What do Chinese Macro Announcements Tell Us About the World Economy?

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Abstract

We examine the effect of scheduled macroeconomic announcements made by China on world financial and commodity futures markets. All announcements related to Chinese manufacturing and industrial output move stock markets, energy and industrial commodities as well as commodity currencies. News about Chinese domestic consumption leaves most markets unaffected, suggesting that market participants view the announcements primarily as a signal of the state of the global economy rather than merely of China's domestic demand. The market response to unexpectedly strong output announcements is not consistent with investors being concerned about tightening of Chinese macroeconomic policy; instead, the world markets view strong Chinese output as a rising tide that lifts all boats.

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1. Introduction

China's spectacular rise to the second largest economy in the last two decades brought about dramatic changes in the world economic landscape. Yet, in spite of China's prominent role in the world economy, we do not know much about how macroeconomic news from China affects the world financial and commodity markets.[1] The only systematic study is a qualitative description of China's economic indicators by Orlik (2011b).[2] We use intraday financial and commodity futures markets data from September 30, 2009 to December 31, 2013 to show that Chinese macroeconomic announcements wield substantial influence over the world markets compared to similar announcements from the U.S. and Japan.

Understanding how Chinese macroeconomic announcements affect asset prices is useful not only for market participants but also for central banks with staff monitoring the world markets to gauge investor views of macroeconomic conditions. For example, our results show that all three announcements related to Chinese manufacturing and industrial output – purchasing manager index (PMI), industrial production (INP) and real gross domestic product (GDP) – move the world stock indices, foreign exchange as well as energy and industrial commodities. On the contrary, news about Chinese domestic consumption measured by Chinese retail sales leaves most markets unaffected. This suggests that the world markets view China's economic news primarily as a barometer of the world economy rather than merely an indicator of China's domestic demand.

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[1] Previous studies have focused on announcements from developed countries. For example, Andersen, Bollerslev, Diebold and Vega (2007), Bauwens, Omrane and Giot (2005), and Hashimoto and Ito (2010) study how markets in developed countries move following U.S., European and Japanese macroeconomic announcements, respectively.

[2] De Pooter, Robitailler, Walker and Zdinak (2014) use a set of six Chinese macro announcements (Consumer Price Index (CPI), GDP, Industrial Production (INP), PMI, Retail Sales and Trade Balance) to study inflation expectation anchoring for Brazil, Chile and Mexico. Using daily data, they conclude that Chinese announcements have no effect on one-year nominal rate in these countries. One-year far-forward inflation compensation is affected only by two announcements (GDP and INP) in one country (Brazil), which the authors attribute to possible statistical noise because the coefficients on these two announcements show opposite signs.

The direction of the market moves also conveys useful information because the market reaction could differ depending on the state of the economy. A positive surprise about Chinese output may drive stock markets up because strong Chinese output will translate into profits for companies in the rest of the world, reflecting global integration in industries such as electronics, where increased production in China not only benefits the Chinese manufacturers but also increases sales of multinational companies.[3] However, a positive surprise may also drive the markets down. The recent global financial crisis brought about a slowdown of the Chinese economy, contributing to GDP growth rate falling from 14.2 percent in 2007 to 9.6 percent in 2008.[4] The Chinese government responded by stimulatory fiscal, monetary and other policies, leading to expansion in investment, credit and real estate sector. While these policies successfully mitigated the shock to the external demand, they also created concerns about an overheating economy, deterioration of credit quality, and overinvestment in the real estate sector (IMF Article IV Reports 2010, 2014). It is, therefore, possible that a positive surprise about Chinese output will drive stock markets down in expectations of tighter macroeconomic policies. In our data, a positive surprise about Chinese output boosts the world stock indices, energy and industrial commodities as well as currencies of commodity exporters (Australia, New Zealand and Canada), suggesting that concerns about policy tightening do not prevail. This stands in contrast to Andersen, Bollerslev, Diebold and Vega (2007) finding that stock market reaction to the U.S. macroeconomic announcements differs across the business cycle with positive surprises causing a negative response in expansions but a positive response in contractions.[5]

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[3] The rising integration of the global economy, where intermediate goods often cross borders multiple times during the manufacturing process, is described by Feenstra (1998). Samuelson (2004) is another seminal study that discusses potential effects that globalization may have on world economies.

[4] World Bank database.

[5] Andersen, Bollerslev, Diebold and Vega (2007) argue that in expansions the discount factor component of the equity valuation prevails compared to the cash flow component due to anti-inflationary monetary policies.

Our findings also add to the literature on the transmission of information across global financial markets. An extensive branch of this literature uses macroeconomic announcements as a proxy for information, and several studies, including Wongswan (2006) and Hausman and Wongswan (2011), have shown that U.S. macroeconomic news moves emerging markets. Our study is the first one to show the transmission in the opposite direction: from macroeconomic announcements in an emerging economy to the world markets. This finding is novel because shocks from emerging economies usually come into the spotlight only in times of crisis. For example, Kaminsky and Reinhart (2000) examine how currency crises are propagated across borders, and Forbes (2004) investigates the effect of the Asian and Russian financial crises on world stock markets. Our results show that there does not have to be a serious crisis for China's emerging economy to rock the world markets; regular, scheduled macroeconomic announcements move them as well.

Finally, our study contributes to the literature that examines whether changes in asset prices can be explained by fundamental factors.[6] Much of this literature uses regressions of asset returns on measures of fundamental news and finds that such regressions tend to have low explanatory power. When researchers are unable to explain price variation by fundamental factors, they often conclude that most of the market volatility is generated by uninformed speculative trading. We show that a part of the price variation unexplained by fundamentals in developed countries can be attributed to day-to-day developments in emerging economies.

Chinese macroeconomic news moves the world markets in spite of concerns about integrity of the data provided by China's government. While Chow (2006) argues that China's data is, for the most part, reliable, other studies have voiced concerns about the quality of

[6] See, for example, Frankel and Meese (1987), Roll (1988), Cutler, Poterba, and Summers (1989), Mitchell and Mulherin (1994), and Boudoukh, Richardson, Shen and Whitelaw (2007).

Chinese data including Koch-Weser (2013), who describes procedures for preparing the national output data, and Sinclair (2012), who studies revisions of economic data. Despite these data quality issues, the world markets do trade on China's most important announcements because it is the best information available to market participants.

2. Methodology

We use the traditional event study methodology of regressing asset returns on the unexpected component of the news announcement.[7] For one announcement and one market, this approach can be represented by the following specification estimated with OLS:

$$R_t = \alpha + \gamma z_t + \varepsilon_t, \tag{1}$$

where R_t is the continuously compounded futures return, defined as the first difference of log futures prices in the intraday event window around the announcement, z_t is the unexpected component of the announcement, or surprise, and ε_t is an i.i.d. error term representing price movements unrelated to the data release.

Because efficient markets react only to the unexpected component of the announcement, the announcement surprise is based on the difference between the actual announcement A_t and the market's expectation of the announcement, $E_{t-\tau}[A_t]$. To convert the announcement surprises to equal units, we standardize them by their respective standard deviations:[8]

$$z_t = \frac{A_t - E_{t-\tau}[A_t]}{\sigma}. \tag{2}$$

[7] In Section 4.8, we also discuss the Rigobon and Sack (2008) identification-through-censoring methodology.
[8] We tested the surprise series, z_t, for autocorrelation. Seven series did not exhibit significant autocorrelation while four series (CPI, Exports, Imports and New Yuan Loans) showed negative autocorrelation and one series (PPI) showed positive autocorrelation. We, therefore, estimated the above regressions with residuals from an AR(1) model used for the surprise, z_t, and computed significance of the coefficients using the HAC standard errors as well as bootstrap standard errors. The results did not materially differ from those reported in the paper. These results are available upon request.

For announcements that are released simultaneously, we extend the above approach and include all simultaneous announcements in the regression to disentangle their effects, as in Balduzzi, Elton and Green (2001):

$$R_t = \alpha + \sum_{i=1}^{I} \gamma_i z_{it} + \varepsilon_t, \quad (3)$$

where $i \in \{1 \dots I\}$ stands for the individual announcements released simultaneously.

3. Data and Background

3.1 China's Macroeconomic Announcements

Data on China's macroeconomic announcements come from the Bloomberg database. Following the previous literature, we use Bloomberg consensus forecasts as a proxy for the market expectations because survey-based forecasts have been shown to outperform forecasts based on past values of macroeconomic variables. The consensus forecast is calculated as the median of individual analyst forecasts.

Table 1 lists all 14 announcements for which Bloomberg forecasts are available.[9] For exposition purposes, we group these announcements into six categories: output, domestic consumption, trade, investment, inflation, and financial and monetary announcements. Our sample period covers 52 months from September 30, 2009 through December 31, 2013.[10] In some months, Chinese macroeconomic announcements are made during weekends, when U.S. futures markets are closed. Due to unavailability of intraday futures data, such observations are

[9] In addition to monthly values, year-to-date values are reported for industrial production and retail sales. We do not list them in Table 1 as they are duplicate announcements. Also, there are several announcements in the Bloomberg database, such as the HSBC Purchasing Manager Index and the Leading Index, for which forecasts are not available. We do not analyze these announcements.

[10] Our sample period begins as of September 30, 2009, which is October 1, 2009 in China Standard Time, because that is the first date when all of the announcements we examine and their respective forecasts are available. Focusing on the most recent period is also desirable for two more reasons. First, Orlik (2011b) and Koch-Weser (2013) note that data reliability has recently improved due to both improved data collection and anti-corruption measures. Second, we avoid structural changes such as China's entry into the World Trade Organization.

removed from the sample. The resulting number of observations is indicated in the tables presenting results for each announcement.

[Insert Table 1 about here]

With the exception of the PMI announcement that is released individually, all other announcements are grouped together in four simultaneous releases. Consumer Price Index (CPI) is announced at the same time as the Producer Price Index (PPI). GDP, INP and Fixed Assets Investment are announced simultaneously with Retail Sales. Foreign Exchange Reserves are announced with New Yuan Loans, Money Supply M1, and Money Supply M2, and Exports and Imports are announced simultaneously with Trade Balance. The two measures of money supply are highly correlated, so we omit Money Supply M1 from our analysis.[11] For the same reason, we omit the Trade Balance announcement as it contains no information beyond Exports and Imports. This leads to a total of 12 announcements that we analyze. The PMI announcement is analyzed using equation (1) and the other announcements, released in four simultaneous group releases, are analyzed using equation (3), leading to a total of five regressions.

Using a test similar to the one in Pearce and Roley (1985), we examine whether Bloomberg consensus forecasts are unbiased. The results, available upon request, show that the null hypothesis of unbiasedness cannot be rejected.

3.2 Announcement Release Procedures and Data Leakage

The process for releasing macroeconomic data in the U.S. is well documented, and strict procedures exist for preventing data leakage ahead of the official releases. For example, Baumohl (2013) describes how the U.S. government agencies restrict the number of employees

[11] Since March 2012, Money Supply M0 has also been announced simultaneously with these announcements. Until June of 2011, the CPI and PPI announcements were released simultaneously with the GDP, INP, Fixed Assets Investment and Retail Sales announcements.

with access to macroeconomic data and manage special "lock-up rooms" where journalists can preview the data ahead of time but are prohibited to communicate with the outside world during the lock-up period.[12] According to Orlik (2011b), the process in China differs. For example, he describes a routine procedure that involves releasing GDP data to numerous journalists 10 to 15 minutes before the data is made publicly available, with the journalists allowed to communicate with the outside world during this period.

In addition to these early releases by the official government agencies, the macroeconomic data is also subject to possible leakage by the government personnel. China Business Focus described in August 2011 that some financial institutions attempt to establish relationships with government officials by offering them positions such as honorary chairmen or other roles within their companies hoping to gain access to macroeconomic data ahead of the official releases. Wall Street Journal on June 21, 2011 argued that the Chinese news organizations also contribute to the leakage by competing to publish the news ahead of the official release. For example, Bloomberg Businessweek noted on April 21, 2011 that the CPI was reported in the media before the official release in five out of the previous six months. In mid-2011, the Chinese government took steps to reduce data leakage by decreasing the number of officials who have advance access to the data and shortening the time lag between data finalization and release. China has also attempted to crack down on data leakage by jailing two former government officials for leaking data, as reported by Bloomberg News on October 24, 2011.

These early releases and data leakage may explain why the markets tend to move prior to the time of the public release. Figure 1 provides an example of such a move for the crude oil

[12] Andersson, Overby and Sebestyen (2009) investigate whether macroeconomic announcements made by Belgium, Euro area, Germany, France, Italy, Spain, U.K. and U.S. appear in the news before the official scheduled time using news wire data and find that only one out of 44 announcements (German unemployment) appears in the news early.

futures market on April 14, 2013, when the markets were expecting the simultaneous announcement of China's GDP, INP, Fixed Assets Investment and Retail Sales scheduled to be released at 22:00 Eastern Time. The announced growth rate in Retail Sales matched the market expectations based on the Bloomberg consensus forecasts. However, the GDP, INP and Fixed Assets Investment data came below expectations. Figure 1 shows that the decline in the crude oil nearby contract futures price (top panel) as well as an increase in trading activity measured as the number of 1,000-barrel contracts (bottom panel) started about 15 minutes prior to the official release time.[13] We discuss in Section 4.7 how the early releases and data leakage may lead to understating our results since announcements that seemingly do not move the markets might actually be moving them before our event window.

[Insert Figure 1 about here]

3.3 Futures Returns

To investigate the effect of China's macroeconomic announcements on the world markets, we use intraday futures prices and volumes at 5-minute intervals for a variety of assets including stock index, foreign exchange, and energy, metal and agricultural commodities.[14] Because China's macroeconomic announcements take place during China's business hours, which coincide with nighttime in the U.S. (and early morning in Europe) as shown in Figure 2, we analyze only futures markets open at that time.

[Insert Figure 2 about here]

[13]The one percent decline in the crude oil futures price within the 20-minute window is a sizable price move. For comparison, the standard deviation of daily (close-to-close) returns during our sample period is about 1.7 percent. The one percent price move is especially large for the nighttime period (in Eastern Time) when volatility is relatively low compared to daytime period (in Eastern Time). The increase in volume in Figure 1 is also substantial. For example, trading volume around the Chinese GDP announcements with one-standard deviation surprises triples during our sample period, compared to almost no change in trading activity around the Japanese GDP announcements.

[14] The futures market data are obtained from Genesis Financial Technologies.

For each asset category, we include multiple markets, as listed in Table 2. For stock indices, we use the E-mini S&P 500, E-mini Nasdaq-100 and E-mini Dow, the three largest U.S. equity index futures products traded on the Chicago Mercantile Exchange (CME) Globex electronic platform.[15] We also include stock index futures for Japan, Taiwan, Hong Kong, and Australia to study the effect on the Asia-Pacific region. We exclude stock index futures for other countries such as Canada, Germany, France and the United Kingdom because they do not trade during the hours when China's macroeconomic announcements are made.[16]

[Insert Table 2 about here]

For commodities, we include energy, metal and agricultural commodities. Crude oil is the largest energy commodity and China ranked as the second largest consumer and net importer in 2011.[17] Copper and silver are the two industrial metal futures markets with the largest open interest on the CME, and China imports the highest volume of copper and large quantities of silver primarily used in industrial applications.[18] In agricultural commodities, China dominates the soybean market with 62 percent of world trade. China has not comprised a large percentage of world trade in the corn and wheat markets (3 percent and 2 percent in 2012, respectively) but it accounts for 24 percent and 28 percent of world consumption, respectively, according to the U.S. Department of Agriculture. In cotton, an input in the textile industry, China is the world's largest importer, accounting for 43 percent of world trade in 2012.[19]

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[15] We include multiple stock indices to ensure our results are not specific to a particular type of stock index but instead hold for stock markets in general.

[16] The U.K. FTSE-100 stock index futures have been trading during the time when most Chinese announcements are made only since mid-2011. The results, available upon request, are similar to the reported U.S. stock index results.

[17] Energy Information Administration of the U.S. Department of Energy.

[18] There are other metal commodities, for example, iron and steel, important for the world economy. However, these commodities are either not traded on the CME futures market or their trading activity is too low to allow analysis.

[19] Among the markets we analyze, cotton is the only futures market that is closed when some of China's macroeconomic announcements are released, since it does not trade from 14:30 to 21:00 ET. Announcements made before 21:00, including several PMI observations, are omitted from estimation of regressions for cotton. For

From foreign exchange futures markets, we include the Australian dollar, New Zealand dollar and Canadian dollar, considered commodity currencies as these countries rely heavily on commodity exports.[20] Also included are the British Pound, Euro and Japanese Yen that, along with the Australian dollar, rank as the four most actively traded currency futures contracts on Globex. All these foreign exchange contracts are denominated in U.S. dollars per unit of the foreign currency. In addition, to analyze the effect on the U.S. dollar, we include the U.S. Dollar Index futures that represent the value of U.S. dollar against a basket of world currencies.[21]

We compute continuously compounded returns in an intraday event window surrounding the announcement using 5-minute prices of the nearby futures contract. The nearby contract becomes relatively illiquid in its last few days of trading. Therefore, we switch to the next-to-mature contract when its daily contract volume exceeds the nearby contract volume. As Figure 3 shows, there is significant trading volume around the three output announcements (PMI, INP and GDP) even though their timing coincides with the U.S. nighttime.

[Insert Figure 3 about here]

The futures returns used in regression analysis are computed in the event window from 10 minutes before to 10 minutes after the announcement time, since the cumulative average

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announcements made at 21:00, we calculate the event window return for cotton futures using the 14:30 and 21:10 ET prices.

[20] For example, considering the top ten 2011 export categories at the Harmonized Commodity Description and Coding System 4-digit level from the United Nations Comtrade and World Bank databases, commodity exports comprised 13 percent, 9 percent and 14 percent of GDP in Australia, Canada and New Zealand, respectively, compared to only 1 percent in the U.S. Also, Chen and Rogoff (2003) show that the real exchange rates of Australia and New Zealand are strongly affected by world commodity prices. The short-run co-movement between the real exchange rate and commodity prices is somewhat weaker for Canada, but there is evidence of a long-run cointegrating relation between the Canadian dollar exchange rate and commodity prices.

[21] In the foreign exchange markets, *spot* markets are also open when the Chinese announcements occur. We have analyzed the six currencies for which we have intraday spot data (Australian dollar, New Zealand dollar, Canadian dollar, Euro, British Pound and Japanese Yen). The results are similar to the futures markets results and available upon request. We additionally included the Japanese Yen-Australian dollar spot exchange rate. A stronger than expected PMI led to a decline in the Japanese Yen value relative to the Australian dollar. We also analyzed the spot exchange rate of the Chinese yuan to the U.S. dollar because the Chinese yuan futures did not start trading on the CME until February 2013. This exchange rate did not change on many days in our sample period and did not appear to be moved by Chinese macroeconomic announcements.

return (CAR) graphs presented in Figure 4 indicate that most of the announcement impact occurs in this 20-minute window.[22] The CARs are presented separately for positive and negative surprises. The stock index, commodity and foreign exchange markets for commodity currencies such as the Australian dollar tend to rise when the announcement surprise is positive and fall when the announcement surprise is negative, suggesting that stronger than expected Chinese output boosts these markets. The figure shows that the price impact of the news appears to be permanent. Interestingly, the figure indicates that the markets start moving in the "right" direction even before the announcement is made, as suggested by the example in Figure 1.[23,24]

[Insert Figure 4 about here]

4. Empirical Results

4.1 Manufacturing Purchasing Manager Index

Along with the GDP announcement, the PMI exerts the strongest influence on the markets. The PMI is prepared by the China Federation of Logistics and Purchasing (CFLP) in cooperation with the National Bureau of Statistics (NBS) and reported on the first day of the month. Fashioned after purchasing manager indices in other countries, it is constructed based on data from a survey of manufacturing businesses that covers aspects such as new orders, production, and inventory. On a scale of 0 to 100, a score above 50 indicates an improving economy, whereas a score below 50 means a worsening economy compared to the previous month.

[22] We describe robustness checks with wider windows in Section 4.7.
[23] As discussed in Section 3.2, these pre-announcement price drifts may be explained by early releases and data leakage. An alternative explanation proposed by Kurov, Sancetta, Strasser and Wolfe (2015) is that some traders are able to construct superior forecasts of the announcements by analyzing public information or collecting proprietary information.
[24] We conducted tests of statistical significance of the CARs shown in Figure 4 after aggregating the CARs across the three output announcements. The CARs in the 30-minute window before the official announcement time are significant in most cases. These results are available upon request.

The PMI moves prices in all asset categories, as summarized in Table 3. In the stock markets, a one-standard-deviation PMI positive surprise increases the E-mini S&P 500 futures price by 0.10 percent, with the PMI surprises explaining 45 percent of the price variation in the announcement window.[25] The effect on the crude oil market is also strong with a coefficient of 0.11, suggesting that a higher than expected PMI will translate into a stronger economy, with higher demand for crude oil pushing oil prices up. The PMI announcement also moves the metals markets, with coefficient estimates of 0.18 and 0.06 for copper and silver, respectively. This agrees with Roache (2012) who documents a prominent role played by China in the metals markets using a structural supply-demand framework. Interestingly, our results differ from the findings of Elder, Miao and Ramchander (2012) who analyze the effect of 20 U.S. macroeconomic announcements on metals futures prices. They find that announcements reflecting an unexpected improvement of the economy have a positive effect on copper but a negative effect on silver, possibly because an unexpected improvement of the economy makes investors switch from silver to other assets such as stocks. Our results show that both copper and silver react positively to news indicating the Chinese economy is stronger than expected, suggesting that investors consider silver an input in production.[26] Among all markets, cotton, used as an input in the textile industry, reacts the strongest with a coefficient estimate of 0.32. Agricultural commodities used in the food industry (corn, soybeans and wheat) show no significant reaction to the PMI news.

[Insert Table 3 about here]

[25] The coefficients on the Japanese and Taiwanese markets are estimated less precisely perhaps because the PMI announcement is released soon after these markets open when volatility is especially high. However, both coefficients have the same positive sign as the corresponding estimates for U.S. and Australian markets.
[26] According to a study of the Chinese silver market, industrial uses account for most of China's silver demand: https://www.silverinstitute.org/site/wp-content/uploads/2012/12/ChineseSilverMarket2012.pdf.

In the foreign exchange markets, the PMI's strongest effect is on the commodity currencies of Australia, Canada and New Zealand. Positive coefficients suggest that a higher than expected Chinese PMI translates into a higher demand for commodities, leading to appreciation of commodity currencies. In contrast to the commodity currencies, the Japanese Yen shows a negative sign, reflecting an unfavorable impact of rising imported commodity prices on which Japan depends. The effect on the U.S. Dollar Index is not significant, perhaps reflecting a combination of complex factors including the U.S. exports of commodities such as cotton, U.S. imports of commodities such as crude oil, global economic conditions, and expectations of U.S. and Chinese monetary policy changes.

The PMI probably exerts the strongest influence of all China's macroeconomic announcements for several reasons. The PMI is released on the first day of the month, making it the first major Chinese economic news release received by the markets about the previous month. This agrees with Andersen, Bollerslev, Diebold and Vega (2003) who study the effect of German and U.S. macro announcements in the foreign exchange markets, and show that announcements released earlier in the month move markets more than announcements released later in the month. Second, with questions about business aspects such as new orders that will translate into stronger industrial activity in the upcoming months, it is more forward-looking than other announcements such as the quarterly announcement on Foreign Exchange Reserves. Third, it is the only Chinese macroeconomic announcement that has a direct competitor. Every month, Markit, a financial information services firm, publishes the HSBC purchasing manager indices for over 30 countries, including China. Although the sample of firms differs, with more small and medium-size companies in the HSBC PMI compared to China's own PMI that emphasizes larger state-owned companies, the HSBC PMI represents a competitor that puts additional

pressure on the CFLP and NBS to report accurately. Finally, since the PMI involves surveying firms directly, it lessens the influence of local government officials misreporting statistics, an issue that has been known to occur with other announcements (Orlik, 2011a).

4.2 Industrial Production and Real Gross Domestic Product

The Industrial Production (INP) announcement provides a report of industrial output broken down by sectors such as textiles and telecommunication equipment, as well as by-products such as steel and cement. It is announced by the NBS simultaneously with Retail Sales and Fixed Asset Investment on or around the 11th day of each month, i.e., ten days after the PMI release. The January, April, July and October releases are delayed until the 15th day of the month to be released simultaneously with the quarterly GDP announcement. The GDP announcement offers a more comprehensive view of China's economy than the PMI and INP announcements, although its quarterly releases provide less timely information.[27] Despite data quality issues documented by Sinclair (2012) and Koch-Weser (2013), among others, the GDP announcement exerts substantial influence on all asset categories, with coefficient magnitudes in Table 4 similar to those for the PMI, albeit at lower significance levels. Copper and silver futures markets move even more after the GDP announcements than after the PMI announcements.

[Insert Table 4 about here]

The INP announcement ranks third after the PMI and GDP announcements in the effect on the markets. It moves the markets in the same direction as the PMI and GDP. Specifically, a higher than expected INP increases the stock index and commodity futures prices. However, compared to the PMI, the impact is smaller, perhaps because this announcement lags the PMI

[27] The number of observations in Table 4 reflects the number of simultaneous monthly announcements for INP, Retail Sales and Fixed Asset Investment. In January, April, July and October, GDP is released at the same time requiring a joint model of all four announcements. In the non-quarter-end months, we use zero surprise for the GDP.

announcement by almost two weeks. Also, as Orlik (2011b) points out, the breakdown into products may actually cause strong industrial production to have a dampening effect on the world economy. For example, strong steel production often means that China's excess steel will flood the world markets, lowering production elsewhere.

4.3 Chinese Announcements as a Barometer of Global Economic Conditions

With all three output related announcements moving the markets, the question remains whether the output reflects rising Chinese domestic demand or demand for Chinese products from the rest of the world. Therefore, we analyze the effect of Chinese retail sales announcements, the best available measure of Chinese domestic consumption.[28] As Table 4 shows, this announcement does not move the U.S. stock, foreign exchange, energy or metal commodity futures markets. With consumption accounting for only 34 percent of China's GDP from 2009 to 2012 compared to 71 percent in the U.S., announcements reflecting the state of China's domestic consumption may be less important for these world markets.

A story then emerges of the markets viewing China's economic announcements primarily as leading indicators of the world economy rather than merely of China's domestic demand. China is a key link in the global value chain. Acting as the world's manufacturing center, China imports materials and intermediate inputs, and exports finished products. Much of the value added of these products comes from other countries in the supply chain.[29] Therefore, indicators of China's real economic activity indirectly reveal the strength of the world economy rather than merely of China's domestic demand, serving as a barometer of the world demand.

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[28] Orlik (2011b) discusses the differences between retail sales and consumption. For example, the retail sales include goods but exclude services while consumption includes both goods and services.

[29] For example, Xing and Detert (2010) show that Chinese manufacturing accounts for less than 4% of the total cost of making an iPhone. The bulk of the cost is represented by components made in many other countries. Most of the profit is captured by Apple.

However, the growing importance of Chinese domestic demand shows in the Chinese Retail Sales announcements having a significant effect on Japanese, Hong Kong and Australian stock markets in the Asia-Pacific region, perhaps due to their geographic proximity and strong trade links with China.[30] This is also the case for two of the three agricultural food markets (corn and soybeans), perhaps because higher than expected retail sales are likely to translate into higher purchases of food products. The effect is, however, fairly small, as most food consumption is non-discretionary.

4.4 Comparison with Similar U.S. and Japanese Announcements

To put the magnitudes of the coefficients reported in Tables 3 and 4 in perspective, we compare the effect of Chinese announcements to the effect of U.S. and Japanese announcements. We select the most similar announcements for this comparison. It must be noted, however, that the announcement sets are not identical across countries. For example, the survey samples used to construct the manufacturing indices differ across countries. In the U.S., a purchasing manager index compiled monthly by the Institute of Supply Management (ISM) and known as the ISM Manufacturing Index has the closest resemblance to the Chinese PMI. Table 5 shows the results for the U.S. PMI announcement that in our sample period is the second most important macroeconomic announcement in the U.S., following the U.S. non-farm employment announcement.[31] A one standard deviation surprise in the U.S. PMI leads to a 0.26 percent increase of the E-mini S&P 500 futures price, with the news explaining about 41 percent of the price variation in the announcement window. This comparison shows the impact of China's PMI

[30] We also analyzed the effect of the announcements on the Chinese stock market. The majority of the announcements we analyze are released either when the Chinese stock market is closed or during the opening minutes. We, therefore, analyzed daily close-to-close returns on the Shanghai Stock Exchange Composite Index. This analysis showed that the Industrial Production and Retail Sales announcements move the Chinese stock prices.

[31] We examined 31 U.S. announcements considered most important by previous studies and financial press. The U.S. PMI announcement ranks second in the average impact on stock index, foreign exchange and commodity futures markets. These results are available upon request.

announcement is sizeable: more than a third of the impact of the U.S. PMI. In addition, as discussed in Section 4.5, the market response to China's PMI appears to have increased over the sample period, raising the relative importance of Chinese announcements.

[Insert Table 5 about here]

The impact of Chinese announcements on commodity markets is again substantial compared to that of the U.S. announcements. In the crude oil market, the effect of China's PMI announcement is about half that of the U.S. PMI announcement while in the copper and silver markets, the effect of China's PMI exceeds that of the U.S. PMI. Underscoring the power that China wields in the commodity currency markets, in the Australian dollar and New Zealand dollar markets, the impact of China's PMI is twice as strong as that of the U.S. PMI.

A comparison of the market response to Chinese, U.S. and Japanese GDP and Industrial Production announcements produces qualitatively similar conclusions. For example, a one standard deviation Chinese GDP surprise leads to 0.25 percent increase in copper prices, exceeding the effect of the U.S. GDP announcement. Mirroring its strong effects on copper and silver prices, China's GDP announcement also beats the U.S. GDP announcement in the impact on the Australian dollar and Canadian dollar markets. It also moves the crude oil and U.S. stock markets with approximately the same force as the U.S. GDP announcement. The effect of China's GDP announcement also surpasses that of Japan's GDP announcement by a factor of two or more in all markets.[32] Similarly, the effect of the Chinese Industrial Production announcement on the equity, commodity and commodity currency markets is at least as strong as

[32] The comparison of Chinese to Japanese announcements is used to control for market liquidity since both Chinese and Japanese announcements are released during U.S. nighttime. However, caution again needs to be exercised when comparing announcements across countries. China releases only one GDP announcement whereas Japan releases two GDP announcements (Preliminary and Final) and the U.S. releases three GDP announcements (Advance, Preliminary and Final).

the effect of comparable U.S. announcement and generally stronger than the impact of the corresponding Japanese announcement.

4.5 Time Trend

Since China's relative importance in the world economy has been increasing, we investigate whether the impact of Chinese macroeconomic announcements on the world markets has also increased. Figure 5 shows time-varying responses of the E-mini S&P 500, Nikkei 225, Australian dollar and crude oil futures to the PMI announcement. These coefficients are estimated using a rolling OLS regression with a window of 17 observations. Since the total number of observations for PMI in our sample is 35, we can interpret the beginning (ending) value of the response coefficients shown in Figure 5 as the average responses to the PMI announcement in the first (second) half of the sample period. The figure shows that all four markets have become more responsive to PMI news since mid-2011.

[Insert Figure 5 about here]

This rolling regression by itself does not tell us whether the changes are statistically significant, so we test for statistical significance of a change in the slope by estimating our model with an interactive term that interacts the surprise term with a dummy equal to one before a given date. We have used different breakpoints. For example, we used April 15, 2011 because this was the date when the Chinese government announced its decision to crack down on data leakage as reported by Bloomberg News and other media. The results, available upon request, showed evidence of a stronger market response to the PMI, GDP and INP announcements in six, eleven and eight markets, respectively. We find no evidence of a rising market response to comparable U.S. and Japanese announcements, which would suggest that the importance of Chinese announcements relative to announcements from the largest and third largest economies

has increased over our sample period. However, it is important to note that these sub-sample tests are based on short sample periods, and time-variation does not appear in all markets and all announcements, perhaps for the reasons discussed in Sections 4.6 and 4.7.

4.6 Exports and Imports Announcement

As reported in Table 6, the effect of the export announcement is significant only for U.S. stock markets, the Hang Seng (Hong Kong) stock market and cotton market, and the magnitude and significance of these coefficients are low when the entire sample period is considered. However, the split-sample testing shows that the magnitude and significance have become stronger in the recent period, and other markets such as foreign exchange and cotton also move following the exports announcements.[33]

Higher than expected exports can have two opposing effects. On the one hand, higher than expected Chinese exports – imports into the U.S. and other developed countries – increase the current account deficit in these countries, which could dampen the world markets. On the other hand, higher than expected exports signal rising demand in the developed world. This latter effect prevails in our data: similarly to the output announcements, the export announcements appear to act as a barometer of global economic conditions and boost the markets.

[Insert Table 6 about here]

4.7 Other Announcements

The results for the other Chinese macroeconomic announcements that we examine are reported in Tables 7 and 8. With some exceptions, these announcements appear to have little effect on financial and commodity futures returns. We question why this is the case. It needs to be pointed

[33] The reason that this trend began only recently is possibly due to the exports data previously being questionable as Chinese exporters were suspected of misreporting shipments to avoid financial capital controls and gain tax rebates, a practice that the Chinese government recently cracked down on (BBC, 2013, and Sevastopulo and Hornby, 2013).

out that even studies of the U.S., European and Japanese macroeconomic news find many insignificant announcements.[34] For example, Elder, Miao and Ramchander (2012) analyze the effect of 20 U.S. macroeconomic announcements on metals futures markets and find that only six or seven announcements move the prices. The 20 announcements they examine are already a selected subset of U.S. macroeconomic news announcements considered the most important. It is, therefore, not surprising to find that some Chinese announcements also do not move markets.

[Insert Table 7 about here]

[Insert Table 8 about here]

Several possible explanations exist. First, although the data release process is said to be improving, issues with early releases and data leakage persist as discussed in Section 3.2. We attempt to capture some of this effect by analyzing an event window that starts 10 minutes prior to the official release. We also conducted robustness checks with wider windows, for example, from 20 minutes before to 20 minutes after the announcement. Overall, the model R-square decreases as the window expands since the ratio of "signal", i.e., news, to noise decreases.[35] However, it needs to be noted that our results may be understated due to early releases and leaks occurring prior to our event window. For example, Orlik (2011a) describes an inflation announcement released on January 21, 2010 showing an unexpected increase in inflation. The

[34] Among the inflation, financial and monetary announcements, CPI is the only one that has a slight effect on returns in a few markets. The response coefficients are negative suggesting that the expectation of China's anti-inflation monetary policy reaction prevails (Girardin, Lunven and Ma, 2012). An example of an announcement that does not move the markets is Fixed Assets Investment since it reflects longer-term investment opportunities with often uncertain future outcomes.

[35] These results agree with previous studies showing that markets adjust within a few minutes of the announcement. For example, Andersen, Bollerslev, Diebold and Vega (2007) report that global stock, bond and foreign exchange markets are affected only within the first five minutes after the announcement.

market reaction was muted but Orlik (2011a) points out that the markets already fell on January 20, 2010 and suggests that the data had leaked earlier.[36]

Second, using the median values from surveys of professional forecasters as proxies for the market expectations can introduce noise into the measurement of surprise as discussed in Section 5. Third, a given announcement may contain both good and bad news. For example, a higher than expected inflation announcement may bundle good news of the economy expanding faster than expected with expectations of a more contractionary monetary policy, pulling the markets in the opposite direction. Fourth, the effect that announcements exert on world markets may differ with circumstances, as noted by Wongswan (2006). This state-dependence can mute the impact on returns measured by our regressions. Therefore, we analyze the effect of announcement surprises on market volatility and trading volume, as Wongswan (2006) suggests. Table 9 shows that some announcements that do not appear significant in the returns regressions, such as inflation announcements, cause volatility and trading volume to be higher on announcement days compared to non-announcement days, indicating that perhaps even these announcements move the markets.

[Insert Table 9 about here]

4.8 Identification-through-Censoring Technique

In addition to the OLS results presented above, we apply the Rigobon and Sack (2008) identification-through-censoring (ITC) technique for analyzing the effect of news announcements on prices. Rigobon and Sack (2008) point out that the OLS estimate of the response coefficient is biased downward because the announcement surprise contains a

[36] Griffin, Kelly and Hirschey (2011) show that the reaction of stock returns to major firm-specific news is much weaker in emerging markets than in developed markets. They provide evidence that this difference is primarily due to prevalence of insider trading in emerging markets.

measurement error due to the forecasts coming from an unrepresentative sample of analysts, forecasts being out of date by the time the announcement is made, or imprecise data released by the government. Using the fact that both the true surprise and the measurement error are "censored" on non-announcement days, Rigobon and Sack (2008) propose the ITC technique for adjusting coefficient estimates for such measurement error bias and identifying the market response to the true surprise.

Our limited sample size does not allow estimating the ITC model when more than two announcements occur simultaneously. However, we are able to apply the ITC technique for the PMI (announced individually), CPI announced with PPI, and Exports announced with Imports. The results, available upon request, show that, for example, in the U.S. stock index futures markets, the ITC estimates of the PMI effect are almost 50 percent higher than the OLS estimates, and the CPI and Exports announcements appear to be much more important than the OLS estimates suggest. Given this finding, it is possible that the market response to the GDP and INP announcements is also stronger than indicated by our OLS estimates.

5. Summary and Conclusions

Rare and severe negative shocks originating in emerging economies have been shown to rock the world markets. We argue that events in emerging economies do not have to escalate into crises to move markets. We illustrate this by studying 12 regular, scheduled macroeconomic news releases made by China from September 30, 2009 to December 31, 2013. We find that all three announcements reflecting the strength of China's manufacturing and industrial output (Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production) move financial and commodity futures markets. Positive surprises in these three

macroeconomic indicators boost the stock index, commodity, and foreign exchange markets for commodity currencies while dampening the currencies of commodity importers. These findings agree with anecdotal evidence from the business press that brings headlines such as "Copper Weakens for Second Day as China's Manufacturing Slows" by Bloomberg Businessweek on April 30, 2013 and "Bernanke and China Send World Stocks Lower" by CNN on June 20, 2013. At the same time, announcements such as Retail Sales that provide the best available information about China's domestic consumption do not move most of the world markets. Thus, our results are consistent with the markets looking to China's macroeconomic announcements primarily as a leading indicator of global economic conditions rather than merely of China's domestic demand. The story of China as a barometer of global demand is reinforced by higher than expected Exports announcements boosting the world markets, which also suggests that the markets do not focus on the effect of Chinese Exports announcements on current account deficits of China's trading partners.

With China's economy continuing on its growth trajectory, it will be interesting to see how the impact of Chinese announcements evolves in the future. If China is successful in improving data quality and curbing data leakage, the announcements could become even more significant. Extending the sample period would also allow studying state dependence, which is important in view of the Andersen, Bollerslev, Diebold and Vega (2007) findings of different market reactions across business cycle stages. Furthermore, a longer sample period would enable fully implementing the Rigobon and Sack (2008) ITC technique for analyzing the effect of news announcements on prices, which would be interesting because our preliminary ITC results indicate a downward bias in the OLS estimates.

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Table 1
Summary Information for Chinese Macroeconomic Announcements

Announcement	Abbreviation	Category	Frequency	Day of the Month when Announcement is Usually Released[a]	Units	Source[b]
Real GDP (YoY)	GDP	Output	Quarterly	15th	%	NBS
Industrial production (YoY)	INP	Output	Monthly	11th	%	NBS
Manufacturing purchasing manager index	PMI	Output	Monthly	1st	Index (0 to 100)	CFLP & NBS
Consumer price index (YoY)	CPI	Inflation	Monthly	11th	%	NBS
Producer price index (YoY)	PPI	Inflation	Monthly	11th	%	NBS
Retail sales (YoY)	RES	Consumption	Monthly	11th	%	NBS
Exports (YoY)	EXP	Trade	Monthly	10th	%	GAC
Imports (YoY)	IMP	Trade	Monthly	10th	%	GAC
Trade balance[e]	TRB	Trade	Monthly	10th	USD billion	GAC
Fixed assets investment (YoY)	FAI	Investment	Monthly	11th	%	NBS
New yuan loans	NYL	Financial	Monthly	10th-15th	Yuan billion	PBOC
Foreign exchange reserves	FER	Financial	Quarterly	10th-15th	USD billion	PBOC
Money supply M1 (YoY)[c]	M1	Monetary	Monthly	10th-15th	%	PBOC
Money supply M2 (YoY)	M2	Monetary	Monthly	10th-15th	%	PBOC

[a] In January, April, July and October, the INP, Fixed Asset Investment and Retail Sales announcements are made on the 15th day of the month to be released simultaneously with the quarterly GDP release. Also, release dates sometimes vary from the above schedule.
[b] China Federation of Logistics and Purchasing (CFLP), General Administration of Customs (GAC), National Bureau of Statistics (NBS), and People's Bank of China (PBOC).
[c] Money supply M1 (YoY) and Trade Balance announcements are excluded from our analysis since they are highly correlated with Money supply M2 (YoY), and Exports (YoY) and Imports (YoY), respectively.

Table 2
Summary Information for Futures Markets

	Contract Symbol	Exchange[a]	Trading Hours (Eastern Time)
Stock Index Futures			
E-mini S&P 500	ES	CME	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
E-mini Nasdaq-100	NQ	CME	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
E-mini Dow	YM	CBOT	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
Nikkei 225 (Japan)	NK	SGX	Vary depending on U.S. daylight saving time
MSCI Taiwan	TW	SGX	Vary depending on U.S. daylight saving time
Hang Seng (Hong Kong)	HS	HKFE	Vary depending on U.S. daylight saving time
SPI 200 (Australia)	AP	SFE	Vary depending on U.S. and local daylight saving time
Foreign Exchange Futures			
Australian dollar	6A	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
New Zealand dollar	6N	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
Canadian dollar	6C	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
Euro	6E	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
British Pound	6B	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
Japanese Yen	6J	CME	Su 18:00 – Fr 17:00 with 1-hour breaks starting at 17:00
U.S. Dollar Index	DX	ICE	Su 18:00 – Fr 17:00 with 3-hour breaks starting at 17:00
Commodity Futures			
Crude Oil	CL	NYMEX	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
Copper	HG	COMEX	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
Silver	SI	COMEX	Su 18:00 – Fr 17:15 with 45-minute breaks starting at 17:15
Cotton	CT	ICE	Su 21:00 – Fr 14:30 with breaks from 14:30 to 21:00
Corn	ZC	CBOT	Mo–Fr 9:30–14:15 & Su–Fr 20:00–8:45
Wheat	ZW	CBOT	Mo–Fr 9:30–14:15 & Su–Fr 20:00–8:45
Soybeans	ZS	CBOT	Mo–Fr 9:30–14:15 & Su–Fr 20:00–8:45

[a] Chicago Board of Trade (CBOT), Chicago Mercantile Exchange (CME), Commodity Exchange (COMEX), IntercontinentalExchange (ICE), New York Mercantile Exchange (NYMEX), Singapore Exchange (SGX), Hong Kong Futures Exchange (HKFE), Sydney Futures Exchange (SFE). All CBOT, CME, COMEX and NYMEX contracts are traded on the CME's Globex electronic platform. U.S. Dollar Index and cotton futures contracts are traded on the ICE electronic platform.

Table 3
Response of Futures Prices to the Manufacturing Purchasing Manager Index (PMI) Announcement

	N	PMI	R^2
Stock Index Futures			
E-mini S&P 500	35	0.10 (0.02)***	0.452
E-mini Nasdaq-100	35	0.10 (0.03)***	0.463
E-mini Dow	35	0.09 (0.02)***	0.467
Nikkei 225 (Japan)	35	0.07 (0.05)	0.101
MSCI Taiwan	31	0.09 (0.08)	0.091
SPI 200 (Australia)	32	0.12 (0.04)**	0.213
Foreign Exchange Futures			
Australian dollar	35	0.12 (0.03)***	0.410
New Zealand dollar	35	0.09 (0.02)***	0.313
Canadian dollar	35	0.04 (0.01)***	0.309
Euro	35	0.03 (0.01)***	0.171
British Pound	35	0.03 (0.01)***	0.381
Japanese Yen	35	-0.04 (0.02)**	0.123
U.S. Dollar Index	35	-0.01 (0.01)	0.042
Commodity Futures			
Crude Oil	35	0.11 (0.02)***	0.552
Copper	35	0.18 (0.04)***	0.356
Silver	35	0.06 (0.03)**	0.189
Cotton	18	0.32 (0.14)**	0.240
Corn	33	0.04 (0.06)	0.013
Wheat	33	0.06 (0.08)	0.019
Soybeans	33	0.06 (0.04)	0.033
Standard deviation of surprise		0.845	

The table shows the estimated responses of futures returns to unexpected changes in the Manufacturing Purchasing Manager Index (PMI). The Hang Seng (Hong Kong) index futures are excluded because they do not trade at the time of the PMI announcements. The sample period is from September 30, 2009 through December 31, 2013. The number of observations varies across the futures markets due to different trading hours. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The coefficients represent the effects of a one standard deviation surprise. In the foreign exchange markets, a positive coefficient signifies currency appreciation. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4
Response of Futures Prices to the Real Gross Domestic Product, Industrial Production (Value Added of Industry), Retail Sales, and Fixed Asset Investment Announcements

	N	GDP	Industrial Production	Retail Sales	Fixed Asset Investment	R^2
Stock Index Futures						
E-mini S&P 500	42	0.09 (0.04)**	0.06 (0.02)**	0.03 (0.02)	0.03 (0.02)	0.131
E-mini Nasdaq-100	42	0.08 (0.04)**	0.05 (0.02)**	0.02 (0.02)	0.02 (0.02)	0.093
E-mini Dow	42	0.07 (0.03)**	0.06 (0.02)**	0.02 (0.02)	0.02 (0.02)	0.097
Nikkei 225 (Japan)	41	0.06 (0.04)	0.10 (0.03)***	0.05 (0.02)*	-0.01 (0.03)	0.234
MSCI Taiwan	41	0.11 (0.04)**	0.04 (0.02)	-0.03 (0.03)	-0.01 (0.03)	0.205
Hang Seng (Hong Kong)	40	0.13 (0.08)	0.17 (0.05)***	0.11 (0.05)**	0.01 (0.05)	0.201
SPI 200 (Australia)	39	0.07 (0.05)	0.12 (0.04)***	0.13 (0.04)**	0.05 (0.04)	0.180
Foreign Exchange Futures						
Australian dollar	42	0.11 (0.05)**	0.07 (0.02)***	0.03 (0.02)	0.05 (0.03)**	0.288
New Zealand dollar	42	0.07 (0.06)	0.07 (0.02)***	0.04 (0.03)	0.05 (0.03)	0.201
Canadian dollar	42	0.06 (0.03)**	0.02 (0.01)*	0.004 (0.01)	0.01 (0.01)	0.227
Euro	42	0.05 (0.02)**	0.02 (0.01)*	-0.002 (0.01)	0.01 (0.01)	0.279
British Pound	42	0.03 (0.01)*	0.02 (0.01)***	0.01 (0.01)	0.004 (0.01)	0.244
Japanese Yen	42	-0.05 (0.03)*	-0.04 (0.01)**	-0.02 (0.01)	-0.01 (0.01)	0.256
U.S. Dollar Index	42	-0.04 (0.02)**	-0.02 (0.01)*	0.002 (0.01)	-0.01 (0.01)	0.210
Commodity Futures						
Crude Oil	42	0.13 (0.08)*	0.08 (0.03)**	0.04 (0.03)	0.05 (0.03)	0.271
Copper	42	0.25 (0.10)**	0.05 (0.04)	0.01 (0.04)	0.03 (0.04)	0.244
Silver	42	0.23 (0.13)*	0.11 (0.04)***	0.02 (0.03)	0.08 (0.06)	0.338
Cotton	39	0.19 (0.08)**	-0.08 (0.05)	0.02 (0.05)	-0.05 (0.04)	0.123
Corn	42	0.01 (0.03)	0.04 (0.02)**	0.03 (0.02)*	0.01 (0.01)	0.079
Wheat	42	0.01 (0.03)	0.01 (0.02)	0.03 (0.02)	0.03 (0.01)**	0.046
Soybeans	42	0.04 (0.03)	0.05 (0.02)**	0.04 (0.02)**	0.003 (0.02)	0.197
Standard deviation of surprise		0.21%	1.23%	1.36%	0.48%	

The table shows the estimated responses of futures returns to unexpected changes in the Real Gross Domestic Product, Industrial Production (Value Added of Industry), Retail Sales, and Fixed Asset Investment. These announcements are made simultaneously. The sample period is from September 30, 2009 through December 31, 2013. The number of observations varies across the futures markets due to different trading hours. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The coefficients represent the effects of a one standard deviation surprise. In the foreign exchange markets, a positive coefficient signifies currency appreciation. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 5
Response of Futures Prices to Comparable U.S. and Japanese Macroeconomic Announcements

	U.S. Announcements						Japanese Announcements			
	Purchasing Manager Index (PMI)		GDP (Advance, Preliminary, Final)		Industrial Production		GDP (Preliminary, Final)		Industrial Production	
	Response Coef.	R^2	Response Coef.	R^2	Response Coef.	R^2	Response Coef.	R^2	Response Coef.	R^2
Stock Index Futures										
E-mini S&P 500	0.26 (0.05)***	0.408	0.09 (0.04)***	0.164	0.03 (0.02)	0.041	0.05 (0.02)**	0.202	0.01 (0.01)	0.029
E-mini Nasdaq-100	0.24 (0.06)***	0.314	0.07 (0.03)***	0.135	0.02 (0.02)	0.029	0.04 (0.02)**	0.168	0.001 (0.01)	0.001
E-mini Dow	0.25 (0.05)***	0.422	0.09 (0.03)***	0.162	0.03 (0.02)*	0.054	0.04 (0.02)**	0.211	0.01 (0.01)	0.023
SPI 200 (Australia)	0.20 (0.04)***	0.377	0.05 (0.03)*	0.067	0.06 (0.02)***	0.176	0.02 (0.03)	0.005	0.03 (0.02)	0.017
Foreign Exchange Futures										
Australian dollar	0.06 (0.03)*	0.087	-0.03 (0.02)	0.059	0.03 (0.01)**	0.082	0.05 (0.01)***	0.234	-0.001 (0.01)	0.001
New Zealand dollar	0.04 (0.03)	0.049	-0.04 (0.02)*	0.069	0.03 (0.02)*	0.051	0.01 (0.02)	0.007	-0.001 (0.01)	0.003
Canadian dollar	0.09 (0.02)***	0.260	0.01 (0.02)	0.004	0.03 (0.01)**	0.086	0.02 (0.01)**	0.168	0.004 (0.004)	0.010
Euro	-0.03 (0.03)	0.027	-0.07 (0.02)***	0.244	0.01 (0.01)	0.005	0.04 (0.01)	0.066	0.001 (0.01)	0.000
British Pound	-0.03 (0.02)	0.019	-0.06 (0.01)***	0.231	0.004 (0.01)	0.006	0.01 (0.01)	0.053	-0.01 (0.01)	0.044
Japanese Yen	-0.14 (0.01)***	0.649	-0.15 (0.02)***	0.526	-0.03 (0.02)	0.087	-0.02 (0.01)*	0.064	-0.004 (0.01)	0.005
U.S. Dollar Index	0.03 (0.02)	0.053	0.07 (0.02)***	0.329	-0.01 (0.01)	0.005	-0.004 (0.01)	0.024	0.001 (0.002)	0.004
Commodity Futures										
Crude Oil	0.24 (0.05)**	0.331	0.11 (0.05)**	0.115	0.11 (0.04)***	0.109	0.03 (0.02)	0.127	0.03 (0.01)**	0.048
Copper	0.14 (0.05)***	0.195	0.10 (0.04)**	0.094	0.07 (0.03)**	0.082	0.07 (0.03)**	0.184	0.06 (0.03)*	0.089
Silver	-0.12 (0.08)	0.051	-0.27 (0.06)***	0.238	-0.04 (0.03)	0.029	0.05 (0.02)*	0.075	0.10 (0.06)*	0.239
St. dev. of surprise	1.84		0.38%		0.38%		0.87%		1.40%	

The sample period is from September 30, 2009 through December 31, 2013. The sample contains 51 observations for U.S. PMI, 52 observations for U.S. GDP, 51 observations for U.S. Industrial Production, 34 observations for Japanese GDP (except for the E-mini Nasdaq-100 and SPI 200 markets where there are 33 observations), and 50 observations for Japanese Industrial Production (except for the SPI 200 market where there are 46 observations). PMI announcement is not available for Japan. Asian index futures and agricultural commodity futures markets are excluded because they do not trade at the time of these announcements. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 6
Response of Futures Prices to the Exports and Imports Announcements

	N	Exports	Imports	R^2
Stock Index Futures				
E-mini S&P 500	36	0.03 (0.01)***	-0.002 (0.01)	0.275
E-mini Nasdaq-100	36	0.03 (0.01)**	-0.004 (0.01)	0.243
E-mini Dow	36	0.03 (0.01)***	-0.001 (0.01)	0.195
Nikkei 225 (Japan)	34	0.06 (0.04)	-0.01 (0.03)	0.088
MSCI Taiwan	34	0.04 (0.04)	0.04 (0.03)	0.125
Hang Seng (Hong Kong)	31	0.11 (0.06)*	0.06 (0.04)	0.315
SPI 200 (Australia)	36	0.03 (0.03)	0.06 (0.03)	0.216
Foreign Exchange Futures				
Australian dollar	36	0.05 (0.04)	0.04 (0.03)	0.297
New Zealand dollar	36	0.02 (0.02)	0.03 (0.02)	0.185
Canadian dollar	36	0.01 (0.01)	0.01 (0.01)	0.213
Euro	36	0.01 (0.01)	0.01 (0.01)	0.121
British Pound	36	0.002 (0.01)	0.01 (0.01)	0.036
Japanese Yen	36	-0.01 (0.02)	-0.01 (0.02)	0.048
U.S. Dollar Index	36	-0.01 (0.01)	-0.01 (0.01)	0.125
Commodity Futures				
Crude Oil	36	0.03 (0.02)	0.01 (0.02)	0.068
Copper	36	0.02 (0.03)	0.04 (0.03)	0.077
Silver	36	0.04 (0.04)	0.02 (0.04)	0.052
Cotton	35	0.09 (0.05)*	0.01 (0.04)	0.174
Corn	36	0.01 (0.01)	-0.04 (0.02)	0.059
Wheat	36	0.02 (0.02)	-0.05 (0.02)**	0.160
Soybeans	36	-0.01 (0.01)	-0.01 (0.02)	0.044
Standard deviation of surprise		7.25%	7.81%	

The table shows the estimated responses of futures returns to unexpected changes in Exports and Imports. These announcements are made simultaneously. The Trade Balance is also released simultaneously with these announcements but is omitted from the model as it contains no information beyond Exports and Imports. The sample period is from September 30, 2009 through December 31, 2013. The number of observations varies across the futures markets due to different trading hours. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The coefficients represent the effects of a one standard deviation surprise. In the foreign exchange markets, a positive coefficient signifies currency appreciation. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 7
Response of Futures Prices to Inflation Announcements

	N	CPI	PPI	R^2
Stock Index Futures				
E-mini S&P 500	42	-0.02 (0.01)	-0.01 (0.01)	0.020
E-mini Nasdaq-100	42	-0.02 (0.01)	-0.01 (0.01)	0.036
E-mini Dow	42	-0.01 (0.01)	-0.01 (0.01)	0.023
Nikkei 225 (Japan)	41	-0.01 (0.02)	-0.02 (0.02)	0.014
MSCI Taiwan	38	-0.08 (0.03)**	0.01 (0.03)	0.089
Hang Seng (Hong Kong)	39	-0.08 (0.05)	-0.01 (0.04)	0.047
SPI 200 (Australia)	40	-0.03 (0.02)*	-0.01 (0.03)	0.046
Foreign Exchange Futures				
Australian dollar	42	-0.05 (0.02)**	0.01 (0.02)	0.092
New Zealand dollar	42	-0.05 (0.02)***	-0.01 (0.02)	0.121
Canadian dollar	42	-0.01 (0.01)	-0.01 (0.01)	0.065
Euro	42	-0.01 (0.01)	0.003 (0.01)	0.018
British Pound	42	-0.01 (0.01)	-0.01 (0.01)	0.061
Japanese Yen	42	0.02 (0.01)**	0.01 (0.01)	0.086
U.S. Dollar Index	42	0.01 (0.01)	-0.002 (0.01)	0.008
Commodity Futures				
Crude Oil	42	-0.06 (0.02)***	0.002 (0.02)	0.111
Copper	42	-0.05 (0.03)	0.04 (0.04)	0.065
Silver	42	-0.06 (0.03)**	0.004 (0.03)	0.082
Cotton	34	-0.21 (0.13)	-0.02 (0.08)	0.168
Corn	42	-0.03 (0.02)*	-0.003 (0.02)	0.051
Wheat	42	-0.02 (0.02)	-0.02 (0.02)	0.036
Soybeans	42	-0.02 (0.02)	0.02 (0.02)	0.044
Standard deviation of surprise		0.23%	0.40%	

The table shows the estimated responses of futures returns to changes in Consumer Price Index (CPI) and Producer Price Index (PPI). These announcements are made simultaneously. The sample period is from September 30, 2009 through December 31, 2013. The number of observations varies across the futures markets due to different trading hours. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The coefficients represent the effects of a one standard deviation surprise. In the foreign exchange markets, a positive coefficient signifies currency appreciation. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 8
Response of Futures Prices to Monetary and Financial Announcements

	N	Money Supply M2	New Yuan Loans	Foreign Exchange Reserves	R^2
Stock Index Futures					
E-mini S&P 500	51	0.02 (0.02)	-0.01 (0.01)	0.02 (0.03)	0.026
E-mini Nasdaq-100	51	0.02 (0.02)	-0.01 (0.01)	0.04 (0.03)	0.049
E-mini Dow	51	0.02 (0.02)	-0.01 (0.01)	0.02 (0.02)	0.037
Nikkei 225 (Japan)	37	-0.02 (0.04)	0.14 (0.11)	0.01 (0.04)	0.126
MSCI Taiwan	36	-0.08 (0.03)**	0.15 (0.06)**	0.02 (0.05)	0.195
Hang Seng (Hong Kong)	45	0.06 (0.06)	0.01 (0.06)	0.01 (0.07)	0.041
SPI 200 (Australia)	38	0.01 (0.02)	0.01 (0.04)	-0.01 (0.03)	0.010
Foreign Exchange Futures					
Australian dollar	51	0.02 (0.02)	0.01 (0.02)	-0.002 (0.03)	0.039
New Zealand dollar	51	0.01 (0.02)	-0.002 (0.02)	0.003 (0.03)	0.011
Canadian dollar	51	0.01 (0.01)	-0.004 (0.01)	-0.02 (0.01)	0.027
Euro	51	0.02 (0.02)	-0.01 (0.01)	0.0003 (0.02)	0.041
British Pound	51	0.02 (0.01)	-0.003 (0.01)	-0.01 (0.02)	0.032
Japanese Yen	51	-0.02 (0.01)*	0.02 (0.01)**	-0.003 (0.02)	0.096
U.S. Dollar Index	51	-0.02 (0.01)	0.01 (0.01)	0.002 (0.02)	0.036
Commodity Futures					
Crude Oil	51	0.04 (0.03)	0.001 (0.02)	-0.002 (0.03)	0.081
Copper	51	0.03 (0.04)	0.02 (0.04)	0.01 (0.05)	0.025
Silver	51	0.05 (0.05)	-0.02 (0.04)	-0.05 (0.07)	0.032
Cotton	50	0.02 (0.04)	-0.10 (0.08)	0.17 (0.09)*	0.070
Corn	51	0.05 (0.02)**	-0.04 (0.03)*	0.01 (0.04)	0.099
Wheat	51	0.03 (0.02)	-0.02 (0.02)	0.01 (0.04)	0.024
Soybeans	51	0.04 (0.02)**	-0.03 (0.02)	0.04 (0.03)	0.097
Standard deviation of surprise		0.76%	101.7 bln yuan	83.2 bln yuan	

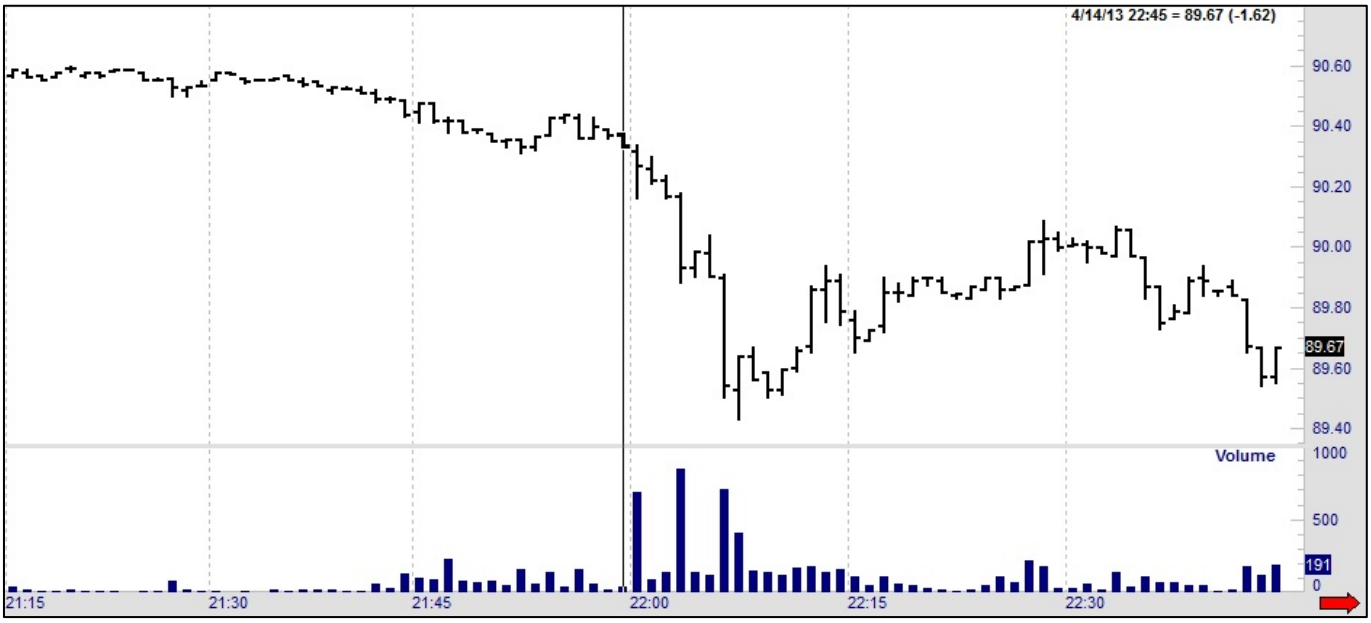
The table shows the estimated responses of futures returns to unexpected changes in the Money Supply M2, New Yuan Loans, and Foreign Exchange Reserves. These announcements are made simultaneously. Money Supply M1 is also released simultaneously with these announcements but is omitted from the model because the two measures of money supply are highly correlated. The sample period is from September 30, 2009 through December 31, 2013. The number of observations varies across the futures markets due to different trading hours. The regression includes an intercept term and is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. The coefficients represent the effects of a one standard deviation surprise. In the foreign exchange markets, a positive coefficient signifies currency appreciation. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 9
Effect of Macroeconomic Announcements on Volatility and Trading Volume

	Realized Volatility					Trading Volume				
	PMI	GDP, INP RES, FAI	EXP, IMP	CPI, PPI	M2, NYL, FER	PMI	GDP, INP RES, FAI	EXP, IMP	CPI, PPI	M2, NYL, FER
Stock Index Futures										
E-mini S&P 500	0.11***	0.13***	0.07	0.09*	0.10	4.81***	5.61***	2.24*	3.46***	5.75
	(0.06)	(0.07)	(0.06)	(0.07)	(0.09)	(2.02)	(2.85)	(1.85)	(2.06)	(5.11)
E-mini Nasdaq-100	0.11***	0.12***	0.07**	0.08*	0.09	0.42***	0.41***	0.23	0.31***	0.55
	(0.06)	(0.06)	(0.06)	(0.06)	(0.08)	(0.19)	(0.21)	(0.17)	(0.21)	(0.48)
E-mini Dow	0.09***	0.11***	0.06	0.08*	0.09	0.34***	0.43***	0.23	0.31**	0.39
	(0.05)	(0.06)	(0.05)	(0.06)	(0.07)	(0.15)	(0.23)	(0.19)	(0.20)	(0.45)
Nikkei 225 (Japan)	0.21	0.20***	0.18***	0.18	0.17	4.36	4.63***	3.14	3.66	3.80
	(0.18)	(0.17)	(0.12)	(0.17)	(0.13)	(4.10)	(3.49)	(2.04)	(3.69)	(2.87)
MSCI Taiwan	0.28	0.22	0.18*	0.26*	0.23	5.78*	3.40	2.73**	3.70	3.88
	(0.22)	(0.18)	(0.16)	(0.22)	(0.18)	(4.96)	(3.06)	(2.51)	(3.61)	(3.42)
Hang Seng (Hong Kong)	---	0.29***	0.25	0.31	0.21	---	7.10***	5.71	8.18***	5.09
		(0.17)	(0.20)	(0.26)	(0.18)		(4.94)	(4.94)	(6.74)	(4.51)
SPI 200 (Australia)	0.20***	0.21***	0.13	0.17**	0.12	1.75***	1.79***	1.04	1.57***	0.77
	(0.13)	(0.12)	(0.14)	(0.13)	(0.09)	(1.08)	(1.02)	(0.91)	(1.02)	(0.55)
Foreign Exchange Futures										
Australian dollar	0.15***	0.15***	0.14***	0.15**	0.10	1.99**	2.39***	1.75***	1.90***	1.51**
	(0.10)	(0.09)	(0.07)	(0.10)	(0.08)	(1.37)	(0.95)	(0.66)	(1.09)	(1.12)
New Zealand dollar	0.16***	0.14**	0.08	0.13	0.11*	0.13	0.15**	0.16*	0.12	0.10
	(0.10)	(0.10)	(0.07)	(0.10)	(0.08)	(0.09)	(0.08)	(0.04)	(0.11)	(0.11)
Canadian dollar	0.07**	0.08***	0.05	0.06*	0.06	0.57***	0.63***	0.36**	0.40**	0.59
	(0.06)	(0.05)	(0.04)	(0.05)	(0.06)	(0.37)	(0.34)	(0.20)	(0.31)	(0.52)
Euro	0.08**	0.07**	0.05	0.06	0.07	1.77	1.81**	1.08	1.44***	3.57*
	(0.06)	(0.05)	(0.04)	(0.05)	(0.07)	(1.55)	(1.40)	(0.79)	(0.93)	(2.64)
British Pound	0.07**	0.06*	0.05	0.05**	0.07	0.68***	0.61***	0.48***	0.50*	1.24
	(0.05)	(0.04)	(0.04)	(0.04)	(0.06)	(0.49)	(0.42)	(0.28)	(0.36)	(0.96)
Japanese Yen	0.11	0.07*	0.06	0.07	0.07*	2.21	1.27	1.07	1.09	1.36
	(0.10)	(0.04)	(0.05)	(0.05)	(0.06)	(1.82)	(1.07)	(0.85)	(1.04)	(1.12)
U.S. Dollar Index	0.07**	0.06**	0.04	0.05**	0.07	0.11**	0.12	0.16**	0.13	0.23
	(0.05)	(0.04)	(0.04)	(0.04)	(0.05)	(0.07)	(0.10)	(0.05)	(0.07)	(0.20)
Commodity Futures										
Crude Oil	0.13	0.15***	0.12	0.14**	0.14	0.48	0.64***	0.33	0.50**	0.62
	(0.11)	(0.09)	(0.13)	(0.10)	(0.13)	(0.38)	(0.31)	(0.43)	(0.30)	(0.59)
Copper	0.28	0.22**	0.17	0.23**	0.20	0.79	0.77**	0.45	0.61**	0.49
	(0.27)	(0.15)	(0.19)	(0.18)	(0.17)	(0.80)	(0.33)	(0.40)	(0.38)	(0.41)
Silver	0.21	0.21	0.18**	0.19	0.19	0.28	0.36*	0.17	0.22	0.30
	(0.23)	(0.17)	(0.16)	(0.17)	(0.19)	(0.30)	(0.18)	(0.22)	(0.20)	(0.26)
Cotton	0.40	0.33	0.18	0.36	0.26	0.12	0.08	0.10	0.10	0.07
	(0.40)	(0.32)	(0.22)	(0.32)	(0.20)	(0.14)	(0.08)	(0.07)	(0.11)	(0.07)
Corn	0.20	0.14	0.12	0.12	0.13*	0.40**	0.19	0.16**	0.23	0.24***
	(0.17)	(0.12)	(0.13)	(0.12)	(0.11)	(0.17)	(0.19)	(0.30)	(0.19)	(0.13)
Wheat	0.25	0.12	0.13	0.14	0.14	0.09***	0.06	0.05*	0.06	0.11
	(0.18)	(0.15)	(0.14)	(0.14)	(0.13)	(0.05)	(0.05)	(0.08)	(0.07)	(0.07)
Soybeans	0.19	0.13	0.11	0.13	0.12	0.54	0.32	0.22*	0.40	0.30
	(0.18)	(0.12)	(0.15)	(0.12)	(0.10)	(0.46)	(0.25)	(0.38)	(0.39)	(0.17)

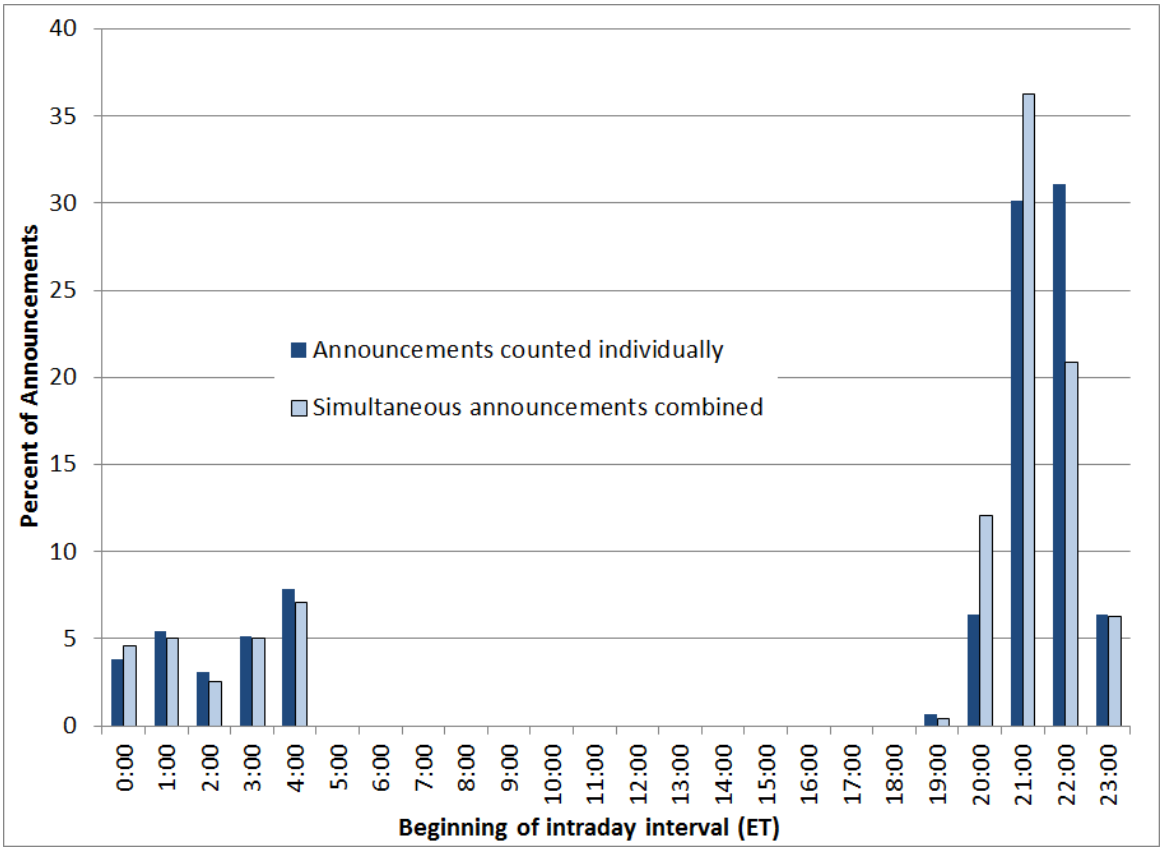
The values in this table show average realized volatility (computed as the square root of the sum of squared 5-minute returns) and trading volume (in thousands of contracts) in the interval from 10 minutes before to 10 minutes after the announcement in each futures market. Average realized volatility and trading volume for the same interval on the previous trading day are shown in parentheses. The sample period is from September 30, 2009 through December 31, 2013. *, **, *** indicate that that the test statistic of the Wilcoxon two-sample test for difference between the announcement and non-announcement samples is significant at 10%, 5%, and 1% levels, respectively.

Figure 1
Crude Oil Futures Price and Trading Volume around China's April 14, 2013
GDP, Industrial Production, Fixed Assets Investment and Retail Sales Announcements



The upper and bottom panels of the figure show the nearby crude oil futures contract price and trading volume measured as the number of 1,000-barrel contracts, respectively. The official announcement time for this simultaneous release is 22:00 U.S. Eastern Time.

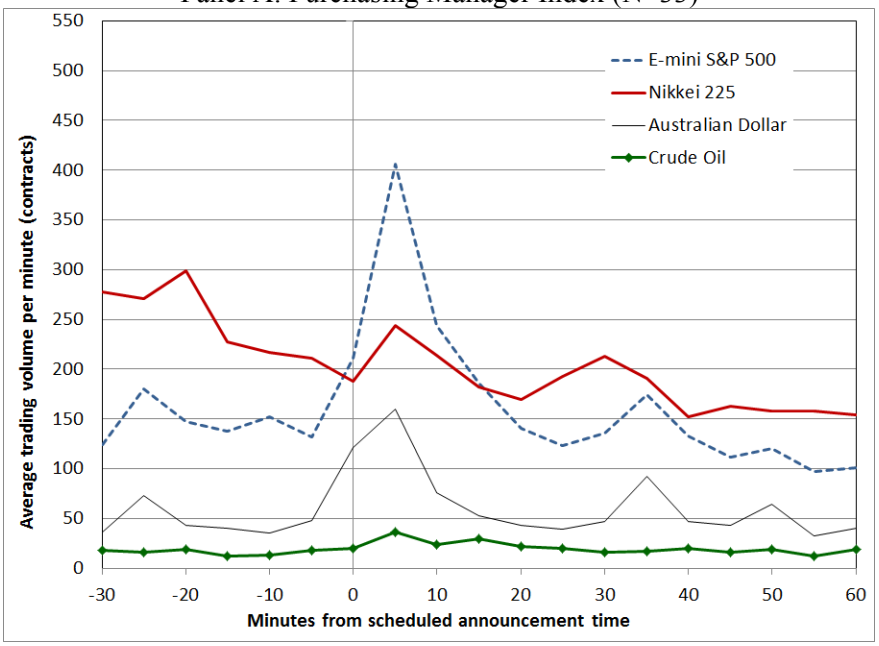
Figure 2
Distribution of Announcement Times



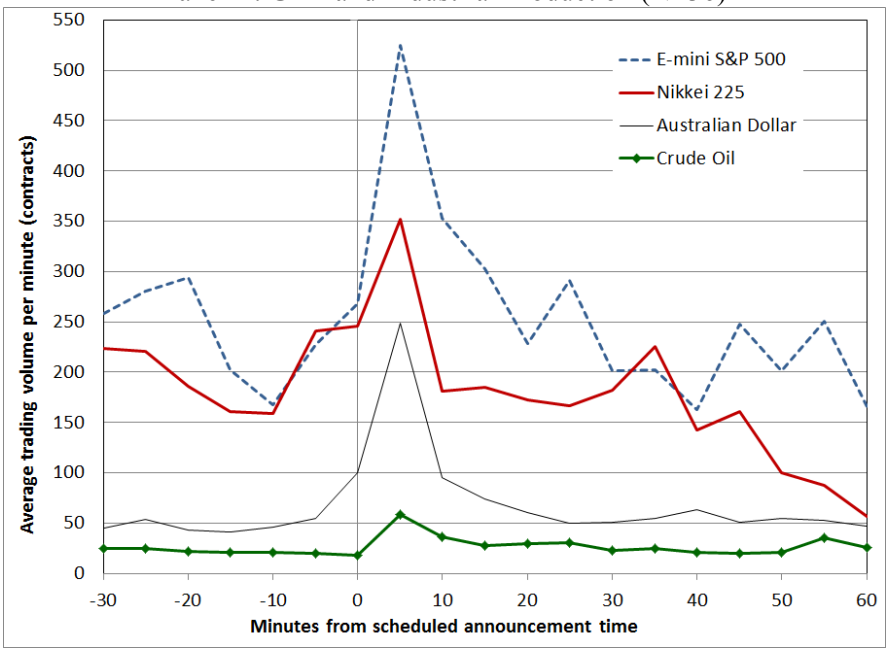
The figure shows the distribution of announcement times stated in U.S. Eastern Time as a percentage of all announcements. The dark bars treat all 14 announcements individually. The light bars combine announcements that are made simultaneously into a single event.

Figure 3
Average Futures Trading Volume around Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production Announcements

Panel A. Purchasing Manager Index (N=33)

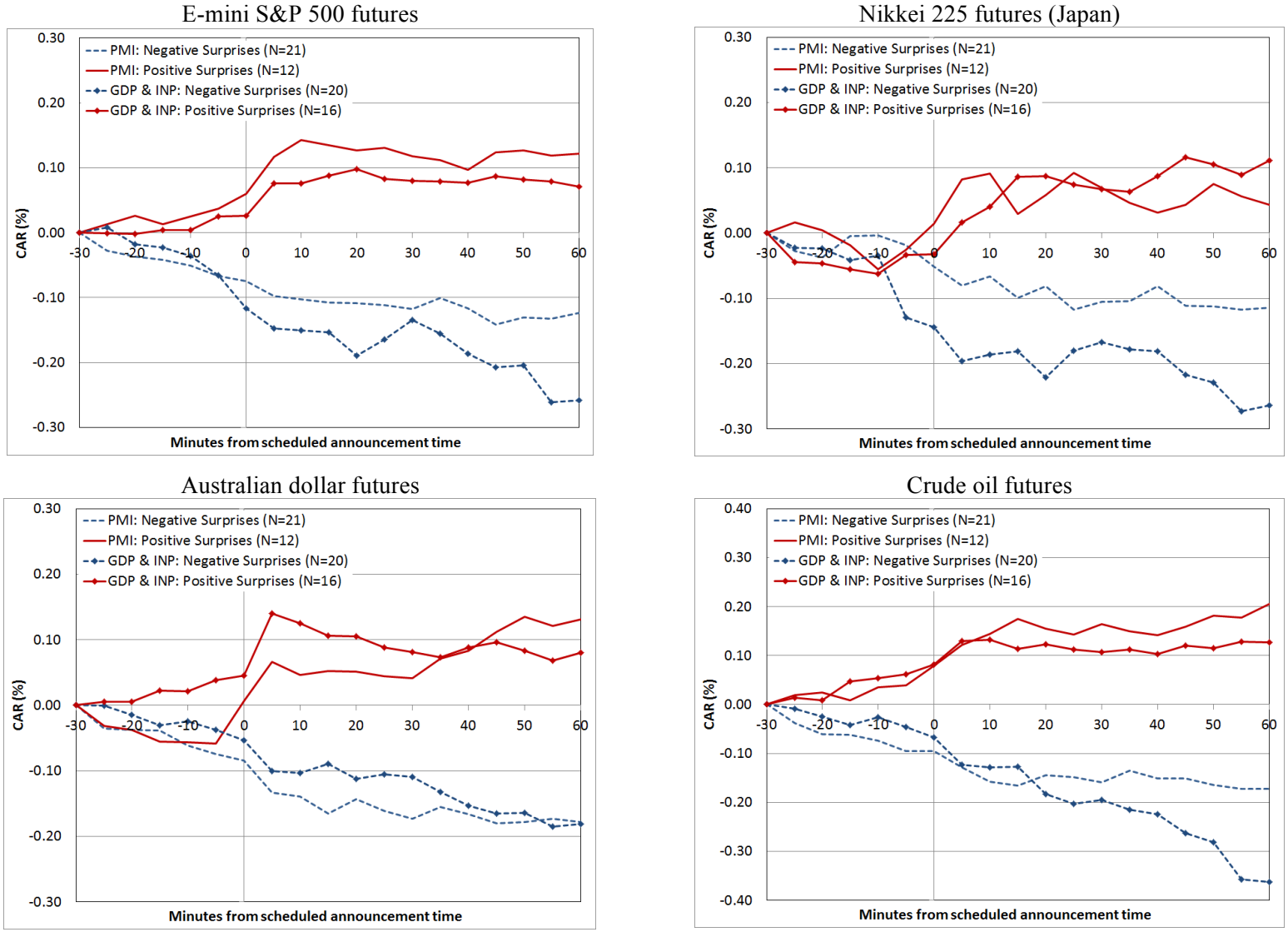


Panel B. GDP and Industrial Production (N=36)



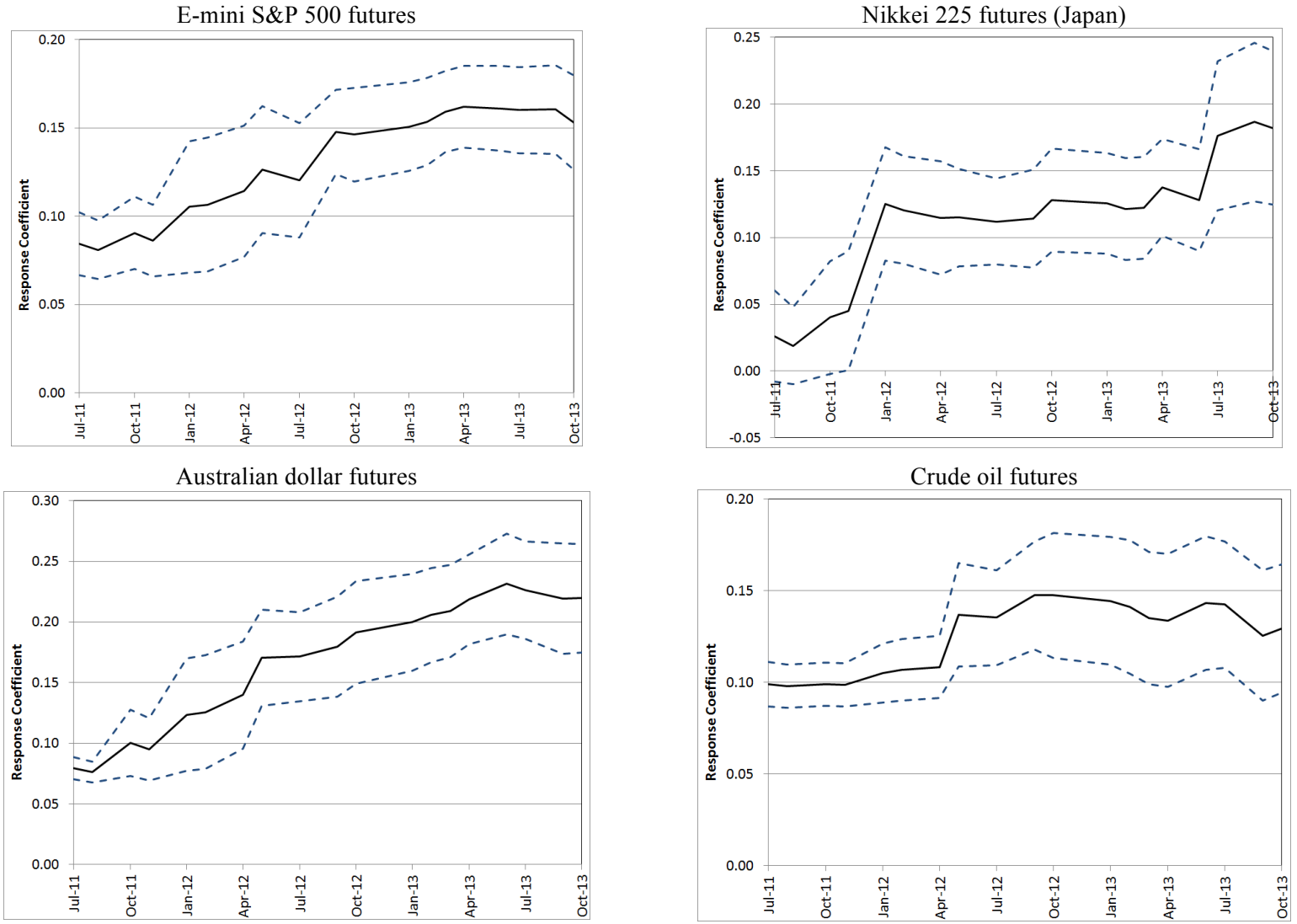
The figure shows the average trading volume per minute around the three output announcements (Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production) for the most important market in each subgroup (U.S. stock index, Asia-Pacific stock index, commodity currency, and energy/industrial commodity). Only the events with non-zero surprises are included to maintain consistency with Figure 4.

Figure 4
Cumulative Average Returns (CAR) around Manufacturing Purchasing Manager Index (PMI), Real Gross Domestic Product (GDP) and Industrial Production (INP) Announcements



The figure shows the cumulative average returns around the three output announcements (Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production) for the most important market in each subgroup (U.S. stock index, Asia-Pacific stock index, commodity currency, and energy/industrial commodity). For the GDP and Industrial Production announcement, when the GDP and Industrial Production announcement surprises have opposite signs, the sign of the GDP surprise is used.

Figure 5
Time-Varying Response of Futures Markets to Manufacturing Purchasing Manager Index Announcements



The figure shows the time-varying response to the Manufacturing PMI announcements for the most important market in each subgroup (U.S. stock index, Asia-Pacific stock index, commodity currency, and energy/industrial commodity). The time-varying response coefficient is estimated with a rolling OLS regression with a window of 17 observations. The 17th observation corresponds to July 31, 2011 which is August 1, 2011 in China Standard Time. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. Dashed lines are one-standard-error bands.

Not-for-Publication Appendix
(Includes Tables A1, A2 and A3 including ITC Results)

Table A1
Test of Unbiasedness of Bloomberg Forecasts

The reported coefficients are for the following regression: $A_t = \alpha_0 + \alpha_1 F_t + \varepsilon_t$, where A_t is the actual announced value of the given macroeconomic statistic and F_t is the consensus Bloomberg forecast. This test of unbiasedness is similar to the one used in Pearce and Roley (1985).

Announcement	N	α_0	α_1	R^2	*p*-value
Consumer price index (YoY)	51	-0.0002 (0.0007)	1.01 (0.02)	0.98	0.78
Exports (YoY)	51	0.017 (0.012)	0.98 (0.08)	0.74	0.23
Fixed assets investment (YoY)	47	0.007 (0.004)	0.97 (0.02)	0.98	0.20
Foreign exchange reserves	16	33.4 (165.3)	1.00 (0.05)	0.95	0.60
Imports (YoY)	51	-0.004 (0.015)	1.08 (0.06)	0.86	0.25
Industrial production (YoY)	45	0.014 (0.010)	0.87 (0.09)	0.83	0.38
Manufacturing purchasing manager index	52	6.24 (3.23)	0.88 (0.06)	0.82	0.13
Money supply M1 (YoY)	44	-0.005 (0.005)	1.00 (0.04)	0.93	0.15
Money supply M2 (YoY)	51	-0.001 (0.003)	1.01 (0.02)	0.97	0.82
New yuan loans	51	83.2 (46.1)	0.88 (0.08)	0.76	0.16
Producer price index (YoY)	51	-0.001 (0.001)	1.01 (0.01)	0.99	0.45
Real GDP (YoY)	17	-0.005 (0.003)	1.06 (0.03)	0.98	0.14
Retail sales (YoY)	45	0.012 (0.02)	0.92 (0.12)	0.68	0.24
Trade balance	51	3.09 (3.81)	0.85 (0.19)	0.47	0.72

The sample period is from September 30, 2009 through December 31, 2013. The regression is estimated using OLS with the White (1980) heteroskedasticity consistent covariance matrix. Standard errors are shown in parentheses. The *p*-values are for the joint Wald test that the intercept is equal to zero and the slope is equal to one.

Table A2
Cumulative Average Returns (CAR) around Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production Announcements

	(-30; 0) minute window				(0; 60) minute window			
	Mean	St. Error of Mean	Median	*p*-value	Mean	St. Error of Mean	Median	*p*-value
Positive Surprises (N=28)								
E-mini S&P 500	0.043	0.014	0.040	0.004	0.052	0.023	0.041	0.034
Nikkei 225 (Japan)	0.052	0.035	0.054	0.160	0.095	0.064	0.103	0.093
Australian dollar	0.030	0.021	0.032	0.169	0.073	0.042	0.047	0.200
Crude oil	0.069	0.019	0.072	0.001	0.081	0.033	0.086	0.010
Negative Surprises (N=41)								
E-mini S&P 500	-0.079	0.030	-0.023	0.012	-0.095	0.056	-0.038	0.113
Nikkei 225 (Japan)	-0.106	0.053	-0.103	0.044	-0.088	0.050	-0.057	0.074
Australian dollar	-0.053	0.026	-0.019	0.123	-0.110	0.038	-0.099	0.005
Crude oil	-0.062	0.023	-0.041	0.018	-0.182	0.078	-0.105	0.002

The table shows the cumulative average returns (CARs) around the three most important announcements (Manufacturing Purchasing Manager Index, Real Gross Domestic Product and Industrial Production) for the most important market in each subgroup (U.S. stock index, Asia-Pacific stock index, commodity currency, and energy/industrial commodity). The sample period is from September 30, 2009 through December 31, 2013. The announcement window from 30 minutes prior to 60 minutes after the announcement matches the event window used in Figure 4. The *p*-values are for the Wilcoxon signed rank test of the null hypothesis that the CARs are equal to zero.

Table A3
Identification through Censoring Estimates for Chinese Macroeconomic Announcements

	Manufacturing	Inflation		Trade	
	PMI	CPI	PPI	Exports	Imports
E-mini S&P 500	0.14***	-0.16***	-0.01	0.22**	-0.17
	(0.02)	(0.05)	(0.04)	(0.09)	(0.10)
E-mini Nasdaq-100	0.14***	-0.17***	-0.03	0.22**	-0.17*
	(0.02)	(0.05)	(0.04)	(0.09)	(0.10)
Australian dollar	0.17***	-0.30***	0.08	0.33***	-0.19
	(0.03)	(0.06)	(0.05)	(0.12)	(0.14)
New Zealand dollar	0.13***	-0.26***	-0.05	0.14**	-0.07
	(0.02)	(0.07)	(0.05)	(0.06)	(0.07)
Crude Oil	0.13***	-0.39***	0.04	0.13*	-0.06
	(0.02)	(0.09)	(0.07)	(0.07)	(0.07)
Copper	0.20***	-0.37***	0.28***	0.13	-0.05
	(0.03)	(0.09)	(0.08)	(0.09)	(0.09)
Proportion of Measured Surprise Due to Noise $\left(\sigma_\eta^2 / \sigma_z^2\right)$	13%	85%	76%	26%	24%

The table shows the estimated responses of futures returns to the Manufacturing PMI, Inflation, and Trade announcements using the identification-through-censoring (ITC) approach. The sample period is from September 30, 2009 through December 31, 2013. The sample contains 35 observations for PMI, 42 observations for Inflation, and 35 observations for Trade. The futures returns are computed from 10 minutes before to 10 minutes after the announcement. The estimation is performed separately for the announcements made individually (PMI) and jointly for the announcements made simultaneously (CPI announced simultaneously with PPI and Exports announced simultaneously with Imports). The model parameters are estimated jointly for the six most important markets since the sample size does not allow us to estimate the model for all markets together. All variables are demeaned prior to estimation. The null hypothesis of the Hansen (1982) test that the over-identifying restrictions of the ITC model are valid is not rejected at the 5% level. Standard errors are shown in parentheses. *, **, *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Identification through Censoring

We apply the "identification-through-censoring" (ITC) technique proposed by Rigobon and Sack (2008). Survey-based forecasts are an imprecise proxy for market expectations because the surveyed analysts may come from an unrepresentative sample of analysts. Also, these forecasts may be out of date at the time when the news is released. In addition, the data released by China's government may be imprecise due to, for example, data collection quality issues. The measured surprise z_t can then be described by:

$$z_t = z_t^* + \eta_t \,,$$

where z_t^* is the unobservable "true" surprise and η_t is the measurement error.

Due to this error-in-variables problem, the OLS estimate of the response coefficient γ in equation (1) is biased downward, and the bias gets larger when the variance of the measurement error increases relative to the variance of the true surprise. Rigobon and Sack (2008) argue that the problem of measurement error is an identification problem. To solve this problem, they propose taking advantage of the fact that both the true surprise and the measurement error are zero, i.e., "censored", on non-event days. Returns on non-event days provide additional information needed for identification. Assuming we have two markets and two simultaneous announcements, the ITC model can be represented as follows:

$$\left.\begin{aligned} R_{1t} &= \gamma_{11} z_{1t}^* + \gamma_{12} z_{2t}^* + \varepsilon_{1t} \\ R_{2t} &= \gamma_{21} z_{1t}^* + \gamma_{22} z_{2t}^* + \varepsilon_{2t} \\ z_{1t} &= z_{1t}^* + \eta_{1t} \\ z_{2t} &= z_{2t}^* + \eta_{2t} \end{aligned}\right\} \quad t \in D,$$

$$\left.\begin{aligned} R_{1t} &= \varepsilon_{1t} \\ R_{2t} &= \varepsilon_{2t} \\ z_{1t} &= 0 \\ z_{2t} &= 0 \end{aligned}\right\} \quad t+1 \in D,$$

where *D* is the set of announcement days.

The response coefficients, as well as the variances of the true surprises z_{it}^* and of the noise terms η_{it}, can be estimated with the generalized method of moments (GMM) using the shift in the covariance matrix of returns and measured surprises in the intraday window around the announcement. Table 9 shows evidence of volatility increases around major Chinese announcements, indicating that the covariance matrix of returns does change on event days. To control for predictable variation of volatility over the trading day, we use pre-event-day returns in the same intraday interval as the interval used to compute event-day returns.[i] The covariance

matrix of the structural shocks ε_{it} is assumed to be the same on event and non-event days. Using the shift in the covariance matrix on event days removes the need to estimate the variances and covariances of the structural shocks, which significantly reduces the number of moment conditions and estimated parameters. The moment equations are given below.

1. $var(R_{1t}) - var(R_{1t-1}) = \gamma_{11}^2\sigma_{z_1^*}^2 + \gamma_{12}^2\sigma_{z_2^*}^2 + 2\gamma_{11}\gamma_{12}cov(z_1^*, z_2^*)$
2. $var(R_{2t}) - var(R_{2t-1}) = \gamma_{21}^2\sigma_{z_1^*}^2 + \gamma_{22}^2\sigma_{z_2^*}^2 + 2\gamma_{21}\gamma_{22}cov(z_1^*, z_2^*)$
3. $var(z_{1t}) = \sigma_{z_1^*}^2 + \sigma_{\eta_1}^2$
4. $var(z_{2t}) = \sigma_{z_2^*}^2 + \sigma_{\eta_2}^2$
5. $cov(R_{1t}, R_{2t}) - cov(R_{1t-1}, R_{2t-1}) =$
   $\gamma_{11}\gamma_{21}\sigma_{z_1^*}^2 + \gamma_{12}\gamma_{22}\sigma_{z_2^*}^2 + (\gamma_{11}\gamma_{22} + \gamma_{12}\gamma_{21})cov(z_1^*, z_2^*)$
6. $cov(R_{1t}, z_{1t}) = \gamma_{11}\sigma_{z_1^*}^2 + \gamma_{12}cov(z_1^*, z_2^*)$
7. $cov(R_{2t}, z_{1t}) = \gamma_{21}\sigma_{z_1^*}^2 + \gamma_{22}cov(z_1^*, z_2^*)$
8. $cov(R_{1t}, z_{2t}) = \gamma_{11}cov(z_1^*, z_2^*) + \gamma_{12}\sigma_{z_2^*}^2$
9. $cov(R_{2t}, z_{2t}) = \gamma_{21}cov(z_1^*, z_2^*) + \gamma_{22}\sigma_{z_2^*}^2$
10. $cov(z_{1t}, z_{2t}) = cov(z_1^*, z_2^*) + cov(\eta_1, \eta_2)$

Estimating this model involves 10 unknown parameters: four response coefficients, two variances of the true surprises z_{it}^*, two variances of the noise terms η_{it}, covariance of the true surprises and covariance of the noise terms. As shown above, we have 10 moment conditions. Thus, this model is identified. As the estimations shown in Table B3 include six markets, the ITC estimator is over-identified, as in Rigobon and Sack (2008).[ii]

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[i] For example, when the PMI is released on at 8:00 p.m. E.T., the event-window returns are computed in the interval from 7:50 p.m. to 8:10 p.m. on the day of the announcement. Non-announcement returns are computed in the interval from 7:50 p.m. to 8:10 p.m. on the day before.

[ii] Estimating the ITC model with six markets and two data surprises involves 18 unknown parameters. The covariance matrix of futures returns and observed data surprises provides 36 moment equations. These equations are not shown to save space.

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