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Abstract

In this paper, we investigate causal relationships among exports, imports, and economic growth in North Korea by using time series data for the period between 1964 and 2004. The empirical results show that there was Granger causality from imports to GNP in the first half of the period. However, there was a causal relationship from GNP to imports in the second half of the period. This implies that economic growth stimulates imports in North Korea. The North Korean economy escaped its import-led growth situation, which some socialist economies had experienced.

JEL Classification: P27, O11, E10

Keywords: North Korea, import-led growth, export-led growth, causality test.

1. Introduction

Many researchers have conducted studies of the North Korean economy. Comprehensive analyses have been undertaken by Kimura (1999), Yang (2000), Jeffries (2006), and Eberstadt (2007). Studies of food shortages have been undertaken by Kim, Lee, and Sumner (1998) and Noland, Robinson, and Wang (2000a, 2001). Economic crises have been studied by Lee (1997) and studies of the recent economic reform have been conducted by Noland, Robinson and Scatasta (1997), Eberstadt (2001), Lee (2002), Hong (2002), Frank (2005), and Noland (2006). In addition, studies of the cost of economic integration between North and South Korea include those of Chang (1997), Lim (1997), and Noland, Robinson, and Wang (2000b). However, most studies are based on the descriptive statistics of economic data. There are few attempts to apply econometric analysis to the data. Exceptions are Lim and Kim (2002), who estimated an import demand function, Kim, Kim, and Lee (2007), who estimated a production function and then applied growth accounting to the estimated results, and Jin (2003), who applied time series analysis to GNP, exports, and imports.

Because of a lack of official statistics, there are few econometric analyses of North Korea. Researchers are limited to conducting empirical work by using the estimates of macroeconomic and trade variables produced by the South Korean government and other institutions.

Estimated per capita GNP implies that North Korea is a developing country. North Korea can be expected to remain in a similar situation to that of other developing countries. In particular, with regard to economic growth, many developing countries depend on exports, which gives rise to the 'export-led growth' hypothesis. This problem is not limited to developing countries; see, for example, Jin and Yu (1996), Shan and Sun (1999), and Awokuse (2006). However, in most studies, the hypothesis is tested for developing countries. For example, studies have been conducted for Asian newly industrialized countries by Kwan, Cotsomitis, and Kwok (1999) and Thangavelu and Rajaguru (2004), for India by Dhawan and Biswal (1999), for Korea by Awokuse (2005), for Taiwan by Kwan, Cotsomitis and Kwok

(1996) and Biswal and Dhawan (1998), for China by Shan and Sun (1998b), for Malaysia by Ghatak, Milner, and Utkulu (1997) and Khalafalla and Webb (2001), for Mexico by Thornton (1996), and for Chile by Siliverstovs and Herzer (2006). The export-led growth hypothesis implies pursuing policies to promote exports to acquire foreign currency reserves and achieving economic growth by importing high-technology goods.

Since its independence, North Korea has been run as a socialist country under the leadership of Kim Il Sung and, following his death, under the leadership of his son, Kim Jong Il. North Korea is likely to have faced the same economic problems experienced by many socialist economies. Chen, Jefferson, and Singh (1992) and Woo (1994) have studied empirically the transition to a market economy. The import-led growth hypothesis advanced by Hanson (1982) suggests an important source of economic growth. According to the model that generates this hypothesis, a socialist economy first imports capital goods and develops industrial infrastructure, and then promotes economic growth. That is, the amount of capital goods that a socialist country can import limits its achievable rate of economic growth.

We investigate two hypotheses relating to North Korea's economic growth: the export-led growth hypothesis and the import-led growth hypothesis. We use time series techniques to identify causal relationships among GNP, exports, and imports.[1] Following previous studies, we use annual estimates from the South Korean government, the Korea Development Institute (KDI) and the International Monetary Fund (IMF). Because of our small sample size, testing for unit roots and cointegrating relationships is inappropriate. Therefore, we test for Granger causality between variables. To test for causality, we use the method developed by Toda and Yamamoto (1995), which is applicable whether or not there are unit roots or cointegrating

[1] Our approach is similar to that of Jin (2003), but he focused on the relationships between economic openness and economic growth, and did not analyze the export-led or import-led growth hypotheses. From the methodological viewpoint, his analysis is limited to the standard Granger causality test. Our approach, proposed by Toda and Yamamoto (1995), considers the existence of cointegrating relationships.

relationships between the time series. This procedure has been applied to data on China by Shan and Sun (1998a) and to data on Greece, India, and other countries by Hatemi-J and Irandoust (2000).

To summarize our results, having split the sample at 1984 to reflect the pre- and post-Gorbachev periods in Soviet Russia and the inception of North Korea's 'Third Seven Year Plan' in 1987, we found evidence to support the import-led growth hypothesis for the first subperiod, and found that there was a causal relationship from GNP to imports for the second subperiod. This represents evidence that North Korea no longer depends on import-led growth.

This paper is organized as follows. In Section 2, we explain data sources and definitions. In Section 3, we conduct our empirical analysis and describe the results of our causality tests. In Section 4, we summarize the empirical results and discuss limitations.

2. Data

Because there are no data on the consumer price index or the GNP deflator for North Korea, we analyze nominal data. To investigate causal relationships, we require time series data on GNP, exports, and imports covering a sufficiently long period. GNP is estimated by the South Korean government and by the KDI. The former covers the period from 1960 to 2004, and the latter is available for only 14 years: 1970, 1975, and from 1980 to 1994. Therefore, we use the data from the South Korean government to lengthen the sample period and thereby facilitate investigation of the time series properties of the data. For data on exports and imports, we use estimates produced by the South Korean government, the KDI, and the IMF. South Korean government estimates are available for the period from 1965 to 2004; KDI estimates are available for the period between 1970 and 1994; those produced by the IMF are available for the period between 1965 and 2005. Although the period covered by the KDI estimates is too short to analyze structural change during the sample period, we use these data in the first step as a reference point.

Because there is one set of estimates for GNP and two for exports and imports, we can combine the GNP estimates and the pairs of estimates for exports and imports to generate empirical results in three ways. Data sources and sample periods are reported in Table 1.

3. Empirical results

We investigate the causal relationships among GNP, exports, and imports by estimating a vector autoregression (VAR) model. Many empirical studies have been used to test the export-led growth hypothesis, but most of them estimate univariate time series models of GNP or a VAR model of GNP and exports; see, for example, Thornton (1996), Biswal and Dhawan (1998) and Hatemi-J and Irandoust (2000). We estimate a VAR model of GNP, exports, and imports to investigate the export-led and import-led growth hypotheses, as identified simultaneously by Hanson (1982). Shan and Sun (1998b), Jin and Yu (1996), and Thangavelu and Rajaguru (2004) used this approach to investigate the export-led growth hypothesis for other countries, but ignored the import-led growth hypothesis.

We apply the causality test proposed by Toda and Yamamoto (1995). This test can be used to investigate causal relationships whether or not cointegrating relationships exist. This method uses a standard F-test on the estimated VAR model with additional lags. By 'additional' is meant the correct lag length plus the number of cointegrating relationships. First, we select the lag length of the VAR model by using the Schwarz Bayesian information criterion. Then, we estimate a VAR model with an additional lag. Table 2 reports the results for lag-length selection for each combination. Because the optimum lag length is one in every case, in the second step we perform causality tests based on models with two lags.

Next, we estimate VAR models by using all the available data and perform the Granger causality test proposed by Toda and Yamamoto (1995). The test statistics are reported in Table 3, and the corresponding diagrams are reported in Figure 1. We found no evidence of causal relationships among GNP, exports, and imports when using the KDI data (case (B)) or the IMF

data (case (C)). However, we found evidence of causality from imports to GNP when using the South Korean government estimates (case (A)). This finding indicates that the North Korean economy experienced import-led growth as had Soviet Russia, Poland, and Hungary previously.

Using the South Korean government estimates (case (A)) or the IMF data (case (C)) yields a sample period of more than 40 years. We cannot neglect the possibility that structural changes occurred in North Korea in this period, given changing international conditions and, in particular, the economic environment that the socialist economies were in during this period. Therefore, we split the sample period at around 1984 and performed the causality test by using the South Korean government data (case (A)) and the IMF data (case (C)). Not only does 1985 represent approximately the middle of the sample period, it was also a year of profound change that marked the inception of the Gorbachev era in the Soviet Union and came shortly before the inception of North Korea's 'Third Seven Year Plan' in 1987. Test statistics are reported in Table 4, and the corresponding diagrams are in Figure 2. Comparing these results with those in Table 3 and Figure 1 reveals evidence of at least one structural break between the first and second subperiods. Therefore, results from the whole sample period are affected by this structural change.

In the first subperiod, both the South Korean government data and the IMF data indicate causality from GNP to exports and from imports to GNP. Causality from GNP to exports reflects North Korea's exports promotion policy based on its economic growth. Causality from imports to GNP supports the import-led growth hypothesis in North Korea and is consistent with the estimation results for the whole period. Arguably, North Korea needed imports, perhaps capital goods, to achieve economic growth and promote exports.

In the second subperiod, evidence of causality from GNP to imports is indicated by both the South Korean government data and the IMF data. This result suggests that the North Korean economy escaped its dependence on import-led growth through economic development. Following this structural change, the North Korean economy may develop into an autonomous

economy in which economic growth raises imports. As Hanson (1982) has pointed out, this has been the experience of other socialist economies. However, there is no evidence of causality from GNP to exports. This means that economic growth raises only imports. As Figure 3 shows, the recent historical trends for imports and exports estimated by the South Korean government indicate that North Korea's imports have exceeded its exports.[2] There are two possible explanations for this: one is the existence of large amounts of accumulated trade deficits in North Korea; the other is that North Korea finances its trade deficits by using aid and transfers from foreign countries. If the former applies, North Korea's economy might be in danger of collapsing, as predicted by, for example, Noland (2006) and Noland, Robinson, and Wang (2000a). Alternatively, there exist several unreported transfers from other countries, particularly Japan. Empirical work by Eberstadt (1996) indicates this possibility.

4. Conclusions

In this study, we have examined causal relationships by constructing a vector autoregression model of GNP, exports, and imports for North Korea. Having split the sample at around 1985, we found evidence of import-led growth for the first subperiod, but not for the second subperiod. This indicates that although North Korea is a developing country, it has not remained dependent on export-led growth, as have many other developing countries. Moreover, as have other socialist economies, North Korea had escaped its dependence on import-led growth by the middle of the 1980s.

However, problems remain. First, the most serious is the lack of official macroeconomic statistics for North Korea. Hence, we had to use estimates produced by the South Korean government and other institutions. This casts doubt on the reliability of the empirical results. Second, the sample time period is short. Recent advances in time series analysis can be used to

[2] The IMF data produce a similar graph.

detect the stationarity of a series (its unit root) and the stationarity of combinations of time series (cointegration). However, we only had access to annual data that cover a short time period. Hopefully, sufficient data will be accumulated over time. Third, we must consider North Korea's continuing trade deficits. How North Korea finances its trade deficits is important for the future of the North Korean economy. In further research, we hope to clarify what awaits.

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Table 1 Data definitions and sources

Data	Institution	Period	Source
GNP	South Korean Government	1960-1989	Yang（2000）p.39（original source: National Unification Board）
		1990-2004	Bank of Korea, Major Indicators Comparison (South Korea/North Korea)
Exports and imports	South Korean Government	1965-1989	Yang（2000) p.321（original sources: National Unification Board）
		1990-2004	Bank of Korea, Major Indicators Comparison (South Korea/North Korea)
	Korea Development Institute (KDI)	1970-1994	Korea Development Institute (1996) p.148
	International Monetary Fund (IMF)	1964-2004	IMF, Direction of Trade Statistics Yearbook, various years

Table 2 Lag length selection based on the Schwarz Bayesian information criterion

Lag length k	case (A)	case (B)	case (C)
1	**-45.7477**	**-32.1653**	**-6.8867**
2	-33.5695	-23.8196	9.1560
3	-20.0188	-8.1880	22.8298
4	-7.0693	2.0724	33.1766

Note: Bold font indicates the selected lag length in the VAR model.

Data sources: case (A): GNP: South Korean government; exports and imports: South Korean government
case (B): GNP: South Korean government; exports and imports: KDI
case (C): GNP: South Korean government; exports and imports: IMF

Table 3 Results of Granger causality tests

＜case (A): 1965-2004＞

H_0 :	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	2.8565	0.073
GNP does not cause Exp.	1(2)	0.8509	0.437
Imp. does not cause GNP	1(2)	4.2365*	0.024
Exp. does not cause GNP	1(2)	2.3832	0.109
GNP does not cause Imp.	1(2)	2.2476	0.123
Exp. does not cause Imp.	1(2)	2.5014	0.098

＜case (B): 1970-1994＞

H_0 :	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	0.8824	0.433
GNP does not cause Exp.	1(2)	0.5079	0.611
Imp. does not cause GNP	1(2)	3.2230	0.067
Exp. does not cause GNP	1(2)	2.0797	0.157
GNP does not cause Imp.	1(2)	0.7491	0.489
Exp. does not cause Imp.	1(2)	0.3640	0.700

＜case (C): 1964-2004＞

H_0 :	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	2.4605	0.101
GNP does not cause Exp.	1(2)	1.3819	0.266
Imp. does not cause GNP	1(2)	0.9411	0.401
Exp. does not cause GNP	1(2)	0.1777	0.838
GNP does not cause Imp.	1(2)	2.3103	0.116
Exp. does not cause Imp.	1(2)	0.8044	0.456

Notes : Imp. = Imports; Exp. = Exports

* Statistically significant at 5% level of significance.

Table 4 Results of Granger causality tests

＜case (A): 1965-1984＞

H_0:	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	3.7534	0.057
GNP does not cause Exp.	1(2)	7.027*	0.011
Imp. does not cause GNP	1(2)	9.8027*	0.004
Exp. does not cause GNP	1(2)	6.3544*	0.015
GNP does not cause Imp.	1(2)	2.7233	0.109
Exp. does not cause Imp.	1(2)	1.0425	0.385

＜case (A): 1985-2004＞

H_0:	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	1.2337	0.329
GNP does not cause Exp.	1(2)	0.3388	0.720
Imp. does not cause GNP	1(2)	1.2149	0.334
Exp. does not cause GNP	1(2)	0.5970	0.567
GNP does not cause Imp.	1(2)	4.2855*	0.042
Exp. does not cause Imp.	1(2)	1.1485	0.352

＜case (C): 1964-1984＞

H_0:	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	3.5817	0.060
GNP does not cause Exp.	1(2)	5.9727*	0.016
Imp. does not cause GNP	1(2)	3.9243*	0.049
Exp. does not cause GNP	1(2)	0.2582	0.777
GNP does not cause Imp.	1(2)	6.6201*	0.012
Exp. does not cause Imp.	1(2)	1.0067	0.394

＜case (C): 1985-2004＞

H_0:	Optimal lag (VAR order)	F-statistic	p-values
Imp. does not cause Exp.	1(2)	1.3521	0.299
GNP does not cause Exp.	1(2)	0.4344	0.658
Imp. does not cause GNP	1(2)	0.1756	0.841
Exp. does not cause GNP	1(2)	0.1217	0.887
GNP does not cause Imp.	1(2)	4.3767*	0.040
Exp. does not cause Imp.	1(2)	0.0159	0.984

Notes : Imp. = Imports; Exp. = Exports

* Statistically significant at 5% level of significance.

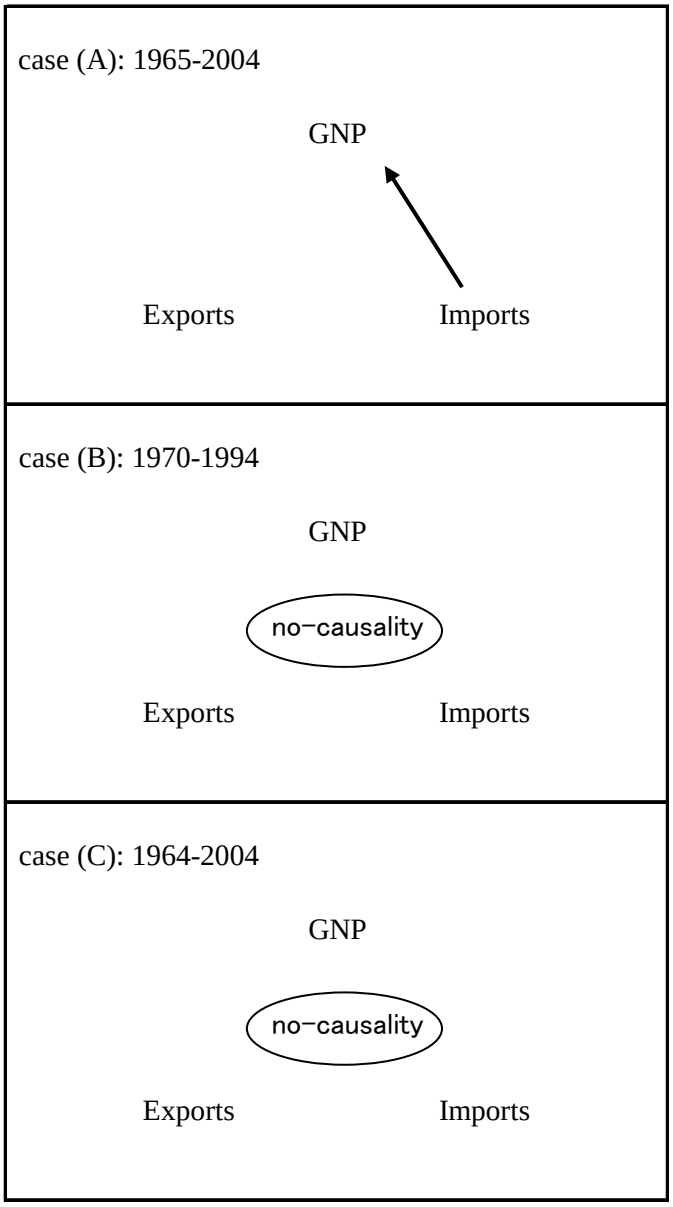

Figure 1. Results of Granger causality tests

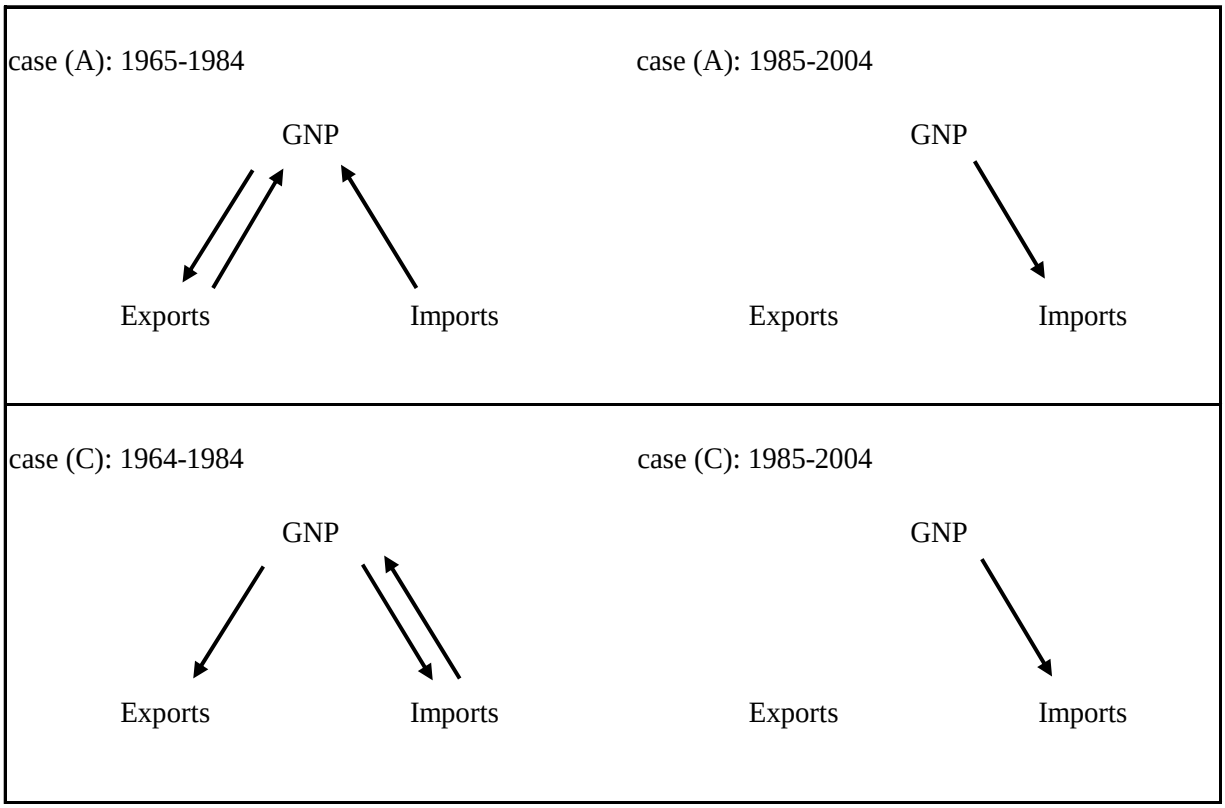

Figure 2. Results of Granger causality tests

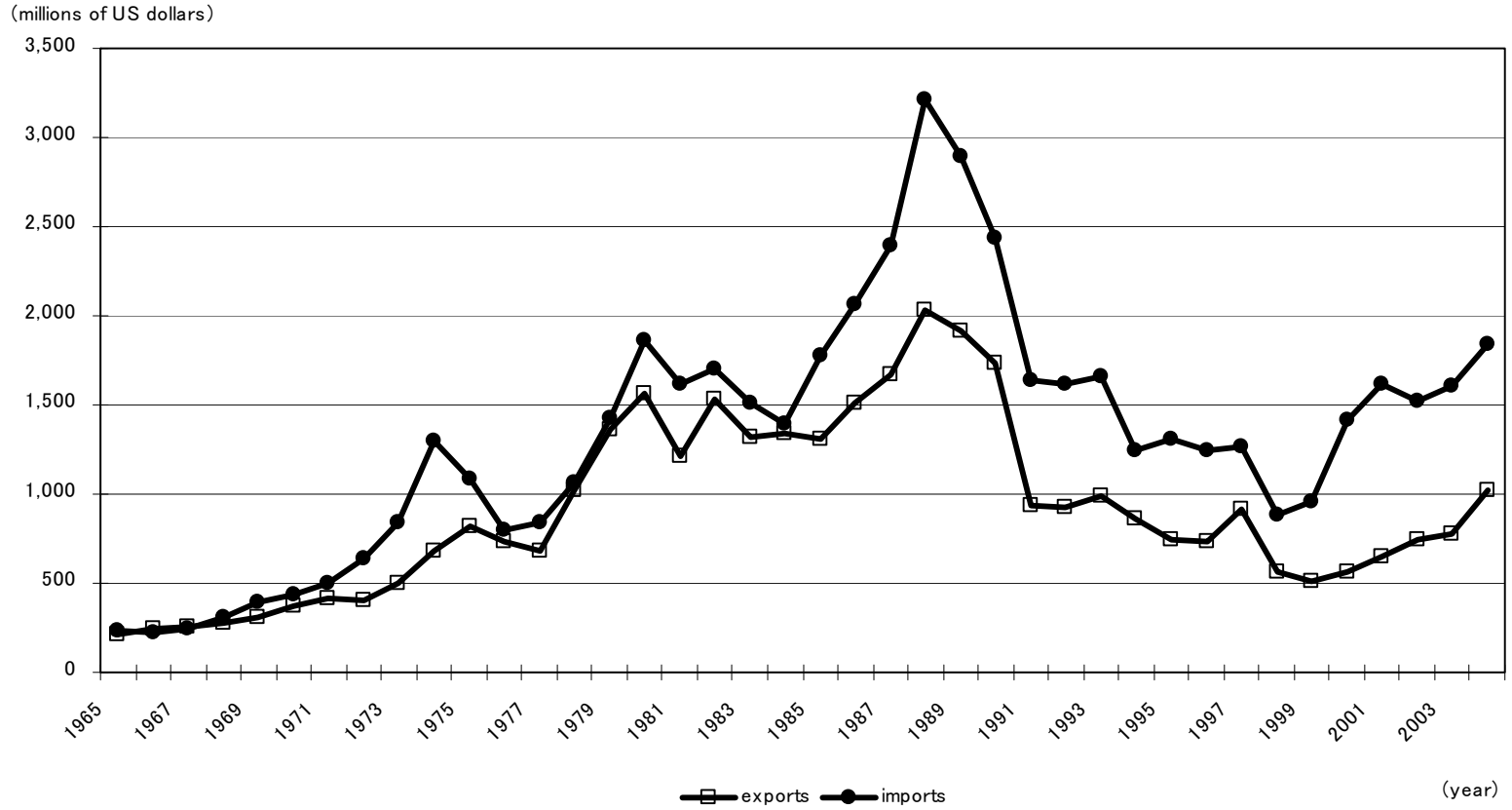

Figure 3. Comparison of exports and imports (Source: South Korean government estimates)