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An Analysis of Macro Aspects Caused by Protectionism in Korea*

Yuri Kim
Korea Institute for International Economic Policy, South Korea
Kyunghun Kim†
School of Economics, Hongik University, South Korea

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Abstract

Purpose – The global trend of protectionism has expanded since the onset of US President Donald Trump's administration in 2017. This global phenomenon has led to a significant reduction in world trade volume and a negative impact on economic development in some countries where the external sector accounts for a large proportion of GDP. Although Korea is a country vulnerable to this deteriorating trade environment, few studies have examined the relationship between protectionism and its business cycles based on Korean data. Thus, this paper investigates the impact of protectionism on Korea's business cycle.

Design/methodology – To identify future implications, we conduct a structural vector autoregression (VAR) analysis using monthly Korean data from 1994 to 2015. Macroeconomic variables in the model include the industrial production index, inflation rates, exports (or net exports), interest rates, and exchange rates. For the identification of the shock reflecting the expansion of protectionism, we use an antidumping investigation (ADI) data. Since ADIs are followed generally by the imposition of antidumping tariffs, they have no contemporaneous impact on tariffs and are also contemporaneously exogenous to other endogenous variables in the VAR model. We examine two kinds of ADI shocks i) shocks on Korean exports imposed by Korea's trading partners (ADI-imposed shocks) and ii) shocks on imports imposed by the Korean government (ADI-imposing shocks).

Findings – We find that Korea's exports decline sharply due to ADI-imposed shocks; the lowest point at the third month after the initial shock; and do not recover until 24 months later. Simultaneously, the inflation rate decreases. Therefore, the ADI-imposed shock can be regarded as a negative shock on the demand curve where both production and price decrease. In contrast, the ADI-imposing shock generates a different response. The net exports decline, but the inflation rate increases. These can be seen as standard responses with respect to the negative shock on the supply curve.

Originality/value – We shed light on the relationship between protectionism and Korea's economic fluctuations, which is rarely addressed in previous studies. We also consider the effects of both protective policy measures on imports to Korea imposed by the Korean government and on policy measures imposed by Korea's trading partner countries on its exports.

Keywords: Antidumping, Business Cycle, Korea, Protectionism, Vector Autoregression
JEL Classifications: E31, F13, F41

1. Introduction

Since the inauguration of the US Administration of President Donald Trump in 2017, global protectionism has expanded. A trade war between the US and China has been fueled by the chronic current account imbalance and protection of domestic industry. This conflict between the US and China has deepened and spread across the globe. Countries around the world have responded to protective trade policies by adding trade policy measures to protect

* This work was supported by the Korea Institute for International Economic Policy.
† **Corresponding author:** khkim@hongik.ac.kr

their own interests. The global expansion of protectionism has led to a significant reduction in world trade and a negative impact on the economic development of some countries, particularly those with relatively large external sectors (i.e., international trade).

Korea is one country that depends extensively on the external sector for its economic growth. Given its difficulty in achieving continued rapid economic growth as in the past due to changes in structural fundamentals, such as maturation in its current stage of economic development, the deterioration of the international trade environment could further impede its economic growth. These effects have been already partially reflected in its GDP growth rate, which has declined from 3.2% in 2017 to 2.0% in 2019.

Despite the signs of the negative impact of protectionism on Korea's economy, particularly in international trade, few studies have examined the relationship of protectionism and its business cycle by rigorously analyzing Korean data. Recent studies have analyzed similar topics using data from other countries. For example, Barattieri, Cacciatore and Ghironi (2018) conduct a vector autoregression (VAR) analysis and find that the restrictive trade policy on imports is associated with an economic downturn and an increase in inflation rates. Li and Whalley (2015) investigate the Chinese case and find that a relatively large number of Chinese exports are subject to trade investigations compared with exports from other countries (from 1997 to 2007). Their results indicate that such measures have a negative impact on industrial profits and employment as well as exports in China, but relatively little impact on production.

In our study, we investigate the relationship between protectionism and Korea's business cycle, which has rarely been discussed before. Although the expansion of protectionism has become a global phenomenon recently, since the Trump administration, it is not difficult to find intermittent instances of protectionism through the use of tariffs, subsidies, and import quotas before the current trend. To examine how the expansion of protectionism has affected Korea's economic fluctuations in the past, and, what this then means for the future, we conduct a structural VAR analysis using Korean monthly data from 1994 to 2015. Our macroeconomic variables include the industrial production index, inflation rates, exports (or net exports), interest rates, and exchange rates.

To identify the shock of the expansion of protectionism on the economy, we use antidumping investigation data (Bown, 2016). Analyzing data after the Uruguay Round agreements (1995-2012), Firme and Vasconcelos (2015) show that antidumping tariffs are the main means of protective trade policy. We identify the antidumping investigation (ADI) as a good proxy variable for protectionism as they are normally followed by antidumping tariffs. Having a close relationship with the antidumping tariff, the ADI is contemporaneously exogenous to the rest of the endogenous variables in the VAR model.

As in our study, ADI is used as a proxy variable for shock in Brown (2005), who studies how the Korean steel industry reacts to ADI which is imposed by the US. Our approach differs in that we focus on the impact of protectionism on economic fluctuations rather than the impact on a specific industry.[1] An ADI is also used as a proxy variable for protectionism in Barattieri, Cacciatore and Ghironi (2018) who analyze how the net exports of Canada and Turkey respond when each country imposes ADI on imports from other countries.

There are a series of studies that have examined the relationship between antidumping tariffs and trade effects going back decades.[2] In an early example, Prusa (1997) examines the

[1] According to the empirical result from Brown (2005), Korean steel exports show a positive correlation with the number of ADIs on Korean products imposed by the US, because Korean steel exports more to China, which substituted for the US market.

[2] In addition to studies analyzing the effects of antidumping tariffs on trade, there are others related to antidumping tariffs: Blonigen and Haynes (2002) examine the effect of antidumping tariffs on exchange

impact of antidumping tariffs on US trade. According to the author's empirical results, the antidumping tariffs encourage diversified imports, which benefits US producers. More recently, Lu, Tao, and Zhang (2013) analyze Chinese monthly data from 2000 to 2006 to assess the impact of US antidumping tariffs on Chinese exports to the US. They use the difference-in-difference method and find that antidumping tariffs have a statistically significant impact on a decrease in exports.

In addition to examining the relationship between protectionism and economic fluctuations using Korean data, our study contributes to the existing literature by considering both the effects of protective trade policy measures on Korean exports imposed by Korea's trading partner countries and measures by the Korean government imposed on imports to Korea. These are denoted as ADI-imposed and ADI-imposing shocks, respectively. In the existing research, only the latter effect on economic fluctuations has been analyzed using Canadian and Turkish data (Barattieri, Cacciatore and Ghironi, 2018).

Our empirical results can be summarized as follows: In the case where there is an ADI-imposed shock, the industrial production index, the inflation rate, and exports decline. In particular, the decrease in exports is large and does not recover until 24 months after the shock. Additionally, the interest rate decreases while the exchange rate wavers. Thus, we can consider the ADI-imposed shock as a negative demand shock. In the case of an ADI-imposing shock, the industrial production index decreases, but inflation rates increase and (net) exports decrease. The Korean won depreciates, whereas the interest rate increases. These are standard responses to a negative shock on the supply side of the economy, although the responses are not statistically significant, except for the exchange rate.

The remainder of this paper is organized as follows. Section 2 presents our empirical methods and basic statistics on the main macroeconomic variables included in the structural VAR model. We discuss the empirical results in Section 3 and conclude in Section 4.

2. Empirical Method and Data

We conduct a structural VAR analysis to estimate the impact of protectionism on macroeconomic variables that reflect the business cycle in Korea. Here, we will discuss the structural VAR model and the time-series of the key variables included in the model. We also examine ADIs, which are used as a proxy for protectionism.

2.1. Method

The VAR model is appropriate for economic time-series analysis. This method analyzes two or more time-series variables that are highly correlated using the past values of endogenous variables. A reduced-form VAR model consisting of highly correlated macroeconomics variables associated with protectionism is shown in Equation (1).

$$\begin{pmatrix} ADI_t \\ IPI_t \\ INF_t \\ EXP_t \\ IR_t \\ ER_t \end{pmatrix} = c + \Phi(L) \begin{pmatrix} ADI_{t-1} \\ IPI_{t-1} \\ INF_{t-1} \\ EXP_{t-1} \\ IR_{t-1} \\ ER_{t-1} \end{pmatrix} + \begin{pmatrix} u_t^{ADI} \\ u_t^{IPI} \\ u_t^{INF} \\ u_t^{EXP} \\ u_t^{IR} \\ u_t^{ER} \end{pmatrix} \tag{1}$$

where $t = 1, 2, \cdots, T,\ u_t \backsim iid\ N(0, \sum)$.

rates, and Bown and Blonigen (2003) investigate how retaliatory threats affect antidumping tariffs.

The subscript t represents time and $\Phi(L)$ is a lag operator, which is a matrix polynomial for L. The left-hand side of Equation (1) is the vector that consists of the following six endogenous variables: the *ADI*, the industrial production index (*IPI*), the inflation rate (*INF*), exports (*EXP*), the interest rate (*IR*), and the exchange rate (*ER*). We identify the structural shock under the recursive short-run restriction by the Cholesky decomposition. The following constraint is given to identify the structural shock, ε_t, of endogenous variables from the reduced-form VAR model.

$$u_t = A\varepsilon_t \tag{2}$$

where $\varepsilon_t \backsim iid\ N(0, I_n)$.

Equation (3) can be derived from Equation (2).

$$E(u_t u_t') = A(\varepsilon_t \varepsilon_t')A' \tag{3}$$

where $\sum = AA^{'}$.

The identification constraint A can be obtained by the Cholesky decomposition of the variance-covariance matrix of u_t. Substituting A into Equation (2) gives

$$\begin{pmatrix} u_t^{ADI} \\ u_t^{IPI} \\ u_t^{INF} \\ u_t^{EXP} \\ u_t^{IR} \\ u_t^{ER} \end{pmatrix} = \begin{pmatrix} \beta_{11} & & & & & \\ \beta_{21} & \beta_{22} & & & & \\ \beta_{31} & \beta_{32} & \beta_{33} & & & \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} & & \\ \beta_{51} & \beta_{52} & \beta_{53} & \beta_{54} & \beta_{55} & \\ \beta_{61} & \beta_{62} & \beta_{63} & \beta_{64} & \beta_{65} & \beta_{66} \end{pmatrix} \begin{pmatrix} \varepsilon_t^{ADI} \\ \varepsilon_t^{IPI} \\ \varepsilon_t^{INF} \\ \varepsilon_t^{EXP} \\ \varepsilon_t^{IR} \\ \varepsilon_t^{ER} \end{pmatrix} \tag{4}$$

According to the identification constraint A, *ADI* will sequentially affect *IPI, INF, EXP, IR,* and *ER*. In contrast, however, *IPI, INF, EXP, IR,* and *ER* will not affect *ADI* contemporaneously. This means that *ADI* is the most exogenous among the endogenous variables in the vector; then, *IPI, INF, EXP, IR,* and *ER* are arrayed in exogenous order.

The *ADI* is a good proxy variable for protectionism because there is a high probability that it will be followed by the imposition of antidumping tariffs, but they have no contemporaneous impacts on tariffs. [3] Since *ADI* is the most exogenous among the endogenous variables, it is placed on top in the vector of the VAR model. Our main focus is to see how the variables in the model respond to the *ADI* shock. The order of the other remaining variables is irrelevant because identifying the shocks of the other macroeconomic variables and their impact on other endogenous variables is not the main focus of our analysis. Despite the irrelevance of the array of variables except for *ADI*, we arrayed the endogenous variables following Barattieri, Cacciatore and Ghironi (2018) for comparison with their study.

[3] ADIs do not have a monthly and quarterly contemporaneous impact on tariffs. The data incorporated in the analysis do not show a contemporaneous impact, as it took several months for ADIs to end up as the final antidumping affirmative(Korea on average: 320 days, US on average: 390 days, EU on average: 537 days).

For our analysis, we do not consider the structural breaks or non-stationary variables as problematic. According to Stock and Watson (1990), the differentiation of variables is not recommended even if the variables possess a unit root, when the purpose of the VAR analysis is to examine the relationships among the variables. Specifically, VAR coefficients gain consistency, given that the variables are stationary. Thus, for hypothesis testing where consistency is needed, it is necessary to ensure that the variables are stationary. However, if the purpose of the analysis is to observe the dynamics of the variables, it is not recommended to differentiate the variables for them to be stationary, since differentiating eliminates the data dynamics. Regarding the variables included in our analysis, a structural break could exist in the variables. However, the analysis endures a non-stationary aspect of the variables, according to its purpose.

2.2. Data

2.2.1. Macroeconomic Variables of Interest

The Korean monthly data incorporated in this study span 1994M2 to 2015M12. The *IPI* is seasonally adjusted with the base year 2010, taken from the IMF. The *INF* is a year-on-year inflation rate excluding prices of food and energy, taken from the OECD. *EXP* and *net EXP* are also seasonally adjusted and deflated based on the CPI (2015=100). These are taken from the Bank of Korea. As *EXP* is reported in billions of US dollar, it is deflated with a country-specific CPI index, following Barattieri, Cacciatore and Ghironi (2018). The *IR* is the three-month interbank interest rate, taken from the OECD. The *ER* is the growth rate (%) of the nominal effective exchange rate (NEER, broad index) from the BIS, and calculated by log differentiation. The NEER starts from 1994M1, but is log differentiated; thus, monthly data start from 1994M2. Moreover, we chose the period ending date of 2015M12 because ADIs are available only from 1980 to 2015.

To simplify the graph, Fig. 1. presents the quarterly data of the main macro variables in Korea from 1994Q1 to 2015Q4. The GDP growth rate, which is incorporated in the quarterly analysis, is seasonally adjusted and year-on-year growth rates of real GDP are from the OECD. The *INF, IR,* and *ER* are the same as in the monthly analysis indicated above but are expressed quarterly. *EXP* and *net EXP* quarterly data represent the ratio to GDP (%).

The variables of interest are *IPI, INF, EXP, IR,* and *ER*. The movements in the variables of interest (1994-2015) are illustrated in Fig. 1. The *IPI* records a consistent increase after 1994. From 1994 to 2015, it shows two drops, in 1998 and 2009, which reflect the 1997 Asian financial crisis (AFC) and the 2008 global financial crisis (GFC), respectively. A similar pattern can be seen in the GDP growth rates. There have been huge declines in the GDP growth rates in the AFC and GFC though there is the downward trend in the long run.

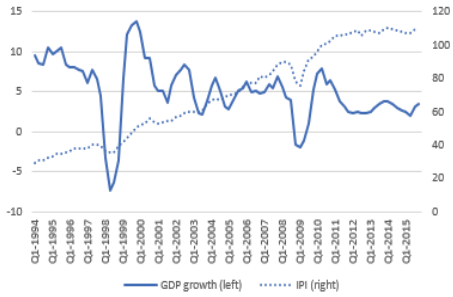
INF shows a downward trend from 1994 to 2015. However, *INF* fluctuates significantly compared with the *IPI*. Notably, *INF* falls (-0.6% in 1999Q2, -0.4% in 1999Q3, and -0.06% in 1999Q4) as Korea suffers from the AFC. However, *INF* increases during the GFC, reaching 4.2% in 2008Q4.

Our main focus is to analyze how *EXP* responds when Korea becomes the target of an ADI initiated by another country. However, *net EXP* are included in our analysis of the ADI-imposing shock because both exports and imports are simultaneously affected by the ADI-imposing shock.

Fig. 1. Main Macro Variables in Korea: 1994~2015

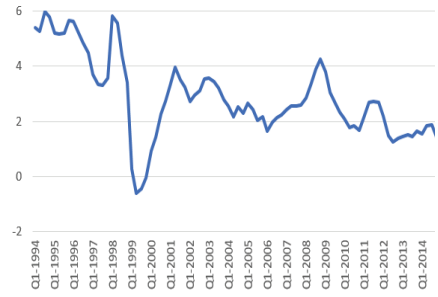
(a) *GDP* and *IPI*

(Unit: YoY %, 2010=100)



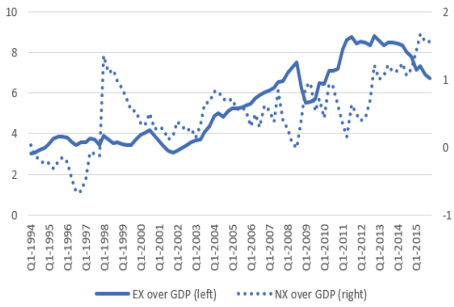
(b) *INF*

(Unit: YoY %)



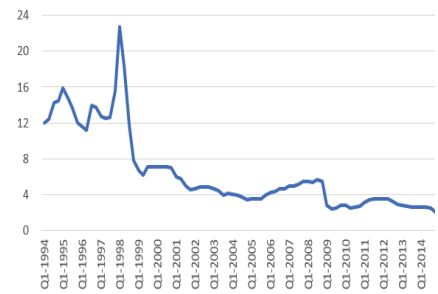
(c) *EXP* and *net EXP*

(Unit: %)



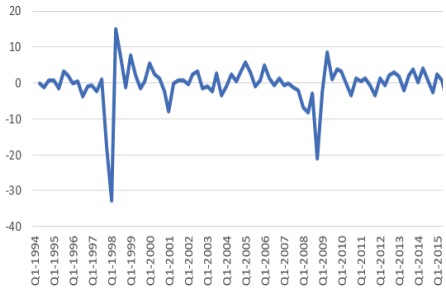
(d) *IR*

(Unit: %)



(e) *ER*

(Unit: %)



Notes: 1. IPI = Industrial Production Index, INF = Inflation Rate, EXP = Exports over GDP, Net EXPs = net exports (exports-imports) over GDP, IR = Interest Rate, ER = Exchange Rate.

2. Interest rates are three-Month rates and yields: Interbank rates for the Republic of Korea, percent, quarterly, not seasonally adjusted. Exchange rate is the growth rate of the nominal effective exchange rate.

Source: IMF, OECD, Bank of Korea, BIS.

While *EXP* experience a significant fall in 2008, from 7.5% in 2008Q3 to 5.5% in 2009Q1, *EXP* do not decrease significantly after the AFC. However, *net EXP* increase after the AFC and decrease after the GFC. Specifically, *net EXP* are -0.65% in 1996Q3 and increase to 1.35% in 1998Q1. Around the GFC, however, the opposite happens, *net EXP* are 0.62% in 2006Q4 which then decrease to -0.013% in 2008Q3.

The *IR* shows a drastic decrease from 1994 to 2015. Specifically, it remains around 10% to 15% before the AFC. However, it is an unprecedented 22.7% in 1998Q1. After the AFC, the *IR* decreases significantly, by approximately 3 to 7%. It experiences another drop after the GFC. The *IR* is 5.7% in 2008Q3, decreasing to 2.4% in 2009Q2. After the GFC, the *IR* wavers around 2 to 3% while consistently decreasing; it is 1.6% in 2015Q4.

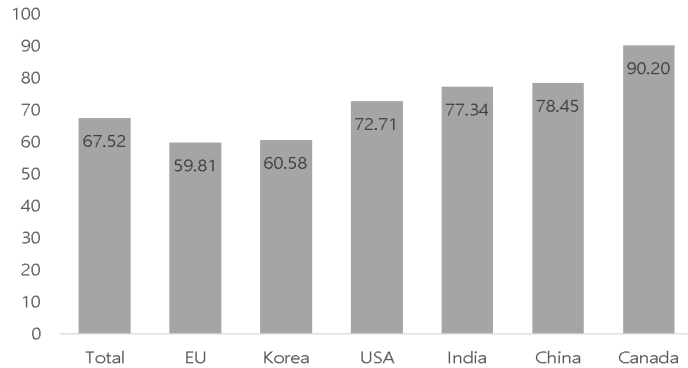
The *ER* experiences two drastic depreciations in 1998 and 2008. It depreciates by 17.9% in 1997Q4 and 32.9% in 1998Q1, respectively compared to its previous quarter. In 2008, the *ER* marks a depreciation rate of 8.2% in 2008Q2 and that of 21.1% in 2008Q4.

2.2.2. Antidumping Investigations

Following Barattieri, Cacciatore and Ghironi (2018), the number of ADIs is used as a proxy variable for protectionism. The greater the number of ADIs-imposed or -imposing shocks, the greater the protectionism. As already stated, we choose ADI as the proxy because most end up with actual antidumping tariffs being imposed. Moreover, ADIs create anticipation by market participants of the actual imposition of tariffs. The final antidumping decision could be largely affirmative, which indicates the imposition of the final affirmative or negative duties. Of the total ADI initiations, 67.52% end up in the final affirmative anti-dumping duties, and 72.71% of the total ADI initiations in the US resulted in the final affirmative anti-dumping duties (Fig. 2). In Korea, 60.58% of the ADI initiations ends up in the final affirmative anti-dumping duties. In China, 78.45% of the ADI initiation ends up in the final affirmative duties.

Fig. 2. Ratio of Final Affirmative Duties in the ADI Initiations

(Unit: %)



Notes: 1. The numbers indicate the ratios of the total number of the final affirmative anti-dumping duties to the total number of ADI initiation by country.
2. The time span considered is from Jan 1994 to Dec 2015 which is identical to that of the analysis.
3. "Total" encompasses all countries included in GAD, except for the countries included in "OTH"(Others)

Source: Authors' calculation based on Global Antidumping Database (GAD).

The procedure for the imposition of antidumping tariffs can be divided into three steps. In the first step, a producer in a certain industry files an antidumping duty petition for the specific case. Until this point, the filing of the petition is not open to the public. However, given that the petition is supported by reliable details, as the second step, the investigation is initiated. At this point, the filing of the petition is known to the public. As the final step, the result of the investigation is presented. Most investigations end up imposing tariffs. Once the resolution is decided, the tariff imposed continues throughout the years. Hence, at the onset of the ADI, the market participants can anticipate that a tariff will be imposed.[4]

The Temporary Trade Barriers Database (TTBD), provided by the World Bank, includes data on the means of trade policy, such as antidumping tariffs, global safeguards, and countervailing duties with specified details, covering more than 30 countries. Specifically, TTBD consists of four different databases, including the Global Antidumping Database (GAD) and other temporary trade barriers.

As illustrated in Table 1, most temporary trade barriers are antidumping tariffs. Table 1 only includes the US, Korea, and China, showing a simplified example. Since the US and China are Korea's largest trading partners, their cases of temporary trade barriers are represented in the table.

Table 1. Number of Temporary Trade Barriers Imposed by Country

	ADI	CVD	SG
US	1360	620	10
China	232	7	1
Korea	166	0	4

Source: World Bank, Temporary Trade Barriers Database.

Note: The number of total Temporary Trade Barriers imposed by the US, China, and Korea from 1980 to 2015 (as of initiation date). ADI (Antidumping Investigation), CVD (Countervailing Duty), SG (Safeguard).

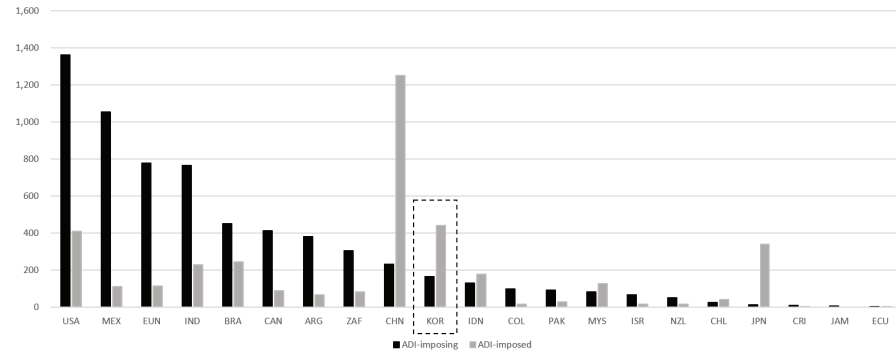
The number of ADIs is calculated from the GAD. The GAD is a database constructed by Bown (2016), containing product-level data on antidumping duties in the countries. GAD is constructed in different ways. In this study, we use the database version that covers data from 1980 to 2015. In particular, GAD includes ADIs initiated and their results; for instance, the level of ad-valorem tax, the specific number of antidumping duties, and the related products. Hence, based on the database, the time-series data are constructed over a period of more than one day. Specifically, we can construct a monthly time-series that indicates how many ADIs have been initiated within a given period of a month.

The structure of GAD mainly focuses on the number of ADIs initiated in each country. Hence, the dataset of a specific country is constructed from the perspective of the ADIs imposing on other countries. This is because the countries that initiate a majority of ADIs including the US, the EU, and Canada have more cases of imposing ADIs on other countries than the cases of ADIs being imposed on them by other countries. Therefore, as most of the literature views it from the perspective of an ADI imposing country, since major countries like the US and EU hold more cases of the ADI-imposing than those of the ADI-imposed. However, as noted in Fig. 3, Korea experienced more cases of the ADI-imposed than those of

[4] According to the GAD, the antidumping procedure proceeds as follows: (1) initiation of the investigation, (2) preliminary dumping decision, (3) preliminary injury decision, (4) imposition of preliminary antidumping measure, (5) final dumping decision, (6) final injury decision, (7) imposition of final antidumping measure, and (8) revocation of antidumping order.

ADI-imposing, unlike other countries, who own more cases of the ADI-imposing than those of the ADI-imposed. Moreover, a majority of the literature that focuses on ADI-imposed cases concentrates on a product or at the firm level. Hence, it is a clear contribution to see the effect of the ADI-imposed shock on the macroeconomic variables by incorporating a business cycle.

Fig. 3. Number of ADI-Imposed and ADI-Imposing by Countries



Notes: 1. ADI-imposing indicates the number of ADIs that each country imposed on other countries' products.
2. ADI-imposed indicates the number of ADIs that each country is imposed by other countries.
3. Each number encompasses a total number of ADIs from 1980s–2015 (the time span for each country varies).

Source: Authors' calculation based on Global Antidumping Database (GAD).

Konings and Vandenbussche (2013) estimated the impact of the antidumping protection on the export behavior of French firms covered by antidumping cases. They examined it from the perspective of the imposing ADIs and also deal with it at the firm level. Chandra and Long (2013) examined the impact of anti-dumping (AD) duties on exporters at the firm level. Regardless of a substantial rise in the instances of AD duties, their impact on the targeted firms is vague.

Also, the literature incorporating macroeconomic factors analyzes the determinant factors for the antidumping filings. Specifically, Knetter and Prusa (2003) examined the relationship between antidumping filings and macroeconomic factors. By incorporating a negative binomial estimation, the authors argued that macroeconomic factors are the determinant factors for the aggregate filings.

Derived from the GAD, Fig. 4. (a) shows the number of times Korea has been the target of ADIs initiated by other countries (ADI-imposed shocks), while Fig. 4. (b) represents the number of times that Korea has initiated ADIs on other countries (ADI-imposing shocks). As Fig. 4. (a) and (b) indicate, it is clear that Korea has been the frequent target of ADIs initiated by other countries compared with the number of times it has initiated ADIs on other countries. Since Korea is highly dependent on exports, becoming the target of ADIs from other countries will have a negative impact on its exports. This decrease in exports could trigger a deterioration in the overall economy in Korea.

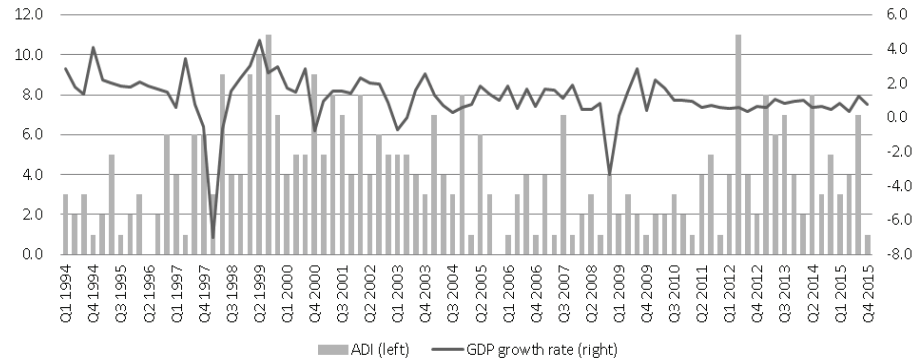
Fig. 4. (a) and (b) also illustrate the real GDP growth rates from 1994 to 2015. In the case of Korea, there is no systemic correlation between the number of ADIs and the aggregate economic condition. Specifically, the correlation between the number of ADI-imposed

shocks and the real GDP growth is 0.15, whereas that between the number of ADI-imposing shocks and the real GDP growth is -0.00018. From this, we can see that the imposition of ADI is exogenous from other economic conditions.

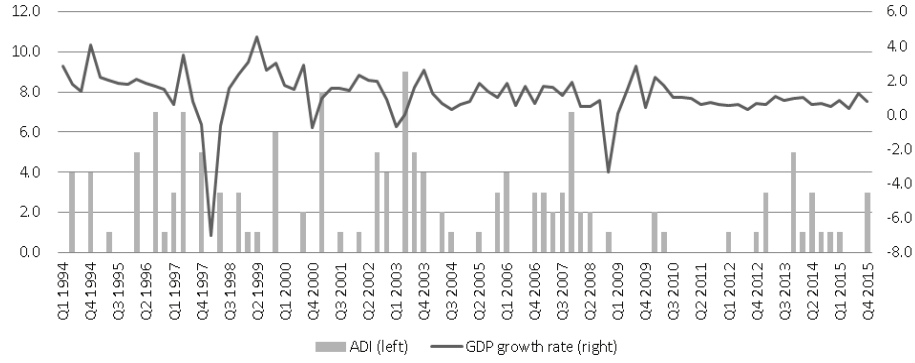
Specifically, Korea experienced a significant decrease in GDP growth during the post-GFC period from 2008Q4 to 2009Q2. In addition, post-GFC, Korea experienced fewer cases of ADI-imposed shocks compared with the early 2000s and 2010s. However, Korea has been the target of ADIs initiated by other countries, particularly in a high number after 2012. The largest number of ADIs targeting Korea are reflected in 2012Q2. The total of 14 cases of ADI is shown during this time and, subsequently, real GDP growth is at its lowest value between 2012Q3 and 2013Q1.

Fig. 4. ADIs and GDP Growth Rates in Korea

(a) ADI-Imposed Shocks



(b) ADI-Imposing Shocks



Note: Gross Domestic Product by Expenditure in Constant Prices: Total Gross Domestic Product for the Republic of Korea. Growth rate compared to the same quarter of previous year, seasonally adjusted.

Sources: GAD, OECD.

3. Empirical Result

In Section 3, we present the impulse responses of the macro variables with respect to the ADI-imposed and -imposing shocks, respectively. We estimate the impulse response

functions incorporating monthly data. The forecast error variance decomposition (FEVD) is also presented to determine how the ADI shock is attributed to the variance of the endogenous variables based on the result of the VAR.

3.1. Impulse Response Function

For the case of the ADI-imposed shock, we estimate VAR with an optimal lag length of 3 because both the Akaike information criterion (AIC) and final prediction error (FPE) criteria choose lag 3 as the optimal lag length. For the ADI-imposing shock, we estimate VAR with lag 2 since AIC, Hannan Quinn (HQ), and FPE choose lag 2 as optimal. The results of the impulse responses are presented in Fig. 5.

IPI shows a negative response after one standard deviation of the ADI-imposed shock. The largest decrease of 0.257% is shown in the third month and is statistically significant as the confidence interval does not include 0 in the graph. This negative response to *IPI* remains for 13 months. On the fourteenth month, the response of the *IPI* reverts to positive and remains positive afterwards.

INF decreases after the ADI-imposed shock occurs. At the eighth month, *INF* declines by 0.079%, marking a trough. Afterwards, *INF* slowly recovers; however, it still shows a negative response for 24 months. The decrease in *INF* remains statistically significant from the sixth to the nineteenth month according to the confidence interval depicted in the graph.

Compared with the other economic variables, the decrease in *EXP* is considerable with respect to the ADI-imposed shock. In the first month after the shock, *EXP* decrease by 2.2%, which indicates an immediate response of *EXP* after the shock. The largest decline is a 4.32% decrease in the fourth month after the shock. Afterwards, *EXP* recovers; however, they still show a negative response for 24 months. This negative response is statistically significant for 12 months since the confidence interval does not include 0 in the graph.

When the ADI-imposed shocks arise, the *IR* decreases in response to the early recession, marking a trough. The *IR* declines by 0.254% at the seventh month. Subsequently, it remains in a negative response and the decline remains persistent for the next 18 months. In addition, the negative response is statistically significant from the fourth to the sixteenth month based on the confidence interval depicted in the graph.

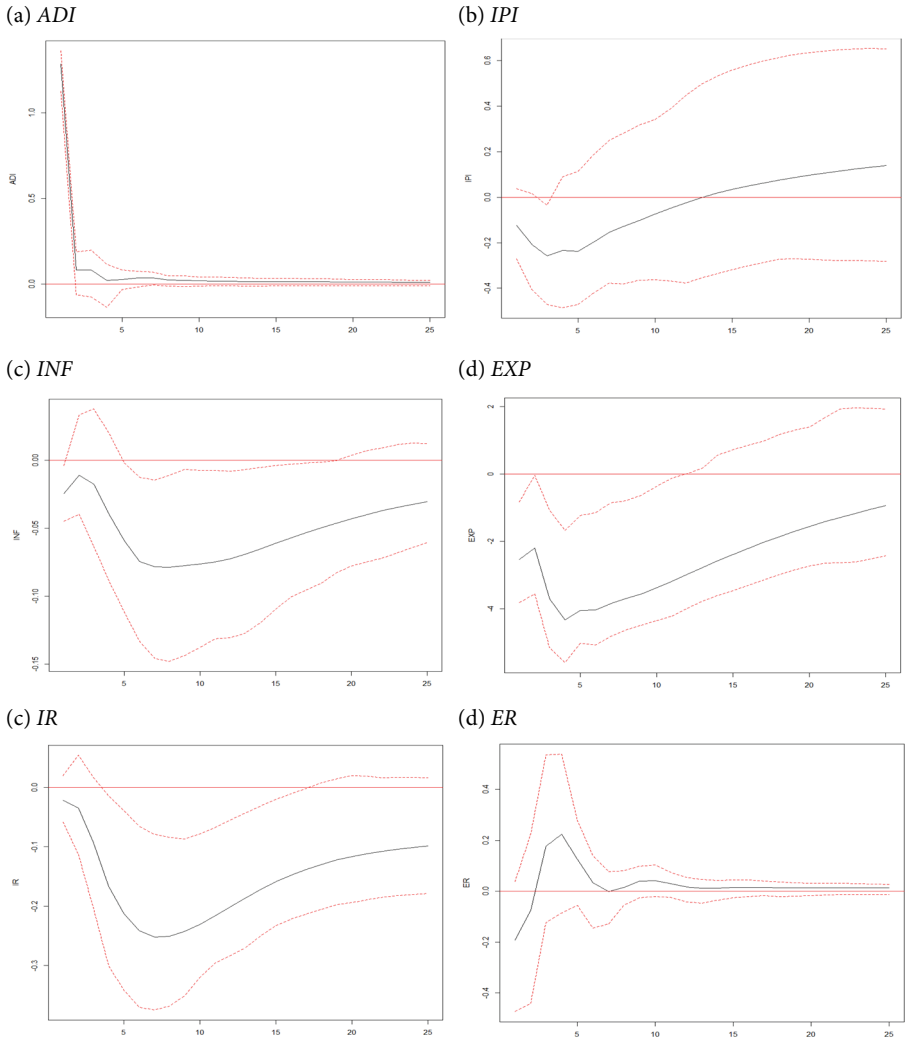
By definition, a decline in the NEER indicates depreciation. Hence, a positive value in the *ER* refers to the appreciation of the Korean won. The *ER* shows a wavering response after an ADI-imposed shock. At the first month after the shock, it depreciates by 0.075%, although this is not statistically significant. However, this negative response shifts from the second month onwards.

From the results of the impulse response function discussed above, it is clear that Korea experiences a significant decrease in *EXP* after an ADI-imposed shock. This result corresponds with the results in Lu, Tao, and Zhang (2013), who show empirically that the decrease in exports occurs after the imposition of antidumping tariffs by the US on products from China. In addition, according to the results of the impulse response function, the *IPI* and *INF* in Korea decrease after an ADI-imposed shock. Thus, we can say that the decrease in exports caused by ADI measures has a negative impact on Korea's overall economy. Therefore, the ADI-imposed shock can be regarded as a negative demand shock.

Fig. 6. illustrates the results from the case where the Korean government initiates ADIs on products from trading partner countries; that is, the case of the ADI-imposing shocks. With respect to this shock, the *IPI* increases for the first four months. The direction of the effect on the *IPI* decreases in the fifth month. In contrast, *INF* shows a slight decrease in the first four

months, but then increases in the fifth month. Responding to the same shock, *net EXP* decline by 0.7% in the second month. However, like *INF*, *net EXP* show a positive response in the fifth month. The impulse responses of the *IPI, INF,* and *net EXP* are small overall and not statistically significant, meaning that the effects of these ADIs on the business cycle are limited.

Fig. 5. Impulse Response Function: the ADI-Imposed Shock (Lag 3)

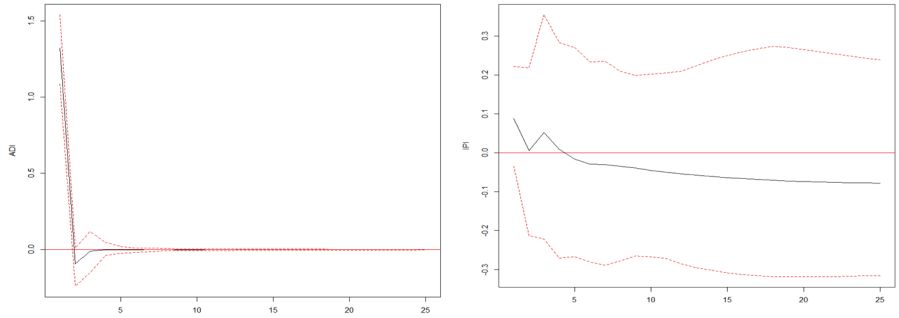


Notes: 1. ADI (antidumping investigation), IPI (industrial production index), INF (inflation rate), EXP (real exports), IR (interest rate), ER (exchange rate).
2. On x-axis, ADI shock is assumed to occur at period 1.
3. Confidence Interval = 90%

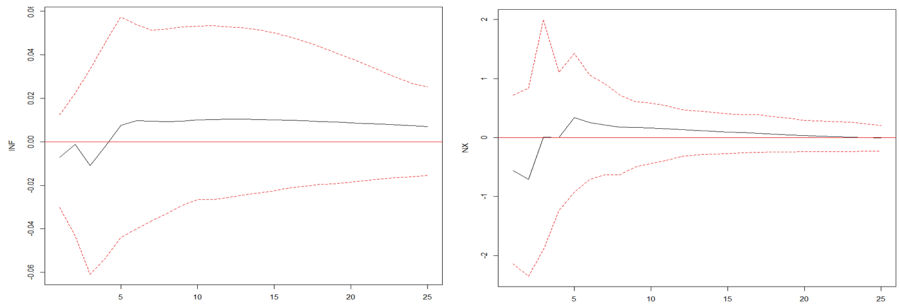
Sources: The authors' calculation. World Bank. IMF. OECD. Bank of Korea. BIS.

Fig. 6. Impulse Response Function: the ADI-Imposing Shock (Lag 2)

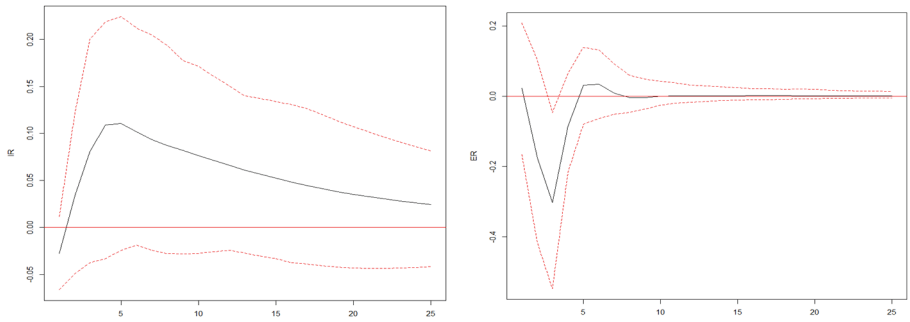
(a) *ADI* (b) *IPI*



(c) *INF* (d) *Net EXP*



(e) *IR* (f) *ER*



Notes: 1. ADI (antidumping investigation), IPI (industrial production index), INF (inflation rate), EXP (real exports), IR (interest rate), ER (exchange rate).
2. On x-axis, ADI shock is assumed to occur at period 1.
3. Confidence Interval = 90%

Sources: The authors' calculation. World Bank. IMF. OECD. Bank of Korea. BIS.

Following the ADI-imposing shock, the *IR* increases due to inflationary pressure. However, the *ER* depreciates for four months. The *ER* depreciates by 0.302%, marking a trough in the third month. Subsequently, it recovers quickly. Its initial response is statistically significant.

The impulse responses with respect to the ADI-imposing shock align with Barattieri,

Cacciatore and Ghironi (2018). Their analysis divides the cases of emerging and developed countries such as Turkey and Canada. According to their results, the industrial production index decreases, but inflation rate increases after an ADI-imposing shock with these results occurring in both emerging and developed countries.

However, the responses of net exports and the exchange rate vary in the emerging countries and developed countries. In the case of Turkey, which represents the case of the emerging country, net exports decrease and the exchange rate depreciates in the third to fifth quarters after the ADI-imposing shock. Subsequently, net exports increase and the exchange rate appreciates. In the case of Canada, however, the results are reversed in that net exports increase and the exchange rate appreciates shortly after the ADI-imposing shock and then reverts directions afterwards. In our analysis of Korea, we find that net exports and the exchange rate show similar results to Turkey.

From the above, we can verify that the Korean economy is more vulnerable to ADI-imposed shocks than ADI-imposing ones. Given that there are many more cases of ADI-imposed rather than ADI-imposing shocks, the growing trend of protectionism should be worrisome for Korea. Our findings of the impulse responses with respect to the ADI-imposing shocks align with the results of Barattieri, Cacciatore and Ghironi (2018). The impulse responses with respect to the ADI-imposed shock are new findings in Korea and a contribution of our study to the existing literature.

3.2. Forecast Error Variance Decomposition (FEVD)

FEVD indicates how the variance of a specific variable is attributed to shocks from other variables based on the estimation of the VAR using monthly data; that is, FEVD describes the significance of each variable on other variables' variances.

In the case of the ADI-imposed shock (Fig. 7), the variance explained by the ADI-imposed shock is the largest in *EXP*. The ADI-imposed shock accounts for 10.6% of the variance of *EXP*, while the ADI-imposed shock only accounts for 1.1% of the *IPI*, 3.1% of the *INF*, 6% of the *IR*, and 1.3% of the *ER* in the nine months after the shock. The impact of the ADI-imposed shock on the variances of the *EXP* reaches its maximum at nine months after the shock and subtly dwindles afterwards.

Fig. 7. Forecast Error Variance Decomposition: ADI-Imposed Shock

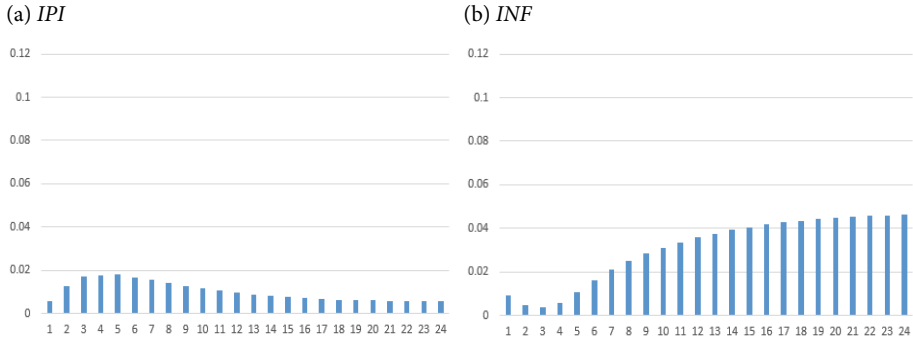
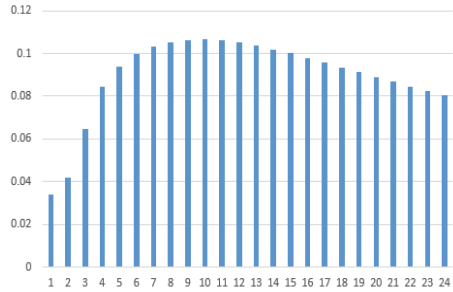
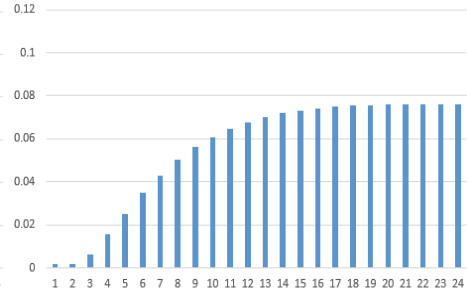


Fig. 7. (Continued)

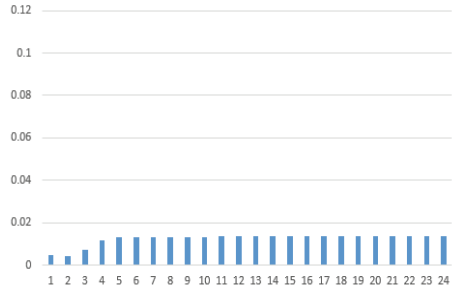
(c) *EXP*



(d) *IR*



(e) *ER*



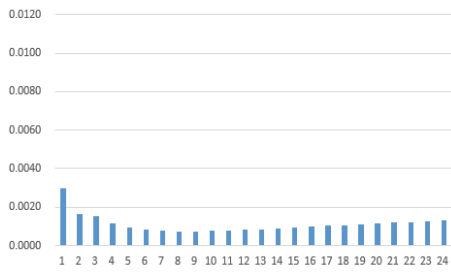
Notes: 1. x-axis indicates the number of months after the shock. y-axis indicates the amount of variance attributed to ADI shock, scaling from 0 to 1.
2. IPI (industrial production index), INF (inflation rate), EXP (real exports), IR (interest rate), ER (exchange rate).

Sources: The authors' calculation. World Bank, IMF, OECD, Bank of Korea, BIS.

However, the impact of the ADI-imposing shock on *net EXP* (Fig. 8.) is fairly weak compared with that shown in Fig. 7. Particularly, as the ADI-imposing shock does not incur significant impulse responses in the *IPI, INF,* and *net EXP*. The actual influence of the ADI-imposing shock on the *IR* and the *ER* is faint, although it appears more influential.

Fig. 8. Forecast Error Variance Decomposition (FEVD): ADI-Imposing Shock

(a) *IPI*



(b) *INF*

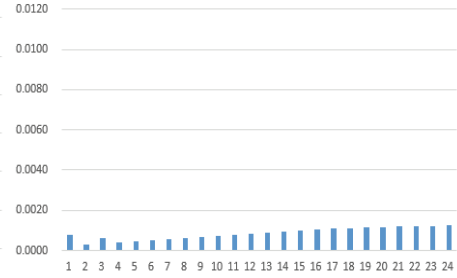
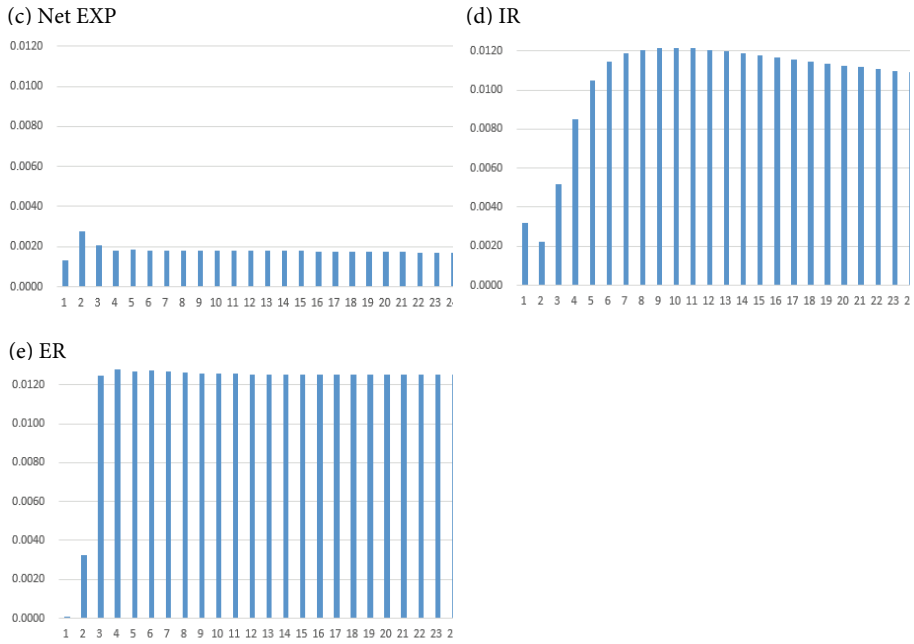


Fig. 8. (Continued)



Notes: 1. x-axis indicates the number of months after the shock. y-axis indicates the amount of variance attributed to ADI shock, scaling from 0 to 1.
2. IPI (industrial production index), INF (inflation rate), EXP (real exports), IR (interest rate), ER (exchange rate).

Sources: The authors' calculation. World Bank, IMF, OECD, Bank of Korea, BIS.

4. Conclusion

This paper examines the relationship between protectionism and Korea's business cycle, which has rarely been discussed before. To this end, we conduct a structural VAR analysis using Korean monthly data from 1994 to 2015. Our macroeconomic variables include the industrial production index, inflation rates, exports (or net exports), interest rates, and exchange rates. The antidumping investigation (ADI) is also used as a proxy variable for protectionism a la Brown (2005) and Barattieri, Cacciatore and Ghironi (2018).

In addition to the effect of protective trade policy measures by the Korean government imposed on imports to Korea, the effect of those on Korean exports imposed by Korea's trading partner countries are also examined. The latter is a new finding, which is a contribution of our study to the existing literature.

Our empirical results can be summarized as follows: In the case where there is an ADI-imposed shock, the industrial production index, the inflation rate, and exports decline. In particular, the decrease in exports is large and does not recover until 24 months after the shock. Additionally, the interest rate decreases while the exchange rate wavers. Thus, we can consider the ADI-imposed shock as a negative demand shock. In the case of an ADI-imposing shock, the industrial production index decreases, but inflation rates increase and

(net) exports decrease. The Korean won depreciates, whereas the interest rate increases. These are standard responses to a negative shock on the supply side of the economy, although the responses are not statistically significant, except for the exchange rate.

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