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What Drives the Stock Market Comovements between Korea and China, Japan and the U.S.?

By Jinsoo Lee and Bok-Keun Yu*

This paper measures the extent of comovements in stock returns between Korea and three major countries (China, Japan and the U.S.) using industry-level data for Korea from 2003 to 2016 in the spirit of the international capital asset pricing model. It also examines what drives the comovements between Korea and the three countries. We find that the comovements of Korean stock returns with those of the U.S. and Japan became smaller after the global financial crisis. In contrast, the comovement in stock returns between Korea and China became larger after the crisis. After an additional analysis, we conclude that trade linkage is the main driver of the comovements between Korea and the three countries.

Key Word: Stock Market Comovement, Trade Linkage, Financial Linkage
JEL Code: F15, F21, G15

I. Introduction

The Korean stock market has shown a high degree of comovement with the stock markets of select major countries, which may reflect the increasing real linkage as well as more financial integration with those countries. It is also intriguing that the extent of this comovement has changed over time and that the degree of change appears to differ for different countries. For example, comparing the period before the global financial crisis with the post-crisis period, the correlations of Korean stock market returns with those of China and the U.S. rose, whereas the stock market comovement between Korea and Japan decreased.[1] In this paper, motivated by these observations, we examine the factors that drive the stock market comovements between Korea and three major countries (China, Japan

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[1]The correlation coefficients of Korea-China, Korea-Japan and Korea-U.S. stock market returns using weekly data from Datastream are 0.49, 0.59 and 0.47, respectively, for the period of 2003-2007. However, the coefficients are 0.69, 0.49 and 0.60, respectively, for the period of 2010-2016.

and the U.S.).

To undertake this task, we initially measure the comovements in stock returns between 24 Korean manufacturing industries and the three countries using a model in the spirit of the international capital asset pricing model (ICAPM), where the expected return of a country's stock market is influenced by global stock market returns. Specifically, we use the market returns of the three major countries as proxies for global stock market returns, and the stock returns for Korean manufacturing industries are related to the market returns of the three countries. In our model, the degrees of the comovements between Korean manufacturing industries and the three countries are measured using the slope coefficients (betas) of the three countries for these industries.

Next, we examine the driver(s) of the comovements between Korean manufacturing industries and the three countries. According to conventional financial theory, the price of a security can be modelled as the present value of future cash flows from the security, with the future cash flows being discounted at appropriate discount rates. If this is the case, the degree of commonality between securities may come from two sources: (i) comovement in cash flows (real linkage) and (ii) comovement in discount rates (financial linkage). In this paper, as proxies for the two sources of comovement, we use the ratio of trade to sales for the real linkage and the share of foreign stock investment for the financial linkage.

From our analysis, we find that the comovements of the Korean stock market with those of the U.S. and Japan were diminished after the global financial crisis. In contrast, the post-crisis comovement in stock returns between Korea and China is greater than that of the pre-crisis period. With the two proxies for real and financial linkages, we find that the trade-to-sales ratio is positively related to the degree of comovements in stock returns between Korea and the three countries. On the other hand, we find no evidence that financial linkage proxied by foreign stock investment is related to comovements in stock returns between Korea and the three countries.

There are previous studies such as Forbes and Chinn (2004), Elekdag *et al.* (2012) and Arslanalp *et al.* (2016) where a two-stage factor model similar to that used here is employed in order to study linkages in financial markets across countries. These studies use aggregate and macro-level data for their sample countries and thus variations in the linkages and related determinants at the country level. In contrast, our study uses industry-level data for an individual country, in this case Korea. As there are cross-sectional variations as well as time-series variations across industries, we can use such variations in order to examine this issue for an individual country in more depth with industry-level data. In this regard, we expect that our study at the industry level for an individual country will complement previous studies at the country level for groups of countries.

The rest of the paper is organized as follows. In Section II, we explain trade and stock market trends in Korea. We provide a review of the literature in Section III. In Section IV, we describe the data and introduce the methodology used for our analysis. We report the empirical results of our analysis in Section V. We conclude the paper in Section VI.

II. Trade and Stock Market Trends in Korea

Korea's trade (exports plus imports) appears to reflect the overall conditions of the global economy as well as its evolvement. Figure 1 shows the shares of exports, imports and trade in Korea's GDP from 2003 to 2016. The trade share continued to rise until 2008, mainly on the back of the favorable global economy. However, it declined sharply in 2009 in the aftermath of the global financial crisis. From 2010, it increased again, reaching 96%, the highest ratio, in 2011. It has been falling since 2012, possibly due to sluggish investment given the delayed global economic recovery from the crisis. The share of trade in GDP was 65% as of 2016, similar to the level in 2007.

Both exports and imports show similar trends. In 2016, the share of exports and imports in GDP was 37% and 28%, respectively. As shown in Figure 1, the trade surplus (exports – imports) has increased since the crisis, mainly due to decreased commodity prices and strong exports of Korea's flagship products such as semiconductors and automobiles.

Figure 2 shows the shares of exports, imports and trade with the three major trading partners of Korea (the U.S., Japan and China) for the period from 2003 to 2016. In the case of the U.S., the shares of exports and imports continued to decline until 2011. The uptrend in recent years is presumably due to the Korea-U.S. FTA, which came into effect on March 15, 2012. For Japan, both the export and import shares showed declining trends throughout the period. As of 2016, the share of imports was 11.7%, whereas the share of exports was 4.9%. In the case of China, in contrast to the U.S. and Japan, the trends in the shares of exports and imports both increased. The shares of exports and imports were 25.1% and 21.4% in 2016, accounting for the largest portion among Korea's trade partners. Consequently, the share for China in Korea's trade is much higher than those of the U.S. and Japan,

FIGURE 1. SHARES OF EXPORTS, IMPORTS AND TRADE IN KOREA'S GDP

Note: Data are based on nominal amounts, goods and Korean won standards.

Source: Bank of Korea (ECOS).

reaching 23.4% in 2016. This indicates that China may become a more dominant player in Korea's trade dynamics and thus may have a greater impact on the Korean economy than before, both in real and financial terms.

FIGURE 2. SHARES OF KOREA'S EXPORTS, IMPORTS AND TRADE WITH THE U.S., JAPAN AND CHINA

Note: Data are based on nominal amounts, goods and U.S. dollar standards.

Source: Bank of Korea (ECOS).

The Korean stock market has continued to advance together with the growth of the real economy in Korea. Figure 3 presents the ratio of market capitalization[2] to GDP and the share of foreign ownership of the stock market in Korea. The ratio of market capitalization to GDP rose from 48% in 2003 to 101% in 2007. During the crisis, the ratio plunged to 56% in 2008. The ratio then resumed its increase before leveling off at around 90%. On the other hand, the foreign-owned share of stocks in Korea approached 40% in both 2003 and 2004, after which it declined gradually to 27% in 2008. It increased afterwards, reaching 32% in 2016, but it still remains lower than in 2003. Figure 4 reports the shares of foreign investors from the U.S.,

FIGURE 3. MARKET CAPITALIZATION/GDP AND FOREIGN-OWNED SHARE IN THE KOREAN STOCK MARKET

Note: Market capitalization is measured by KOSPI plus KOSDAK.

Source: Bank of Korea (ECOS), Koscom and Financial Supervisory Services.

FIGURE 4. SHARES HELD BY THE U.S., JAPAN AND CHINA IN THE KOREAN STOCK MARKET

Note: The equity ratio was determined according to the stock and investment fund shares.

Source: IMF (Coordinated Portfolio Investment Survey).

[2]Market capitalization refers to the total market value of outstanding shares for a company and is computed by multiplying the outstanding shares of the company by the market price of a share. The market capitalization of a country is computed as the sum of the market capitalizations for individual companies.

Japan and China. As of 2016, the U.S. accounted for 49%, whereas the shares of Japan and China were only 3% and less than 1%, respectively. The U.S. portion has been much larger than those of Japan and China throughout the entire period. This implies an outsized influence of U.S. investors on the Korean stock market relative to those of the other two countries.

III. Literature Review

Our paper generally follows the methodology used by Forbes and Chinn (2004), Elekdag *et al*. (2012), and Arslanalp *et al*. (2016). Forbes and Chinn (2004) investigate how trade and financial linkages between five major countries (France, Germany, Japan, the UK and the U.S.) and 38 sample countries affect comovements in stock and bond market returns from 1986 to 2000. First, they estimate the impacts of bilateral, global and sectoral factors on each country's asset returns using a factor model.[3] In the second stage, the bilateral factor loadings, also known as "betas," are regressed on the trade-related and financial variables of trade flows, trade competition in third markets, bank lending and foreign investment. The authors find that trade linkage variables are more significant than financial variables in the explanation of the factor loadings.

Elekdag *et al*. (2012) analyze the evolution of stock market linkages between five major economies (France, Germany, Japan, the UK and the U.S.) and 12 Asian countries[4] during the period of 1992-2011. They document that the degree of financial sensitivity of the Asian countries to the major economies increased, with both trade and financial linkages as the key determinants. They also argue that certain macroeconomic policies the Asian countries, such as reductions in government debt and increases in foreign reserves, made limited contributions to mitigating these levels.

Arslanalp *et al*. (2016) explore comovements in stock markets between Asian countries and four major economic blocks (China, Japan, the euro area, and the U.S.). They build a two-stage model based on Forbes and Chinn (2004) consisting of four major economies and nine Asian countries[5] during the period of 2001-2014 (pre-crisis period: 2001-2007, crisis period: 2008-2009 and post-crisis period: 2010-2014). Their empirical results indicate that the spillover effect from China to the Asian stock markets has increased since the global financial crisis, although the level of its impact is still lower than those by the U.S. and Japan. They also report that the main driver of the spillover from the two major economies in the region (China and Japan) to other Asian stock markets is the trade linkage (the trade linkage for China and trade competition in third markets for Japan) rather than the financial linkage.

[3]The bilateral factors refer to returns for these five countries in the asset markets; the global and sectoral factors include world market returns, global interest rates, oil prices, gold prices and commodity prices, and asset returns for 14 sectoral indexes.

[4]The 12 Asian countries are Australia, China, Hong Kong, India, Indonesia, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan and Thailand.

[5]These blocks are China, Japan, the euro area, and the U.S., and the nine sample countries are Australia, India, Indonesia, Korea, Malaysia, New Zealand, Philippines, Taiwan and Thailand.

In addition to these studies, other studies have examined interdependence in stock market returns between countries. Tavares (2009) examines 40 developed and emerging markets from the 1970s to 1990s, finding that the intensity of bilateral trade increases the correlations in stock market returns between countries, while real exchange rate volatility, asymmetry in output growth and dissimilarity in exports all decrease this correlation. Eiling and Gerard (2015) find that there are significant time trends in cross-country correlations in 32 emerging markets for the period from 1991 to 2009. They argue that official market liberalization, equity market openness, equity market development and trade openness drive these trends. Paramati *et al*. (2015; 2016) find that the degree of trade intensity drives stock market interdependence between Australia and its trading partners.

The above-mentioned papers use aggregate and macro-level data. In contrast to these studies, our study uses industry-level data for an individual country. As there are cross-sectional variations as well as time-series variations in real and financial linkages across industries for an individual country, we can use such variations in order to examine comovements in stock returns between the individual country and foreign countries in more depth.

The literature on stock return comovements and variations across countries using industry and/or firm level data can be traced back to Roll (1992), Heston and Rouwenhorst (1994), and Griffin and Karolyi (1998).

Roll (1992) documents that industry factors such as differences or similarities in industrial compositions are the main factors explaining stock return correlations across countries. In his analysis, he uses daily stock indexes for 24 countries from April of 1988 to March of 1991. However, Heston and Rouwenhorst (1994) argue that variations in the stock returns of countries are mainly due to country-specific factors rather than industry factors. Their sample includes 829 firms in 12 European countries for the period of 1978 to 1992. Griffin and Karolyi (1998) find that the industry effect is greater for traded-goods industries than for nontraded-goods industries in explaining stock return variations for 25 countries for the period of 1992 to 1995.

More recently, Brooks and Del Negro (2006) and Faias and Ferreira (2016) explore international stock market commonality using firm-level data. Brooks and Del Negro (2006) analyze the relationship between international stock market return comovement and the degree of internationalization of firms such as firm's international sales, assets and income as well as sector affiliation (traded versus non-traded). They use firm-level data composed of 1,239 firms in 20 developed and emerging countries for the period from 1985 to 2002. They find that the higher the degree of globalization of a firm, the higher the sensitivity of stock returns to global shocks, indicating that firms that operate internationally have stronger linkages with the global stock market. Faias and Ferreira (2016) find using monthly stock return data from 45 countries for the period from 2001 to 2010 that the degree of stock return variation is better explained by industry and global factors rather than country factors.

There have also been several studies of the stock return comovements of Korean companies using firm-level data. Park (2007) examines the impacts of analysts and foreign investors on the synchronicity of stock returns between Korean individual firms and the market from 2000 to 2003, finding that the degree of synchronicity

becomes greater as the number of financial analysts following a firm increases, whereas the impact of foreign investors as measured by the foreign-owned equity share of the firm is not significant. The author argues that foreign investors rely on firm-specific financial information based on the firm's intrinsic value rather than on market-wide information, whereas analysts provide investors with more market-related information. Kim *et al*. (2015) and Cho and Mooney (2015) investigate the comovement of stock returns for firms belonging to business groups (known as *chaebol*) and its key determinants during the periods of 1980-2009 and 2002-2011, respectively. Both papers report that companies affiliated with business groups exhibit more salient comovements in stock returns with other companies in the same business group than with companies not affiliated with the business group.

IV. Data and Methodology

In the first stage of this paper, we measure comovements in stock returns between Korea and three countries—the U.S., Japan, and China—using stock returns at the industry level, and in the second stage, we examine what drives the comovements between Korea and the three countries. The three countries are chosen based on the fact that they are major trading partners of Korea. From 2003 to 2016, Korea's average proportion of trade with China (20.5%) was the highest, with the U.S. (11.0%), Japan (10.0%), Saudi Arabia (3.7%), Hong Kong (3.2%), and Taiwan (3.0%) following.[6] We choose these three countries as major trading partners of Korea because each of their portions of trade with Korea exceeded 5% for the period.

In the first stage, in order to measure the comovements in stock returns between Korea and the three countries at the industry level, we use two alternative specifications, denoted here as (1) and (2).

$$R_{i,t} = \alpha_i + \beta_{us,i} R_{us,t} + \beta_{Japan,i} R_{Japan,t} + \beta_{China,i} R_{China,t} + \varepsilon_{i,t} \tag{1}$$

$$\begin{aligned} R_{i,t} = {} & \alpha_i + \beta_{us,i} R_{us,t} + \beta_{Japan,i} R_{Japan,t} + \beta_{China,i} R_{China,t} + \beta_{CRB,i} R_{CRB,t} \\ & + \beta_{USTN,i} \Delta Y_{USTN,t} + \beta_{VIX,i} \Delta VIX_t + \beta_{CDS,i} \Delta CDS_t + \varepsilon_{i,t} \end{aligned} \tag{2}$$

In (1), $R_{i,t}$ represents the return of industry i during the week of t for Korea. $R_{us,t}$, $R_{Japan,t}$ and $R_{China,t}$ denote the market returns during week t for U.S., Japan and China, respectively. In the first specification, we follow the spirit of the ICAPM, where the expected return of a country's stock market is influenced by global stock market returns. We use the three market returns of major countries as proxies for global stock market returns. In (2), following Arslanalp *et al*. (2016), we add four control variables to the market returns of the U.S., Japan and China.

[6]We compute the proportions of trade with foreign countries for Korea using data from the Bank of Korea (ECOS).

The four control variables are the returns computed by the CRB (Commodity Research Bureau) index ($R_{CRB,t}$),[7] changes in the yield of U.S. two-year Treasury notes ($\Delta Y_{USTN,t}$), changes in the VIX (ΔVIX_t), and changes in the CDS premium on Korea's five-year bonds from week $t-1$ to week t. We collect the CRB index and VIX data from Bloomberg, the yield of U.S. two-year Treasury notes from the Federal Reserve Economic Data and the CDS premium on Korea's five-year bonds from the Korea Center for International Finance. As the CDS premium is regularly available from 2003, we begin our sample period at that point.

In our sample, we include Korean manufacturing companies for which stocks were traded for the period from 2003 to 2016. We compute weekly stock returns (Wednesday to Wednesday) for each of the stocks using their stock prices adjusted for any distribution to stockholders, such as stock splits and dividend payments.

TABLE 1—KOREAN STANDARD INDUSTRIAL CLASSIFICATION (REVISION 9) FOR MANUFACTURING

Division Code	Name of Division
10	Food products
11	Beverages
12	Tobacco products
13	Textiles, except apparel
14	Wearing apparel, clothing accessories and fur articles
15	Tanning and dressing of leather, manufacture of luggage and footwear
16	Wood and products of wood and cork, except furniture
17	Pulp, paper and paper products
18	Printing and reproduction of recorded media
19	Coke, hard-coal and lignite fuel briquettes and refined petroleum products
20	Chemicals and chemical products, except pharmaceuticals and medicinal chemicals
21	Pharmaceuticals, medical chemicals and botanical products
22	Rubber and plastic products
23	Other non-metallic mineral products
24	Basic metal products
25	Fabricated metal products, except machinery and equipment
26	Electronic components, computer, radio, television and communication equipment and apparatuses
27	Medical, precision and optical instruments, watches and clocks
28	Electrical equipment
29	Other machinery and equipment
30	Motor vehicles, trailers and semi-trailers
31	Other transport equipment
32	Furniture
33	Other manufacturing

Source: Korea National Statistical Office (Korean Standard Industrial Classification, 2008).

[7]The CRB index is based on exchange-traded futures for 19 commodities and reflects price changes in commodity markets. (https://financial.thomsonreuters.com/content/dam/openweb/documents/pdf/financial/cc-crb-total-return-index.pdf).

The adjusted stock prices are provided by DataGuide. We compute weekly value-weighted stock returns for each industry using all stock returns of individual companies included in the industry. We use the market capitalization of each stock in order to compute the value-weighted stock returns for the industry. The data on the industry to which each company belongs and the market capitalization of the company are also provided by DataGuide. For the classification of industries for Korea, we use the Korean Standard Industrial Classification (KSIC, revision 9) provided by the Korea National Statistical Office.[8] There are 24 divisions (industries) for manufacturing in the KSIC (revision 9). Table 1 reports the codes and names for the 24 divisions (industries). For the U.S., Japan and China, we compute stock market returns using the stock market return index provided by Datastream. The stock market returns are also computed weekly (Wednesday to Wednesday) for the period from 2003 to 2016. All returns are computed in terms of local currencies.[9]

In both (1) and (2), we run a regression for each year in our sample period and estimate the coefficients yearly in order to measure the comovements of stock returns for industry i with respect to the U.S., Japan and China for the year.

In the second stage, in order to examine what determines the comovements in stock returns between Korea and the three countries at the industry level, we use three main explanatory variables: (i) the ratio of trade to sales as a proxy for the trade linkage (ii) the proportion of foreign stock investment as a proxy for the financial linkage and (iii) export competition in third markets. In addition, we add a dummy variable for the period of the global financial crisis (2008-2009) following Arslanalp *et al*. (2016), as the stock returns between Korea and the three countries may comove more or less during the crisis. We also consider industry effects for Korea using 23 industry dummies. The ratios of trade to sales and export competition in third markets are computed yearly for each Korean manufacturing division (industry) for each of the three countries (the U.S., Japan and China). The proportion of foreign stock investment is computed for each such division (industry) for a given year. In the regression, we use the natural log of (1+ trade-to-sales ratio $\times 100$) and the natural log of (1+ proportion of foreign stock investment $\times 100$). The specifications without the dummy variables for the second stage are expressed as follows:

$$\beta_{us,i} = \delta_{us,i} + \delta_{us,trade}\mathrm{Trade}_{us,i} + \delta_{us,finance}\mathrm{Finance}_{i} + \delta_{us,xc}\mathrm{ExportCompetition}_{us,i} + \varepsilon_{us,i} \tag{3-1}$$

[8]The KSIC, introduced in 1963, is based on the UN's International Standard Industrial Classification (ISIC). There have been ten revisions since its introduction. The tenth revision went into effect in July of 2017. The ninth revision, which became effective in 2008, was the latest revision in our sample period. The KSIC has a hierarchical five-digit system. The KSIC (revision 9) was divided into 21 sections, and each section is broken down into divisions (denoted by two digits). The divisions are further broken down into groups (three digits), into classes (four digits) and then into subclasses (five digits). There were 76 divisions, 228 groups, 487 classes and 1,145 subclasses for the KSIC (revision 9) (Source: https://unstats.un.org/unsd/cr/ctryreg).

[9]We also used the estimates of betas with the returns denominated in U.S dollars and obtained results qualitatively similar to the current results. .

$$\beta_{Japan,i} = \delta_{Japan,i} + \delta_{Japan,trade}\text{Trade}_{Japan,i} + \delta_{Japan,finance}\text{Finance}_i + \delta_{Japan,xc}\text{ExportCompetition}_{Japan,i} + \varepsilon_{Japan,i} \tag{3-2}$$

$$\beta_{China,i} = \delta_{China,i} + \delta_{China,trade}\text{Trade}_{China,i} + \delta_{China,finance}\text{Finance}_i + \delta_{China,xc}\text{ExportCompetition}_{China,i} + \varepsilon_{China,i} \tag{3-3}$$

Specifically, the ratio of trade to sales for industry i for a certain year for each of the three countries ($\text{Trade}_{us,i}$, $\text{Trade}_{Japan,i}$, and $\text{Trade}_{China,i}$) is computed as follows. We collect the annual exports and imports between Korea and each of the three countries in U.S. dollars from the UN Comtrade database at the level of HS 6-digit codes under HS 1996. Next, we convert HS 6-digit codes under HS 1996 to HS 6-digit codes under HS 2002 using a correspondence table provided by the UN Statistics Division.[10] Subsequently, we use two correspondence tables for the 2010 Input-Output Statistics of Korea.[11] The first is a correspondence table between the HS 6-digit codes under HS 2002 and I-O commodity codes for the 2010 Input-Output Statistics of Korea. The second is a correspondence table between the I-O commodity codes and the KSIC (revision 9) codes. By combining the two correspondence tables, we convert HS 6-digit codes under HS 2002 to KSIC (revision 9) codes. Next, we sum up the annual trade for all of the HS 6-digit codes in each industry so that we can compute the annual trade for the industry. For the sales of each industry, we collect the annual sales in Korean won for each company within the industry from DataGuide and then compute the annual sales in Korean won for the industry by adding up the annual sales for all of the companies in the industry.[12] We then divide the annual sales for the industry in Korean won by the average exchange rate between the Korean won and U.S. dollar for the year[13] and thus compute the annual sales for the industry in U.S. dollars. Lastly, we compute the ratio of trade to sales using the annual trade and sales in U.S. dollars for the industry.

For the proportion of foreign stock investment each year in a Korean industry, we determine the proportion of foreign stock investment for each company in the industry at the end of each month during the sample period using data from DataGuide and compute the value-weighted mean of the proportions for all of the companies in the industry at the end of the month. Next, we calculate the annual average of the monthly proportions for the industry. Following Arslanalp *et al.* (2016), we compute export competition in third markets for industry i each year for each of the three countries ($\text{ExportCompetition}_{us,i}$, $\text{ExportCompetition}_{Japan,i}$, and $\text{ExportCompetition}_{China,i}$) as the minimum between the share of industry i out of all exports for Korea and that for each of the three countries.

[10]https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp

[11]Bank of Korea (2014)

[12]It is possible that sales data underestimate the actual amount of each industry to some degree because DataGuide does not include non-listed companies.

[13]We collect the annual average exchange rates between the Korean won and U.S. dollar from the Bank of Korea (ECOS).

TABLE 2—TRADE-TO-SALES RATIO, PROPORTION OF FOREIGN STOCK INVESTMENT AND EXPORT COMPETITION FOR KOREA (AVERAGE FOR 24 MANUFACTURING DIVISIONS)

Category	Country	2003-2007 (A, %)	2008-2009 (B, %)	2010-2016 (C, %)	(C-A, %p)
Trade to Sales	U.S.	39.7	28.2	26.4	-13.3
	Japan	45.7	34.7	27.9	-17.9
	China	53.4	68.0	72.1	18.7
Foreign Stock Investment	All countries	20.3	17.7	19.8	-0.5
Export Competition	U.S.	2.8	2.7	2.7	-0.1
	Japan	2.9	2.9	2.9	0.0
	China	2.8	2.8	2.8	0.0

Table 2 reports the averages of the trade-to-sales ratio, the proportion of foreign stock investment and export competition for the 24 Korean manufacturing divisions before the global financial crisis (2003-2007), during the global financial crisis (2008-2009), and after the global financial crisis (2010-2016). The average of the trade-to-sales ratio for the U.S. decreased from 39.7% before the crisis to 26.4% after the crisis. The average of the trade-to-sales ratio for Japan also decreased from 45.7% before the crisis to 27.9% after the crisis. On the other hand, the average of the trade-to-sales ratio for China increased from 53.4% before the crisis to 72.1% after the crisis. For the average proportion of foreign stock investment, it was 20.3% before the crisis and changed to 19.8% after the crisis. For export competition, the three countries have similar levels of competition with Korea and show little change over time.

V. Empirical Results

Table 3 reports the estimates of the betas from specification (1), in this case the regression without control variables, in Section IV. Panel A in Table 3 provides the estimates of betas for the 24 Korean manufacturing divisions (industries) with respect to the U.S. and their averages for three sub-periods: before the global financial crisis (2003-2007), during the global financial crisis (2008-2009), and after the global financial crisis (2010-2016). For the U.S., the average betas before and after the global financial crisis are estimated to be 0.270 and 0.218, respectively. Moreover, the beta after the crisis is smaller than that before the crisis for 18 out of 24 divisions. Thus, we conclude that the comovement between the Korean and U.S. stock markets decreases over time. Interestingly, the average beta during the crisis was -0.163, and the beta was negative for 22 out of 24 divisions. This suggests that the Korean and U.S. stock markets moved in opposite directions during the crisis when controlling for the effects of the other two major markets, Japan and China.

Panel B in Table 3 provides the estimates of the betas for the 24 Korean

manufacturing divisions (industries) with respect to Japan and their averages for the three sub-periods. For Japan, the average betas before and after the global financial crisis are estimated to be 0.365 and 0.114, respectively. In addition, the beta after the crisis is smaller than that before the crisis for 23 out of 24 divisions. Thus, the comovement between the Korean and Japanese stock markets also declines over time. The average beta during the crisis was 0.494, which suggests that the Korean and Japanese stock markets moved further in the same direction during the crisis.

Panel C in Table 3 provides the estimates of the betas for the 24 Korean manufacturing divisions (industries) with respect to China and their averages for the three sub-periods. For China, the average betas before and after the global financial crisis are estimated to be 0.129 and 0.229, respectively. Furthermore, the beta after the crisis is larger than that before the crisis for 20 out of 24 divisions.

TABLE 3—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITHOUT CONTROL VARIABLES)

[Panel A: U.S.]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.228	-0.143	0.025	-0.203
11	0.192	-0.168	0.100	-0.092
12	0.294	-0.081	0.153	-0.140
13	0.061	-0.151	0.278	0.217
14	0.310	-0.114	0.119	-0.191
15	-0.006	-0.316	0.543	0.549
16	0.397	-0.030	0.225	-0.171
17	0.259	-0.233	0.194	-0.065
18	0.666	0.040	0.232	-0.434
19	0.273	-0.029	0.257	-0.016
20	0.402	-0.087	0.259	-0.143
21	0.226	-0.220	-0.061	-0.288
22	0.217	-0.155	0.286	0.070
23	0.213	-0.287	0.214	0.002
24	0.334	0.265	0.289	-0.046
25	0.164	-0.440	0.412	0.248
26	0.265	-0.011	0.202	-0.063
27	0.462	-0.336	0.230	-0.231
28	0.400	-0.135	0.231	-0.169
29	0.375	-0.350	0.337	-0.038
30	0.166	-0.173	0.104	-0.062
31	0.147	-0.225	0.381	0.234
32	0.326	-0.080	0.122	-0.204
33	0.110	-0.446	0.089	-0.021
Average	0.270	-0.163	0.218	-0.052

TABLE 3—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITHOUT CONTROL VARIABLES) *(CONTINUED)*

[Panel B: Japan]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.322	0.306	0.133	-0.189
11	0.329	0.116	0.116	-0.213
12	0.039	0.168	0.012	-0.026
13	0.323	0.403	0.158	-0.165
14	0.303	0.284	0.226	-0.077
15	0.278	0.199	0.059	-0.218
16	0.271	1.037	0.153	-0.118
17	0.134	0.483	0.058	-0.075
18	0.172	0.556	0.073	-0.099
19	0.170	0.296	-0.080	-0.249
20	0.388	0.517	0.053	-0.335
21	0.269	0.440	0.272	0.003
22	0.405	0.580	0.118	-0.287
23	0.426	0.636	0.115	-0.311
24	0.711	0.454	0.030	-0.681
25	0.414	0.744	0.126	-0.288
26	0.614	0.487	0.277	-0.338
27	0.391	0.655	0.104	-0.287
28	0.354	0.604	0.103	-0.251
29	0.569	0.788	0.184	-0.385
30	0.715	0.437	-0.015	-0.729
31	0.545	0.722	0.195	-0.350
32	0.198	0.201	0.061	-0.136
33	0.424	0.754	0.197	-0.227
Average	0.365	0.494	0.114	-0.251

TABLE 3—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITHOUT CONTROL VARIABLES) *(CONTINUED)*

[Panel C: China]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.102	0.205	0.053	-0.049
11	0.138	0.207	0.060	-0.078
12	-0.042	0.021	-0.003	0.039
13	0.162	0.215	0.130	-0.032
14	0.061	0.280	0.060	-0.001
15	0.043	0.512	0.120	0.077
16	0.030	0.286	0.201	0.171
17	0.038	0.224	0.179	0.141
18	0.105	-0.129	0.210	0.105
19	0.239	0.251	0.578	0.339
20	0.255	0.222	0.392	0.138
21	0.113	0.244	0.117	0.004
22	0.129	0.181	0.170	0.041
23	0.145	0.312	0.213	0.069
24	0.226	0.421	0.440	0.214
25	0.130	0.387	0.240	0.110
26	0.191	0.066	0.330	0.138
27	0.111	0.363	0.264	0.154
28	0.137	0.067	0.278	0.141
29	0.166	0.466	0.304	0.138
30	0.183	0.224	0.348	0.165
31	0.267	0.556	0.419	0.152
32	0.109	0.154	0.139	0.029
33	0.062	0.232	0.247	0.185
Average	0.129	0.249	0.229	0.100

Thus, we conclude that the comovement between Korean and Chinese stock markets increases over time. The average beta during the crisis was 0.249. This suggests that the Korean and Chinese stock markets moved further in the same direction during the crisis.

Table 4 reports the estimates of the betas from specification (2), in this case regression with control variables, in Section IV. Panel A in Table 4 provides the estimates of the betas for the 24 Korean manufacturing divisions (industries) with respect to the U.S. and their averages for the three sub-periods. For the U.S., the average betas before and after the global financial crisis are estimated to be 0.479 and 0.006, respectively. In addition, the beta after the crisis is smaller than that before the crisis for 21 out of 24 divisions. Panel B in Table 4 provides the estimates of the betas for the 24 Korean manufacturing divisions (industries) with respect to Japan and their averages for the three sub-periods. For Japan, the average

betas before and after the global financial crisis are estimated to be 0.304 and 0.124, respectively. The beta after the crisis is smaller than that before the crisis for 20 out of 24 divisions. Panel C in Table 4 provides the estimates of the betas for the 24 Korean manufacturing divisions (industries) with respect to China and their averages for the three sub-periods. For China, the average betas before and after the global financial crisis are estimated to be 0.112 and 0.192, respectively. In addition, the beta after the crisis is larger than that before the crisis for 19 out of 24 divisions. By industry, the increase in the value of beta was especially significant in divisions 19 (0.270), 24 (0.231) and 30 (0.182).

When we look at the post-crisis period (2010-2016) in terms of specific Korean industries, the estimated beta with regard to China was the highest in division 19 (0.533), followed by divisions 24 (0.396), 30 (0.344), 20 (0.338), 31 (0.331) and 26 (0.320). The betas in divisions 19 (0.410), 31 (0.406), 22 (0.255) and 30 (0.254) were

TABLE 4—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITH CONTROL VARIABLES)

[Panel A: U.S.]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.300	-0.301	-0.204	-0.504
11	0.087	-0.401	-0.161	-0.248
12	0.300	-0.217	0.071	-0.229
13	0.378	-0.084	-0.144	-0.522
14	0.460	0.004	-0.136	-0.596
15	0.272	0.177	0.201	-0.071
16	0.711	-0.056	-0.352	-1.063
17	0.429	-0.086	0.044	-0.474
18	1.662	0.310	-0.112	-1.774
19	0.265	-0.141	0.410	0.145
20	0.581	0.108	0.169	-0.412
21	0.389	-0.085	-0.249	-0.638
22	0.283	0.110	0.255	-0.029
23	0.167	-0.274	0.031	-0.136
24	0.775	0.453	-0.040	-0.815
25	0.466	-0.310	0.030	-0.436
26	0.584	0.349	0.134	-0.450
27	1.036	-0.104	-0.214	-1.250
28	0.620	0.179	0.026	-0.594
29	0.743	0.110	0.179	-0.564
30	0.078	0.762	0.254	0.176
31	0.091	0.260	0.406	0.315
32	0.410	-0.151	-0.160	-0.570
33	0.407	-0.539	-0.197	-0.604
Average	0.479	0.003	0.006	-0.473

TABLE 4—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITH CONTROL VARIABLES) *(CONTINUED)*

[Panel B: Japan]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.265	0.169	0.140	-0.125
11	0.247	0.051	0.171	-0.076
12	0.057	0.184	0.060	0.003
13	0.295	0.227	0.150	-0.145
14	0.163	0.088	0.192	0.029
15	0.299	-0.087	0.036	-0.263
16	0.223	0.689	0.198	-0.025
17	0.059	0.361	0.082	0.023
18	0.130	0.519	0.060	-0.070
19	0.116	0.134	-0.051	-0.167
20	0.276	0.313	0.081	-0.195
21	0.202	0.457	0.327	0.125
22	0.367	0.312	0.121	-0.246
23	0.379	0.476	0.123	-0.256
24	0.578	0.149	0.080	-0.499
25	0.321	0.398	0.145	-0.176
26	0.587	0.317	0.255	-0.332
27	0.362	0.491	0.070	-0.291
28	0.282	0.434	0.100	-0.183
29	0.500	0.512	0.183	-0.317
30	0.656	0.040	-0.028	-0.684
31	0.420	0.309	0.232	-0.188
32	0.182	0.185	0.058	-0.124
33	0.336	0.545	0.189	-0.148
Average	0.304	0.303	0.124	-0.180

TABLE 4—ESTIMATES OF BETAS FOR THE KOREAN MANUFACTURING INDUSTRY WITH RESPECT TO U.S., JAPANESE AND CHINESE STOCK MARKET RETURNS (WITH CONTROL VARIABLES) *(CONTINUED)*

[Panel C: China]

Industry	2003-2007 (A)	2008-2009 (B)	2010-2016 (C)	(C-A)
10	0.083	0.096	0.041	-0.043
11	0.130	0.163	0.016	-0.114
12	-0.033	-0.032	-0.001	0.032
13	0.169	0.065	0.107	-0.061
14	0.033	0.125	-0.023	-0.055
15	0.042	0.396	0.058	0.016
16	-0.017	0.101	0.147	0.164
17	0.008	0.150	0.141	0.133
18	0.097	-0.155	0.140	0.043
19	0.263	0.149	0.533	0.270
20	0.209	0.142	0.338	0.129
21	0.126	0.174	0.110	-0.016
22	0.112	0.035	0.157	0.045
23	0.106	0.191	0.166	0.060
24	0.165	0.348	0.396	0.231
25	0.112	0.235	0.188	0.076
26	0.186	-0.007	0.320	0.135
27	0.081	0.228	0.231	0.150
28	0.107	0.000	0.278	0.171
29	0.131	0.380	0.270	0.139
30	0.162	0.173	0.344	0.182
31	0.272	0.411	0.331	0.059
32	0.086	0.142	0.114	0.029
33	0.048	0.055	0.212	0.163
Average	0.112	0.149	0.192	0.081

the highest with respect to the U.S.. In the case of Japan, the betas in divisions 21 (0.327), 26 (0.255) and 31 (0.232) were the highest.

Thus, together with the results from Table 3 and Table 4, we conclude that the comovements in stock returns between Korea and the U.S. and between Korea and Japan decline over time. In contrast, the comovement in stock returns between Korea and China increases over time.

Table 5 reports the results of a regression analysis where we examine the drivers of comovements in stock returns between Korea and the three countries. In Panel A of Table 5, we use the betas for the 24 Korean manufacturing divisions (industries) with respect to the U.S. from specifications (1) and (2) in Section IV, i.e., regression without and with control variables, as dependent variables. When we use the beta from specification (1), i.e., without control variables, as a dependent variable, and the variables of trade flows, foreign stock investment and export

competition in third markets as independent variables, the variable of trade is positive and significant at the 5% level, but the variables of foreign stock investment and export competition are not significant at any conventional level. When we add a dummy variable for the global financial crisis, none of the three variables is significant. When we use the beta from specification (2), i.e., with control variables, as a dependent variable, the variable of trade is positive and significant at the 5% level, whereas the variables of foreign stock investment and export competition are not statistically significant. When we add a dummy variable for the global financial crisis, the variable of trade is still positive and significant at the 5% level. However, the variables of foreign stock investment and export competition are not significant. Thus, for the U.S., we conclude that the variable of trade has a positive relationship with beta, but the variables of foreign stock investment and export competition show no relationship with beta.

In Panel B of Table 5, we use the betas for the 24 Korean manufacturing divisions (industries) with respect to Japan from specifications (1) and (2) as dependent variables. When we use the beta from specification (1) as a dependent variable, the variable of trade is positive and significant at the 1% level, but the variables of foreign stock investment and export competition are not significant. When we add a dummy variable for the global financial crisis, the variable of trade is still positive and significant at the 1% level, but the variables of foreign stock investment and export competition are not significant. When we use the beta from specification (2) as a dependent variable and variables of trade and foreign stock investment as independent variables, the variable of trade is still positive and significant at the 5% level, but the variables of foreign stock investment and export competition are not significant. When we add a dummy variable for the global financial crisis, the variable of trade is still positive and significant at the 5% level. However, the variables of foreign stock investment and export competition are not significant. Thus, in the case of Japan, we conclude that the variable of trade has a positive relationship with beta, whereas the variables of foreign stock investment and export competition are unrelated to beta.

In Panel C of Table 5, we use the betas for the 24 Korean manufacturing divisions (industries) with respect to China from specifications (1) and (2) as dependent variables. When we use the beta from specification (1) as a dependent variable, the variable of trade is positive and significant at the 1% level, but the variables of foreign stock investment and export competition are not statistically significant. When we add a dummy variable to represent the global financial crisis, the variable of trade is still positive and significant at the 1% level, but the variables of foreign stock investment and export competition are not significant. When we use the beta from specification (2) as a dependent variable, the variable of trade remains positive and significant at the 10% level, but the variables of foreign stock investment and export competition are not significant. When we add a dummy variable for the global financial crisis, the variable of trade is still positive and significant at the 10% level. However, the variables of foreign stock investment and export competition are not significant. Therefore, for China, we conclude that the variable of trade is positively related to beta but that the variables of foreign stock investment and export competition are not.

TABLE 5—REGRESSION OF BETA ON TRADE, FOREIGN STOCK INVESTMENT AND EXPORT COMPETITION FOR THE KOREAN MANUFACTURING INDUSTRY

[Panel A: U.S.]

Independent Variables	Dependent Variable: Beta of the Korean Manufacturing Industry			
	Without Control Variables		With Control Variables	
Trade	0.161** (2.11)	0.082 (1.12)	0.335** (2.44)	0.301** (2.20)
Finance	0.007 (0.09)	-0.031 (-0.45)	-0.068 (-0.63)	-0.084 (-0.78)
Export Competition	-0.009 (-0.34)	-0.006 (-0.24)	-0.008 (-0.18)	-0.006 (-0.15)
Crisis Dummy		-0.395*** (-7.55)		-0.169** (-2.17)
Industry Effect	Yes	Yes	Yes	Yes
N	336	336	336	336
R^2	0.054	0.166	0.079	0.087

[Panel B: Japan]

Independent Variables	Dependent Variable: Beta of the Korean Manufacturing Industry			
	Without Control Variables		With Control Variables	
Trade	0.225*** (3.70)	0.230*** (4.02)	0.123** (2.10)	0.128** (2.17)
Finance	0.057 (0.95)	0.074 (1.35)	0.022 (0.41)	0.029 (0.55)
Export Competition	-0.012 (-0.72)	-0.010 (-0.63)	0.005 (0.28)	0.006 (0.33)
Crisis Dummy		0.279*** (7.10)		0.105*** (2.73)
Industry Effect	Yes	Yes	Yes	Yes
N	336	336	336	336
R^2	0.143	0.240	0.102	0.118

Note: 1) Numbers in parentheses are heteroscedasticity-robust t-statistics. 2) ***, **, and * denote statistical significance at the levels of 1%, 5% and 10%, respectively.

TABLE 5—REGRESSION OF BETA ON TRADE, FOREIGN STOCK INVESTMENT AND EXPORT COMPETITION FOR THE KOREAN MANUFACTURING INDUSTRY *(CONTINUED)*

[Panel C: China]

Independent Variables	Dependent Variable: Beta of the Korean Manufacturing Industry			
	Without Control Variables		With Control Variables	
Trade	0.134*** (3.11)	0.132*** (2.98)	0.087* (1.95)	0.087* (1.96)
Finance	0.019 (0.70)	0.022 (0.83)	0.023 (0.77)	0.022 (0.75)
Export Competition	-0.014 (-1.06)	-0.013 (-1.03)	-0.004 (-0.32)	-0.005 (-0.33)
Crisis Dummy		0.060 (1.69)		-0.011 (-0.33)
Industry Effect	Yes	Yes	Yes	Yes
N	336	336	336	336
R^2	0.239	0.248	0.212	0.212

Note: 1) Numbers in parentheses are heteroscedasticity-robust t-statistics. 2) ***, **, and * denote statistical significance at the levels of 1%, 5% and 10%, respectively.

Together with the results for the U.S., Japan and China, we conclude that the trade linkage is the main driver of comovements in stock returns between Korea and the three major countries. We find no evidence that either the financial linkage proxied by foreign stock investment or export competition is related to comovements in stock returns between Korea and the three countries. However, we admit that the proxy used for measuring the bilateral financial linkage between Korea and the three countries in our paper may have some limitations if used to explain the interconnection.

VI. Conclusion

This paper measures the extent of comovements in stock returns between Korea and three major countries (China, Japan and the U.S.) using industry-level data for Korea from 2003 to 2016, in the spirit of the ICAPM. It also examines what drives the comovements between Korea and the three countries.

From our analysis, we find that the comovements of the Korean stock market with those of the U.S. and Japan decline after the global financial crisis. In contrast, the post-crisis comovement in stock returns between Korea and China is greater than that during the pre-crisis period.

Next, we examine the drivers of comovements in stock returns between Korea and the three countries. Specifically, we use betas for 24 Korean manufacturing divisions (industries) with respect to the U.S., Japan and China as dependent

variables and variables of trade and foreign stock investment as independent variables in an effort to examine whether either the trade or financial linkage between Korea and the three countries can explain the degrees of comovements in stock returns between Korea and the three countries. From our analysis, we find that the trade linkage is the main driver of comovements in stock returns between Korea and the three countries. On the other hand, we find no evidence that the financial linkage proxied by foreign stock investment is related to comovements in stock returns between Korea and the three countries.

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