The Informational Role of Commodity Futures Prices*

Conghui Hu† and Wei Xiong‡

May 2013

Abstract

This paper analyzes information flow between commodity futures prices traded in the United States and stock prices of East Asian economies including China, Japan, Hong Kong, South Korea, and Taiwan. We find significantly positive stock price reactions across all these stock markets and across a broad range of industries to the lagged overnight futures returns of copper and soybeans, albeit not crude oil, after mid-2000s. Our findings highlight significant information flow from daily futures returns of copper and soybeans to Asian stock markets and establish the futures prices of these commodities as barometers of global economic strength.

* This paper is prepared for *Après le Déluge: Finance and the Common Good after the Crisis*, edited by E. Glen Weyl, Edward L. Glaeser, and Tano Santos. We are grateful to Mark Aguiar, Ing-haw Cheng, Lutz Kilian, and Jose Scheinkman for helpful comments.

† Peking University, Email: huconghui@pku.edu.cn.

‡ Princeton University and NBER, Email: wxiong@princeton.edu.

Information discovery is an important role fulfilled by modern financial markets (e.g., Grossman, 1989). Through centralized trading, prices of financial assets aggregate information possessed by different participants to reflect their collective expectations of assets' economic fundamentals. The profit from trading on one's information also gives incentives to acquire costly information. The information revealed by the traded prices in turn allows firms to make efficient investment decisions and policy makers to make informed policy choices.

Commodity futures markets represent an important sector in global financial markets. It is widely recognized that commodity futures markets allow commercial hedgers such as farmers and producers to hedge their commodity price risk, as emphasized by the longstanding hedging pressure theory of commodity futures prices (e.g., Keynes, 1930; Hicks, 1939; Hirshleifer, 1988). Due to the lack of centralized spot markets for many commodities, futures markets often serve as the central platform for trading commodities. However, academia and policy makers have paid much less attention to the informational role of commodity futures prices. Do commodity futures prices contain useful information? If so, what kind of information? Do people react to information contained in commodity futures prices?

Due to the important roles played by commodity prices in a range of policy issues from price inflation, to food and energy security, to economic and political stability of countries whose economies rely heavily on commodity imports and exports, policy makers across the world have become increasingly concerned with greatly increased commodity price volatility occurring since the mid-2000s. In this environment, it is even more pressing to fully understand information contained in commodity futures prices.

To address this issue, we analyze information flow between commodity futures prices traded in the US and stock prices of several East Asian economies, including China, Japan, Hong Kong, South Korea, and Taiwan. The US commodity futures markets offer liquid futures contracts on a large set of commodities, which are heavily traded by traders from all over the world. Our analysis focuses on three key commodities, copper, soybeans, and crude oil, which represent three important commodity sectors---industrial metals, grains, and energy. East Asia is one of the most vibrant parts of the world economy. China and Japan are the second and third largest economies after the U.S. In particular, as a result of its rapid economic growth in the last twenty years, China is widely recognized as a main engine of world economic growth. As a whole, East

Asia has also imported a large fraction of the world's commodity output in recent years, which we summarize in Section I.A.

If US commodity futures prices reveal useful information about global commodity demands and thus global economic strength, we expect East Asian stock prices to react to the commodity futures prices. The time zone difference between East Asia and the U.S. introduces asynchronous trading in the East Asian stock markets and the U.S. futures markets, which in turn allows us to directly analyze whether East Asian stock prices react to the lagged overnight returns of commodity futures traded in the U.S. In our analysis, we also control for the lagged overnight return of S&P 500 Index futures and the lagged spot return of the commodity to isolate information transmitted from the futures prices of the commodity to East Asian stock markets. We also examine the reverse information flow from Asian stock prices to U.S. commodity futures prices.

We find an evident change in the reactions of East Asian stock prices to U.S. commodity futures prices around mid-2000s. There is little evidence of stock prices in East Asian stock markets reacting to the commodity futures prices before 2005. In the latter period, there are *positive* and significant price reactions across the indices of all the East Asian stock markets to the lagged overnight futures returns of copper and soybeans, albeit not crude oil. By separately examining stock price reactions of a set of industries in China, Japan and Hong Kong, ranging from supply industries that produce a given commodity, consumer industries that demand the commodity as an important production input, and other industries that are not directly related to the commodity, we also find consistently positive and significant price reactions to the lagged futures returns of copper and soybeans across all these industries. Year 2005 is not a precisely identified break point. Rather, our analysis indicates the emergence of significant information flow in the recent years from futures prices of copper and soybeans traded in the U.S. to East Asian stock markets.

One might argue that the futures prices of copper and soybeans may simply reflect news that exogenously arrives at the markets during the hours the East Asian stock markets are closed and that East Asian stock prices would eventually incorporate the news regardless of the trading in the U.S. commodity futures markets. While it is difficult to attribute the information revealed by the futures prices of copper and soybeans to active information acquisition of traders in these markets, two features of our analysis highlight that the information is special. First, the East Asian stock prices react to the lagged futures returns of copper and soybeans even after controlling for the lagged return of S&P 500 Index futures. This suggests that the futures prices of copper and soybeans contain information beyond that in the S&P 500 Index, the widely followed financial indicator of the U.S. stock market and the global economy. Second, the futures prices of copper and soybeans have stronger predictive powers for East Asian stock prices than their spot prices, which indicate that the futures prices are more informative than the spot prices.

To interpret information revealed by the futures prices of copper and soybeans, it is important to differentiate between sources of shocks to commodity prices. To the extent that commodity price increases driven by supply shocks and idiosyncratic demand shocks of the U.S. would make it more costly for East Asian economies to import commodities, these shocks should suppress rather than boost East Asian stock prices. It is also difficult to attribute the positive responses of East Asian stock prices to the futures prices of copper and soybeans to discount rate shocks in the global financial markets for two reasons. First, we have controlled for S&P Thus, the positive reactions of East Asian stock prices to the lagged futures returns of copper and soybeans reflect information regarding global demand shocks. However, it is common for policy makers to interpret increases in commodity prices as supply shocks and thus an impediment to the economy. See, for example, the recent speech of Yellen (2011). In sharp contrast to this view, our findings suggest that East Asian stock markets tend to interpret increases in commodity prices as positive news to their economies.[1]

In light of our finding that people across the world react to potential information in commodity futures prices, this informational role can serve as a channel for futures market noise to feed back to the real economy. Singleton (2012) argues that informational frictions might have played an important role in driving the price boom and bust of crude oil in 2007-2008. Sockin and Xiong (2012) provide an equilibrium model to explicitly analyze the feedback effects of commodity futures prices. They emphasize that in the presence of information frictions,

[1] As the S&P 500 Index return is also positively correlated with futures returns of many commodities in recent years (e.g., Tang and Xiong, 2012), it is difficult to interpret commodity price fluctuations as pure cost factors to the U.S. economy too.

industrial producers cannot differentiate an increase in commodity futures prices driven by a stronger global economy or by futures market noise. If the complementarity in industrial producers' production decisions (due to their need to trade produced goods with each other) is sufficiently strong, Sockin and Xiong show that each producer may respond to higher commodity futures prices by increasing production and thus commodity demand, despite the higher costs of acquiring commodities. Through this informational feedback effect, market noise can distort commodity demand and the real economy.

Indeed, there was confusion regarding the interpretation of the large commodity price increases during the commodity market boom in 2007-2008, which many argue was partially driven by the large inflow of investment capital to commodity futures markets. Interestingly, according to reports released by the European Central Bank (ECB), the ECB interpreted the rising commodity prices as signals for strength of emerging economies and thus for strong inflation risk in the Euro zone. This interpretation partially motivated the ECB to raise its key interest rate in early 2008---the eve of the most severe world economic recession since the Great Depression. In retrospect, this interest rate hike appears poorly timed and demonstrates the possibility for commodity price fluctuations to feed back into the real economy through an informational channel.

The possibility of such a feedback effect makes it imperative to protect the informational environment of commodity futures markets. The greatly increased commodity price volatility in recent years has led to a serious concern in public and policy circles as to whether the large investment positions taken by commodity index investors potentially destabilizes commodity prices (e.g., Masters, 2008; U.S. Senate Permanent Subcommittee on Investigations, 2009). In response to this concern, the U.S. Congress and Commodity Futures Trading Commission (CFTC) have passed rules to limit futures positions of speculators. It is important to note that large investment positions per se may not affect commodity prices if market participants can readily separate futures price fluctuations driven by global economic fundamentals and commodity index traders' trading. On the other hand, noise induced by index investment flows or other forms of speculation in the futures markets can lead to a large feedback effect if market participants cannot differentiate such noise from genuine commodity demands driven by a growing global economy. Thus, improving market transparency by mandating disclosure of large investment positions to the public could be a more effective way of reducing the undesirable information distortion than imposing position limits.

There is a large body of literature analyzing the effects of oil price shocks on stock markets in the U.S. and other countries. For example, Jones and Kaul (1996), Nandha and Faff (2008), and Park and Ratti (2008) document that oil price increases have a negative impact on equity returns across different countries and different industries (except mining and energy sectors), although Huang, Masulis, and Stoll (1996) find little correlation between daily returns of oil futures and various stock indexes in the U.S. Kilian and Park (2009) highlight different impacts of supply and demand shocks to oil on stock prices by using a structural model to decompose oil price shocks. Consistent with the findings of Kilian and Park (2009), we find that East Asian stock returns are negatively correlated with oil futures returns before 2005, but positively correlated after 2005. This change in correlation represents a potential structural change in the composition of oil shocks. The complex and time-varying nature of oil price shocks perhaps underlies our finding that East Asian stock markets do not extract significant information flow from oil futures price changes.

The literature has given little attention to the interaction between prices of non-energy commodities and stock prices. It is rather striking that after 2005, East Asian stock prices have reacted positively to the lagged overnight futures returns of copper and soybeans, but not to crude oil. This finding is new and should motivate more systematic studies of the informational role of non-energy commodities.

This paper is organized as follows: Section I describes our empirical design, and Section II introduces the data. We report our findings in Section III and then conclude in Section IV.

I. Empirical Design

In this section, we first summarize commodity imports of East Asia. We then describe the approach we use to examine information flow from U.S. futures prices to East Asian stock prices and vice versa. Finally, we discuss how we interpret the information flow in light of demand, supply, and financial market shocks to commodity markets.

A. Commodity Imports of East Asia

Table 1 summarizes the imports of copper, soybeans and crude oil by different regions in 2010. Mainland China contributed 28.9%, 59.5%, and 10.9% of the total world imports of copper, soybeans, and crude oil, Japan contributed 2.0%, 3.6%, and 7.9% of the total world imports of these commodities, and South Korea contributed 3.9%, 1.3%, and 5.4%.

Figure 1 also plots the imports of these commodities across different regions in the recent years. The rapid growth in imports by China in the past decade clearly stands out, especially for copper and soybeans. In imports of copper, despite the contraction by the U.S. and Europe during the recent world economic recession from 2006 to 2009, China maintained a consistent, high growth rate except for a brief slowdown in 2008. In imports of soybeans, China had a steady growth after 2003 in sharp contrast to the flat curves of all other regions. In imports of crude oil, China also maintained a steady and modest growth rate, although its growth during the recent recession was rather modest relative to the significant contractions experienced by the U.S., Japan and South Korea.

Taken together, East Asian countries contribute to significant fractions of the world imports of copper, soybeans and crude oil. Their large demands of these commodities make the interactions between their stock markets and commodity futures prices traded in the U.S. interesting subjects to examine.

B. Identify Information Flow

Our empirical analysis focuses on examining how East Asian stock prices react to U.S. commodity futures price changes and vice versa. We take advantage of the time zone difference between the U.S. and East Asia. As daytime in East Asia is nighttime in the U.S., the reactions of East Asian stock prices to the return of U.S. commodity futures during the previous night reflect information flow from U.S. commodity futures prices to East Asian stock prices. Similarly, reactions of U.S. commodity futures prices to the East Asian stock returns during the previous night reflect information flow from East Asian stock prices to U.S. commodity futures prices.

Panel A of Figure 2 illustrates the regular trading hours of Chinese stock markets and U.S. futures markets. The Shanghai Stock Exchange opens at 9:30 a.m. (GMT + 8) and closes at 3:00 p.m. with a lunch break from 11:30 a.m. to 1:00 p.m., while the U.S. futures markets trade from 9:00 a.m. to 2:30 p.m. (GMT – 5). As the Shanghai time is 13 hours ahead of New York time

(12 hours when the U.S. adopts daylight savings time), the trading in the Shanghai stock market closes even before it starts in the U.S. commodity futures markets. To examine information flow from $R_{US\_Commodity,t-1}$, the U.S. commodity futures return on day t-1 (return from 2:30 p.m. of day t-2 to 2:30 p.m. of day t-1), to $R_{Asian\_Stock,t}$, Asian stock return on day t (price change from 3 p.m. of day t-1 to 3 p.m. of day t in Shanghai time), we run the following regression:

$$R_{Asian\_Stock,t} = b_0 + b_1 R_{US\_Commodity,t-1} + b_2 R_{S\&P500,t-1} + b_3 R_{Asian\_Stock,t-1} + \varepsilon_t \quad (1)$$

The term $b_1 R_{US\_Commodity,t-1}$ measures the information transmitted from the U.S. commodity futures return during the U.S. trading hours to Asian stock prices after the Asian markets open the next day.

It is a relevant concern that the commodity futures prices may simply passively reflect exogenous news during the U.S. trading hours, and East Asian stock prices may eventually incorporate the news even without observing the commodity futures prices. Because we cannot find a counterfactual of how East Asian stock prices would fluctuate without the commodity futures markets, it is difficult to identify information actively acquired by traders in the commodity futures markets. Instead, we use two strategies to show that information revealed by the commodity futures prices is special. First, we include the overnight S&P stock index futures return $R_{S\&P500,t-1}$ in the regression as a control. If the coefficient b_1 is still significant, it means that the information revealed by the commodity futures return is not subsumed by the information in the futures return of the S&P 500 Index, a widely followed indicator for the strength of the U.S. and world economies. Second, we also include the spot return of the commodity during the previous night to control for information contained by the commodity's spot price.

Furthermore, to control for potential price momentum in East Asian stock markets, we also include the return of the Asian stock on the previous day $R_{Asian\_Stock,t-1}$.

Similarly, we use the following regression to examine information flow from Asian stock return on day t to U.S. commodity futures return on day t:

$$R_{US\_Commodity,t} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R_{US\_Commodity,t-1} + \varepsilon_t \quad (2)$$

Note that the trading in the U.S. on day t is after the trading in East Asian on the same day. We include the lagged commodity futures return $R_{US\_Commodity,t-1}$ to control for price momentum.

A nuanced issue in our analysis is overnight trading in U.S. commodity futures markets. GLOBEX introduced overnight trading of commodity futures in 1994 and electronic trading systems further facilitated trading during night sessions, although futures trading during night sessions was light before 2005. With the introduction of overnight trading, U.S. commodity futures markets are open for almost 24 hours a day, which means trading in East Asian stock markets overlaps with night sessions of U.S. futures markets.

For the sample after 2005, tick-by-tick transaction data of U.S. commodity futures prices and S&P 500 Index futures prices are available. We use this high-frequency data to construct returns of a commodity's futures and S&P 500 index futures during hours overlapping and non-overlapping with each East Asian stock market in our sample. Specifically, we divide each day into two sub-intervals, one that overlaps with the trading hours of an East Asian stock market (for example, the Shanghai stock market) and the other that does not overlap with the trading hours of the East Asian market. Note that the division of these sub-intervals may vary across different East Asian markets. Panel B of Figure 2 illustrates the overlapping trading hours and marks the division of the two sub-intervals.

Then, we regress the return of the East Asian stock market on the commodity futures return and S&P 500 Index futures return during the lagged non-overlapping trading hours, $R^{NonOverlap}_{US\_Commodity,t-1}$ and $R^{NonOverlap}_{S\&P500,t-1}$, to examine information transmitted from these markets:

$$R_{Asian\_Stock,t} = b_0 + b_1 R^{NonOverlap}_{US\_Commodity,t-1} + b_2 R^{NonOverlap}_{S\&P500,t-1} + b_3 R_{Asian\_Stock,t-1} + \varepsilon_t \quad (3)$$

To control for information transmitted by the spot price of the commodity, we also add the lagged spot return from the previous day $R_{US\_spot,t-1}$ to the regression:

$$R_{Asian_{Stock},t} = b_0 + b_1 R^{NonOverlap}_{US\_Commodity,t-1} + b_2 R_{US\_spot,t-1} + b_3 R^{NonOverlap}_{S\&P500,t-1} \quad (4)$$

$$+ b_4 R_{Asian\_Stock,t-1} + \varepsilon_t$$

As the U.S. commodity futures markets are open during the trading hours of East Asian stock markets, the commodity futures prices can immediately absorb information revealed by East Asian stock prices. The transaction data allows us to separately examine reactions of U.S.

commodity futures during the non-overlapping and overlapping hours of the two markets. We first regress the U.S. commodity futures return during the overlapping hours of day t (during night time of the U.S.) on the contemporaneous Asian stock return $R_{Asian\_Stock,t}$:

$$R^{Overlap}_{US\_Commodity,t} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R^{NonOverlap}_{US\_Commodity,t-1} + b_3 R^{Overlap}_{US\_Commodity,t-1} + \varepsilon_t \quad (5)$$

To control for the momentum effect that may exist in commodity futures returns, we include the futures returns during the previous non-overlapping sub-interval ($R^{NonOverlap}_{US\_Commodity,t-1}$) and during the overlapping sub-interval of the previous day ($R^{Overlap}_{US\_Commodity,t-1}$). We then regress the U.S. commodity futures return during the non-overlapping hours of day t on the East Asian stock return of the same day $R_{Asian\_Stock,t}$ and other momentum control variables:

$$R^{NonOverlap}_{US\_Commodity,t} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R^{Overlap}_{US\_Commodity,t} + b_3 R^{NonOverlap}_{US\_Commodity,t-1} + \varepsilon_t \quad (6)$$

It is straightforward to interpret the lagged term $b_1 R_{Asian\_Stock,t}$ in (6) as information transmitted from the East Asian stock return to the U.S. commodity futures return during the non-overlapping hours. However, the interpretation of the contemporaneous term $b_1 R_{Asian\_Stock,t}$ in (5) during the overlapping hours is subtle. As both markets are open during the overlapping hours, the information flow may appear in the form of significant return correlations between the two markets rather than one market leading the other. To the extent that most participants in the U.S. markets are asleep, it seems reasonable to attribute most of the information acquisition to participants of the Asian stock markets as opposed to those of the U.S. futures markets. Thus, any significant return correlation between the U.S. futures markets and Asian stock prices during their overlapping trading hours is more likely to reflect information flow from the Asian stock markets to U.S. futures markets than in the reverse direction.

C. Interpret Information Content

To interpret information flow between U.S. commodity futures prices and East Asian stock prices, it is important to have a clear view of determinants of commodity futures prices. We can loosely classify determinants of commodity futures prices into several categories: supply shocks, demand shocks and financial market shocks. These shocks originate from different sources and have different implications for commodity futures prices and their joint dynamics with stock prices. We briefly describe these shocks and summarize the extent to which the joint dynamics of East Asian stock prices and U.S. commodity futures prices reflect these shocks.

C.1 Supply Shocks

Economists have long recognized that shocks to oil supply are important drivers of oil price fluctuations, which in turn can have significant real effects on the economy. Hamilton (1983) shows that disruptions to oil supply and dramatic oil price increases preceded almost all of the U.S. recessions after World War II. Mork (1989) and Hamilton (2003) further document that the relation between oil price changes and GDP growth is nonlinear---oil price increases have much more important effects than oil price decreases. Backus and Crucini (2000) provide evidence that oil price increases exacerbate international business cycles through the term of trades between countries. Davis and Haltiwanger (2001) find that oil price increases significantly reduce U.S. manufacturing jobs although oil price decreases do not lead to job creation in the same magnitude. A recent study by Blanchard and Gali (2010) emphasizes that the real effects of oil shocks changed over time and were much smaller after 1984. They attribute the decreased impact to three possible reasons: reduced real wage rigidity, monetary policy changes, and reduced share of oil in the real economy.

Suppose that a supply shock drives up the futures price of a commodity. The price increase raises commodity import costs to East Asian economies. As a result, the supply shock should push down the overall East Asian stock prices. The effect of the supply shock may vary across industries in that it hurts consumer industries that demand the commodity as production input but it benefits supply industries that produce the commodity.

C.2 Demand Shocks

Several recent studies highlight that demand shocks might also play an important role in driving oil prices. Kilian (2009) uses a global index of dry cargo freight rates to measure global economic activity and develops a structural VAR model for the dynamics of global oil production, global economic activity, and oil price. By decomposing the shocks in the economy to three orthogonal sources: an oil supply shock, an aggregate demand shock, and an oil specific demand shock based on certain identification restrictions, this study finds that the aggregate demand shock has a bigger impact on the oil market than previously thought. Hamilton (2009) also points out that strong demand confronting stagnating world production was a major factor for the run-up of oil prices in 2007-2008.

In discussing the effects of commodity demand shocks on East Asian stock prices, it is useful to differentiate between idiosyncratic demand shocks to the U.S. and global demand shocks. For example, the popularity of SUVs in the U.S. may increase U.S. oil consumption and thus oil futures prices. As this demand shock is associated with the U.S. economy, the subsequent oil price increase represents an increase in cost of oil imports to East Asian economies. Like supply shocks, the local U.S. demand shock should drive down the overall stock prices in East Asian industries, with a particularly strong effect on consumer industries that directly demand the commodity, although the shock would benefit supply industries that produce the commodity.

Global demand shocks have rather different effects. For example, the rapid economic expansion of emerging economies has led to growing demand for many commodities, such as oil, copper, iron ore, and soybeans. While growing global demand drives up the futures prices of these commodities, the booming global economy should lead to higher stock prices in East Asia despite the increased cost of commodity imports. In this case, we expect East Asian stock prices across all industries to rise with commodity futures prices.

C.3. Financial Market Shocks

Commodity futures prices may also fluctuate due to financial market shocks. The long-standing hedging pressure theory of commodity futures prices (e.g., Keynes, 1930; Hicks, 1939; Hirshleifer, 1988) emphasizes that commercial hedgers, such as farmers and oil producers, need to short commodity futures to hedge commodity price risks inherent in their commercial business. To induce financial traders or other speculators to take the long side of the futures markets, they are willing to offer positive risk premia by lowering futures prices.[2] More recently, Cheng, Kirilenko, and Xiong (2012) point out the need to expand the classic hedging pressure theory to incorporate time-varying risk capacity of financial traders on the long side. While most of the time financial traders trade to facilitate the hedging needs of hedgers, there are also times, in particular during financial crises, when binding risk constraints cause financial traders to

[2] Consistent with this theory, Bessembinder (1992) and de Roon, Nijman and Veld (2000) find that returns of commodity futures increase with commercial hedgers' hedging needs after controlling for systematic risk.

liquidate positions with hedgers taking the other side. The equilibrium futures prices balance the trading needs of financial traders and hedgers at any given time and induce risk to flow from the side with greater stress to the other side with less stress. Through such a risk convection mechanism, shocks to financial traders affect commodity futures prices.

Furthermore, shocks to financial markets can also affect commodity markets through an interest rate channel. As interest rate determines the opportunity cost of commodity producers and speculators to store physical commodities, a decrease in interest rates reduces the cost of storing commodities and thus leads to larger commodity inventories. As set forth by Frankel (2006) and Caballero, Farhi, and Gourinchas (2008), this storage-cost effect in turn causes commodity spot prices to rise.

Financial market shocks tend to induce positive correlations among prices of financial assets. For example, consider commodity index traders (CITs)--large portfolio investors who have invested hundreds of billions of dollars into commodity futures markets in recent years (e.g., Tang and Xiong, 2012). A positive shock to CITs' other asset holdings, such as U.S. stocks, would increase their portfolio values and risk capacities, and induce greater demands for investing in commodity futures. Such greater investment demands would in turn drive up commodity futures prices. To the extent that the shock may also induce CITs and other institutional investors to demand more East Asian stocks, the shock induces commodity futures prices to become positively correlated with East Asian stock prices. Basak and Pavlova (2013) develop a dynamic equilibrium model to describe such a mechanism through index investors' discount rate.

Two considerations allow us to isolate effects of financial market shocks in our analysis. First, due to stringent capital controls that prevent capital from freely moving across the Chinese border, China's financial markets are largely segmented from the world financial markets. Thus, we do not expect outside financial market shocks to directly impact Chinese stock prices through the trading of CITs and other institutional investors. Second, we expect the return of S&P 500 index to control for financial market shocks in our analysis of price reactions of other East Asian stocks.

In summary, different shocks to commodity futures prices have different implications for East Asian stock prices. In practice, neither market participants nor economic researchers like us observe the nature of shocks that drive commodity futures price fluctuations. Nevertheless, by analyzing the daily reactions of East Asian stock prices to U.S. commodity futures prices over a period of time, our study can uncover how participants of East Asian stock markets on average interpret information revealed by fluctuations of U.S. commodity futures prices. As the economic environment in the commodity markets and the global economy is likely to change over time, the composition of shocks to the economy might also change over time. As a result, we expect the information transmitted between the U.S. commodity futures markets and East Asian stock markets to vary over time as well.

II. Data

A. Commodity Prices

We obtain daily futures prices of copper, soybeans and crude oil from the GFD. The GFD uses a rolling contract for its futures data. In most of analysis, we use returns of rolling across the most actively traded futures contracts of these commodities. These contracts are typically front-month contracts.[3] For robustness, we also examine returns of more distant contracts. The results are similar to those obtained from front-month contracts.

Copper futures returns are measured as log changes of daily prices of the high grade copper futures contracts traded in COMEX. Soybean futures returns are calculated as log changes of daily prices of soybean futures traded in CBOT. Crude oil futures returns are measured as log changes of daily prices of West Texas Intermediate (WTI) light crude oil futures contracts traded on NYMEX. For copper and soybeans, daily futures data starts in January 1959, while crude oil futures data is only available after March 1983.

GLOBEX introduced overnight trading of commodity futures in 1994 and the emergence of electronic trading systems further facilitated trading during night sessions. For copper and crude

[3] An exception is copper. In recent years, COMEX expanded the set of copper contracts from the initial five contracts that mature in March, May, July, September, and December to 12 contracts maturing in each month of the year. Nevertheless, the newly added contracts remained inactive even when they were front-month contracts. In our analysis, we skip these contracts by rolling into the most active contracts based on trading volume.

oil, open outcry trading on NYMEX goes from 9:00 a.m. to 2:30 p.m. eastern time on weekdays. Electronic trading starts at 6:00 p.m. eastern time on Sunday and closes at 5:15 p.m. on Friday. It stops trading from 5:15 p.m. to 6:00 p.m. each day. For soybeans, open outcry trading on CBOT goes from 9:30 a.m. to 2:00 p.m. central time. Electronic trading goes from 5:00 p.m. central time on Sunday to 2:00 p.m. on Friday with a daily break from 2:00 p.m. until 5:00 p.m.

As shown by Ulibarri (1998) and Lin and Tamvakis (2001), futures trading during night sessions was rather light in the early years. For the sample before 2005, we compute daily futures returns using closing prices of the most active contracts of each commodity during regular outcry sessions. For the sample after January 2005, Tick Data gives use intraday prices of copper, soybeans, and crude oil futures, as well as intraday prices of S&P 500 Index futures. The data in this database is presented tick-by-tick, and delivered in compressed ASCII files with the TickWrite software that allows clients to quickly and easily output time series data in ASCII format. TickWrite also makes it easy to create continuous futures data. We use the AutoRoll method recommended by TickWrite to roll futures contracts. AutoRoll computes daily tick volume for the most active and other contracts and rolls to a back contract when the daily tick volume of the back-month contract exceeds the daily tick volume of the current most-active month contract. As discussed in the previous section, we split the daily return of each commodity futures into overlapping and non-overlapping parts in accordance with trading hours of each Asian stock market by using the tick-by-tick data.

We obtain metal bulletin copper high-grade cathode spot prices (MBCUUSHG) from Bloomberg. Daily spot prices of soybeans and crude oil are obtained from the GFD. The soybean spot prices are based upon the closing prices in Southeast Iowa that are offered to producers as of 2:30 p.m. local time. This daily price report is prepared by the Marketing Bureau of Iowa Department of Agriculture and Land Stewardship. Spot prices of crude oil are closing prices for West Texas Intermediate crude oil offered at Cushing, Oklahoma at 2:30 p.m. local time. The sample period starts in January 2005 and ends in September 2012.

B. East Asian Stock Prices

We obtain daily prices of Asian stock indices from the Global Financial Database (GFD). We choose the most comprehensive and diversified stock index available for each market. For Japan, we use the Tokyo Price Index (TOPIX), which is a capitalization-weighted price index of all first section stocks traded in the Tokyo Stock Exchange. Daily prices of TOPIX are available from 1959 on. The morning trading session of TOPIX goes from 9:00 a.m. to 11:00 a.m. Tokyo time (GMT + 9) and the afternoon session is from 12:30 p.m. to 3:00 p.m.

For Hong Kong, we use the Hang Seng Index, which includes the 33 largest firms in Hong Kong and represents about seventy-five percent of equity capitalization of the Stock Exchange of Hong Kong (SEHK). The Hang Seng Index is a value-weighted arithmetic index. Daily prices of the Hang Seng Index are available from 1972 on. The morning session of SEHK is from 10:00 a.m. to 12:30 p.m. and the afternoon session is from 2:30 p.m. to 4:00 p.m. (GMT + 8).[4]

The Korea Composite Stock Price Index is a capitalization-weighted price index including all stocks listed on the Seoul Stock Exchange. Daily prices of the Korea Composite Stock Price Index are available from 1962 on. The regular trading session of the Seoul Stock Exchange goes from 9:00 a.m. to 15:05 p.m. (GMT + 9) with a lunch break in the middle.

We use the Shanghai Market Index and the Taiwan Market Index to represent stocks traded in mainland China and Taiwan. Both indices are value-weighted arithmetic indices including all stocks traded in these markets. The data for the Taiwan Market Index starts in 1969, while the Shanghai Market Index became available only after 1991. In Shanghai, the morning session goes from 9:30 a.m. to 11:30 a.m. (GMT + 8) and the afternoon session goes from 1:00 p.m. to 3:00 p.m. In Taiwan, the regular trading session goes from 9:00 a.m. to 1:30 p.m. (GMT + 8).

In Section III.C, we also use returns of individual stocks to construct returns of a set of industries in the stock markets of Japan, Hong Kong, and mainland China.

III. Empirical Results

We first examine the weekly return correlations between the three commodity futures traded in the U.S. and East Asian stock indices. We then study the reactions of East Asian stock prices

[4] On March 7, 2011, SEHK extended its trading hours in the first of two phases. The morning session was changed to from 9:30 a.m. to 12:00 noon, followed by a ninety-minute lunch break and an afternoon session from 1:30 p.m. to 4:00 p.m.. On March 5, 2012, the lunch break was cut to sixty minutes, with the afternoon session running from 1:00 p.m. to 4:00 p.m.

to the lagged overnight return of each of the commodity futures at both market and industry levels. Finally, we analyze the reactions of U.S. commodity futures prices to the returns of East Asian stock prices.

A. Weekly Return Correlation

To get an overall picture of the joint movements of U.S. commodity futures prices and East Asian stock prices, we plot correlations of weekly returns of the futures prices of copper, soybeans, and crude oil with index returns of the five East Asian stock markets in our sample based on two-year rolling windows. We choose correlations of weekly rather than daily returns to mitigate effects of asynchronous trading hours between U.S. markets and East Asian markets. For comparison, we also plot the weekly return correlations of the three commodity futures with the S&P 500 Index futures.

Figure 3 depicts the return correlations of copper, soybeans, and oil futures with the six stock market indices in Panels A, B, and C, respectively. The starting year of each plot varies due to availability of data.

In the first plot of Panel A, the return correlation between copper futures and the S&P 500 Index futures varies substantially over time. The correlation is particularly high in two periods, one in the late 1970s and early 1980s and the other in recent years--after the mid-2000s. It is well known that during the former period stagflation caused both high inflation and slow economic growth in the U.S. and other advanced economies. The high return correlation between copper futures and S&P Index futures reflects the stagflation at the time. The high correlation in the latter period, as pointed out by many commentators, may reflect the dependence of both copper prices and the U.S. economy on the rapid economic growth of emerging economies such as China and India. The correlation in these two periods rises above 0.5, while outside these two periods, it is small and insignificant from zero.

The return correlations of copper futures with the stock indices of Japan and Hong Kong also have two peaks, one in the late 1970s and early 1980s and the other in recent years. The peak in the latter period was particularly high--higher than 0.5 and the previous peak. These two peaks likely reflect the same forces responsible for driving the correlation of copper futures with the S&P Index, as discussed earlier. Outside these two periods, the correlation is small. The return correlations of copper futures with the stock indices of the Taiwan, South Korea, and Shanghai markets remain small and insignificant from zero until the mid-2000s, when they all experienced large increases and reached levels above 0.5. The absence of any pronounced correlation increase in late 1970s and early 1980s for these markets may reflect the fact that their economies were in the early stages of development at the time. The economies of Taiwan and South Korea reached an advanced level and became well integrated to the world economy only in 1990s. China's economy reached this stage even later, as China did not have a stock market until the early 1990s. Despite the different stages of development of these East Asian economies, their stock markets all experienced the same large increases in correlations with copper futures in recent years. The focus of our analysis is to examine this common correlation increase.

Panel B of Figure 3 depicts the return correlations of soybean futures with the six stock market indices. There are two notable points. First, the correlations of soybean futures with stock prices are more variable than the corresponding correlations of copper futures. Second, despite the greater variability, the correlations of soybeans futures with the stock market indices also experienced a common increase after the mid-2000s. This common increase resembles the increases in the correlations of copper futures with these stock market indices in the same period.

Panel C of Figure 3 depicts return correlations of crude oil futures with the six stock market indices. As WTI crude oil futures started trading only in 1983, the correlation plots for all stock markets start in 1985, except the plot for China starts in 1995. There are also two notable episodes in these plots. First, in early 1990s, we observe large drops in the correlations of oil futures with the stock indices of the U.S., Japan, Hong Kong, and South Korea to significantly negative levels. These drops were driven by the Gulf War, which caused oil prices to spike and stock markets across the world to decline. As widely recognized by the literature (e.g., Hamilton, 2003), this episode reflects the effect of an oil supply shock. Second, since the early 2000s, there is a common increasing trend in the correlations of oil futures with these different stock market indices. In particular, at the peak in 2010, the correlations with the S&P 500, Hong Kong, and Taiwan indices have risen above 0.5. The increases in correlations with other market indices are more modest but nevertheless significant.

Taken together, Figure 3 demonstrates a clear pattern that despite the large heterogeneity in the three commodities and the six stock markets, the return correlations between these commodity futures and stock market indices have all experienced large increases and become significantly positive in recent years. These largely increased correlations are consistent with the finding of Tang and Xiong (2012) and motivate our study of information flow between commodity future markets and stock markets.

B. Reactions of East Asian Market Indices to U.S. Commodity Futures Prices

We now analyze the reactions of East Asian stock prices to U.S. commodity futures prices. We first report results at the market index level in this subsection and then provide some additional results at the industry level in the next subsection.

Table 2 reports results from analyzing the regression specified in (1) of Section I for the sample before 2005, during which we have only daily data on commodity futures returns. Panel A summarizes the results from using the lagged copper futures return to predict the daily index return of each East Asian stock market. We find that East Asian stock indices positively react to the copper futures return without controlling for the S&P 500 Index futures return. The estimate of the response coefficient b_1 is positive in each market and is statistically significant in Japan, Hong Kong and South Korea. However, the estimate of b_1 becomes insignificant for all markets after including the lagged S&P 500 Index futures return in the regression, indicating that before 2005, copper futures prices do not contain additional information beyond what is in S&P 500 Index. Furthermore, all East Asian stock market indices except the Shanghai Market Index respond positively and significantly to the lagged S&P 500 Index return.

Panel B reports the results on the reactions of East Asian market index returns to the lagged soybean futures return. We find little reaction in these markets with an exception in Hong Kong, where the Hang Seng Index has a positive and marginally significant reaction to the lagged soybeans futures return without controlling for the lagged S&P 500 Index futures return. Overall, there is little evidence before 2005 for price reactions of East Asian market indices to the lagged futures returns of either copper or soybeans after controlling for the lagged S&P 500 Index futures return.

Panel C summarizes reactions to the lagged crude oil futures return. In contrast to the reactions to lagged copper and soybeans returns, the reactions of the East Asian market indices to the lagged crude oil return are mostly negative except for the Shanghai Market Index. Without controlling for the lagged S&P 500 Index futures return, the estimate of b_1 is significantly negative for Japan, Taiwan and South Korea. After controlling for the lagged S&P 500 Index futures return, the estimate of b_1 remains significantly negative for Japan and Taiwan. In light of our discussion in Section I.B, the negative reactions indicate that crude oil futures returns reveal information regarding supply shocks of crude oil and that most Asian market indices react negatively to such information. This result is also consistent with the studies referenced in the introduction, which find that crude oil prices tend to have negative return correlations with stock prices across the world.

For the sample period in 2005-2012, we are able to use tick-by-tick data to construct futures returns of the three commodities and S&P 500 Index in two sub-intervals of each day, one for overlapping hours and the other for non-overlapping hours with each East Asian stock market. In Table 3, we examine the reactions of the East Asian market indices to the lagged U.S. commodity futures return during the non-overlapping hours by running the regression specified in (3) of Section I. Panels A, B, and C report the reactions to the lagged return of copper, soybeans and crude oil, respectively.

In sharp contrast to the results before 2005, we find positively significant reactions for all East Asian market indices to the lagged returns of both copper and soybean futures even after controlling for the lagged return of S&P 500 stock index futures. The estimate of b_1 in each market with respect to the lagged futures return of either copper or soybeans is not only substantially larger in magnitude relative to the corresponding estimate reported in Table 2 for the pre-2005 sample but also statistically significant. Taken together, these results imply that after 2005, the futures prices of copper and soybeans contain information beyond what is revealed by the price of S&P 500 Index futures and that East Asian stock markets respond significantly to price fluctuations of copper and soybeans futures. Given the tremendous popularity of S&P 500 Index futures among financial institutions as a key indicator of the economic growth of the U.S. and the world, one would have expected S&P 500 Index futures prices to serve as a sufficient statistic of information revealed by the commodity futures prices. Thus, it is rather striking to observe that the futures prices of copper and soybeans contain additional information.

While our main analysis uses rolling returns of the active futures contracts of the three commodities, we have also examined reactions of East Asian stock returns to returns of distant futures contracts of these commodities. The results are similar. This is not surprising as it is well known that the prices of distant contracts move very closely with the front-month contracts. Our analysis suggests that distant contracts do not provide additional information relative to front-month contracts.

What kind of information is revealed by the futures prices of copper and soybeans? In section I.C, we classify four types of shocks to commodity futures prices: supply shocks, idiosyncratic demand shocks, global demand shocks, and financial market shocks. To the extent that commodity price increases driven by supply demands have adverse effects on commodity import economies, the positive reactions of East Asian market indices to futures prices of copper and soybeans cannot be explain by information regarding supply shocks of these commodities. Neither can the positive reactions be explained by information regarding idiosyncratic demand shocks of these commodities. This is because high commodity prices driven by idiosyncratic demand shocks in the U.S. would also boost commodity import costs of East Asian economies and should thus generate negative price reactions in East Asian stock markets.

It is possible for financial market shocks to cause a positive correlation between commodity futures return and Asian stock market returns. However, it is difficult for this mechanism to fully explain the positive predictability of copper and soybean futures returns for China’s market return. As China’s stock market is largely segmented from the outside world due to its capital controls, one would not expect trading by outside investors to directly affect the Shanghai Market Index. Furthermore, as we have controlled for the return of S&P 500 index, which would have captured financial market shocks, it is also difficult to attribute the positive responses of other East Asian stock markets.

The positive reactions of East Asian market indices to the lagged copper and soybean futures returns are likely to reflect information regarding global demand shocks to these commodities, which is ultimately related to the strength of the global economy. This is because a stronger global economy leads to higher stock prices in East Asian economies despite their greater commodity import costs. In the next subsection, we further explore the stock price reactions of different industries to the lagged returns of commodity futures.

Panel C of Table 3 reports reactions of the Asian market indices to the lagged oil futures return. The reactions to the lagged oil futures return have also dramatically changed after 2005. Without controlling for the lagged S&P 500 Index futures return, the reactions of all East Asian market indices are positive and significant, as opposed to the negative reactions before 2005 shown in Table 2. These positive reactions are broadly consistent with decreased effects of oil supply shocks documented by Blanchard and Gali (2010) and with the potentially more important effects of global oil demand shocks emphasized by Kilian (2009). However, after controlling for the lagged S&P 500 Index futures return, the reactions of all markets become insignificant. This indicates that information revealed by the oil futures return is subsumed by that in S&P 500 Index futures return. As we discussed before, as one would have expected the S&P 500 Index futures market to reflect most of the information about the global economy, this result is not so surprising. However, this result does make the significant amount of information revealed by copper and soybean futures prices even more striking.

One might argue that the information revealed by copper and soybean futures prices may simply reflect passive news that hits the public domain during the hours when the U.S. futures markets are open and the East Asian stock markets are closed. It is difficult to directly trace the information revealed by futures prices of copper and soybeans to active acquisition of traders in the U.S. futures markets. We can nevertheless compare the ability of futures and spot prices of these commodities in predicting the East Asian stock prices. If the futures prices have stronger predictive power, it shows that the information in the futures prices is superior to that in the spot prices, and thus cannot be taken for granted.

In Table 4, we compare the information in the futures prices and spot prices of copper, soybeans and crude oil in the post-2005 sample. Specifically, we run the regression specified in (4) of Section I, which adds the lagged spot return of the commodity from the previous day. Due to the lack of high-frequency data on spot prices, we cannot construct spot returns during the non-overlapping trading hours as we do for the futures return. The spot return from the previous day should nevertheless be sufficient to capture information contained in the spot prices.

Panel A of Table 4 reports the results from using both lagged futures and spot returns of copper to predict the return of each of the East Asian market indices. We find that if the lagged futures return is not included in the regression, the lagged spot return of copper is able to predict stock index returns of some markets such as Japan and Taiwan. However, once the lagged futures return is included, the lagged spot return of copper becomes insignificant in all markets except Taiwan, while the lagged futures return is significant in Japan, Hong Kong and Shanghai. It is clear that the lagged futures return of copper has stronger predictive power than the lagged spot return.

Panel B of Table 4 reports the results from using both lagged futures and spot returns of soybeans to predict the return of each East Asian market index. The superior predictive power of the futures return of soybeans is even more evident. When lagged futures and spot returns are both included in the regression, the lagged futures return has significant predictive power in all markets, while the lagged spot return is insignificant in all markets. Taken together, Table 4 shows that futures prices of both copper and soybeans contain information superior to spot prices of these commodities.

C. Price Reactions of East Asian Stocks: An Industry-Level Analysis

Our analysis in the previous subsection shows significantly positive reactions of East Asian stock market indices to lagged futures returns of copper and soybeans after 2005. An analysis of stock price reactions in different industries can further sharpen our understanding of the type of information transmitted by the futures prices of copper and soybeans to Asian stock prices. For example, price increases of copper futures driven by supply shocks should hurt industries that consume copper as production input but benefit industries that produce copper, whereas price increases driven by global demand shocks represent a stronger global economy and thus may boost stock prices of all industries, despite the increased copper consumption costs for consumer industries.

We use the Thomson Reuters Business Classification (TRBC) codes to classify firms into different industries. TRBC, which is owned and operated by Thomson Reuters, gives an industry classification of global companies.[5] We focus on a set of industries listed in Table 5 with the corresponding TRBC codes. We further group these industries into three categories: 1) supply industries that directly profit from sales of a given commodity; 2) consumer industries

[5] See http://thomsonreuters.com/products_services/financial/thomson_reuters_indices/trbc/ for more details.

that heavily rely on a given commodity as production input; 3) other unrelated industries that are not directly connected to a given commodity in production and operation. To ensure that there are sufficient firms in each industry, we perform the industry-level analysis only in the three largest stock markets in our sample: Japan, mainland China and Hong Kong.

Table 6 reports results of the industry-level analysis, which uses the same regression specification as Table 3. Panel A displays the results from using the lagged futures return of copper as the predicting variable. As expected, the price reactions of supply industries in the stock markets of Japan, Hong Kong, and Shanghai are all positive and significant. Among consumer industries, such as electric equipment and electronics industries, we also observe positive and mostly significant stock price reactions to the lagged copper futures return, although the estimate of the reaction coefficient b_1 is noticeably smaller than that of the supply industries. We also examine a set of other unrelated industries, ranging from cyclical industries such as steel and real estate to stable, non-cyclical industries such as telecoms or healthcare. Our regression result shows that even the stock prices of these industries that are not directly related to either production or consumption of copper have positive and significant reactions to the lagged copper futures return. This pattern is stable and consistent across all three stock markets.

Taken together, our industry-level analysis of the price reactions of Asian stocks to the lagged copper futures return shows that our earlier result of significantly positive reactions at the market index level is robust with consistent support across different industries. The fact that even consumer industries and other unrelated industries exhibit significantly positive stock price reactions underlies a clear message that Asian stock markets consistently interpret futures prices of copper as a barometer of the global economy.

Panel B of Table 6 reports results from using the lagged futures return of soybeans as the predicting variable. Overall, the industry-level stock price reactions to the lagged soybean futures return are consistently positive and significant across supply industries, consumer industries and other industries in both Hong Kong and mainland China, similar to the reactions to the lagged copper futures return. The industry-level results for Japan are somewhat weaker. We do not find significant price reactions to the lagged soybean futures return in supply and consumer industries, although there are significantly positive reactions in some other industries, such as those in steel and auto equipment. Perhaps this is because the Japanese economy is less involved in producing agricultural products and Japanese investors do not pay as much attention to agricultural commodity prices as investors in Hong Kong and mainland China.

Panel C of Table 6 reports results from using the lagged futures return of crude oil as the predicting variable. We only find significant price reactions to the lagged crude oil futures return in supply industries. Supply industries in Japan, Hong Kong and mainland China all exhibit significantly positive stock price reactions to the lagged crude oil futures return. On the other hand, across all three stock markets, consumer industries and other unrelated industries do not show any significant reaction, except steel industry in Japan. The lack of price reactions outside supply industries is consistent with the weak market-level reactions to the lagged crude oil futures return. Taken together, these results show that oil futures prices do not transmit much information to East Asian stock prices.

D. Reactions of U.S. Commodity Futures Prices to East Asian Stock Prices

In this subsection, we analyze the information flow from East Asian stock markets to U.S. commodity futures markets. Specifically, we adopt regressions specified in (5) and (6) of Section I.

Table 7 reports regression results using the pre-2005 sample. Panel A provides results from using the lagged index return of each East Asian stock market to predict the futures return of copper. We find that it has significantly positive reactions to the lagged index returns of all markets except Shanghai. This shows that participants in the U.S. copper futures market interpret the prosperity of Asian stock markets as important signals for copper prices. Panels B and C report results from using the lagged index return of each East Asian market to predict the futures returns of soybeans and crude oil. We do not find any significant influence of Asian stock returns on the futures prices of these commodities before 2005.

Table 8 summarizes regression results using the post-2005 sample. To save space, we only report the estimate of the response coefficient of each commodity future to the return of each Asian stock market index. Due to the popularity of overnight trading in the U.S. commodity futures markets after 2005, we separately analyze the futures return of each commodity during the hours that overlap with each of the Asian markets and during the non-overlapping hours.

When we regress the futures return of each commodity during the non-overlapping hours on the lagged return of each East Asian market index, we find little response across almost all commodity-stock market pairs. Given that the U.S. commodity futures markets are open during the trading hours of the East Asian stock markets, we expect any information revealed by the East Asian stock prices to be quickly absorbed by the U.S. commodity futures prices. As a result, it is not surprising to see that the East Asian stock index returns cannot predict the subsequent returns of U.S. commodity futures in the non-overlapping hours.

When we regress the futures return of each commodity during the overlapping hours on the contemporaneous return of each Asian market index, Table 8 shows significantly positive coefficients in all commodity-stock market pairs. It is usually difficult to interpret a significant correlation between two contemporaneous return processes as information flow from one market to the other. However, given that the overlapping trading hours of the U.S. commodity futures markets and the East Asian stock markets occur at nighttime in the U.S., it is reasonable to argue that participants in the East Asian stock markets are more active. As a result, the significantly positive return correlations between the two markets during this period are more likely to reflect information flow from East Asian stock prices to U.S. commodity futures prices than the other way around.

IV. Conclusion

This paper provides evidence of significantly positive stock price reactions across all East Asian stock markets and across a broad range of industries to the lagged overnight futures returns of copper and soybeans, albeit not crude oil, after mid-2000s. Our findings highlight significant information flow from daily futures returns of copper and soybeans to Asian stock markets and establish the futures prices of these commodities as barometers of global economic strength. This informational role of commodity futures prices provides a channel for speculative trading in commodity futures markets to feed back into spot markets and real economy, and thus makes it imperative to protect the informational environment of commodity futures markets.

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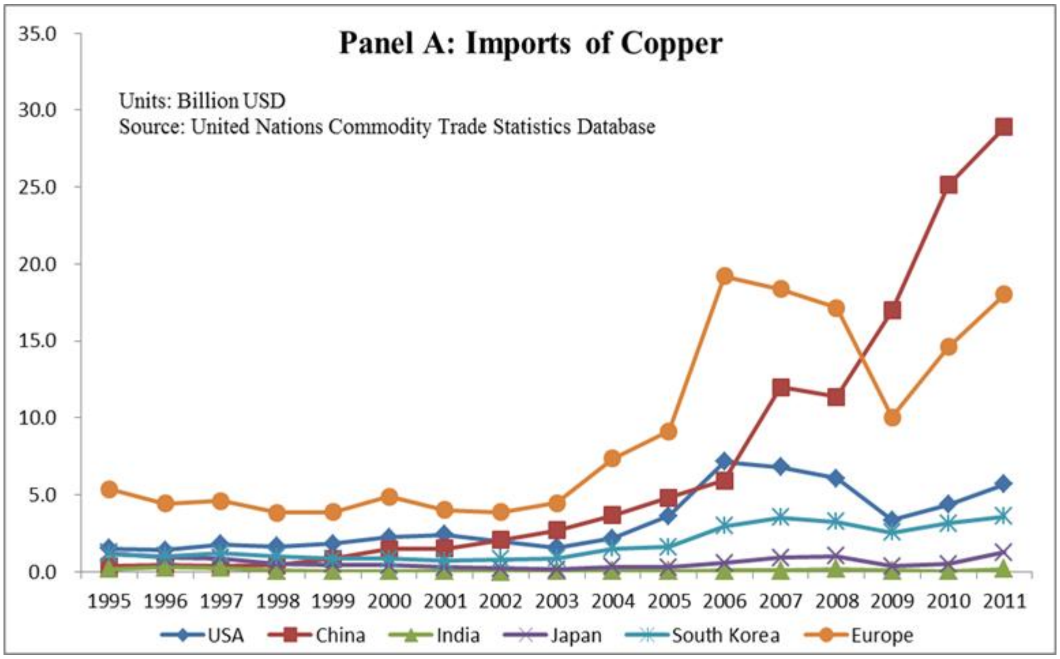
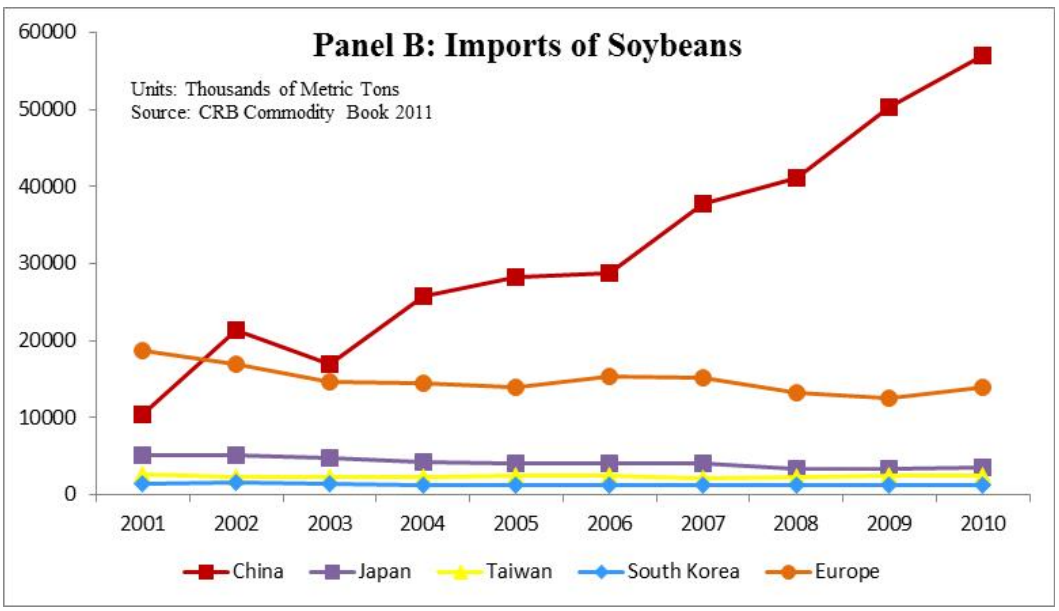
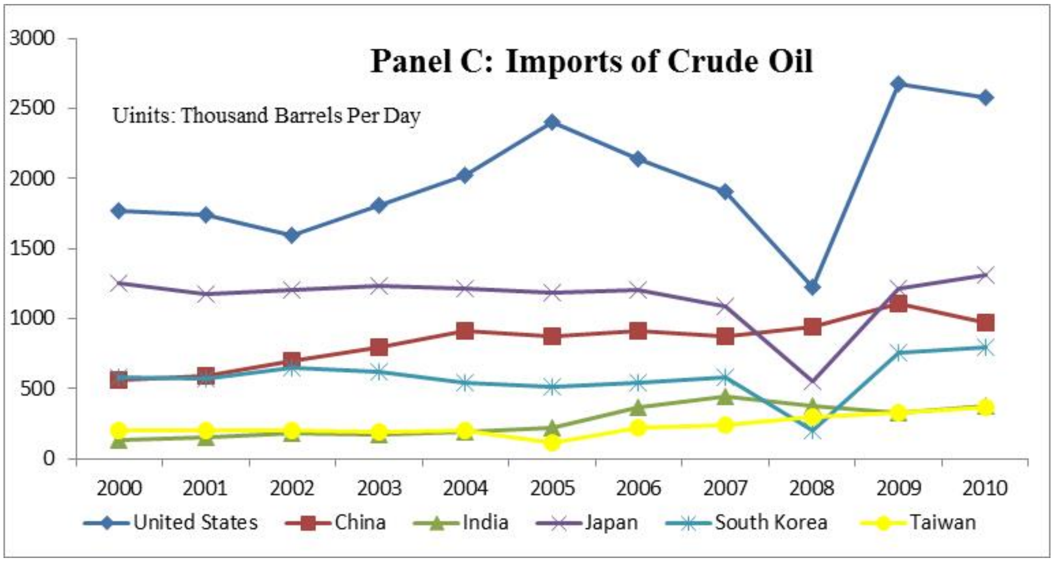
Figure 1: Commodity Imports across Regions

This figure plots the recent trends in imports of copper, soybeans and crude oil by various regions of the world. The data on copper is provided by the United Nations Commodity Trade Statistics Database, which records the dollar-denominated imported value of copper and articles by countries. The data on soybeans and crude oil is obtained from the CRB Commodity Yearbook 2011 and International Energy Statistics, respectively.



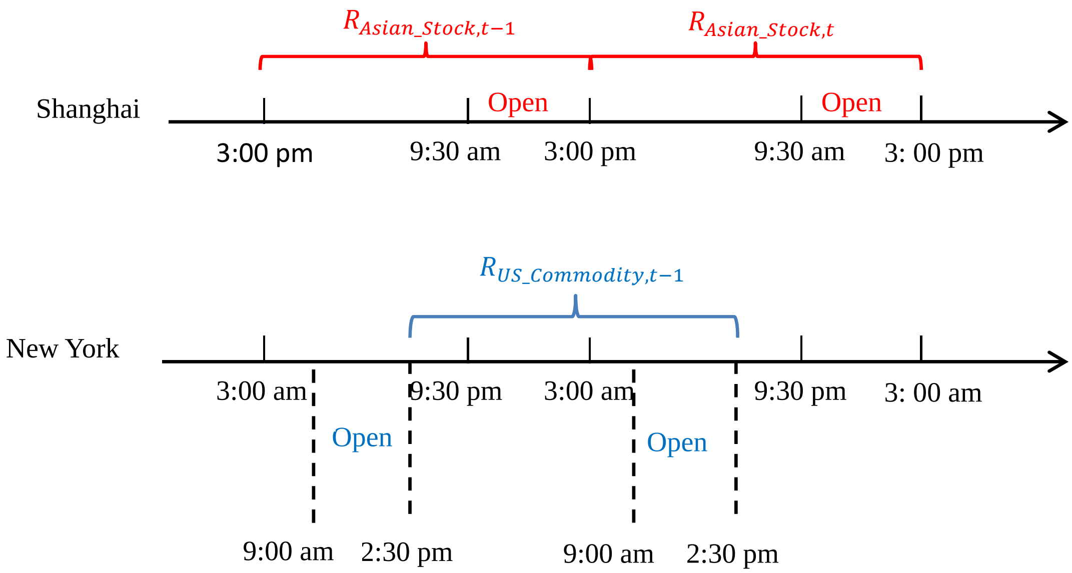




Panel C: Imports of Crude Oil
Units: Thousand Barrels Per Day
3000
2500
2000
1500
1000
500
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
United States
China
India
Japan
South Korea
Taiwan

Figure 2: Trading Hours

Panel A: Trading Hours without Overnight Trading



Panel B: Trading Hours with Overnight Trading

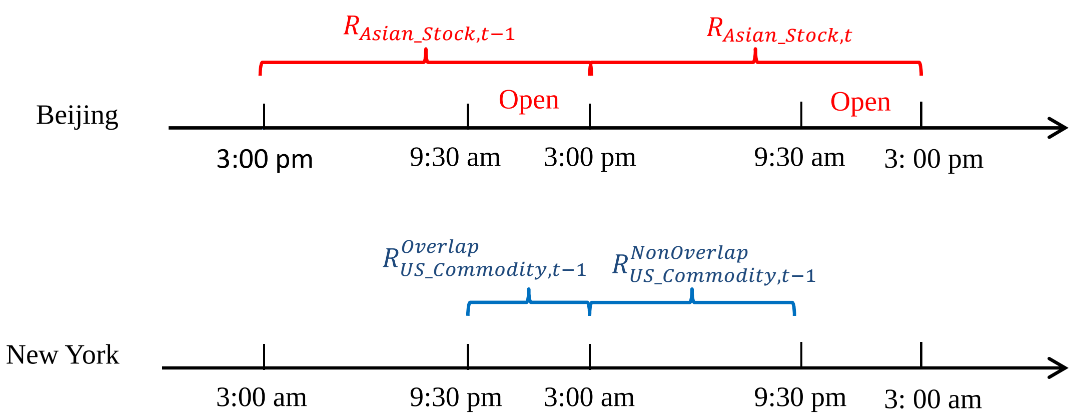
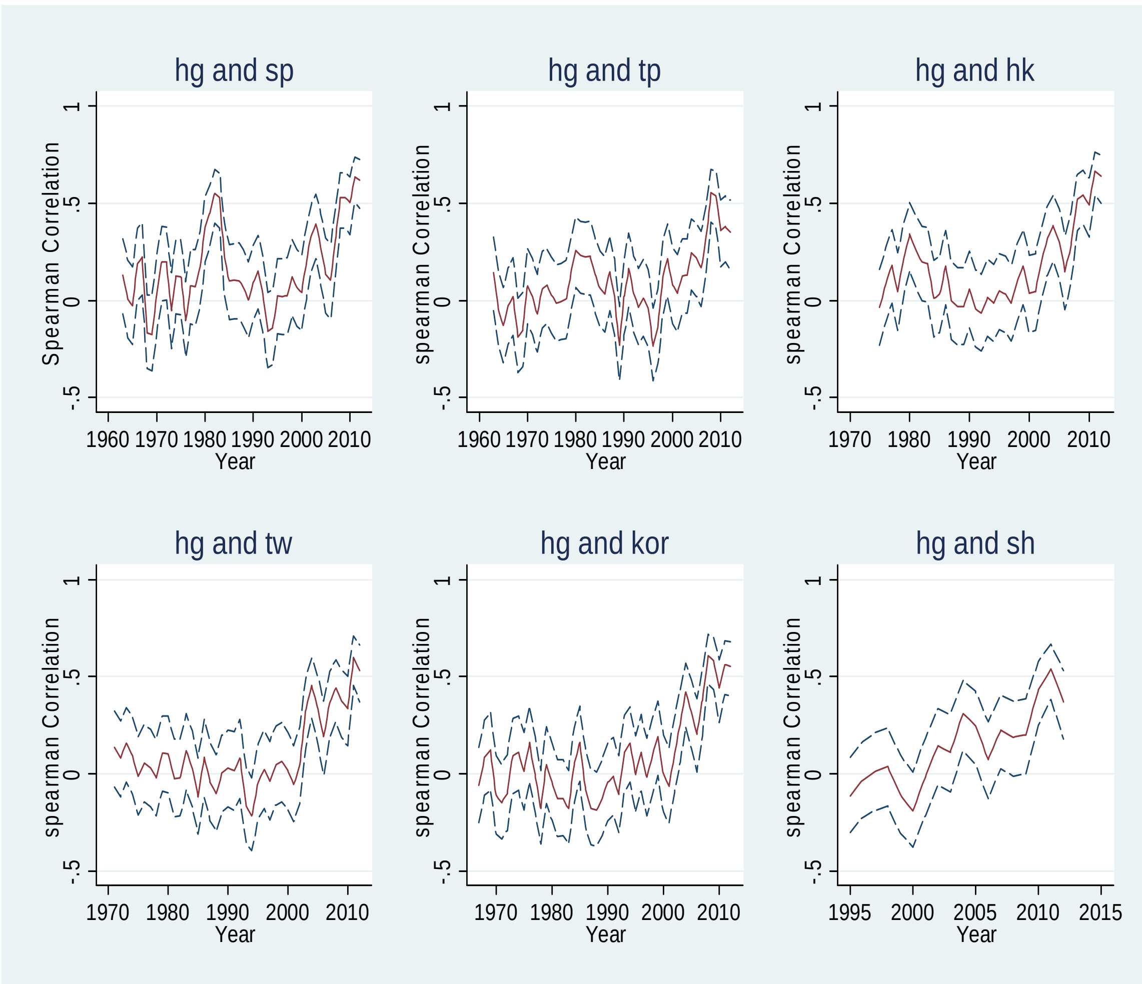


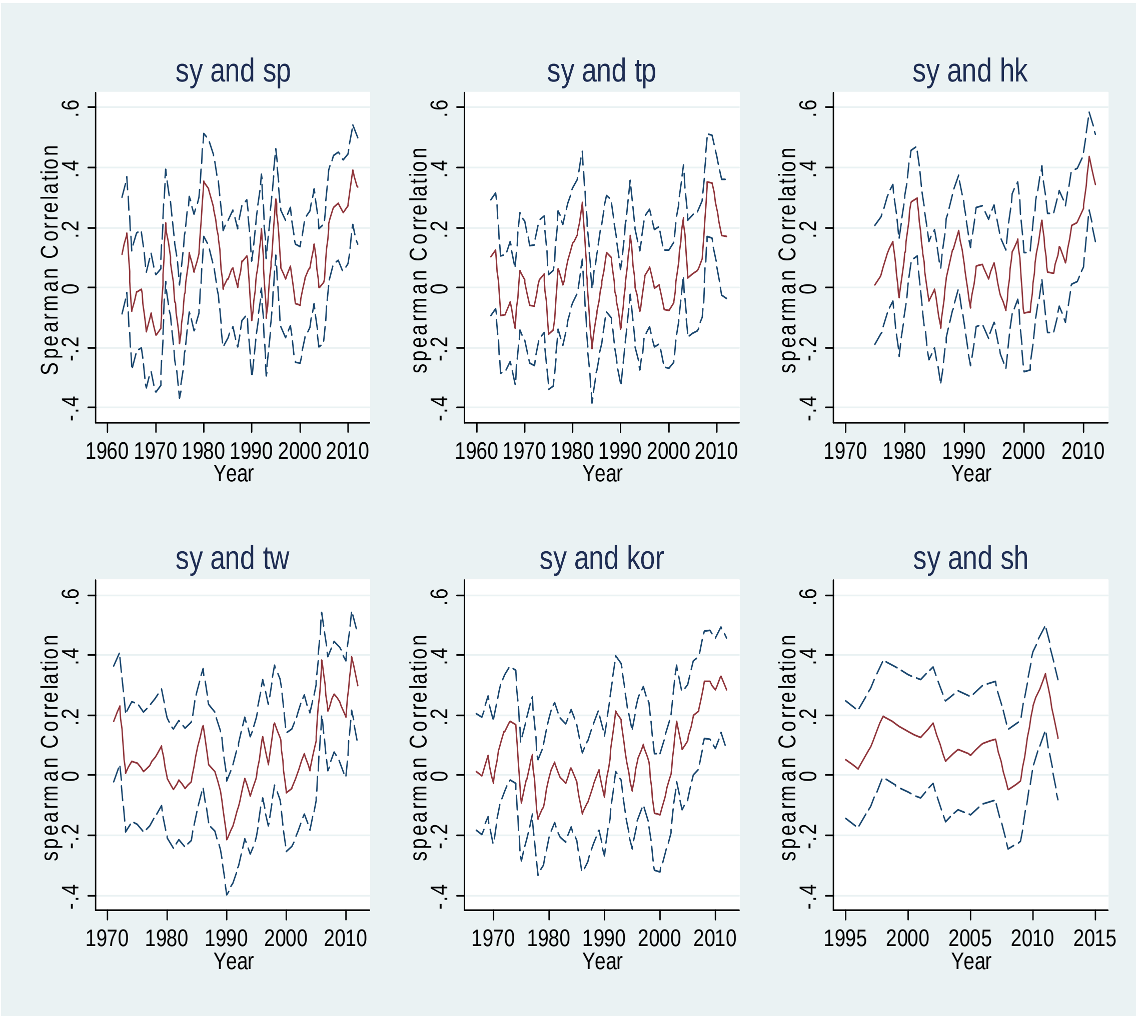
Figure 3: Weekly Return Correlations between US Commodity Futures Prices and Stock Indices

This figure depicts two-year rolling weekly return correlations of U.S. commodity futures prices with the S&P 500 Index (sp), the Tokyo Price Index (tp), the Hang Seng Index (hk), the Taiwan Market Index (tw), the Korea Composite Stock Price Index (kor), and the Shanghai Market Index (sh). Panels A, B, and C report the correlations of copper (hg), soybeans (sy), and oil (cl), respectively.

Panel A: Correlations of Copper Futures with Stock Indices



Panel B: Correlations of Soybean Futures with Stock Indices



Panel C: Correlations of Oil with Stock Indices

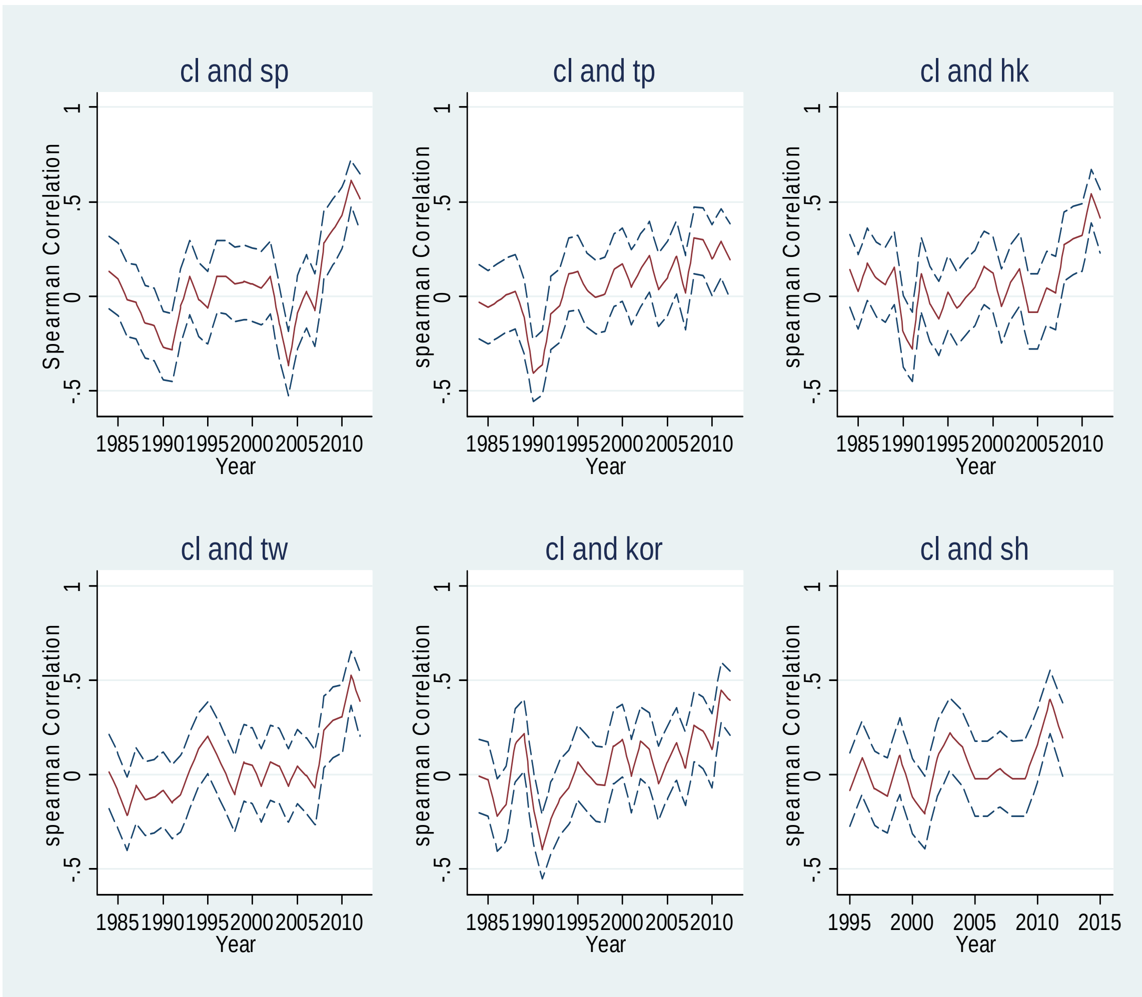


Table 1: Commodity Import in 2010 by Regions

This table describes imports of copper, soybeans and crude oil by various regions of the world in 2010. The data on copper is provided by the United Nations Commodity Trade Statistics Database, which records the dollar-denominated imported value of copper and articles by countries. The data on soybeans and crude oil is obtained from the CRB Commodity Yearbook 2011 and International Energy Statistics, respectively.

	Units	World	Mainland China	Japan	South Korea	Taiwan	U.S.	Europe
Copper	Billion USD	48.3	25.1	0.5	3.1		4.4	14.6
	% of World Import	100.0%	51.9%	1.0%	6.5%		9.0%	30.2%
Soybeans	Thousands of Metric Tons	95,869	57,000	3,450	1,260	2,500		14,000
	% of World Import	100.0%	59.5%	3.6%	1.3%	2.6%		14.6%
Crude Oil	Thousand Barrels Per Day	43,677	4,754	3,472	2,372	886	9,213	
	% of World Import	100.0%	10.9%	7.9%	5.4%	2.0%	21.1%	

Table 2: Reactions of Asian Stock Indices to U.S. Commodity Futures Prices before 2005

This table reports regression results on reactions of Asian stock indices to U.S. commodity futures prices using daily returns before 2005. For each pair of stock market index and commodity in our sample, we run the following regression:

$$R_{Asian\_Stock,t} = b_0 + b_1 R_{US\_Commodity,t-1} + b_2 R_{S\&P500,t-1} + b_3 R_{Asian\_Stock,t-1} + \varepsilon_t.$$

The sample period of each regression varies with the availability of data. Panels A, B and C display regression results with the futures return of copper, soybeans, or crude oil as the predicting variable. In each panel, we report regression results without or with the control of the contemporaneous S&P 500 Index return ($R_{S\&P500,t-1}$). The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	**Japan**		**Hong Kong**		**Taiwan**		**South Korea**		**Shanghai**	
					Panel A: Copper					
b_1	0.0119*	0.000170	0.0274**	0.00308	0.0159	0.00553	0.0162*	0.00749	0.00829	0.00653
	(1.80)	(0.03)	(2.16)	(0.26)	(1.58)	(0.55)	(1.91)	(0.88)	(0.31)	(0.24)
b_2		0.268***		0.458***		0.205***		0.181***		0.0262
		(10.08)		(14.25)		(9.89)		(7.05)		(0.78)
b_3	0.0836***	0.0615***	0.0100	-0.0127	0.0726***	0.0684***	0.0890***	0.0859***	0.0427	0.0428
	(3.69)	(3.01)	(0.41)	(-0.49)	(4.59)	(4.39)	(2.90)	(2.78)	(1.60)	(1.60)
Observations	9,999	9,976	6,980	6,979	8,770	8,748	9,849	9,830	3,092	3,091
Adj R^2	0.008	0.082	0.001	0.068	0.006	0.023	0.009	0.017	0.002	0.002
					Panel B: Soybeans					
b_1	0.00447	-0.00142	0.0293*	0.0189	0.0144	0.0110	0.00144	-0.00188	0.0340	0.0339
	(0.73)	(-0.25)	(1.93)	(1.26)	(1.48)	(1.14)	(0.14)	(-0.18)	(1.01)	(1.00)
b_2		0.266***		0.454***		0.204***		0.179***		0.0270
		(10.06)		(14.27)		(9.92)		(7.06)		(0.82)
b_3	0.0912***	0.0682***	0.0110	-0.0123	0.0718***	0.0661***	0.0909***	0.0875***	0.0434	0.0435
	(3.96)	(3.24)	(0.45)	(-0.48)	(4.54)	(4.24)	(2.98)	(2.83)	(1.63)	(1.63)
Observations	10,060	10,027	7,012	7,007	8,812	8,784	9,913	9,884	3,107	3,103
Adj R^2	0.009	0.081	0.001	0.067	0.006	0.023	0.009	0.017	0.002	0.002
					Panel C: Crude Oil					
b_1	-0.0268***	-0.0168**	-0.00439	0.00938	-0.0442***	-0.0361***	-0.0229**	-0.0140	0.0117	0.0132
	(-3.56)	(-2.44)	(-0.46)	(1.03)	(-3.14)	(-2.70)	(-2.09)	(-1.33)	(0.73)	(0.83)
b_2		0.372***		0.500***		0.272***		0.296***		0.0315
		(10.23)		(13.09)		(9.95)		(10.18)		(0.96)
b_3	0.0649**	0.0280	-0.0383	-0.0728**	0.0922***	0.0873***	0.0587***	0.0469**	0.0443*	0.0444*
	(2.13)	(1.07)	(-1.21)	(-2.18)	(4.69)	(4.51)	(3.04)	(2.52)	(1.66)	(1.66)
Observations	4,591	4,590	4,507	4,506	5,089	5,089	5,078	5,077	3,094	3,093
Adj R^2	0.008	0.128	0.002	0.108	0.013	0.040	0.005	0.044	0.002	0.002

Table 3: Reactions of Asian Stock Indices to U.S. Commodity Futures Prices After 2005

This table reports regression results on reactions of Asian stock indices to US commodity futures prices using daily returns from January 2005 to September 2012. For each pair of stock market index and commodity in our sample, we regress the Asian stock index return on the lagged non-overlapping return of the commodity futures:

$$R_{Asian\_Stock,t} = b_0 + b_1 R^{NonOverlap}_{US\_Commodity,t-1} + b_2 R^{NonOverlap}_{S\&P500,t-1} + b_3 R_{Asian\_Stock,t-1} + \varepsilon_t$$

Panels A, B and C display regression results with the futures return of copper, soybeans, or crude oil as the predicting variable. In each panel, we report regression results without or with the control of the S&P 500 Index return ($R^{NonOverlap}_{S\&P500,t-1}$), which is contemporaneous to the commodity return $R^{NonOverlap}_{US\_Commodity,t-1}$. Due to the different trading hours of the Asian markets in our sample, the non-overlapping sub-interval for computing the returns of U.S. commodity futures ($R^{NonOverlap}_{US\_Commodity,t-1}$) and S&P 500 Index futures ($R^{NonOverlap}_{S\&P500,t-1}$) varies across different stock markets. The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

VARIABLES	(1) Japan	(2) Japan	(3) Hong Kong	(4) Hong Kong	(5) Taiwan	(6) Taiwan	(7) South Korea	(8) South Korea	(9) Shanghai	(10) Shanghai
Panel A: Copper										
b_1	0.284***	0.0977***	0.327***	0.103***	0.195***	0.0393*	0.221***	0.0701***	0.176***	0.100***
	(11.23)	(4.23)	(10.40)	(3.53)	(7.91)	(1.75)	(6.88)	(2.58)	(6.84)	(3.40)
b_2		0.608***		0.679***		0.495***		0.460***		0.231***
		(17.46)		(15.18)		(13.27)		(9.62)		(4.41)
b_3	0.0347	0.0370	-0.0410	-0.0643	0.0458	0.0529*	0.112**	0.109**	0.00848	0.0130
	(0.87)	(0.99)	(-0.91)	(-1.38)	(1.64)	(1.93)	(2.47)	(2.49)	(0.30)	(0.46)
Observations	1,796	1,796	1,833	1,833	1,842	1,842	1,825	1,825	1,828	1,828
Adj R^2	0.135	0.372	0.124	0.326	0.072	0.242	0.080	0.196	0.028	0.047
Panel B: Soybeans										
b_1	0.188***	0.0600**	0.249***	0.0968**	0.151***	0.0552**	0.159***	0.0601*	0.188***	0.137***
	(5.41)	(2.35)	(5.86)	(2.53)	(5.95)	(2.34)	(4.69)	(1.91)	(5.72)	(3.81)
b_2		0.654***		0.720***		0.506***		0.489***		0.260***
		(19.68)		(16.90)		(14.50)		(10.59)		(5.44)
b_3	0.0126	0.0311	-0.0392	-0.0645	0.0420	0.0544**	0.113**	0.110**	0.0163	0.0199
	(0.29)	(0.82)	(-0.83)	(-1.41)	(1.52)	(1.98)	(2.49)	(2.52)	(0.56)	(0.69)
Observations	1,794	1,794	1,832	1,832	1,841	1,841	1,823	1,823	1,826	1,826
Adj R^2	0.040	0.364	0.052	0.324	0.030	0.244	0.037	0.194	0.023	0.052
Panel C: Crude Oil										
b_1	0.173***	0.0280	0.188***	0.0114	0.125***	0.0105	0.122***	0.00317	0.0683***	0.000448
	(8.06)	(1.64)	(7.30)	(0.54)	(6.45)	(0.61)	(5.03)	(0.15)	(2.87)	(0.02)
b_2		0.654***		0.741***		0.514***		0.504***		0.297***
		(19.72)		(17.01)		(14.66)		(10.97)		(5.82)
b_3	0.00649	0.0286	-0.0594	-0.0686	0.0291	0.0507*	0.102**	0.107**	0.00487	0.0133
	(0.15)	(0.75)	(-1.21)	(-1.44)	(1.06)	(1.86)	(2.25)	(2.45)	(0.17)	(0.46)
Observations	1,796	1,796	1,833	1,833	1,842	1,842	1,825	1,825	1,828	1,828
Adj R^2	0.066	0.361	0.056	0.316	0.040	0.240	0.041	0.191	0.006	0.040

Table 4: Comparing Reactions of Asian Stock Indices to U.S. Commodity Futures and Spot Prices (2005-2012)

This table reports regression results for comparing the reactions of Asian stock indices to U.S. commodity futures and spot prices from January 2005 to September 2012. For each pair of commodity and East Asian market index, we run the following regression:

$$R_{Asian\_Stock,t} = b_0 + b_1 R^{NonOverlap}_{US\_Commodity,t-1} + b_2 R_{US\_spot,t-1} + b_3 R^{NonOverlap}_{S\&P500,t-1} + b_4 R_{Asian\_Stock,t-1} + \varepsilon_t$$

Panels A, B, and C report regression results with the futures and spot returns of copper, soybeans and oil as the predicting variables. The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
VARIABLES	**Japan**		**Hong Kong**		**Taiwan**		**South Korea**		**Shanghai**	
					Panel A: Copper					
b₁		0.0956***		0.142***		0.0267		0.0653*		0.155***
		(2.74)		(3.00)		(0.69)		(1.95)		(3.25)
b₂	0.107***	0.0916***	0.0623	0.0401	0.0729***	0.0693**	0.0535	0.0440	-0.00720	-0.0259
	(3.32)	(2.98)	(1.23)	(0.86)	(2.84)	(2.19)	(1.27)	(1.10)	(-0.20)	(-0.73)
b₃	0.643***	0.581***	0.696***	0.600***	0.462***	0.444***	0.461***	0.418***	0.299***	0.197***
	(17.49)	(13.78)	(15.22)	(10.77)	(11.80)	(9.47)	(8.42)	(6.85)	(6.28)	(3.09)
b₄	-0.0305	-0.0107	-0.102	-0.0809	0.0118	0.0154	0.0579	0.0660	0.0188	0.0223
	(-0.58)	(-0.20)	(-1.51)	(-1.27)	(0.34)	(0.45)	(0.94)	(1.08)	(0.47)	(0.57)
Observations	1,024	1,024	1,048	1,048	1,067	1,067	1,051	1,051	1,043	1,043
Adj R^2	0.416	0.425	0.312	0.324	0.242	0.243	0.193	0.197	0.054	0.068

VARIABLES	(1) Japan	(2)	(3) Hong Kong	(4)	(5) Taiwan	(6)	(7) South Korea	(8)	(9) Shanghai	(10)
					Panel B: Soybeans					
b₁		0.0618**		0.110***		0.0684***		0.0801**		0.135***
		(2.26)		(2.96)		(2.61)		(2.47)		(3.53)
b_2	0.0128	-0.00970	0.00960	-0.0297	-0.00550	-0.0294	-0.0164	-0.0438*	0.0407	-0.00653
	(0.74)	(-0.53)	(0.32)	(-1.04)	(-0.31)	(-1.53)	(-0.65)	(-1.73)	(1.40)	(-0.22)
b_3	0.672***	0.657***	0.740***	0.713***	0.513***	0.498***	0.510***	0.490***	0.285***	0.254***
	(20.51)	(19.60)	(17.63)	(17.00)	(14.89)	(14.46)	(11.02)	(10.47)	(6.16)	(5.33)
B_4	0.0245	0.0312	-0.0733	-0.0638	0.0518*	0.0586**	0.107**	0.114***	0.00663	0.0146
	(0.63)	(0.79)	(-1.52)	(-1.42)	(1.91)	(2.15)	(2.43)	(2.60)	(0.23)	(0.51)
Observations	1,770	1,765	1,801	1,800	1,811	1,808	1,799	1,794	1,798	1,794
Adj R^2	0.362	0.365	0.315	0.323	0.236	0.241	0.192	0.196	0.040	0.049
					Panel C: Crude Oil					
b_1		0.0106		0.0252		-0.00199		0.0838**		0.0402
		(0.40)		(0.61)		(-0.07)		(2.33)		(1.02)
b_2	0.0241*	0.0168	0.00534	-0.0123	0.0118	0.0131	-0.0265	-0.0827**	-0.0108	-0.0372
	(1.67)	(0.75)	(0.25)	(-0.30)	(0.78)	(0.54)	(-1.41)	(-2.48)	(-0.51)	(-1.20)
b_3	0.656***	0.653***	0.735***	0.727***	0.506***	0.507***	0.511***	0.483***	0.293***	0.279***
	(19.77)	(19.73)	(17.02)	(17.31)	(14.69)	(14.55)	(10.97)	(10.52)	(6.20)	(5.51)
B_4	0.0205	0.0223	-0.0767	-0.0722	0.0449	0.0445	0.105**	0.118***	0.00557	0.00869
	(0.53)	(0.57)	(-1.61)	(-1.50)	(1.62)	(1.61)	(2.35)	(2.60)	(0.19)	(0.30)
Observations	1,752	1,752	1,793	1,793	1,798	1,798	1,784	1,784	1,784	1,784
Adj R^2	0.361	0.361	0.316	0.316	0.237	0.237	0.190	0.193	0.039	0.039

Table 5: Industry Categories and TRBC Codes

We use the Thomson Reuters Business Classification (TRBC) codes to classify firms into different industries. TRBC, which is owned and operated by Thomson Reuters, gives an industry classification of global companies. This table lists names and TRBC codes of different industries analyzed in this paper.

Names of Industries	**TRBC Codes**
Oil Production Related Industries	501020;501030
Diversified Metals & Mining	51201010;51201030;51201050
Electrical Components & Equipment	52102030;52102040
Consumer Electronics	53204020
Semiconductors	571010
Farming	54102010
Beverage	541010
Food	54102020
Chemicals	511010
Transportation	5240
Construction Materials	51202010
Steel	51201020
Industrial Machinery	52102010;52102020
Auto Parts & Equipment	531010
Real Estate Activities	554020
Food and Beverages	541010;54102020;543010
Healthcare	5610;5620
Software & IT Services	5720

Table 6: Reactions of Asian Stocks to US Commodity Futures Prices: Cross-Industry Analysis

This table reports the regression results on reactions of Asian stocks to U.S. commodity futures prices using daily industry-level returns. We classify industries based on Thomson Reuters Business Classification (TRBC) codes described in Table 5. We then group industries into three categories: 1) supply firms; 2) consumer firms; 3) other firms. To ensure that there are sufficient firms in each industry, we perform the industry-level analysis only in the three largest stock markets in our sample, which includes Japan, Hong Kong, and mainland China. The regression specification is the same as that used in Table 3. To save space, we only report the estimate of the coefficient b_1 for each industry return. Panels A, B and C display regression results with the futures return of copper, soybeans, or crude oil as the predicting variable. The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

	Japan		**Hong Kong**		**Shanghai**	
	Coef	**t-stat**	**Coef**	**t-stat**	**Coef**	**t-stat**
Panel A: Copper						
Supply Industries						
Diversified Metals & Mining	0.118***	(4.66)	0.123***	(3.13)	0.392***	(7.89)
Consumer Industries						
Electrical Components & Equipment	0.113***	(4.71)	0.134***	(2.97)	0.0812**	(2.51)
Consumer Electronics	0.0724**	(2.05)	0.0571	(1.46)	0.0493	(1.25)
Semiconductors	0.0625***	(3.69)	0.0691**	(2.32)	0.0697*	(1.95)
Other Unrelated Industries						
Construction Materials	0.0929***	(4.03)	0.131***	(2.63)	0.0959***	(2.69)
Steel	0.152***	(4.75)	0.0984***	(2.72)	0.0619**	(1.97)
Industrial Machinery	0.096***	(4.14)	0.0490*	(1.73)	0.0813**	(2.34)
Auto Parts & Equipment	0.131***	(3.36)	0.0843***	(3.02)	0.0722***	(2.92)
Real Estate Activities	0.0587***	(2.74)	0.0656***	(2.69)	0.0454	(1.56)
Food and Beverage	0.0364***	(3.18)	0.0835**	(2.55)	0.0725**	(2.34)
Health Care	0.0451***	(2.63)	0.0664***	(2.77)	0.0562**	(2.31)
Software and IT Services	0.0411**	(2.19)	0.0500	(1.62)	0.0442	(1.58)

	Japan		Hong Kong		Shanghai	
	Coef	**t-stat**	**Coef**	**t-stat**	**Coef**	**t-stat**
Panel B: Soybeans						
Supply Industries						
Farming	-0.0157	(-0.86)	0.0994***	(3.35)	0.217***	(3.60)
Consumer Industries						
Beverage	0.000881	(0.04)	0.0658	(1.58)	0.136***	(3.42)
Food Processing	-0.00632	(-0.35)	0.0988***	(4.24)	0.209***	(3.41)
Other Unrelated Industries						
Construction Materials	0.0389	(1.23)	0.0721	(1.23)	0.151***	(3.68)
Steel	0.0746**	(1.97)	0.0888**	(2.16)	0.138***	(3.00)
Industrial Machinery	0.0460	(1.48)	0.0661**	(2.16)	0.182***	(3.71)
Auto Parts & Equipment	0.0525*	(1.74)	0.0771***	(2.73)	0.151***	(3.26)
Real Estate Activities	0.0167	(0.54)	0.0824***	(3.30)	0.117**	(2.45)
Health Care	0.0236	(1.13)	0.0750***	(2.83)	0.153***	(3.42)
Software and IT Services	0.0259	(1.08)	0.0786***	(2.62)	0.133***	(3.19)
Panel C: Crude Oil						
Supply Industries						
Oil Production Related Industries	0.0709***	(4.39)	0.0669***	(3.16)	0.116***	(2.63)
Consumer Industries						
Chemicals	0.0265	(1.54)	0.0159	(0.86)	0.00506	(0.16)
Transportation	0.0114	(0.79)	0.0225	(1.07)	-0.0463	(-1.55)
Other Industries						
Construction Materials	0.0176	(1.00)	0.0525	(1.32)	-0.00263	(-0.27)
Steel	0.0632***	(2.82)	0.0506	(1.54)	-0.0214	(-0.59)
Industrial Machinery	0.0337*	(1.79)	0.0280	(1.32)	-0.0164	(-0.50)
Auto Parts & Equipment	0.0239	(1.32)	0.0248	(1.10)	-0.0466	(-1.45)
Real Estate Activities	0.0176	(0.90)	-0.0129	(-0.62)	-0.0363	(-1.10)
Food and Beverage	0.0172	(1.17)	-0.0241	(-1.09)	-0.00994	(-1.38)
Health Care	0.0100	(0.73)	0.0213	(1.14)	-0.0276	(-0.96)
Software and IT Services	0.00584	(0.36)	0.0364	(1.33)	-0.0264	(-0.94)

Table 7: Responses of US Commodity Futures to Asian Index Returns before 2005

This table reports regression results on reactions of U.S. commodity futures prices to Asian stock indices using daily returns before 2005. For each pair of Asian market index and commodity futures in our sample, we run the following regression:

$$R_{US\_Commodity,t} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R_{US\_Commodity,t-1} + \varepsilon_t$$

The sample period of each regression varies with the availability of data. Panels A, B, and C regression results with the futures return of copper, soybeans, or crude oil as the dependent variable. The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	**Japan**	**Hong Kong**	**Taiwan**	**South Korea**	**Shanghai**
	Panel A: Dep.Var: $R_{US\_Copper,t}$				
b₁	0.103***	0.0492***	0.0238*	0.0203*	0.000113
	(4.06)	(4.25)	(1.72)	(1.92)	(0.02)
b₂	-0.0364**	-0.0351**	-0.0347**	-0.0324*	-0.0552**
	(-2.22)	(-2.10)	(-2.06)	(-1.95)	(-2.53)
Observations	8,987	7,191	7,467	8,353	3,049
Adj R^2	0.005	0.004	0.002	0.002	0.003
	Panel B: Dep.Var: $R_{US\_Soybeans,t}$				
b₁	0.00691	0.0253**	0.0158	0.00383	-0.0121*
	(0.45)	(2.24)	(1.43)	(0.71)	(-1.66)
b₂	0.0203	0.0245	0.0256	0.0208	0.0116
	(1.14)	(1.30)	(1.33)	(1.16)	(0.41)
Observations	9,060	7,229	7,513	8,424	3,064
Adj R^2	0.000	0.002	0.001	0.001	0.001
	Panel C: Dep.Var: $R_{US\_Oil,t}$				
b₁	-0.00309	-0.00540	-0.0222	-0.0224	-0.00464
	(-0.08)	(-0.23)	(-0.80)	(-0.87)	(-0.35)
b₂	-0.0174	-0.0140	-0.0203	-0.0219	-0.00153
	(-0.66)	(-0.54)	(-0.76)	(-0.83)	(-0.05)
Observations	4,531	4,607	4,469	4,483	3,052
Adj R^2	0.000	0.000	0.001	0.001	0.000

Table 8: Responses of U.S. Commodity Futures to Asian Index Returns after 2005

This table reports regression results on reactions of U.S. commodity futures prices to Asian stock market indices from January 2005 to September 2012. For the futures return in the overlapping sub-interval of day t, we run the following regression:

$$R_{US\_Commodity,t}^{Overlap} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R_{US\_Commodity,t-1}^{NonOverlap} + b_3 R_{US\_Commodity,t-1}^{Overlap} + \varepsilon_t$$

For the futures return in the non-overlapping sub-interval of day t, we run the following regression:

$$R_{US\_Commodity,t}^{NonOverlap} = b_0 + b_1 R_{Asian\_Stock,t} + b_2 R_{US\_Commodity,t}^{Overlap} + b_3 R_{US\_Commodity,t-1}^{NonOverlap} + \varepsilon_t$$

Panels A, B, and C report regression results with the futures return of copper, soybeans, or crude oil as the dependent variable. The t-statistics adjusted for heteroskedasticity and serial correlations using the Newey-West method with five lags are reported in parentheses. We use *, **, *** to indicate significance at the 10%, 5%, and 1% levels, respectively.

	Panel A: Copper			
	Dep.Var: $R_{US\_Copper,t}^{Overlap}$		**Dep.Var:** $R_{US\_Copper,t}^{NonOverlap}$	
Variables	**Coef**	**t-stat**	**Coef**	**t-stat**
Japan	0.181***	(6.87)	-0.00984	(-0.21)
Hong Kong	0.237***	(11.85)	0.0649	(1.46)
Taiwan	0.226***	(10.01)	0.0183	(0.46)
South Korea	0.155***	(6.51)	0.0381	(0.89)
Shanghai	0.132***	(9.74)	0.0229	(0.81)
	Panel B: Soybeans			
	Dep.Var: $R_{US\_Soybeans,t}^{Overlap}$		**Dep.Var:** $R_{US\_Soybeans,t}^{NonOverlap}$	
Variables	**Coef**	**t-stat**	**Coef**	**t-stat**
Japan	0.0541***	(3.65)	-0.0214	(-0.53)
Hong Kong	0.0895***	(7.07)	-0.0159	(-0.48)
Taiwan	0.0715***	(5.40)	-0.0177	(-0.55)
South Korea	0.0622***	(4.41)	-0.0368	(-1.21)
Shanghai	0.0615***	(7.64)	-0.0398*	(-1.72)
	Panel C: Crude Oil			
	Dep.Var: $R_{US\_oil,t}^{Overlap}$		**Dep.Var:** $R_{US\_Oil,t}^{NonOverlap}$	
Variables	**Coef**	**t-stat**	**Coef**	**t-stat**
Japan	0.121***	(8.26)	0.0176	(0.33)
Hong Kong	0.149***	(12.51)	0.107**	(2.48)
Taiwan	0.149***	(9.48)	0.0684	(1.39)
South Korea	0.106***	(7.54)	0.0552	(1.15)
Shanghai	0.0802***	(8.74)	0.0276	(0.92)