Uncertainty and Manufacturing Stock Market in Korea

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Abstract

Purpose - We study the dynamic linkages of the economic policy uncertainty (EPU) in the US on the manufacturing stock market returns in Korea. In detail, we examine the casual link between EPU index in the US and the manufacturing stock indexes in Korea.
Research design, data, and methodology - We measure mainly the distribution effect of the US EPU on the manufacturing stock market in Korea of 1990-2017 by the vector error correction model (VECM).
Result - In result, we estimate the impact of the US EPU index has significantly a negative response to the manufacturing stock market in Korea such as non-metal stock index, chemical stock index, food stock index, textile·clothes stock index, automobile·shipbuilding stock index, machinery stock index, steel·metal stock index. Also the remaining variables such as electric·electronics stock index, S&P 500, and producer price index in Korea have a negative relationship with US EPU index.
Conclusions - We find out that the relationship between EPU index of the US and the manufacturing stock market in Korea has the negative relationships. We determine the EPU of the US has the spillover effect on the industry stock markets in Korea.

Keywords: Manufacturing Stock Market, Economy Policy Uncertainty, VECM.

JEL Classifications: C32, E60.

1. Introduction

The share of manufacturing in the industrial economy is so much larger than any other industries. According to the 2017 Bloomberg Innovation Index, Korea ranked first in the world in research and development intensity versus GDP, manufacturing value-added, and patent activity in 2016, among the world's most innovative economies. We find that manufacturing plays a leading part of Korean economy.

By the Korea Customs Service, the US is the second largest exporter in Korea, followed by China. The US economy is closely related to Korea's industrial economy. We suggest the dynamic linkages of the US economic policy uncertainty (EPU) on Korea 's industrial economy, especially on manufacturing. If the US economic policy is uncertain, the US economy will deteriorate and it has a bad influence on US exports, which may ultimately lead to the production of Korean manufacturing.

In other words, the manufacturing productivity is interrelated

to Gross Domestic Product (GDP), employment (Bloom, 2009; Born & Pfeifer, 2014). Increased productivity increases employment and investment (Foster, Haltiwanger, & Krizan, 2006). In addition, Baker, Bloom, and Davis (2016) also show that GDP growth is interrelated to the US EPU. In detail, if the EPU of a country rises, the economy will deteriorate and the GDP growth rate will slow down. Thus, the EPU is interrelated to the production of the manufacturing sector.

This study analyzes the stock price indexes of manufacturing in order to understand Korea's industrial economy by using the US EPU index. Previous studies have explored macroeconomic variables based on economic or policy uncertainty (Abel, 1983; Bachmann, Elstner, & Sims, 2013; Fernandez-Villaverde, Pablo, Keith, & Juan, 2015). This study not only provides the dynamic link of EPU index reflecting the economic uncertainty but also the policy on the industrial economy of Korea through empirical analysis.

This study is interesting in analyzing the manufacturing more finely compared with previous studies on EPU. Our main research findings provide the impact of the US EPU on each industry stock market returns of manufacturing in Korea and examine the contribution of the different economic mechanisms and effect to the US EPU shock.

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The sensitivity to economic policy in Korea has a great impact on society at large. In particular, since stock prices are important data reflecting real-time economic and policy conditions in Korea, we can indirectly understand the EPU on Korea's industrial economy.

2. Literature Review

We have a lot of previous studies on EPU and macroeconomics with stock markets. Pantzalis, Stangeland, and Turtle (2000) study the response to the stock market during the political election period for 33 countries including the US and Korea. In the two weeks prior to the political election, they found that it is positive and meaningful stock market reactions. Thus, they estimate the asset value increases as uncertainty increases and uncertainty resolves just before the election process. Beltratti and Morana (2010) argue that the G-7 countries, especially the US do a key role to global economic fluctuations by creating a global economic crisis. Specifically, they have a large impact on real economic activities such as stock prices. Lee (2010) studies the news shocks on the volatile movement of internal financial markets.

Gourio, Siemer, and Verdelhan (2013) study the relationships among unemployment rate, the world realized volatility, and industrial production (IP) in G7 countries with monthly data. They document the higher disaster risk exposures in a worldwide recession, the larger productivity and capital shocks in a country.

Kang and Ratti (2013) also study that the increase in the US uncertainty has a negative impact on stocks. The impact of oil prices has heightened EPU and adversely affected European stocks and energy exporters, Canada. The impact of EPU in the US has a key impact on the macroeconomics than in the European counterpart.

Bloom (2014) notes that stock market volatility and GDP volatility are often used as a means of uncertainty about US economic policy uncertainty (EPU), because the volatility is becoming more volatile and uncertainty is increasing if unpredictable. Especially in the recession, the volatility of S&P 500 is even higher.

Antonakakis, Gupta, and Andre (2015) examine the relation between the stock market volatility (VIX) and EPU. They find that the unconditional correlation between EPU and VIX is negative. Besides, EPU has a negative relation with housing market and IP.

Jurado, Ludvigson, and Ng (2015) show the uncertainty shocks and business cycles. They estimate how economic uncertainty can affect the macroeconomic volatility. Choi & Loungani (2015) explore the relationship between uncertainty shocks and unemployment dynamics using S&P 500. They suggest that the more aggregate uncertainties, the more unemployment rate. Leduc and Liu (2016) show the uncertainty and an aggregate demand shock is a negative

relation. Warshaw (2016) documents the parallel currency markets and exchange rate with vector error-correction model (VECM). In a result of VECM, the findings relate to the macroeconomic conditions such as monetary policy, volatility, economic uncertainty. Morikawa (2016) uses the quarterly survey data of Japanese companies to measure the business uncertainty.

Meinen and Roehe (2017) show the uncertainty shrinks rapidly the scale of investment for machinery and equipment by focusing four European countries and Spain. He (2018) shows the relationship between monetary policy in China and exchange rate in South Korea. In an empirical result, the monetary policy in China has a negative relation with exchange rate by using the VECM. Jeon (2018) documents the housing market in Korea using Asian EPU indexes. Section 3 evaluates the sample we use to estimate the empirical methodology. Section 4 provides the summary of the VECM. Section 5 provides the discussions. Section 6 concludes and offers the summary, limitations, and future studies.

3. Sample and methodology

3.1. Sample

Sample frequencies are monthly. The sample used to this study includes the period 1990-2017. In the model with the EPU index of the US, non-metal stock index (NSI), chemical stock index (CSI), food stock index (FSI), textile·clothes stock index (TSI), automobile·shipbuilding stock index (ASI), machinery stock index (MSI), electric·electronics stock index (ESI), steel·metal stock index (SSI), producer price index (PPI) in Korea, and S&P 500.

Firstly, the EPU index is gained by Baker et al. (2016) and determines economic-related policy uncertainty of the US. The EPU index of the US contains the following three words about the 'economy', 'policy', 'uncertainty' from leading newspapers such as Washington Post, Dallas Morning News, Boston Globe, and so on. The EPU index calculates the article volume and standardize monthly the newspaper series, and normalize the newspapers using a mean of 100 for 1985-2009 to make the EPU index.

The stock index in Korea and S&P 500 for this study is collected by Fnguide in Korea. The PPI is obtained from the Bank of Korea. Jeon (2017) shows the PPI is a signal to improve the economy in the research of the US purchasing managers' index (PMI) to Korea. In Figure 1, we find the exports of Korea to the US was affected by Lehman collapse during the recession period from 2008: M9 to 2009: M12 in the US. The EPU index had increased over the recession period. the export amount of Korea was decreased for the economy deterioration of the US. This phenomenon indirectly shows the EPU of the US and the economy of Korea is inextricably linked.
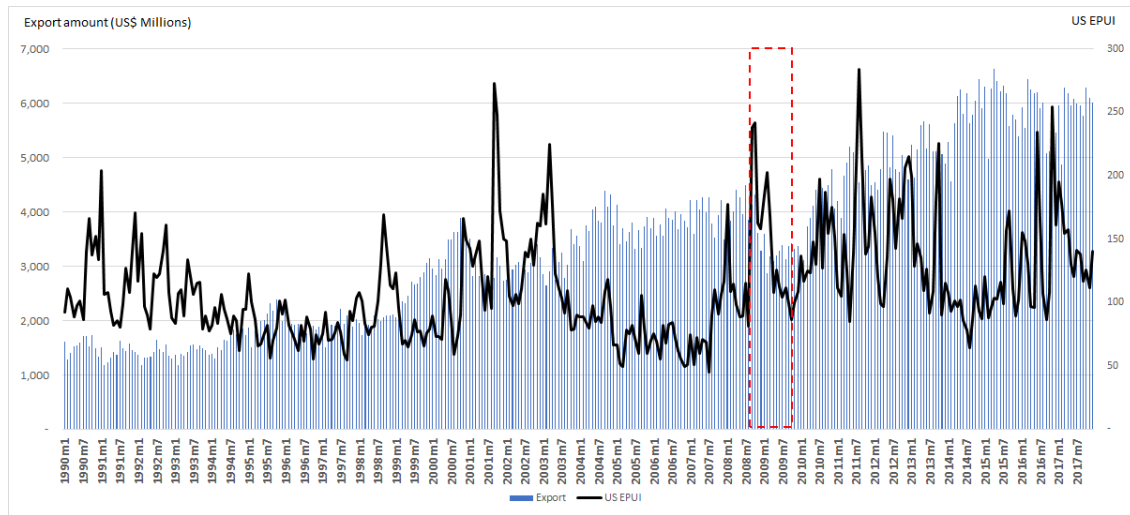
Note: The dotted box denotes periods for Lehman collapse & recession from 2008:M9 to 2009:M12.

Figure 1: Trend of EPU index (EPUI) of US and Korean Exports to US

Table 1: Statistics Summary

	US EPUI	NSI	CSI	FSI	TSI	ASI	MSI	ESI	SSI	S&P 500	PPI
Mean	4.657	6.740	7.248	7.335	5.731	6.789	6.628	8.250	7.666	6.924	4.409
Median	4.625	6.732	6.973	7.165	5.611	6.774	6.790	8.401	7.471	7.057	4.406
Min.	3.802	5.360	5.574	6.117	4.252	5.190	4.979	6.616	6.243	5.727	4.007
Max.	5.648	7.552	8.726	8.690	7.104	8.147	7.834	9.902	8.975	7.888	4.691
S.D.	0.347	0.392	0.898	0.736	0.726	0.752	0.588	0.863	0.832	0.539	0.201
N	336	336	336	336	336	336	336	336	336	336	336

Note: EPUI, NSI, CSI, FSI, TSI, ASI, MSI, ESI, SSI, S&P 500, and PPI indicate separately economic policy uncertainty index, non-metal stock index, chemical stock index, food stock index, textile·clothes stock index, automobile·shipbuilding stock index, machinery stock index, electric·electronics stock index, steel·metal stock index, Standard and Poor's 500, and producer price index.

We show the summary of descriptive statistics using the natural logs of the sample in Table 1.

3.2. Methodology

Firstly, we estimate the stationary of time series with unit root tests. When the samples have a unit root, the data are not stationary. And we measure whether the data exist a cointegration to confirm the long-term relationship and check the short-run dynamics. Even if the first differenced model has no unit root, we have to analyze the cointegration. In the result of unit root tests and cointegration test, we choose the VECM not VAR as Equation (1) because the first differenced model can cause the loss of long-run information by Engle and Granger (1987).

$$\triangle Y_t = \sum_{i=1}^{k-1} \varXi_i \triangle Y_{t-i} + \alpha \beta^{'} Y_{t-k} + \Psi + \epsilon_t \qquad (1)$$

where Y_t is a vector of $(p \times 1)$ matrix when the endogenous variables are I (1), that is, p is US EPU index, NSI, CSI, FSI, TSI, ASI, MSI, ESI, SSI, PPI, S&P 500; i is lag order (1, 2, ..., N); k is maximum of lag order; t is period (1, 2, ..., T); $\varXi_i$ is $p \times p$ matrix coefficient; $\alpha \beta^{'} Y_{t-k}$ is lagged error correction term, where α is adjustment parameters, and $\beta^{'}$ is cointegration vectors; Ψ is vector of deterministic components; ϵ_t is $(p \times 1)$ vector of disturbances.

4. Results

4.1. Unit Root Tests

We estimate where a unit root exists in the natural logarithm of the samples. In Table 2, the first difference data has not a unit root so that the samples have the stationary data.

Table 2: Unit root tests

		ADF		PP	
		Log-Level	1st Difference	Log-Level	1st Difference
US EPUI	Con.	-5.227	-15.013***	-7.008	-25.296***
	Con. & Trend	-5.573	-14.991***	-7.427	-25.250***
NSI	Con.	-2.561	-10.294***	-2.561	-16.529***
	Con. & Trend	-2.777	-10.298***	-2.776	-16.529***
CSI	Con.	-0.376	-10.014***	-0.335	-17.190***
	Con. & Trend	-2.762	-10.021***	-2.773	-17.208***
FSI	Con.	-0.941	-9.994***	-0.847	-17.562***
	Con. & Trend	-3.504	-9.976***	-3.480	-17.541***
TSI	Con.	-1.675	-9.634***	-1.649	-17.068***
	Con. & Trend	-1.481	-9.644***	-1.428	-17.080***
ASI	Con.	-1.154	-10.139***	-1.155	-17.059***
	Con. & Trend	-2.027	-10.129***	-2.026	-17.051***
MSI	Con.	-1.809	-10.629***	-1.764	-17.916***
	Con. & Trend	-1.987	-10.636***	-1.915	-17.917***
ESI	Con.	-0.703	-11.048***	-0.661	-17.106***
	Con. & Trend	-4.418	-11.037***	-4.245	-17.089***
SSI	Con.	-1.078	-10.269***	-0.957	-17.009***
	Con. & Trend	-2.606	-10.252***	-2.519	-16.982***
S&P 500	Con.	-1.070	-9.185***	-1.059	-14.499***
	Con. & Trend	-1.725	-9.177***	-1.760	-14.483***
PPI	Con.	-1.842	-9.095***	-1.972	-9.533***
	Con. & Trend	-1.637	-9.244***	-1.388	-9.621***

Note:
1. EPUI, NSI, CSI, FSI, TSI, ASI, MSI, ESI, SSI, S&P 500, and PPI indicate separately economic policy uncertainty index, non-metal stock index, chemical stock index, food stock index, textile·clothes stock index, automobile·shipbuilding stock index, machinery stock index, electric·electronics stock index, steel·metal stock index, Standard and Poor's 500 index, and producer price index.
2. ***, **, * represent 1%, 5%, 10% levels.
3. Con, Con. & Trend connote constant, and constant and trend separately.

Table 3: Cointegration test results

Null hypothesis	Trace	5% Critical Value	λmax	5% Critical Value
r=0	344.34	277.71	104.48	68.83
r≤1	239.86	233.13	65.03	62.81
r≤2	174.83*	192.89	49.29	57.12
r≤3	125.53	156.00	35.56	51.42
r≤4	89.96	124.24	26.73	45.28
r≤5	63.22	94.15	22.10	39.37

Note: * represents 5% levels.

4.2. Johansen's co-integration Test

To check the long-term equilibrium of samples, we examine more than one co-integration relationship by using the cointegration test by Johansen(1991). As a result, we document that the samples have the cointegration in Table 3.

4.3. Granger Causality Tests

In Table 4, Granger causality tests show the results the between the US EPU index and the samples in Korea. The null hypothesis (Ho) of Granger causality indicates the EPU index does not cause the samples, or the samples do not

cause the EPU index.

The US EPU index has a significant cause for the samples except S&P 500 and PPI in Korea. Then, the manufacturing stock indexes in this study are significantly affected by the US EPU index. On the contrary, the manufacturing stock indexes have a significant cause for the US EPU index except TSI. In other words, the US EPU index is significantly affected by the samples except TSI.

Table 4: Granger causality tests

	Ho	F-Statistic
NSI and US EPUI	NSI ⇏ US EPUI	2.670**
	US EPUI ⇏ NSI	3.983**
CSI and US EPUI	CSI ⇏ US EPUI	4.254**
	US EPUI ⇏ CSI	2.556**
FSI and US EPUI	FSI ⇏ US EPUI	2.938***
	US EPUI ⇏ FSI	3.557**
TSI and US EPUI	TSI ⇏ US EPUI	1.555
	US EPUI ⇏ TSI	2.298**
ASI and US EPUI	ASI ⇏ US EPUI	2.930**
	US EPUI ⇏ ASI	3.411***
MSI and US EPUI	MSI ⇏ US EPUI	3.033**
	US EPUI ⇏ MSI	3.412***
ESI and US EPUI	ESI ⇏ US EPUI	4.894***
	US EPUI ⇏ ESI	5.317***
SSI and US EPUI	SSI ⇏ US EPUI	4.751***
	US EPUI ⇏ SSI	2.009*
S&P 500 and US EPUI	S&P 500 ⇏ US EPUI	4.508***
	US EPUI ⇏ S&P 500	0.670
PPI and US EPUI	PPI ⇏ US EPUI	4.355**
	US EPUI ⇏ PPI	0.385

Notes:
1. ***, **, * connote 1%, 5%, and 10% levels.
2. ⇏ represents "does not Granger Cause".
3. EPUI, NSI, CSI, FSI, TSI, ASI, MSI, ESI, SSI, S&P 500, and PPI indicate separately economic policy uncertainty index, non-metal stock index, chemical stock index, food stock index, textile·clothes stock index, automobile·shipbuilding stock index, machinery stock index, electric·electronics stock index, steel·metal stock index, Standard and Poor's 500 index, and producer price index.

4.4. VECM Results

We select the optimal lag order before analyzing the VECM. In Table 5, Lag 2 by AIC is decided as the optimal lag length.

Table 5: Lag Selection

lag	AIC	HQIC	SBIC
0	-1.837	-1.787	-1.711
1	-33.583	-32.980	-32.070
2	-33.773*	-32.617	-30.874
3	-33.633	-31.924	-29.347
4	-33.424	-31.161	-27.750

Note: * means the selected lag order.

We find the samples in this study is affected by the US EPU index in Table 6. In detail, the manufacturing stock indexes except ESI in Korea has negatively a significant relationship with the US EPU index. Meanwhile, the S&P 500 and PPI is not significantly affected by the US EPU index. And all samples have a negative relationship with the US EPU index.

Table 6: VECM results

	US EPUI
Non-metal Stock Index (NSI)	-0.069*** (0.024)
Chemical Stock Index (CSI)	-0.045** (0.021)
Food Stock Index (FSI)	-0.035* (0.020)
Textile·clothes Stock Index (TSI)	-0.043* (0.023)
Automobile·shipbuilding Stock Index (ASI)	-0.041* (0.024)
Machinery Stock Index (MSI)	-0.059** (0.025)
Electric·electronics Stock Index (ESI)	-0.037 (0.025)
Steel·metal Stock Index (SSI)	-0.038* (0.022)
Standard and Poor's 500 Index (S&P 500)	-0.009 (0.008)
Producer Price Index (PPI)	-0.000 (0.001)

Notes:
1. ***, **, * connote 1%, 5%, and 10% levels.
2. ( ) represents standard errors.

4.5. Impulse Response Function

Using the VECM, we estimate the impulse response function (IRF) between EPU indexes in the US and the samples of Korea. In Figure 2, all responses of the samples in Korea as well as S&P 500 have initially moving toward a negative direction to the shock of the US EPU index. This result of the negative responses at the beginning by impulse response function is the same as it of the VECM.

In particular, NSI, TSI, ASI, MSI, ESI, SSI, PPI tend to remain in the negative area due to the spillover effect of an impact of the US EPU. In addition, responses of CSI and FSI are intersecting in 3 months and going toward the zero point.

Otherwise, the response of the US EPU index has been initially declining toward the negative direction to the shock of ASI, MSI, ESI, SSI, and PPI. On the other hand, the US EPU index has been rising toward the positive direction to the shock of NSI, CSI, FSI, TSI, and S&P 500 at the beginning.

Moreover, FSI, ASI, MSI, and S&P 500 tend to stay on the negative area due to the spillover effect of an impact of the US EPU. Additionally, responses of NSI, CSI, TSI, ESI, SSI, and PPI are crossing in turn the negative and positive ways, and going toward the zero point.
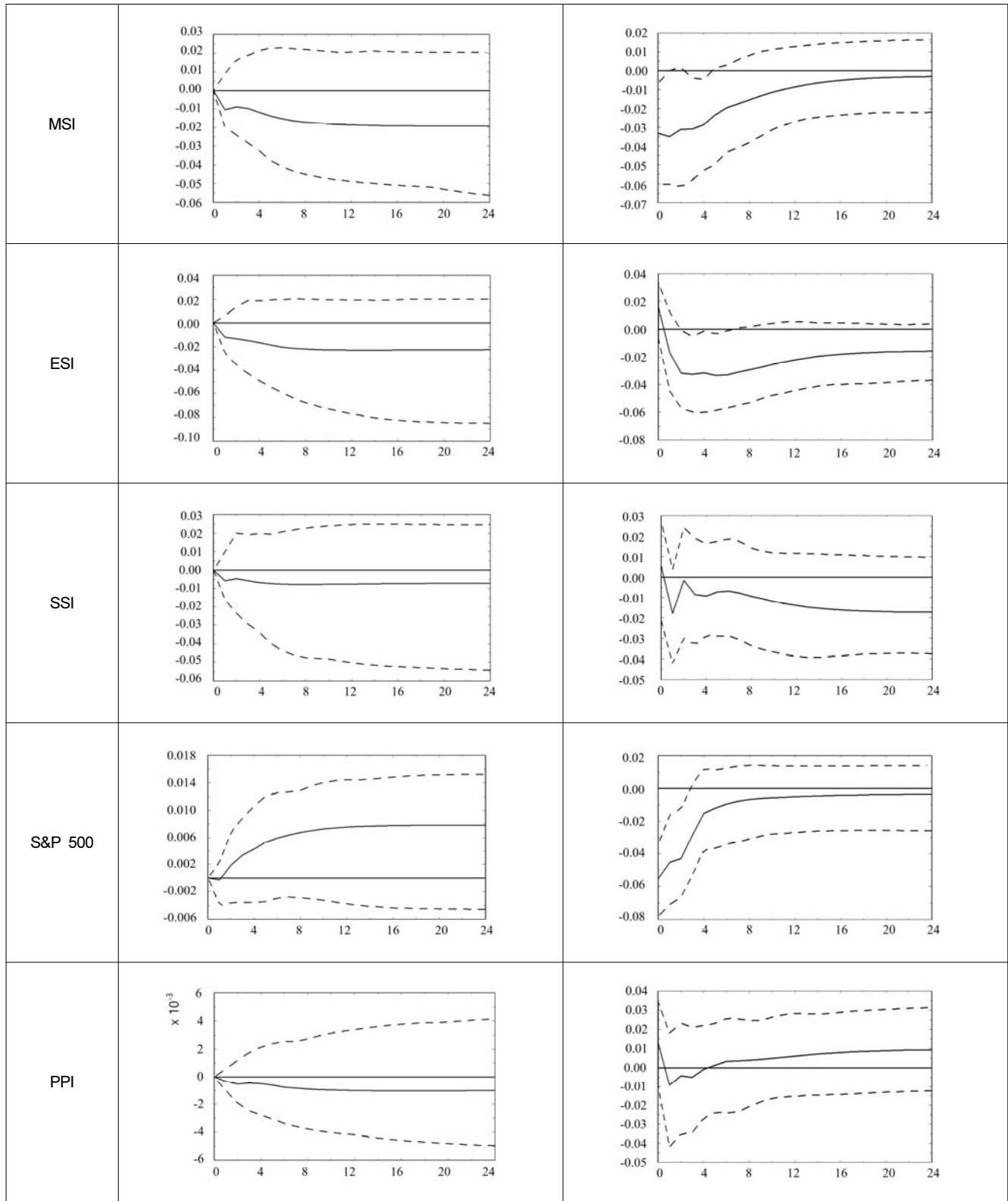
	US EPUI (Impulse)	US EPUI (Response)
NSI		
CSI		
FSI		
TSI		
ASI		
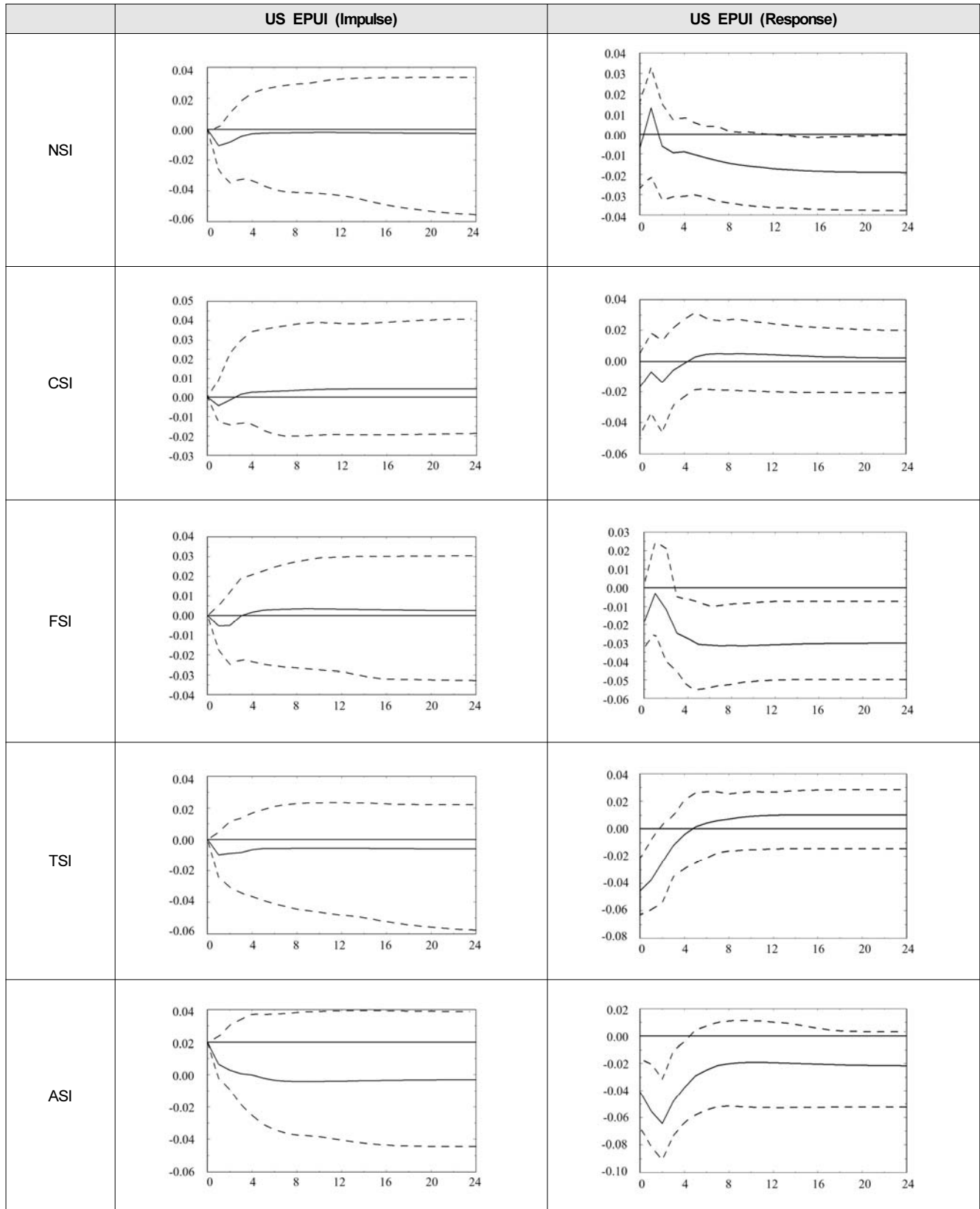
Figure 2: Impulse response between EPU Index of the US and variables in Korea

5. Discussions

The presented results of this paper show the shock of the US EPU index on the manufacturing stock index returns in Korea. In the results of the VECM test, we find the US EPU index considerably influenced to the economy in Korea. To illustrate the effect on the US EPU index, we use the VECM with the monthly samples about the manufacturing stock index such as NSI, CSI, FSI, TSI, ASI, MSI, ESI, SSI, PPI in Korea, and S&P 500 in the US from 1990 to 2017.

In the results of Granger causality relationship, we find all samples except S&P 500 and PPI in Korea is affected by the US EPU index. It shows the manufacturing stock indexes are closely related with the US EPU index. Whereas the manufacturing stock indexes except TSI have a significant cause for the US EPU index. Therefore, the US EPU index is significantly affected from all samples except TSI.

6. Conclusions

6.1. Summary

In the empirical results of the VECM, we find the relationship between the US EPU index and the manufacturing stock indexes has a negative correlation. Shortly, if the US EPU index will move up, the manufacturing stock indexes will worsen, and then the PPI will decrease.

This paper has three contributions referring on EPU. First, we estimate the dynamic relationship between the US EPU and the manufacturing stock market in Korea using the US EPU index designed by Baker et al. (2016). Then, we find out that the relationship between the US EPU index and the manufacturing stock index in Korea has the negative relationships. We determine the EPU of the US has the spillover effect on the industry stock markets in Korea by the VECM. Second, we use the stock indexes of the manufacturing in the major industry categories of Korean exports for the US to verify the casual link between the Korean stock market and the US EPU index. And we select the PPI as one of the indexes related to both the manufacturing and production. Finally, unlike the previous literatures, this study indirectly leads to an evidence for the Korean industry market closely connected with the US EPU.

In sum, we suggest that this study can provide the important information to make a decision for the production scale in manufacturing and to predict the export market to the US following the US EPU index.

6.2. Limitations and Future studies

We propose the stock market of manufacturing in Korea by using the US EPU index in this study. But We can applied to the relationship between other countries' EPU and stock market in Korea. We apply the high-tech industry stock indexes for the fourth industry such as robotics, artificial intelligence, biotechnology. Moreover, we can investigate the shock of the EPU index on stock returns with the OECD or the G7 countries. And we can add to other variables such as the oil price, Korea-US exchange rate, and interest rate in Korea for future study. In addition, we can suggest the effect of the EPU index on stock returns during the recession period such as the Asian financial crisis.

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