma^{y,r}\right)$.

We next estimate the effect of US macro news on foreign interest rates ($\gamma^{y,r}$). While this coefficient is of interest on its own, we will also combine it with the overall effect ($\gamma^{y,q}$) and the fact that $c_i > 0$ to infer the effect of US news on the combined cash flow and risk premium channel ($\gamma^{y,c}$). This indirect approach is needed because the combined cash flow and risk premium channel is not observed. A negative correlation of stock return and bond yield (e.g. $\gamma^{y,q} > 0$ and $\gamma^{y,r} < 0$) would imply that the interest rate channel dominates the combined cash flow and risk premium channel (if $\gamma^{y,c} < 0$) or that the two channels

[21] The "cash flow" component is sometimes referred to as the "dividend" component. To avoid confusion, we use the former term throughout the paper.

affect stock prices in the same direction (if $\gamma^{y,c} > 0$). In contrast, a positive correlation (e.g. $\gamma^{y,q} > 0$ and $\gamma^{y,r} > 0$) implies that the combined cash flow and risk premium channel is positive ($\gamma^{y,c} > 0$) and dominates the interest rate channel.

Analogous to specification (2) in Section 3, we estimate equation (15) in a pooled sample, and include other surprises as controls. The left-hand-side variable is now the 30-minute change of country i's 10-year government bond yield. We focus on 10-year government bonds compared to other maturities because it is a standard measure of long-term interest rates and it is available for all countries in our sample.[22] We exclude bond market data during sovereign debt crises in Argentina and Greece. Table 7 reports the results. For convenience, the table also reports the previously obtained estimates for stock indexes from Table 3.

As Table 7 shows, foreign bond yields increase significantly after all 12 releases. For instance, a positive one standard deviation surprise in Nonfarm Payrolls raises foreign long-term interest rates, on average, by 1.67 basis points. Importantly, for all 10 releases about US real activity, a positive surprise raises international stock prices *despite* the increase in international long-term bond yields. This positive co-movement of stock return and bond yield implies that the interest rate channel is dominated by the combined cash flow and risk premium channel, that is $\gamma^{y,c} > \gamma^{y,r} > 0$.

In contrast, positive inflation surprises (Core CPI and Core PPI) raise long-term bond yields while lowering international stock prices. This negative co-movement implies that the interest rate channel can explain the observed stock price response. Without further knowledge about constant c_i in equation (12), we cannot determine the sign of $\gamma^{y,c}$.

Lastly, since neither the cash-flow effect nor the equity risk premium are directly observed, it is not possible to separately identify these two channels. However, to the extent that the VIX serves as a rough proxy for risk premia (as argued by Law, Song, and Yaron, 2018), our findings from Section 3.2 suggest that the risk-premium channel is active. The VIX falls after positive surprises about US real activity, suggesting that the risk premium falls after such surprises. While a sufficiently large drop in the risk premium could explain the rise in stock prices, we cannot rule out that the cash flow channel is also active. The increase in the VIX observed after positive Core CPI inflation surprises, suggests an increase in the risk premium, complementing the rise in long-term interest rates and unambiguously exerting downward pressure on stock prices.

[22]We rely 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: Effect on 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**	12.61***	-9.06***	-4.58***	5.63***	17.81***
	(2.30)	(2.07)	(1.86)	(1.37)	(1.61)	(3.43)
R^2	0.06	0.13	0.11	0.15	0.10	0.26
Observations	5907	5903	5576	5686	5468	1864
10-Year Bond Yield (bp)						
News	0.21***	0.54***	0.66***	0.44***	0.29***	0.88***
	(0.06)	(0.08)	(0.11)	(0.08)	(0.10)	(0.16)
R^2	0.02	0.10	0.05	0.10	0.04	0.19
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	4.86***	11.36***	4.23***	17.24***	10.14***	5.71***
	(0.74)	(2.28)	(1.47)	(3.02)	(2.28)	(1.57)
R^2	0.09	0.12	0.03	0.13	0.15	0.04
Observations	23741	5393	5743	5556	5672	5562
10-Year Bond Yield (bp)						
News	0.28***	0.88***	0.27***	1.67***	0.46***	0.28***
	(0.04)	(0.09)	(0.06)	(0.20)	(0.09)	(0.07)
R^2	0.03	0.17	0.04	0.23	0.15	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 government bond yields, i.e. estimates of γ^y of equation (2), where the left-hand variable is now the 30-minute change of country i's 10-year government bond yield. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

In summary, for news about US real activity the combined cash flow and risk premium channel drives the international stock price response. After a positive surprise expected future cash flows increase, the risk premium falls, or both. While international long rates increase, this effect is not dominant. For positive inflation surprises international long-term interest rates rise and foreign stock prices fall. In this case, the interest rate channel is potentially dominant.

Implications for the role of US monetary policy While our identification scheme rules out that US monetary policy *shocks* drive the observed foreign stock price responses, systematic policy responses to news could affect foreign stock prices. For instance, after a positive surprise about US real activity or inflation, market participants could expect the Federal Reserve to raise interest rates. This, in turn, could raise long-term interest rates, it could raise the risk premium through a credit or risk-taking channel, and it could reduce expected future cash flows. Indeed, prior work has documented that US long-term bond yields rise after positive surprises about US real activity and inflation (e.g., Gürkaynak, Kısacıkoğlu, and Wright, 2018).[23] Our evidence above further shows that foreign bond yields also increase after such news releases.

Yet, for news about US real activity, the response of US monetary policy cannot explain the observed changes in foreign stock prices. After a positive real activity surprise, an expected tightening of monetary policy should reduce foreign stock prices, whether it be through a reduction in future cash flows, an increase in the risk premium, or a rise in the interest rate. In the data, however, stock prices increase, because a sufficiently positive effect through the combined cash flow and risk premium channel offsets the rise in the interest rate.

For news about prices, it is possible that the US monetary policy response to news drives the negative effect on foreign stock prices. As we show in the Appendix Figure B4, however, price news explain only a small fraction of the quarterly variation in foreign stock prices. To obtain these results, we re-run the explanatory power exercise from Section 4 separately for price and real activity news.[24] It turns out that most of the variation in foreign stock prices is explained by news about US real activity. We conclude that the systematic reaction of US monetary policy to news can—in large part—*not* explain foreign stock price responses to US news.

Time-varying Effects Prior work has established that the effects of news on equity prices vary over the business cycle.[25] We extend our analysis above and allow for time-varying effects in Appendix Table B5. Consistent with earlier findings, we document a time-varying effect of news on stock markets, while the effect on bond yields is roughly stable over the business cycle.[26] This suggests that the strength of the combined cash flow and equity premium channel is time varying. In the case of news about real activity, the combined cash

[23]We confirm this finding for our sample period in Appendix Table B4.

[24]For a classification of all news releases into the real activity and price category, see Appendix Table A1.

[25]See, for instance, McQueen and Roley (1993); Boyd, Hu, and Jagannathan (2005); Andersen et al. (2007); Gürkaynak, Kısacıkoğlu, and Wright (2018).

[26]Our estimates are consistent with prior work, which studies the response of the US, British or German stock market (McQueen and Roley, 1993; Andersen et al., 2007; Gürkaynak, Kısacıkoğlu, and Wright, 2018). Boyd, Hu, and Jagannathan (2005) document time-varying effects on government bond yields over the business cycle. They also find no evidence for a time-varying risk premium. Since they focus on unemployment releases, their findings are principally consistent with ours.

flow and equity premium channel is weaker during expansions. Yet, it continues to dominate the interest rate channel through all phases of the business cycle. Our conclusions about the limited role of monetary policy for explaining the foreign stock price response to news are therefore robust.

5.3 The Role of Financial Integration

Our estimates in Figure 3 of Section 3.1 show that stock market responses to US news systematically differ across countries. In this section, we explore whether observables can explain this heterogeneity. We are interested, in particular, in a measure of global financial integration, an intuitive exposure measure to international financial conditions.

We estimate the specification

$$\begin{aligned} \Delta q_{i,t} = \alpha_i + \gamma^y s^y_{US,t} + \delta^y \left(s^y_{US,t} \times \text{finInt}_{i,t-}\right) + \sum_{k \neq y} \gamma^k s^k_{US,t} \\ + \sum_{k \neq y} \delta^k \left(s^k_{US,t} \times \text{fintInt}_{i,t-}\right) + \zeta \, \text{finInt}_{i,t-} + \varepsilon_{i,t}, \end{aligned} \tag{16}$$

where $\text{finInt}_{i,t-}$ is a measure of financial 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 (16) 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

$$\text{finInt}_{i,\tau} = \frac{\text{FA}_{i,\tau} + \text{FL}_{i,\tau}}{\text{GDP}_{i,\tau}}, \tag{17}$$

where $\text{FA}_{i,\tau}$ and $\text{FL}_{i,\tau}$ denote the stock of foreign assets and liabilities, respectively. Note that $\text{FA}_{i,\tau}$ and $\text{FL}_{i,\tau}$ include asset holdings and liabilities vis-à-vis *all* countries and not only vis-à-vis the US, in line with recent work emphasizing the importance of multilateral effects (Huo, Levchenko, and Pandalai-Nayar, 2020). All series are measured in current US dollars, and the data are taken from Lane and Milesi-Ferretti (2007, 2017).[27]

As we document in Appendix Figure B5, a handful of countries experience an enormous

[27] The asset and liability measures include portfolio equity and debt, foreign direct investment, other investment (including loans, deposits, and trade credit), financial derivatives, and reserve assets. Excluding foreign direct investment does not substantially affect our results.

growth in financial integration, most notably Ireland (IRL). While we report results for all countries in Appendix B, we prefer a set of baseline results, which 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 8: Effect on International Stock Markets and The Role of Financial Linkages

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	5.82**	13.64***	-9.28***	-5.13***	6.22***	18.45***
	(2.38)	(2.31)	(2.07)	(1.52)	(1.68)	(3.62)
Fin. Integration × News	1.43	1.35	2.85***	2.19***	0.08	-0.42
	(1.11)	(1.06)	(0.92)	(0.76)	(0.86)	(1.99)
R^2	0.07	0.15	0.11	0.18	0.11	0.27
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	5.39***	12.35***	4.51***	21.77***	11.44***	5.92***
	(0.85)	(2.47)	(1.51)	(3.45)	(2.42)	(1.73)
Fin. Integration × News	1.15**	4.41**	0.97	14.63***	3.72***	0.49
	(0.51)	(1.66)	(0.90)	(2.48)	(1.09)	(0.75)
R^2	0.10	0.14	0.04	0.20	0.18	0.05
Observations	15941	3673	3888	3725	3846	3788

Notes: This table presents estimates of γ^y and δ^y of equation (16) 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 * indicate significance at the 1, 5, and 10 percent level. Appendix Table B6 shows the regression results including all countries, and Appendix Table B7 shows results controlling for trade integration and sectoral dissimilarity.

Table 8 shows the estimates of equation (16) using the financial integration measure in (17). For 6 out of 12 news releases, the interaction term has a highly significant and positive 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 openness responds twice as much as the average country. Further, the interaction term on financial integration is positive for both price and real activity news. This suggests that financial integration mitigates the effect of the interest rate channel and/or amplifies the combined cash flow and risk premium channel. Overall, the results indicate a potentially important role of financial integration for understanding international equity market responses to US news.

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 (16) including a measure of trade integration, a measure of industry dissimilarity, and their interactions with the surprises as controls. The results are shown in Appendix Table B7. Reassuringly, the results as shown in Table 8 are largely unaffected.

Rey (2016) argues that models with financial frictions can explain why US monetary policy shocks drive the GFC. She emphasizes two mechanisms: the "international credit channel" (in the spirit of Bernanke and Gertler, 1989; Bernanke, Gertler, and Gilchrist, 1999) and the "risk-taking channel" (e.g. Borio and Zhu, 2012; Adrian and Shin, 2014; Bruno and Shin, 2015b). We interpret the evidence in this section as consistent with both of these channels. Since both channels affect firms' external costs of funds, and since credit relationships are sticky (Chodorow-Reich, 2014), both mechanisms share the prediction that—all else equal—stock markets of countries which are more financially integrated into the world economy should be more sensitive to changes in international credit conditions. This is indeed what our results suggest.

5.4 The Role of the US Dollar Exchange Rate

We lastly study countries' exchange rate responses to US macro news and examine a possible link to their stock price responses.[28] Bruno and Shin (2015b) lay out a model in which foreign firms borrow funds in US dollar but finance assets in local currency and therefore have currency mismatch. A dollar depreciation improves their balance sheets and reduces credit risk for their lenders (local banks). This reduction in credit risk, in turn, raises banks' lending capacity and therefore improves global liquidity. If the Bruno and Shin (2015b) mechanism is dominant, we expect to observe a US dollar appreciation (depreciation) simultaneously

[28] See Andersen et al. (2003) for prior work on the effects of macroeconomic news on US dollar exchange rates.

with a decrease (increase) in international stock markets.

To see whether this prediction is consistent with our findings, we re-estimate the pooled regression (2), where $\Delta q_{i,t} = q_{i,t+20} - q_{i,t-10}$ is now the 30-minute change of country i's US dollar exchange rate.[29] Exchange rates are measured in US dollars per one unit of foreign currency so that a positive coefficient indicates a depreciation of the US dollar. Table 9 reports the results of this exercise, jointly with the previously obtained estimates for stock indexes from Table 3.

Table 9: Effect on International Stock Markets and US Dollar Exchange Rates

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	4.98**	12.61***	-9.06***	-4.58***	5.63***	17.81***
	(2.30)	(2.07)	(1.86)	(1.37)	(1.61)	(3.43)
R^2	0.06	0.13	0.11	0.15	0.10	0.26
Observations	5907	5903	5576	5686	5468	1864
Exchange Rate (bp)						
News	0.00	-0.28	-6.02***	-3.28***	-1.43	-7.91***
	(1.06)	(1.23)	(1.38)	(0.86)	(0.82)	(2.55)
R^2	0.02	0.02	0.10	0.08	0.07	0.11
Observations	3849	3894	3721	3804	3695	1256

	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
Stock Index (bp)						
News	4.86***	11.36***	4.23***	17.24***	10.14***	5.71***
	(0.74)	(2.28)	(1.47)	(3.02)	(2.28)	(1.57)
R^2	0.09	0.12	0.03	0.13	0.15	0.04
Observations	23741	5393	5743	5556	5672	5562
Exchange Rate (bp)						
News	-0.56	-3.95**	-1.37*	-11.82***	-2.43*	-0.88
	(0.51)	(1.41)	(0.74)	(2.78)	(1.33)	(0.84)
R^2	0.05	0.06	0.04	0.17	0.14	0.01
Observations	16101	3875	3820	3777	3787	3588

Notes: The table presents results of the pooled regression for the stock indexes, as shown in Table 3, and the US dollar exchange rate, i.e. estimates of γ^y of equation (2), where the left-hand variable is now the 30-minute change of country i's exchange rate to the US dollar. Exchange rates are expressed in US dollars so that an increase reflects a depreciation of the US dollar relative to the foreign currency. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level. See Appendix Table A2 for details on the sample.

[29] For members of the Euro Area, we do not use country-specific exchange rates prior to the inception of the currency union due to the short samples. We further drop Denmark from the sample because the Danish Krone is tightly and credibly pegged to the Euro. See Appendix Table A2 for details.

As the table demonstrates, the US dollar typically appreciates after positive surprises about both US real activity and inflation. For real activity news, stock prices increase while the dollar appreciates. This relationship suggests that the mechanism by Bruno and Shin (2015b) is not dominant.

After positive news about inflation, international stock markets decrease while the dollar appreciates. These responses echo earlier findings on the effects of contractionary monetary policy shocks in the literature (Eichenbaum and Evans, 1995; Miranda-Agrippino and Rey, 2020). They are also in line with our earlier evidence of a potentially dominant interest rate channel in the case of price news. In the case of inflation surprises, the joint response of exchange rates and stock prices is consistent with the mechanism by Bruno and Shin (2015b).

6 Conclusion

Prior work has convincingly established that capital flows, risky asset prices, credit growth, and leverage co-move globally. However, as pointed out by Bernanke (2017), the existence of a common global factor by itself neither points to financial market malfunction nor does it necessarily imply that the US economy is the source of these disturbances.

In this paper, we contribute to our understanding of the GFC by establishing 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, and explain a sizable fraction of their variation. Since the co-movement of these risky asset prices is a defining feature of the GFC, we interpret our 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.

We also documented a striking asymmetry between the effects of US macro news and foreign macro news. While US macro news have large effects on foreign stock markets, foreign macro news have essentially no effect on the US stock market. This findings highlights the US' central position in the global financial system, and suggests a limited role for global common shocks. Consequently, and providing a partial answer to Bernanke's (2017) observation mentioned above, our evidence *does* indicate that the US business cycle drives international financial conditions.

Lastly, our evidence suggests a direct link between US macroeconomic conditions and the risk-taking capacity of international investors. This channel is consistent with prior work emphasizing the role of risk-taking capacity but differs from these earlier findings because the effect operates independent of US monetary policy. We conjecture that the sensitivity of global risk-taking capacity to US news reflects the US' central position in the global financial system.

References

Acalin, Julien and Alessandro Rebucci. 2020. "Global Business and Financial Cycles: A Tale of Two Capital Account Regimes." Working Paper 27739, National Bureau of Economic Research.

Adrian, Tobias and Hyun Song Shin. 2014. "Procyclical leverage and value-at-risk." *The Review of Financial Studies* 27 (2):373–403.

Alquist, Ron, Saroj Bhattarai, and Olivier Coibion. 2019. "Commodity-price comovement and global economic activity." *Journal of Monetary Economics* .

Altavilla, Carlo, Domenico Giannone, and Michele Modugno. 2017. "Low frequency effects of macroeconomic news on government bond yields." *Journal of Monetary Economics* 92:31 – 46.

Andersen, Torben G., Tim Bollerslev, Francis X. Diebold, and Clara Vega. 2003. "Micro Effects of Macro Announcements: Real-Time Price Discovery in Foreign Exchange." *American Economic Review* 93 (1):38–62.

———. 2007. "Real-time price discovery in global stock, bond and foreign exchange markets." *Journal of International Economics* 73 (2):251 – 277.

Balduzzi, Pierluigi, Edwin J Elton, and T Clifton Green. 2001. "Economic news and bond prices: Evidence from the US Treasury market." *Journal of financial and Quantitative analysis* 36 (4):523–543.

Bastourre, Diego, Jorge Carrera, Javier Ibarlucia, and Mariano Sardi. 2012. "Common drivers in emerging market spreads and commodity prices." Tech. rep., Working Paper.

Beaudry, Paul and Franck Portier. 2006. "Stock prices, news, and economic fluctuations." *American Economic Review* 96 (4):1293–1307.

Beechey, Meredith J and Jonathan H Wright. 2009. "The high-frequency impact of news on long-term yields and forward rates: Is it real?" *Journal of Monetary Economics* 56 (4):535–544.

Bekaert, Geert, Marie Hoerova, and Nancy R Xu. 2020. "Risk, Uncertainty and Monetary Policy in a Global World." *Available at SSRN 3599583* .

Bernanke, Ben and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *The American Economic Review* 79 (1):14–31.

Bernanke, Ben S. 2017. "Federal reserve policy in an international context." *IMF Economic Review* 65 (1):1–32.

Bernanke, Ben S, Mark Gertler, and Simon Gilchrist. 1999. "The financial accelerator in a quantitative business cycle framework." *Handbook of macroeconomics* 1:1341–1393.

Borio, Claudio and Haibin Zhu. 2012. "Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism?" *Journal of Financial Stability* 8 (4):236 – 251.

Boyd, John H, Jian Hu, and Ravi Jagannathan. 2005. "The stock market's reaction to unemployment news: Why bad news is usually good for stocks." *The Journal of Finance* 60 (2):649–672.

Bruno, Valentina and Hyun Song Shin. 2015a. "Capital flows and the risk-taking channel of monetary policy." *Journal of Monetary Economics* 71:119–132.

———. 2015b. "Cross-border banking and global liquidity." *The Review of Economic Studies* 82 (2):535–564.

Byrne, Joseph P., Giorgio Fazio, and Norbert Fiess. 2013. "Primary commodity prices: Co-movements, common factors and fundamentals." *Journal of Development Economics* 101:16 – 26.

Calvo, Guillermo A, Leonardo Leiderman, and Carmen M Reinhart. 1993. "Capital inflows and real exchange rate appreciation in Latin America: the role of external factors." *Staff Papers* 40 (1):108–151.

———. 1996. "Inflows of Capital to Developing Countries in the 1990s." *Journal of economic perspectives* 10 (2):123–139.

Canova, Fabio. 2005. "The transmission of US shocks to Latin America." *Journal of Applied Econometrics* 20 (2):229–251.

Canova, Fabio and Jane Marrinan. 1998. "Sources and propagation of international output cycles: common shocks or transmission?" *Journal of International Economics* 46 (1):133–166.

Cerutti, Eugenio, Stijn Claessens, and Andrew K Rose. 2019. "How important is the global financial cycle? Evidence from capital flows." *IMF Economic Review* 67 (1):24–60.

Chinn, Menzie D. and Olivier Coibion. 2014. "The Predictive Content of Commodity Futures." *Journal of Futures Markets* 34 (7):607–636.

Chodorow-Reich, Gabriel. 2014. "The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis." *The Quarterly Journal of Economics* 129 (1):1–59.

Coibion, Olivier. 2012. "Are the effects of monetary policy shocks big or small?" *American Economic Journal: Macroeconomics* 4 (2):1–32.

Diaz-Alejandro, Carlos. 1983. "Stories of the 1930s for the 1980s." In *Financial policies and the world capital market: The problem of Latin American countries*. University of Chicago Press, 5–40.

Diaz-Alejandro, Carlos F. 1984. "Latin American debt: I don't think we are in Kansas anymore." *Brookings papers on economic activity* 1984 (2):335–403.

Ehrmann, Michael, Marcel Fratzscher, and Roberto Rigobon. 2011. "Stocks, bonds, money markets and exchange rates: measuring international financial transmission." *Journal of Applied Econometrics* 26 (6):948–974.

Eichenbaum, Martin and Charles L Evans. 1995. "Some empirical evidence on the effects of shocks to monetary policy on exchange rates." *The Quarterly Journal of Economics* 110 (4):975–1009.

Etula, Erkko. 2013. "Broker-dealer risk appetite and commodity returns." *Journal of Financial Econometrics* 11 (3):486–521.

Faust, Jon, John H. Rogers, Shing-Yi B. Wang, and Jonathan H. Wright. 2007. "The high-frequency response of exchange rates and interest rates to macroeconomic announcements." *Journal of Monetary Economics* 54 (4):1051 – 1068.

Forbes, Kristin J and Francis E Warnock. 2012. "Capital flow waves: Surges, stops, flight, and retrenchment." *Journal of international economics* 88 (2):235–251.

Gertler, Mark and Peter Karadi. 2015. "Monetary policy surprises, credit costs, and economic activity." *American Economic Journal: Macroeconomics* 7 (1):44–76.

Gilbert, Thomas, Chiara Scotti, Georg Strasser, and Clara Vega. 2017. "Is the intrinsic value of a macroeconomic news announcement related to its asset price impact?" *Journal of Monetary Economics* 92:78 – 95.

Goldberg, Linda S and Cédric Tille. 2008. "Vehicle currency use in international trade." *Journal of international Economics* 76 (2):177–192.

Gopinath, Gita. 2015. "The international price system." Tech. rep., National Bureau of Economic Research.

Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller. 2020. "Dominant Currency Paradigm." *American Economic Review* 110 (3):677–719.

Gorodnichenko, Yuriy and Walker Ray. 2017. "The effects of quantitative easing: Taking a cue from treasury auctions." Tech. rep., National Bureau of Economic Research.

Gorton, Gary and K Geert Rouwenhorst. 2006. "Facts and fantasies about commodity futures." *Financial Analysts Journal* 62 (2):47–68.

Gourinchas, Pierre-Olivier and Helene Rey. 2007. "From world banker to world venture capitalist: US external adjustment and the exorbitant privilege." In *G7 current account imbalances: sustainability and adjustment*. University of Chicago Press, 11–66.

Gourinchas, Pierre-Olivier, Hélène Rey, and Maxime Sauzet. 2019. "The international monetary and financial system." *Annual Review of Economics* 11:859–893.

Gürkaynak, Refet S, Burçin Kısacıkoğlu, and Jonathan H Wright. 2018. “Missing events in event studies: Identifying the effects of partially-measured news surprises.” Tech. rep., National Bureau of Economic Research.

Gürkaynak, Refet S., Brian Sack, and Eric Swanson. 2005. “The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models.” *American Economic Review* 95 (1):425–436.

Gürkaynak, Refet S. and Jonathan H. Wright. 2013. “Identification and Inference Using Event Studies.” *The Manchester School* 81 (S1):48–65.

Hasbrouck, Joel. 2003. “Intraday price formation in US equity index markets.” *The Journal of Finance* 58 (6):2375–2400.

Huo, Zhen, Andrei A Levchenko, and Nitya Pandalai-Nayar. 2020. “International comovement in the global production network.” .

Jordà, Òscar, Moritz Schularick, Alan M Taylor, and Felix Ward. 2019. “Global financial cycles and risk premiums.” *IMF Economic Review* 67 (1):109–150.

Kilian, Lutz and Clara Vega. 2011. “Do energy prices respond to US macroeconomic news? A test of the hypothesis of predetermined energy prices.” *Review of Economics and Statistics* 93 (2):660–671.

Kurov, Alexander, Alessio Sancetta, Georg Strasser, and Marketa Halova Wolfe. 2019. “Price Drift Before U.S. Macroeconomic News: Private Information about Public Announcements?” *Journal of Financial and Quantitative Analysis* 54 (1):449–479.

Kurov, Alexander and Raluca Stan. 2018. “Monetary policy uncertainty and the market reaction to macroeconomic news.” *Journal of Banking & Finance* 86:127–142.

Lane, Philip R and Gian Maria Milesi-Ferretti. 2007. “The external wealth of nations mark II: Revised and extended estimates of foreign assets and liabilities, 1970–2004.” *Journal of international Economics* 73 (2):223–250.

———. 2017. “International financial integration in the aftermath of the global financial crisis.” IMF Working Paper 17/115, International Monetary Fund.

Law, Tzuo Hann, Dongho Song, and Amir Yaron. 2018. “Fearing the fed: How wall street reads main street.” *Available at SSRN 3092629* .

Lucca, David O and Emanuel Moench. 2015. “The pre-FOMC announcement drift.” *The Journal of Finance* 70 (1):329–371.

Ludvigson, Sydney C, Sai Ma, and Serena Ng. 2015. “Uncertainty and business cycles: exogenous impulse or endogenous response?” Tech. rep., National Bureau of Economic Research.

Maggiori, Matteo, Brent Neiman, and Jesse Schreger. 2020. “International Currencies and Capital Allocation.” *Journal of Political Economy* 128 (6):2019–2066.

McQueen, Grant and V Vance Roley. 1993. "Stock prices, news, and business conditions." *The Review of Financial Studies* 6 (3):683–707.

Miranda-Agrippino, Silvia and Hélène Rey. 2020. "US Monetary Policy and the Global Financial Cycle." *The Review of Economic Studies* Rdaa019.

Monnet, Eric and Mr Damien Puy. 2019. *One Ring to Rule Them All? New Evidence on World Cycles*. International Monetary Fund.

Nakamura, Emi and Jón Steinsson. 2018. "High-frequency identification of monetary non-neutrality: the information effect." *The Quarterly Journal of Economics* 133 (3):1283–1330.

Obstfeld, Maurice. 2015. "Trilemmas and trade-offs: living with financial globalisation." .

Pindyck, Robert S and Julio J Rotemberg. 1990. "The Excess Co-Movement of Commodity Prices." *The Economic Journal* 100 (403):1173–1189.

Ramey, Valerie A. 2016. "Macroeconomic shocks and their propagation." In *Handbook of macroeconomics*, vol. 2. Elsevier, 71–162.

Reinhart, Carmen M. and Vincent R. Reinhart. 2008. "Capital Flow Bonanzas: An Encompassing View of the Past and Present." *NBER International Seminar on Macroeconomics* 5 (1):9–62.

Rey, Helene. 2013. "Dilemma not trilemma: the global cycle and monetary policy independence." Proceedings - Economic Policy Symposium - Jackson Hole y:2013:x:9, Federal Reserve Bank of Kansas City.

Rey, Hélène. 2016. "International channels of transmission of monetary policy and the Mundellian trilemma." *IMF Economic Review* 64 (1):6–35.

Rigobon, Roberto and Brian Sack. 2008. "Noisy macroeconomic announcements, monetary policy, and asset prices." In *Asset prices and monetary policy*. University of Chicago Press, 335–370.

Swanson, Eric T. and John C. Williams. 2014. "Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates." *American Economic Review* 104 (10):3154–85.

Timmer, Marcel P, Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J De Vries. 2015. "An illustrated user guide to the world input–output database: the case of global automotive production." *Review of International Economics* 23 (3):575–605.

For online publication

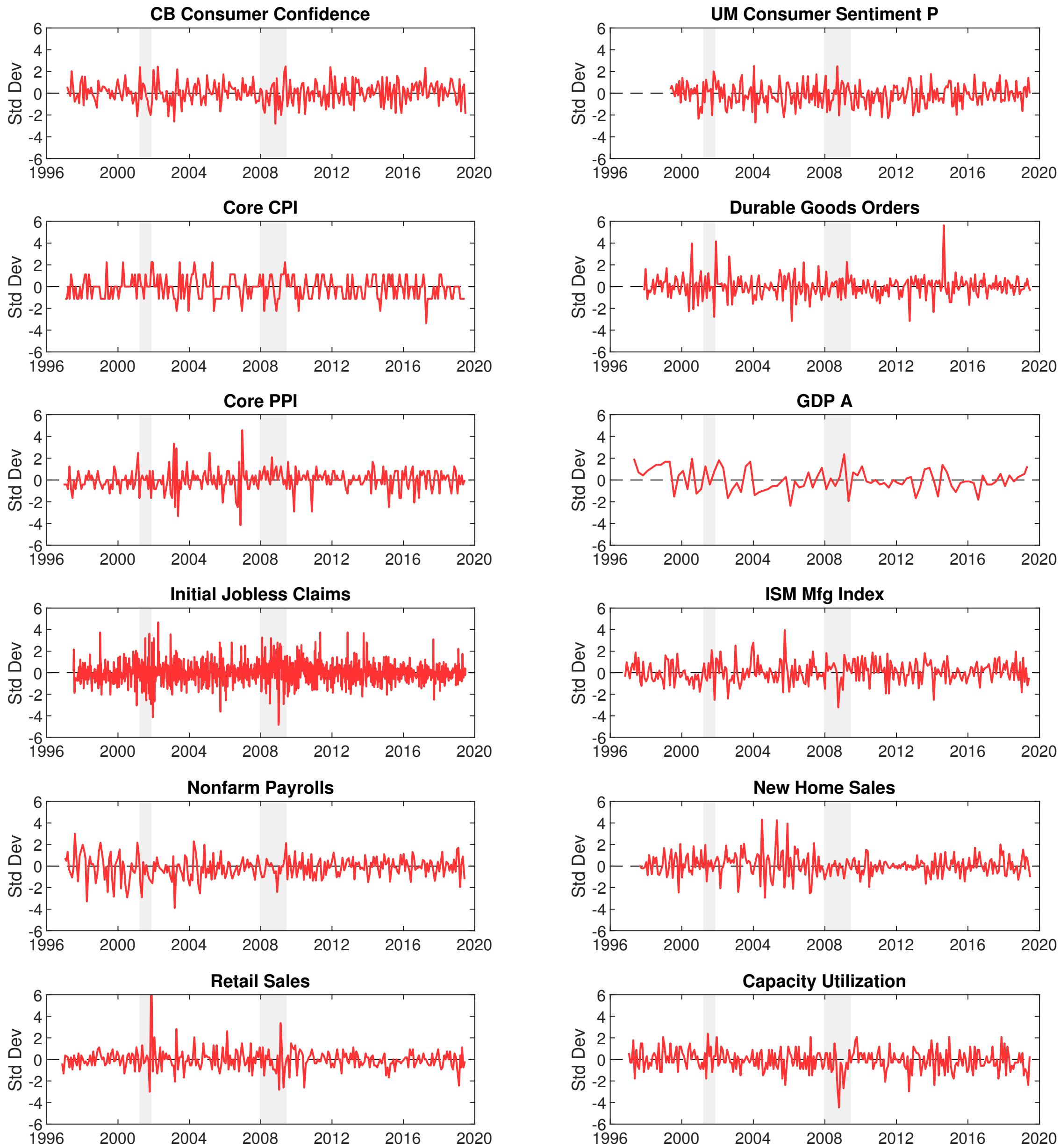
A Data Appendix

Table A1: Overview of All US Macroeconomic News

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

Notes: This table displays the entirety of macroeconomic series analyzed in the paper. The sample ranges from November 1996 to June 2019. *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
10-Year Treasury Futures	TYc1,TYc2	1996–2019

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. *Ticker* refers to the Reuters Instrument Code (RIC). For a given country, the table provides details of the major stock index, US exchange rate, and 10-year government bond yield with the respective samples periods. For members of the Euro Area, we do not use country-specific exchange rates prior to the inception of the currency union due to the small sample period. Further, we drop Denmark from the sample since the Danish Krone is tightly and credibly pegged to the Euro. Abbreviations: ISO — 3 digit ISO country code.

Table A3: Overview of Open/Closed Equity Markets during US 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

Event	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 US 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.

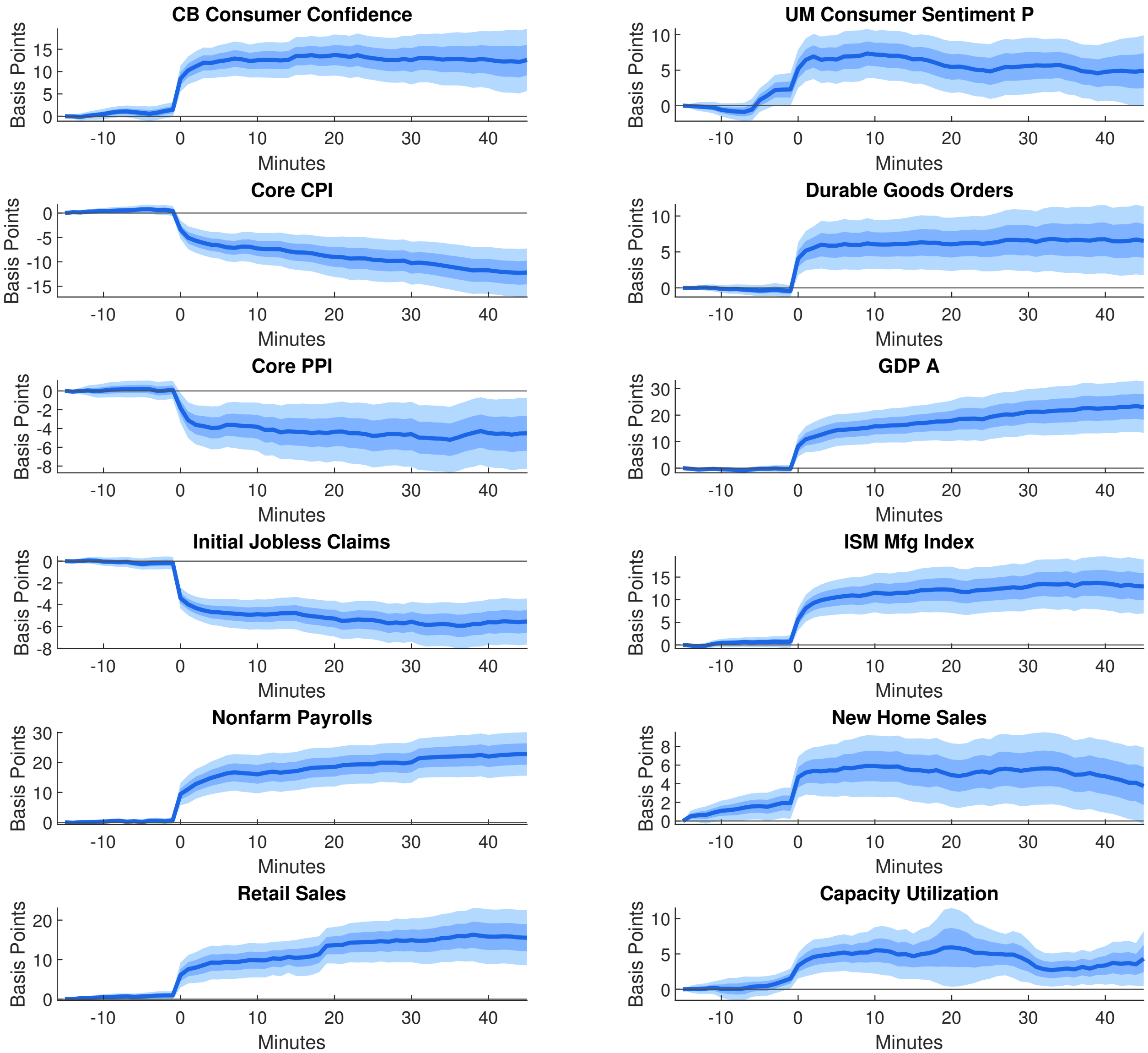
Table A4: Overview of Major Foreign Macroeconomic News

	Frequency	Observations		Frequency	Observations
Canada			*Italy*		
(Core) CPI	Monthly	198	Consumer Confidence	Monthly	213
GDP	Quarterly	79	CPI (P)	Monthly	249
Industrial Product Price Index (PPI)	Monthly	248	GDP (P)	Quarterly	66
Retail Sales	Monthly	258	Industrial Production	Monthly	241
Unemployment Rate	Monthly	267	Retail Sales	Monthly	171
			PPI	Monthly	190
			Unemployment Rate	Monthly	139
France			*Japan*		
Consumer Confidence	Monthly	230	Consumer Confidence	Monthly	146
CPI (P)	Monthly	253	CPI	Monthly	211
GDP (P)	Quarterly	87	GDP (P)	Quarterly	71
Industrial Production	Monthly	264	Industrial Production (P)	Monthly	231
PPI	Monthly	161	PPI	Monthly	187
Unemployment Rate	Monthly	171	Retail Sales	Monthly	191
			Unemployment (Jobless) Rate	Monthly	231
Germany			*United Kingdom*		
(GfK) Consumer Confidence	Monthly	152	(GfK) Consumer Confidence	Monthly	197
CPI (P)	Monthly	239	(Core) CPI	Monthly	164
GDP (P)	Quarterly	87	GDP (A)	Quarterly	80
Industrial Production	Monthly	264	Industrial Production	Monthly	268
PPI	Monthly	266	(Core) PPI (Output)	Monthly	153
Retail Sales	Monthly	248	Retail Sales	Monthly	110
Unemployment Rate (Change)	Monthly	267	(ILO) Unemployment Rate	Monthly	203

Notes: This table displays the major macroeconomic series of non-US G7 countries analyzed in Section 5. The data are obtained from Blomberg's Economic Calendar and the sample ranges from November 1996 to May 2019. *Observations* refers to number of observations (surprises) of a macroeconomic series in the sample, *Frequency* to the frequency of the data releases. Note that the reported number of observations in Table 6 is smaller than the one reported here due to the unavailability of the E-mini S&P 500 futures on certain dates. Abbreviations: A — advanced; P — preliminary; GFK — Society for Consumer Research; ILO — International Labor Organization.

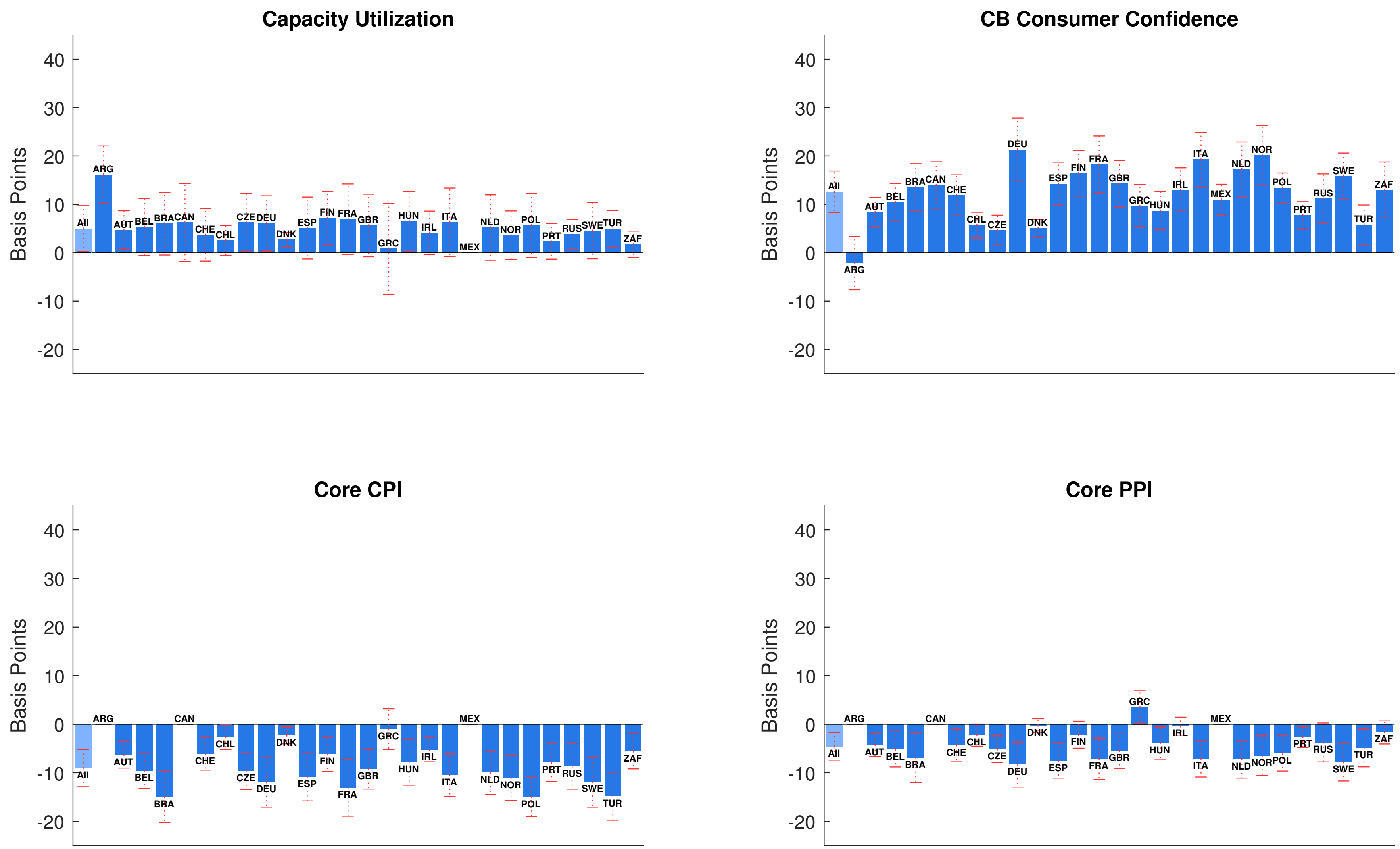
B Additional Results

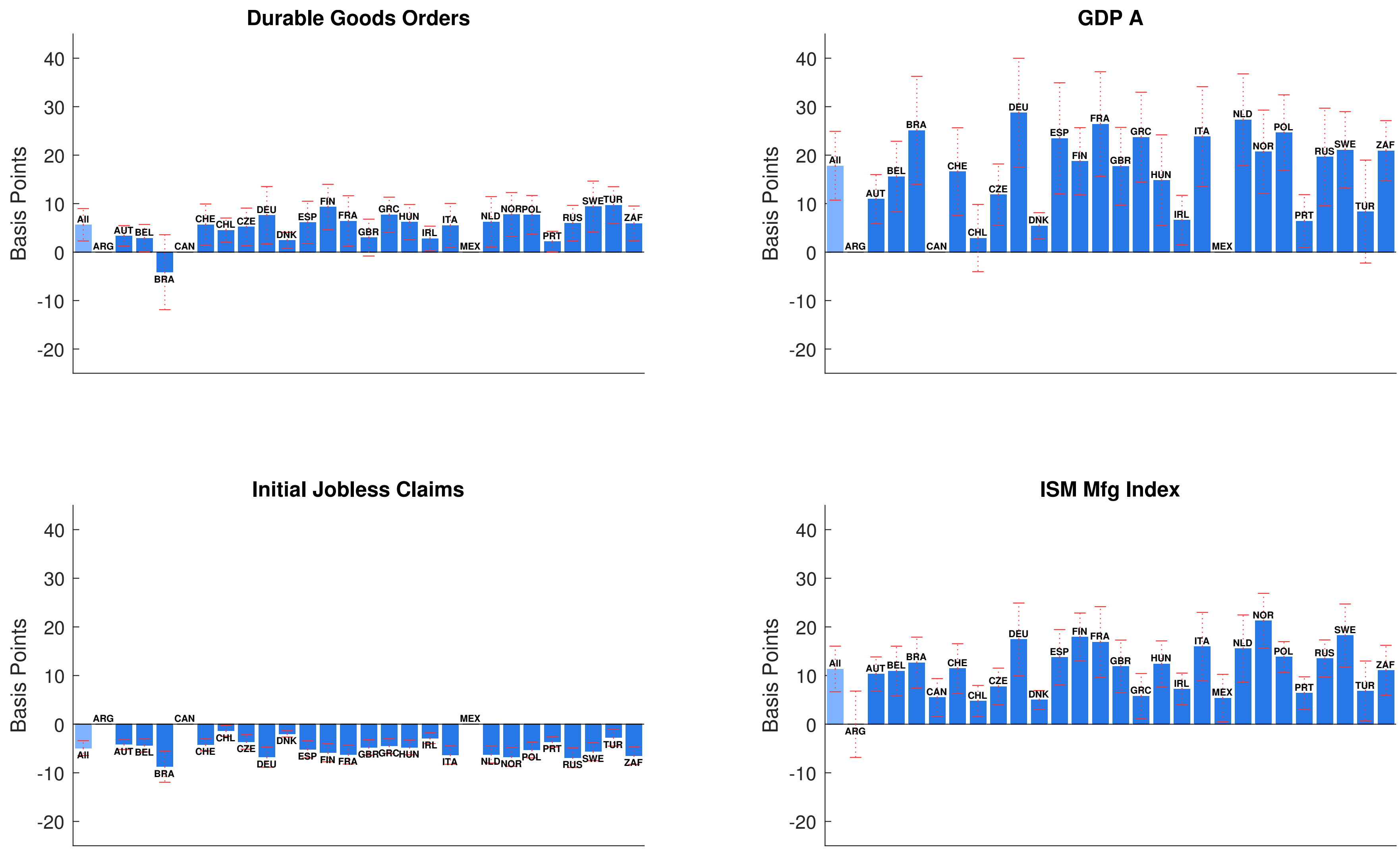
Figure B1: Average Paths within 60-minute Window for Selected Announcements

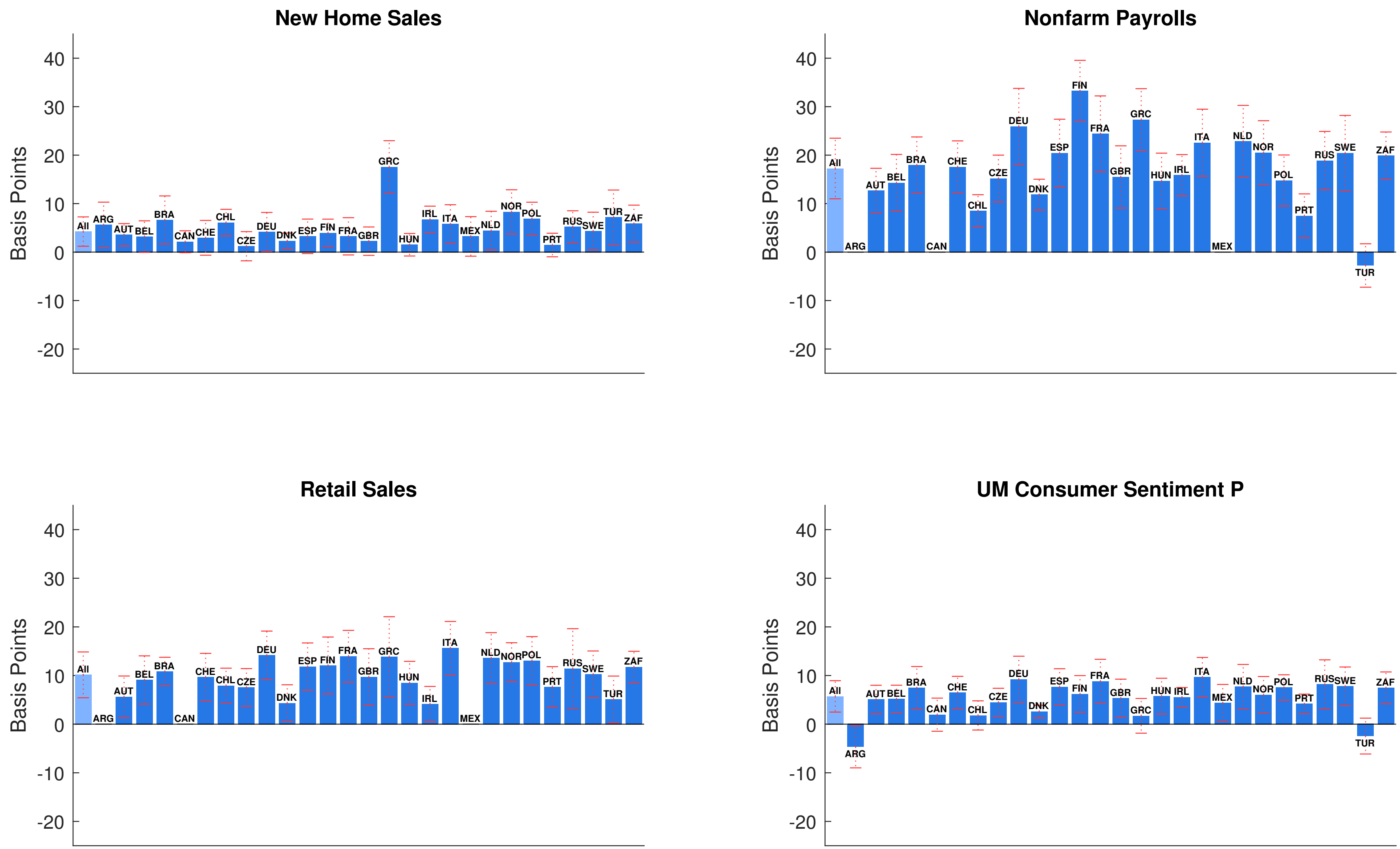


Notes: This figure displays the average path for stock indexes within a 60 minute window for a given news release. The units are expressed in basis points. The changes are relative to the level 15 minutes prior to each release. The dark and light blue bands display the 68 percent and 95 percent confidence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

Figure B2: Effect of US News on International Stock Markets by Country




Durable Goods Orders
GDP A
Initial Jobless Claims
ISM Mfg Index
Basis Points
40
30
20
10
0
-10
-20
All
ARG
AUT
BEL
BRA
CAN
CHE
CHL
CZE
DEU
DNK
ESP
FIN
FRA
GBR
GRC
HUN
IRL
ITA
MEX
NLD
NOR
POL
PRT
RUS
SWE
TUR
ZAF



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 indicate cases in which the country is dropped because it had fewer 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 B1: 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 B2: 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

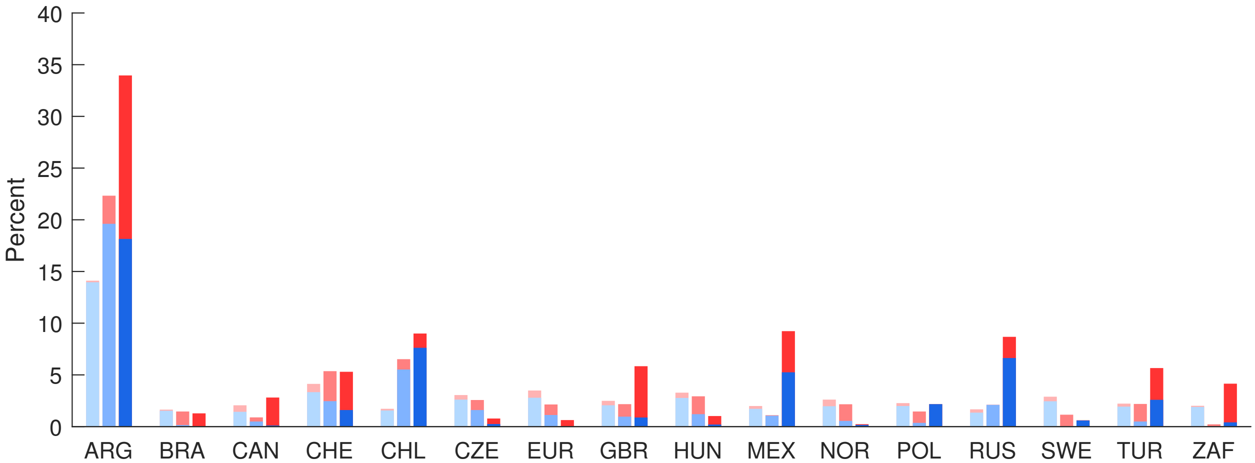
Notes: This table shows the loadings and explained variance of the first two factors of the commodity data. They are estimated using principal components on 30-minute changes of the S&P GS energy, industrial metals, and agriculture commodity index around the 12 macroeconomic announcements.

Table B3: 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)

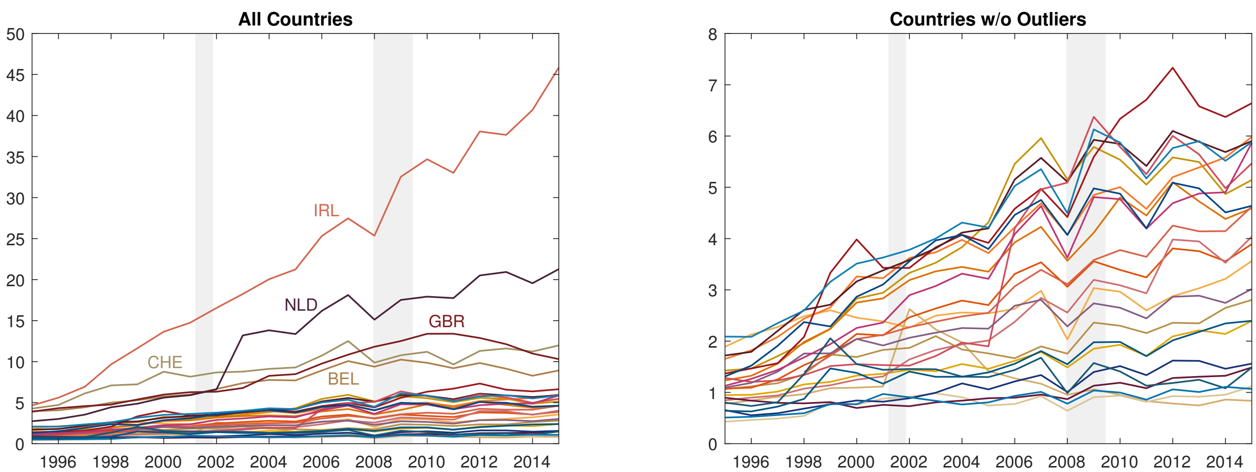
Notes: This table reports, country-by-country, the R-squared of equation (8) (daily) and, R-squared and coefficient values of equation (9) (monthly and quarterly) for stock indexes. The same R-squared are illustrated in Figure 5. The sample ranges from January 1, 2000 to June 28, 2019 and Newey-West 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 B3: Daily, Monthly, and Quarterly R-Squared for US Dollar Exchange Rates



Notes: For each US dollar-denominated exchange rate, this figure plots the R-squared of equation (8) for the daily frequency, and the R-squared of equation (9) 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 exchange rate and frequency, the blue bar represents the R-squared of US macroeconomic news and the red bar represents the R-squared of US monetary policy shocks. The sample runs from January 1, 2000 to June 28, 2019.

Figure B5: Time Series of Financial Integration Measure by Country



Notes: This figure shows the time series of financial integration from 1995 to 2015. The construction of the measure follows equation (17). The left hand side panel shows 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 B4: Effect of US News on 10-Year Treasury Yield

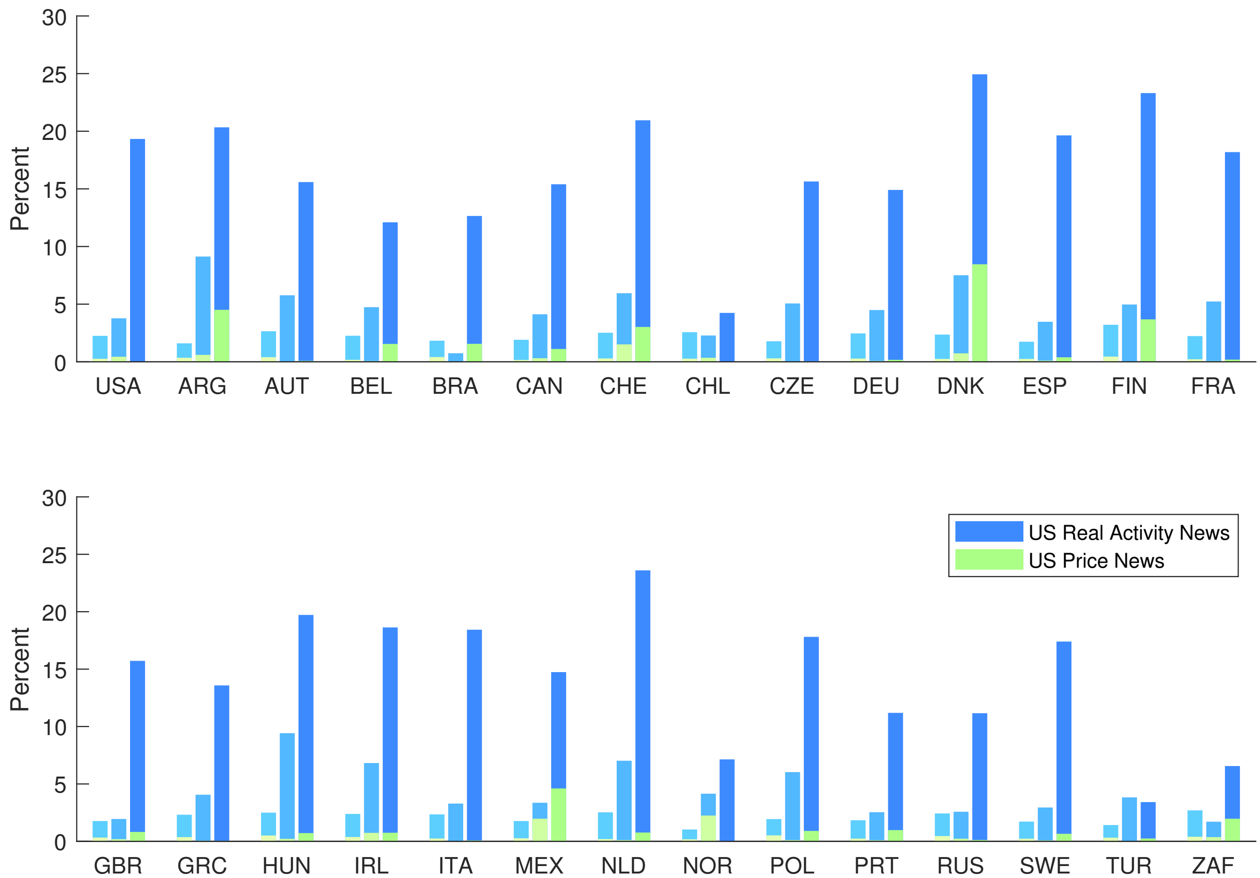
	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
10-Year Treasury Yields (bp)						
News	0.45***	1.14***	1.40***	1.03***	0.43	1.57***
	(0.11)	(0.17)	(0.23)	(0.16)	(0.26)	(0.34)
R^2	0.13	0.37	0.25	0.37	0.24	0.30
Observations	264	191	258	268	183	88
	Initial Jobless Claims $\cdot(-1)$	ISM Mfg Index	New Home Sales	Nonfarm Payrolls	Retail Sales	UM Consumer Sentiment P
10-Year Treasury Yields (bp)						
News	0.59***	2.09***	0.73***	4.12***	1.31***	0.60***
	(0.07)	(0.18)	(0.13)	(0.42)	(0.34)	(0.12)
R^2	0.22	0.46	0.29	0.46	0.34	0.13
Observations	1001	267	186	268	266	237

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, $s^k_{US,t}$ are other surprises released in the same time window, and Δq_t is the 30-minute change in the 10-year Treasury yield. Following Gürkaynak, Kısacıkoğlu, and Wright (2018), we construct the yield change by using changes in 10-year Treasury futures, where we divide the 30-minute change of the futures price by its approximate duration (7 years) and flip the sign. Following Gorodnichenko and Ray (2017), we focus on the closest quarterly contract except in the month of expiration in which case we employ the second-closest contract. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

Figure B4: Daily, Monthly, and Quarterly R-Squared for Stock Indexes



Notes: For each country's stock index, this figure plots the R-squared of equation (8) for the daily frequency, and the R-squared of equation (9) 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 country and frequency, the blue bar represents the R-squared of US real activity news and the green bar represents the R-squared of US price news. The sample runs from January 1, 2000 to June 28, 2019. Appendix Table A1 provides an overview of the news releases and their classification into the two groups.

Table B5: Time-Varying Effect of US News

	Capacity Utilization	CB Consumer Confidence	Core CPI	Core PPI	Durable Goods Orders	GDP A
Stock Index (bp)						
News	1.08	7.25***	-11.64***	-6.32***	2.44*	12.73***
	(1.05)	(1.99)	(2.15)	(1.75)	(1.29)	(3.63)
News - Recession	7.64*	9.53***	6.39**	3.92*	8.35***	13.45**
	(4.04)	(3.04)	(2.88)	(2.10)	(2.87)	(4.92)
R^2	0.08	0.17	0.14	0.18	0.13	0.32
Observations	5809	5783	5576	5686	5468	1864
10-Year Bond Yield (bp)						
News	0.22***	0.42***	0.81***	0.52***	0.21**	0.80***
	(0.07)	(0.11)	(0.13)	(0.08)	(0.09)	(0.17)
News - Recession	-0.02	0.21*	-0.38***	-0.21*	0.25	0.17
	(0.08)	(0.10)	(0.13)	(0.10)	(0.20)	(0.24)
R^2	0.03	0.10	0.06	0.12	0.04	0.21
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	4.42***	7.88***	4.39**	13.43***	9.24***	6.97***
	(0.71)	(2.61)	(1.68)	(3.67)	(2.32)	(1.56)
News - Recession	0.68	8.75**	-0.20	8.89*	1.14	-2.89
	(1.08)	(3.50)	(2.35)	(4.58)	(3.69)	(2.90)
R^2	0.11	0.17	0.03	0.15	0.17	0.05
Observations	23741	5274	5630	5556	5672	5465
10-Year Bond Yield (bp)						
News	0.28***	0.81***	0.32***	1.83***	0.65***	0.24***
	(0.05)	(0.10)	(0.07)	(0.26)	(0.12)	(0.07)
News - Recession	0.01	0.16	-0.13	-0.41	-0.27**	0.08
	(0.07)	(0.13)	(0.11)	(0.27)	(0.13)	(0.11)
R^2	0.03	0.18	0.04	0.24	0.16	0.03
Observations	18753	3956	4128	4378	4431	3985

Notes: This table presents estimates of ψ^y for stock indexes and 10-year governmanet bond yields from the following specification:

$$\Delta q_{i,t} = \alpha_i + \gamma^y s^y_{US,t} + \psi^y s^y_{US,t} \mathbf{1}^{rec}_{i,t} + \sum_{k \neq y} \left(\gamma^k s^k_{US,t} + \psi^k s^k_{US,t} \mathbf{1}^{rec}_{i,t} \right) + \varepsilon_{i,t},$$

where $\mathbf{1}^{rec}_{i,t}$ is a monthly indicator equal to one if the US is in a recession or if country i is in a recession. Hence, ψ^y captures the differential effect of announcement y during recession periods, and is the coefficient of interest. To measure US recession periods we use the business cycle dates from the National Bureau of Economic Research (NBER), and for the other countries we use the dates provided by the Organisation for Economic Co-operation and Development (OECD). We obtain our data from the Federal Reserve Economic Data (FRED). For Argentina, there is no data available to us and hence we drop it from our sample for this analysis. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level.

Table B6: The 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**	13.84***	-9.07***	-5.19***	5.73***	18.05***
	(2.54)	(2.26)	(1.95)	(1.47)	(1.65)	(3.51)
Fin. Integration × News	0.80	1.12	1.55**	1.45***	-0.66*	-1.05
	(0.75)	(0.71)	(0.73)	(0.50)	(0.32)	(1.39)
R^2	0.07	0.15	0.11	0.17	0.11	0.28
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	5.17***	11.94***	4.23***	18.99***	10.38***	5.94***
	(0.80)	(2.47)	(1.52)	(3.47)	(2.49)	(1.68)
Fin. Integration × News	0.36	1.96	0.93**	8.60**	1.18	0.32
	(0.46)	(1.40)	(0.44)	(3.90)	(1.47)	(0.34)
R^2	0.10	0.13	0.04	0.15	0.17	0.05
Observations	20835	4738	4992	4887	5030	4819

Notes: This table presents estimates of γ^y and δ^y of equation (16) 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 * indicate significance at the 1, 5, and 10 percent level.

Table B7: The 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**	15.49***	-9.22***	-5.02***	6.42***	19.88***
	(2.52)	(2.35)	(2.19)	(1.52)	(1.81)	(3.65)
Fin. Integration × News	1.45	0.35	3.64*	3.24**	0.79	-2.36
	(1.32)	(1.55)	(1.91)	(1.40)	(1.52)	(2.86)
Trade Integration × News	-0.61	-2.69***	0.66	0.16	0.01	-3.36**
	(0.37)	(0.93)	(0.46)	(0.50)	(0.36)	(1.26)
Industry Dissimilarity × News	0.80	-1.41	1.87	2.17*	1.29	-1.90
	(1.06)	(1.36)	(1.65)	(1.17)	(1.37)	(2.62)
R^2	0.09	0.20	0.13	0.21	0.14	0.35
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	5.36***	13.64***	4.82***	23.72***	11.82***	6.78***
	(0.89)	(2.56)	(1.52)	(3.61)	(2.49)	(1.73)
Fin. Integration × News	2.10***	4.77**	2.60*	16.52***	5.14***	-0.14
	(0.68)	(2.16)	(1.40)	(3.13)	(1.33)	(1.24)
Trade Integration × News	-0.98*	-2.53*	-2.28**	-3.92	-2.06*	-1.03*
	(0.52)	(1.30)	(0.95)	(2.33)	(1.07)	(0.57)
Industry Dissimilarity × News	0.97	2.19	2.37**	5.54**	1.67	-0.48
	(0.68)	(1.61)	(0.93)	(2.16)	(1.00)	(1.15)
R^2	0.13	0.19	0.07	0.24	0.22	0.06
Observations	14045	3044	3268	3240	3329	3270

Notes: This table presents estimates of γ^y and δ^y from an adapted version of equation (16), where we include as controls measures of trade integration and industry dissimilarity from the US, as well as their interactions with the surprises. The units are expressed in basis points. Standard errors are clustered by announcement and country, and reported in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent level. Trade integration (or openness) is calculated for country i and year τ as

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

where the data on nominal imports, exports, and GDP are obtained from the United Nations Statistics Division. Country i's sectoral dissimilarity relative to the US 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, and the data are obtained from the World Input-Output Database (Timmer et al., 2015).

C 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 US 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 an element in 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

$$q_{i,\tau} = E\left[\sum_{k\in\mathcal{C}} a^q_{i,k} x_{k,\tau} + a^q_{i,glob}\, x_{glob,\tau}|\mathcal{I}_\tau\right], \tag{C1}$$

where $a^q_{i,k}$, $k \in \mathcal{C}$, 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 $x_{k,\tau}$ and the global state variables in $x_{glob,\tau}$. Similarly, we can express country j's macroeconomic variable y of interest as

$$y_{j,\tau} = \sum_{k\in\mathcal{C}} a^y_{j,k} x_{k,\tau} + a^y_{j,glob}\, x_{glob,\tau}. \tag{C2}$$

For most of the paper, we are interested in US macroeconomic variables so that $j = US$.

Under the assumption that $x_{k,t+\Delta^+} = x_{k,t-\Delta^-}$ for all k 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

$$\begin{aligned}\Delta q_{i,t} &= q_{i,t+\Delta^+} - q_{i,t-\Delta^-} \\ &= \sum_{k\in\mathcal{C}} a^q_{i,k}\left(E\left[x_{k,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{k,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right]\right) \\ &\qquad + a^q_{i,glob}\left(E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right]\right).\end{aligned} \tag{C3}$$

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 $\mathcal{I}_{t+\Delta^+} = \mathcal{I}_{t-\Delta^-} \cup \mathcal{N}_{[t-\Delta^-,t+\Delta^+]}$, and parameterize the conditional expectations in equation (C3),

$$E\left[x_{k,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{k,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right] = b_k^y s_{US,t}^y + u_{k,t}, \qquad \text{for } k \in \mathcal{C}, \tag{C4}$$

$$E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t+\Delta^+}\right] - E\left[x_{glob,t+\Delta^+}|\mathcal{I}_{t-\Delta^-}\right] = b_{glob}^y s_{US,t}^y + u_{glob,t}. \tag{C5}$$

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 $u_{k,t}$ 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* b_k^y and b_{glob}^y 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 b_{US}^y is nonzero. If the surprise is not useful for estimating particular state variables, then the relevant entries in b_k^y and b_{glob}^y are zero.

We make no specific assumptions on how agents update their estimate of the state. They could, for instance, use the Kalman filter, but we do not impose this assumption. We only require that the estimation of the unobserved state requires a nonzero correlation between the observed macroeconomic variable and the state of interest. Formally, we require

Assumption 1. *For all* $k \in \mathcal{C} \cup \{glob\}$: $b_k^y \neq 0 \Rightarrow a_{US,k}^y \neq 0$.

Plugging equations (C4) and (C5) into equation (C3) gives

$$\Delta q_{i,t} = \left(\sum_{k \in \mathcal{C}} a_{i,k}^q b_k^y + a_{i,glob}^q b_{glob}^y \right) s_{US,t}^y + \varepsilon_{i,t}, \tag{C6}$$

where $\varepsilon_{i,t} = \sum_{k\in\mathcal{C}} a_{i,k}^q u_{k,t}^y + a_{i,glob}^q u_{glob,t}$. Letting $\gamma_i := \sum_{k\in\mathcal{C}} a_{i,k}^q b_k^y + a_{i,glob}^q b_{glob}^y$, delivers our estimating equation (3).

Discussion For a given asset price $q_{i,t}$ and surprise $s_{US,t}^y$, equation (C6) 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 $a_{i,k}^q$ and $a_{i,glob}^q$. Second, the response reflects market participant's updates about the state of the world, as measured by vectors b_k^y and b_{glob}^y. 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 (C6) by country into four different components,

$$\Delta q_{i,t} = \left(\underbrace{a_{i,US}^q b_{US}^y}_{\text{(a)}} + \underbrace{a_{i,i}^q b_i^y}_{\text{(b)}} + \underbrace{\sum_{j \neq US,i} a_{i,j}^q b_j^y}_{\text{(c)}} + \underbrace{a_{i,glob}^q b_{glob}^y}_{\text{(d)}} \right) s_{US,t}^y + \varepsilon_{i,t}.$$

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 b^y_{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, $b^y_k = 0$ for $k \notin \{US, glob\}$. 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. Under Assumption 1, a sufficient condition for this to hold is that countries other than the US are *small* relative to the US. 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. Formally, Assumption 1 immediately implies that $a^y_{US,BEL} = 0 \Rightarrow b^y_{BEL} = 0$. The premise is satisfied because Belgium is small relative to the US.

Under this assumption, equation (C6) becomes

$$\Delta q_{i,t} = \left(\underbrace{a^q_{i,US} b^y_{US}}_{\text{transmission from US}} + \underbrace{a^q_{i,glob} b^y_{glob}}_{\text{common shock}} \right) s^y_{US,t} + \varepsilon_{i,t}. \tag{C7}$$

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 b^y_{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 $a^q_{i,US} b^y_{US}$ 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 (b^y_{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.